DIET QUALITY AND NUTRIENT INTAKE

OF NATIVE AMERICAN WOMEN

IN OKLAHOMA

By

ALICIA CLAIRE SPARRER

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Thesis Approved:

Kathryn S. Keim

Thesis Adviser

Gail Gates

Elizabeth Droke

Timothy J. Pettibone

Dean of the Graduate College

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CHAPTER I

INTRODUCTION

The Native American population is under-represented in national nutrition monitoring surveys, including the National Health and Nutrition Examination Surveys (NHANES) and the Nationwide Food Consumption Survey (NFCS). Out of 15,000 participants in the US Department of Agriculture's (USDA) 1994-1996 Continuing Survey of Food Intakes by Individuals (CSFII), only 107 individuals who identified themselves as Native American (Basiotis et al., 1999). Native Americans are inadequately represented in these national studies, but are at high risk for health consequences due to poor dietary intake and impaired nutritional status (Vaughan et al., 1997).

Broussard et al. (1991) noted that in less than two generations, Native Americans changed their diet and lifestyles so dramatically that they now display one of the highest rates globally for clinical obesity and diabetes. These changes may be related to genetic predisposition, lack of physical exercise and dietary change from more healthful, traditional foods to a westernized diet (Welty, 1991). Traditional foods can be defined as all food within a particular culture obtainable from local natural resources that are culturally accepted (deGonzague et al., 1999). Until the middle of the twentieth century, the Navajo lived an active lifestyle and ate a wide variety of cultivated and gathered foods (Ballew et al., 1997). An increasingly sedentary lifestyle and deviation from the traditional diet patterns towards a high fat, refined, processed and nutrient poor diet pattern may contribute to increased obesity and chronic disease among the Navajo and other tribes.

Federal recommendations, including the Dietary Guidelines and Food Guide Pyramid, advocate a selection of a variety of foods, as well as a diet low in fat, saturated fat, cholesterol, and a moderate salt intake (Bowman et al., 1998). The role of nutrition and diet in reducing the risk of certain chronic diseases has been well documented. An extensive amount of scientific evidence suggests that diets high in total fat, saturated fat, and cholesterol, and low in fiber and complex carbohydrates are linked to coronary artery disease, stroke, diabetes, and certain forms of cancer. Increased intake of dietary fat has specifically been implicated in the development of diabetes mellitus, as well as to the increased prevalence of obesity, a major risk factor for type 2 diabetes (Marshall et al., 1994).

There is little research on diet quality of the non-reservation living Native American population. A literature search showed that studies investigating the diets of reservation-living Native Americans, such as the Pima and the Navajo, are more prevalent than research regarding Native Americans integrated into western society. Due to the lack of dietary data for Native American adults in the United States, more documentation is needed about current dietary practices before specific recommendations can be made regarding ways to improve diet quality and overall health. The purpose of this study was to determine the current diet quality of non-reservation Native American women in Oklahoma. The diet quality data will be communicated to the Native American health clinics to shape nutritional programs targeting Native American women. This study will contribute to the literature available on diet quality and food habits of Native Americans.

Research Objectives

The objectives of this study were to:

1. Determine the nutrient intake of Native American women.
2. Determine differences in nutrient intake due to diabetes status.
3. Determine diet quality of Native American women.
4. Determine differences in diet quality due to diabetes status.

Assumptions

In this study, the researchers assumed that the information obtained from the subjects was accurate and the participants were trained adequately by the interviewers on how to accurately weigh their foods. It was assumed subjects did not alter what they consumed over the four-day period. In addition, it was assumed that the interviewers reviewed the food records for completeness and asked for clarification if needed.

CHAPTER II

REVIEW OF THE LITERATURE

The review of the literature includes an overview of measurement of diet quality, food and nutrient assessment methods, history of the Native American diet, diet and chronic disease in Native Americans, nutrient intake of Native American women, and diet quality of Native Americans.

Measurement of Diet Quality

Kant et al. (1996) stated that the definition of diet quality can depend on the criteria used by the investigator. Diets that meet nutrient needs such as protein or certain vitamins or minerals at a particular energy level can be defined as a high quality diet. Low-fat diets with high intakes of fruits, vegetables and grains that can help decrease risk of or help prevent chronic disease can also be defined as high quality. Several diet quality indexes have been studied and each measures diet quality differently.

The Mean Adequacy Ratio (MAR) is one method used to measure nutritional adequacy and diet quality (Ghany, 1978). The MAR is an index of the percent of the recommended nutrient intake for 11 nutrients: protein, calcium, iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, and vitamins B_6, B_{12}, and C (Krebs-Smith et al., 1987). The MAR is calculated by adding the estimated intake of each nutrient expressed as a percentage of the Recommended Dietary Allowance (RDA) for an individual, truncated at 100 percent, and then divided by the number of nutrients. The higher the MAR, the better the nutritional adequacy of the diet. The main limitation of the MAR is that it only evaluates the nutrient adequacy of the diet. It also is limited by the lack of food composition data for some nutrients, such as folacin and zinc (Cronin et al., 1985). The MAR is not a good method to use to evaluate overall diet quality.

The Diet Quality Index (DQI) assesses overall diet quality and risk of chronic disease related to overall dietary patterns (Patterson et al., 1994). The DQI is based on eight recommendations from the 1989 National Academy of Sciences publication *Diet and Health* (National Research Council, 1989). The DQI includes six nutrients (total fat, saturated fat, cholesterol, protein, sodium, calcium) and servings from two food groups, fruit and vegetables,(before the fruit and vegetable group was divided into two groups) and grains. Recommended dietary intake goals of the Committee on Diet and Health (Nutrition Research Council 1989) were used as cutoffs to divide the population into three groups (Patterson et al. 1994). These recommendations placed roughly one-third of the population into an "excellent" diet category, one-third into a "fair" diet category, and one-third into a "poor" diet category. Individuals that met a dietary goal were given a score of zero. Those that did not meet the dietary goal, but had a fair diet, were given a score of one. Individuals with a poor diet were given two points. The points were summed across the eight recommendations to create the DQI range of 0-3 (excellent diet), 4-13 (fair diet) and 14-16 (poor diet).

In comparing an excellent diet to a poor diet, the excellent diet consisted of about 25 percent of energy from fat, whereas a poor diet had 44 percent of energy from fat. The percent of energy from saturated fat was 8 percent in the excellent diet compared to 16 percent in the poor diet. The association between amount of fat and energy intake was strong and constant ($r=.70$; $p=.0001$) (Patterson et al., 1994).

The DQI covers both adequacy and moderation in diet, but does not reflect the quality of the total diet because of its comparatively few components (Basiotis et al., 1995). The DQI also requires that foods be grouped appropriately, requiring time and extensive decision-making. This index may have potential bias because it is based on the 1987-88 Nationwide Food Consumption Survey (NFCS). The 1987-88 NFCS had a low response rate, but can be used for methodological purposes and for research that does not generalize to the US population (Patterson et al., 1994). The DQI was created before the Food Guide Pyramid, thus the grouping of foods was different from what might be done today using the Food Guide Pyramid (FGP) (USDA, 1992). The DQI groups grains and legumes together. In the FGP, legumes are considered part of the meat and the vegetable group. Fruits and vegetables are separated into two separate groups in the FGP. Thus the DQI is not the most current or accurate way to assess diet quality.

Haines et al. (1999) revised the DQI, calling it the Diet Quality Index Revised (DQI-R). The DQI -R includes current dietary guidelines and addresses dietary moderation and variety. The DQI-R also uses improved methods of estimating food portions. The DQI-R kept the original method of scoring on three levels, but the authors made dramatic changes to everything else. Data from the 1994 Continuing Survey of

Food Intake by Individuals (CSFII) was used to calculate the index. The response rate for the CSFII was higher than for the 1987-88 NFCS database used for the DQI.

The DQI-R consists of 10 components (Haines et al., 1999). The first three components measure macronutrient distribution of total fat, saturated fat, and cholesterol against the 1995 Dietary Guidelines (USDA, 1995). The next three components measure consumption of fruits, vegetables, and grains. Number of servings for individuals is based on recommended energy intakes from the FGP. Calcium and iron are the next two components of the DQI-R. The authors use calcium instead of dairy products to account for the number of individuals that may be lactose intolerant. The Adequate Intake (AI) value is used for calcium and iron is measured as a percentage of the 1989 RDA value. Haines et al. (1999) stated that as the new Dietary Reference Intakes are published, the iron values would be updated. The last two components of the DQI-R were developed to measure moderation and variety of diet.

The moderation component of the DQI-R is comprised of added sugars, discretionary fat, sodium intake, and alcohol consumption (Haines et al., 1999). Discretionary fat includes "all excess fat from the five major food groups beyond that which would be consumed if only the lowest fat forms (of a given food) were eaten. This measure includes fats added to foods in preparation or at the table, including margarine, cheese, oil, meat drippings, and chocolate" (Food Surveys Research Group, 1994). Added sugars are measured to show amounts of added sugar, where 1 teaspoon of sugar is equal to 1 teaspoon of sweetener. Alcohol intake is measured using the number of drinks per day, exhibiting how many grams of ethanol were consumed over a 2-day period. Sodium intake is measured in milligrams of sodium ingested as food, but does not reflect use of salt at the table.

The dietary diversity or variety component was created to show consumption of food over 23 different food group categories (Haines et al., 1999). Grains make up seven of the food groups. There are two categories for fruits, seven for vegetables, and seven groups of animal-based products to make up the 23 food categories. Half a serving, defined by the FGP, needs to be consumed over the 2-day survey period to count towards an item in the variety category. Food groups were used instead of individual foods to account for limitations of other food intake methods. Haines et al. (1999) believes that as the number of days of dietary food intake data decreases, the possibility of dietary intake of a single food declines, thus the 23 categories in the DQI-R may show a truer form of variety in the diet.

Each component contributes 10 points to the total DQI-R score, making the total DQI-R score 100 points (Haines et al., 1999). The closer the score is to 100, the better the diet quality of the individual. The fruit, vegetable, and grain groups are scored proportionately. A score of 10 is allocated if the maximum amount of servings, based of FGP criteria, were consumed over 2 days. A score of 0 is assigned if no servings for a food group are consumed. Iron and calcium are scored based on the percentage met of the RDA or AI, respectively, and then converted to a score of 0 to 10. For percentage of energy from fat and saturated fat, and cholesterol, the original scoring from the DQI was followed. If the recommendation is met, a score of 10 was given. If the individual was within 30 percent of the recommendation, a score of 5 is given. Individuals consuming more than 30 percent over the upper threshold receive a score of 0. The dietary diversity score is based on the weighted average of scores for each of the primary subgroups, grains, vegetables, meat and dairy. Within each subgroup, the score shows the percentage of the possible maximum score. Each subgroup can receive a maximum of 2.5 points, totaled together for a maximum score of 10. Dietary moderation scores are based on the weighted average of scores for the four subgroups, added sugars, discretionary fat, sodium intake, and alcohol consumption. They are scored similar to the total fat and saturated fat components, except that the dietary moderation component consists of 4 subgroups and the values include 2.5, 1.5, 1.0 and 0 points. Subjects consuming less than or equal to 100 percent of the recommendation for added sugars receive a score of 2.5. Subjects consuming more than 200 percent of the recommendation receive a score of 0. Consumption of added sugars in between 100 and 200 percent are scored proportionally. The alcohol component is scored in a similar manner. Recommendations for alcohol are one drink per day for women and two drinks per day for men for people 21 years and older. For the sodium subgroup, subjects consuming less than or equal to 2,400 mg of sodium per day receive a score of 2.5. Subjects consuming more than 3,400 mg of sodium per day receive a score of 0. For the discretionary fat subgroup, persons consuming less than or equal to 25 grams of discretionary fat per day receive the maximum 2.5 points, whereas those that consume more than 75 g per day receive a score of 0.

Haines et al. (1999) used the DQI-R to assess dietary quality of 3,202 people from the 1994 CSFII database. The mean DQI-R score was 63.4 (SD = 13.2). Almost 12 percent of the sample scored above 80, indicating high compliance with the 1995 Dietary Guidelines and a good diet quality. About 20 percent of the sample scored between 71 and 80, 26 percent scored between 61 and 70, 25 percent scored between 51 and 60, and about 17 percent of the sample scored between 41 and 50.

Food and nutrient values were correlated across the range of DQI-R scores to determine if the index was a valid way to measure diet quality (Haines et al., 1999). Each of the components was found to be statistically significant at a level of $p< 0.01$. Individuals from the sample that scored above 80 on the DQI-R consumed the lowest amounts of fat and cholesterol, as well as sufficient amounts of grains, fruits, and vegetables. They also had the highest scores for calcium and iron, as well as high scores for the moderation and dietary diversity component.

Haines et al. (1999) found that the DQI-R was not highly correlated with energy intake ($r = 0.02$). A higher intake of energy and nutrients will not cause the individual to receive a higher DQI-R score. The DQI-R also correlated poorly with B_{12} ($r = 0.02$), zinc ($r = 0.01$), and sodium ($r = 0.04$) intake. The lack of animal products in the DQI-R may be the cause of these weak relationships. The possibility of over reporting and underreporting of the sample may also affect the DQI-R score.

The Healthy Eating Index (HEI) is another method used to determine diet quality and has some similar components to the DQI-R. It is a summary measure of diet quality used to monitor changes in consumption patterns. It is a more comprehensive approach to analyzing diet quality, incorporating nutrient needs and dietary guidelines for the US consumer in one measure (Kennedy et al., 1995). The HEI provides data on the types of dietary improvements that need to be made to bring US eating habits more in line with the recommendations of the Food Guide Pyramid and Dietary Guidelines (Kennedy et al., 1995). It also serves as a useful tool for nutrition education. Educators can use the results of the HEI to provide direction and better targeting of nutrition programs to particular audiences and food behavior to change. For example, if the HEI score for sodium reflects high sodium intake, the intervention can target sodium intake. The HEI provides an overall depiction of the type and quantity of foods people eat, their compliance with dietary recommendations, and the variety of their diets (Bowman et al., 1998).

The HEI consists of 10 dietary components, weighted equally. Each component has a minimum score of 0 and a maximum score of 10 (Kennedy et al., 1995). The maximum overall score of the HEI is 100. High component scores reflect intake close to the recommended range, low component scores indicate less compliance to the recommendation. A HEI score of over 80 indicates a "good" diet; a HEI score between 51 and 80 means the diet "needs improvement;" and a HEI score below 51 indicates the diet is "poor" (Kennedy et al., 1995).

The 10 components represent different facets of a healthful diet. Components one through five measure the degree that the individual's diet conforms to the serving recommendations of the USDA Food Guide Pyramid (FGP) for the grains, vegetables, fruits, milk, and meat food groups, as adjusted for energy intake. In other words, if energy needs are greater, the minimum serving is higher (Bowman et al., 1998). For example, the RDA recommends an energy intake for a 25-year old woman of 2200 kcals, and the minimum Food Guide Pyramid grain serving is nine. For each of the food groups, serving definitions used to calculate the scores are the same as the FGP serving sizes. For example, one slice of bread, ½ cup of pasta, one medium orange, one cup of milk, and 2.5 oz of lean meat are described as single-serving sizes (Kennedy et al. 1995).

fat, with a mean HEI score of 4.0 and 5.1, respectively. The population surveyed scored the highest or best in the cholesterol category with a mean score of 8.0.

Kennedy et al. (1995) validated the HEI categories against energy intake and key RDA nutrients. As the mean score for HEI increased, the possibility of falling below 75 percent of the RDA decreased. For each of the key nutrients, there was a positive correlation between nutrient intake and the HEI score, with correlations ranging from r=0.06 to r=0.42. The correlation between energy intake and HEI score was moderate, r=0.21 and means that the HEI score will not improve substantially in individuals who consumed more energy. The correlations between the key nutrients and the HEI index also show that the HEI is a valid way to measure diet quality based on the FGP, rather that based solely on nutrient intake.

Bowman et al. (1998) used the data set from the 1994-1996 CSFII survey to present a more recent measure of dietary intake in the United States. Dietary intake from two non-consecutive days of food intake records and an in-person 24-hour dietary food recall were collected. The HEI was calculated for individuals who completed the first day of the food intake record for the survey. The HEI was calculated for individuals 2 years and older, because dietary guidelines are only pertinent to these ages. Lactating and pregnant women were excluded from this study. The sample size was 5,200 individuals for 1994, 4,900 for 1995, and 4,800 for 1996.

Bowman et al. (1998) found that Americans had a mean HEI score of 63.6, in 1994 and 63.5, and 63.8 for 1995 and 1996, respectively. About 70 percent of Americans had a diet that needed improvement, based on the convention that an HEI score of 51-80 needs improvement (Bowman et al., 1998). About 12 percent of the population had a good diet with an HEI score over 80, and about 18 percent had a poor diet with an HEI score less than 50. During the 1994-1996 period, the US population consumed cholesterol at a level that resulted in a high HEI score or best component in the diet (Bowman et al., 1998). On a scale of 1-10, with 10 being the best score (indicating consumption of 300 mg or less of cholesterol), the sample had an average cholesterol score of 7.8. Variety was the second highest component with a score of 7.6. The fruit group was the lowest component, with a score of 3.9. The milk group was the second lowest component with a score of 5.4. The other scores averaged between 6 and 7.

Dwyer et al. (2002) used the HEI to determine if students involved in CATCH (The Child and Adolescent Trial for Cardiovascular Health) scored higher on the HEI than students not involved with CATCH. The CATCH trial focused on reducing fat, saturated fat, and sodium intake of students. The CATCH trial used a diet pattern similar to the Food Guide Pyramid in school meals among a cohort of children in third to fifth grade. The CATCH post-intervention tracking study conducted one 24-hour recall with a representative sub-sample of 1,532 students from the cohort in eighth grade, with a mean age of 14 years.

Students who stated they bought breakfast or lunch at school were classified as school meal participants (Dwyer et al., 2002). The 24-hour recalls were gathered and entered into laptop computers by trained and certified interviewers using software developed by the University of Minnesota Nutrition Coordinated Center (NCC) Nutrition Database System (NDS); Food Database version 12A, Nutrient database 27. Each food in the 24-hour record was allocated a five-digit NCC food code and classified into an appropriate food group or groups. The servings consumed from the five food groups were then compared to the FGP servings recommendations for age (14 years) and sex (boys and girls): grains (9.9 for boys and 9 for girls), vegetables (4.5 and 4), fruits (3.5 and 3), milk (3 and 2), and meat (2.6 and 2).

Dwyer et al. (2002) found that the total mean HEI scores did not vary between students involved in CATCH (61.7) and the control group (60.5). However, mean HEI scores for saturated fat and total fat were significantly higher for the intervention group than the control group (p=0.05, p=0.04, respectively). The mean HEI score was significantly higher among students that purchased school meals (p=0.002). School meal participants scored significantly higher in almost all components regarding the FGP, except for fruit (p=0.50). School meal participants scored significantly lower than non-participants in sodium (p=0.0002), saturated fat (p=0.0001) and variety (p=0.0001).

Lino et al. (1999) used the HEI to look at the diet quality of children and adolescents. The HEI was used to study the diet of children ages 2-18 to determine how diet quality declined as children got older. The 1994-1996 CSFII data set used for this study contained information on diets for about 5,000 children. Lino et al. (1999) discovered that most children had a diet that was poor or needed improvement. As children got older, their overall HEI score decreased. For children 2-3 years old, 35 percent had a good diet and 5 percent had a poor diet. For males 15-18 years old, 21 percent had a good diet and 6 percent had a poor diet. The HEI was also used to identify which components of the diet children were lacking. The diets of most children were found to be lacking in fruits, vegetables, and milk products.

Gaston et al. (2001) used the HEI to look at the overall diet quality of three age groups of independent, free-living elderly Americans, 65-74 years (the young old), 75-84 years (the old), and 85 and older (the oldest-old). The 1994-1996 CSFII data set was used for this study. Scores for the three groups were compared with the overall HEI for the age group 45-64. The authors found that as age increased among all three age groups, the percent of individuals with a good diet quality was consistent at about 20-21 percent (Gaston et al., 2001). With an increase in age, the percent of individuals with a poor diet increased and the percent of elderly with a diet quality rated "needs improvement" decreased.

The fruit and milk components were the lowest HEI scores for all elderly age groups (Gaston et al., 2001). The median fruit score for all three age groups ranged from 4.6 to 4.9, showing that they were eating less than the recommended 2-4 fruit servings a day. The scores for milk ranged from 4.3 to 5.0, demonstrating that most were not meeting the goal of 2 milk group servings a day. All age groups had a score of 10 for cholesterol. The HEI component scores of the younger old group (65-74 years) were lower than those of the other two elderly age groups (75-84 and 85 and older) in three (fruit, total fat, and sodium) out of ten components. However, the younger old group met or exceeded the older groups in six other food components, grains, vegetables, milk, meat, saturated fat, and variety. Significance was not noted in this article.

The next study used the HEI to assist in identifying beliefs and attitudes of the US population toward their diet (Dinkins, 2001). Data from a survey conducted by the Market Research Corporation of America (MRCA) in years 1991-1994 was used. The survey consisted of people's food and beverage intake over 14 days, as well as their opinions and beliefs on health, diet, food preparation, shopping, media, and general interests. The sample consisted of 1,851 adults that were 18 years and older. A modified version of the HEI was used to analyze the diets of the participants. The first nine components from the original HEI were used. These include the five groups from the FGP, as well as total fat, saturated fat, sodium, and cholesterol. Variety was omitted because the MRCA survey did not provide adequate information to evaluate variety in the diet on any given day. Actual serving sizes were not gathered for this study. Diet records collected for this study were analyzed using standard serving sizes and are considered estimates of food intake (Loughrey et al., 2001). The HEI scores of the participants were modified to fit the 100-point scale of the original HEI, making the maximum score 100. Scores were divided into the same three categories with the same point allocation; greater than 80 implied a good diet, between 51 and 80 implied that the diet needs improvement, and less than 50 implied a poor diet.

Dinkins (2001) found that for this nationally representative population, total HEI scores ranged from 54.2 to 59.2, falling in the category of needing improvement. Those that wanted to improve their diet had a similar score (54.4) as those that were not interested in improving their diet (54.2). The participants scored the highest, or the best with the cholesterol component, ranging between 7.93 and 8.11. The people surveyed scored the lowest, or the worst with the fruit component, with scores ranging from 2.26 to 3.82. The author concluded from this study that people know that their diet is poor and that regardless of their opinions of their diet, it is in need of improvement.

An additional study was conducted using the same data set and the modified HEI scoring to assess "the usefulness of segmentation and audience-profiling techniques in promoting the Dietary Guidelines" (Loughrey et al., 2001). The sample consisted of women aged 25 through 55, with a household income between $20,000 and $125,000 and no major health problems. The researchers classified 491 women into three categories ("better eaters," "fair eaters" and "poor eaters") based on their HEI scores. Demographic information regarding health and diet orientation, values about, and perceived benefits and barriers to healthy eating, nutrition, food preparation, shopping habits, and media habits was compared to the HEI scores.

The Better Eaters had the highest HEI score and were used as the basis of comparison with the other two groups, Fair Eaters and Poor Eaters (Loughrey et al., 2001). Based on percentages, the three groups, Better Eaters, Fair Eaters and Poor Eaters, averaged a HEI score of 57 percent. The Better Eaters had an average of 74 percent, with the Fair Eaters scoring 62 percent and the Poor Eaters scoring 52 percent. The Better Eater was more likely ($p<0.05$) to have a higher education than the Fair or Poor Eater. The Better Eater, compared with the Poor Eater, was more likely ($p<0.05$) to have a lower Body Mass Index (BMI) score and to be White or of a race other than Black. The three groups did not significantly differ in age, household size, household income, and self-reported weight. The researchers also found that the women overall were interested in improving their diets and varied in opinion on barriers, benefits, and values of eating a healthy diet. The information gathered can be used to assist in program planning and nutrition education for a population similar to the one identified in the study.

Hann et al. (2001) conducted a study to validate HEI scores with plasma biomarkers of dietary exposure. The sample consisted of 172 women with newly diagnosed breast cancer, 149 women without cancer, and 19 women with a high risk for breast cancer. Three days of food intake, one was a weekend day, were recorded by the women. The data was converted into CSFII food codes to calculate FGP servings. Fasting venous blood samples were collected at time of enrollment. Plasma cholesterol and carotenoids concentrations were measured in 333 respondents. Plasma folate concentrations were measured in 99 respondents and vitamin C concentrations were measured for 175 respondents. The HEI score was calculated using all 10 components. An alteration to the HEI in this study concerned the tenth component, variety. Hann et al. (2001) allocated a high score of 10 if the individual consumed 24 or more different foods over 3 days, instead of 16 foods as used by Kennedy et al. (1995). A score of 0 was given if the individual consumed nine or less different foods over a three-day period.

In the Hann et al. (2001) study, the HEI scores were divided into four groups. Individuals that received a score over 85 had a good diet. Individuals that scored below 65 had a poor diet, with scores from 65-74 and 75-84 in between. In the original HEI, scores are divided into three groups, with scores above 80 considered good, scores below 51 considered poor, and scores in between as needs improvement.

There was no significant difference for energy, protein, carbohydrate, fat, fiber, or vitamin C among the women with newly diagnosed breast cancer (case) and those without cancer (control), thus the data were pooled (Hann et al., 2001). The total mean HEI score for the sample was 77.3, falling in between a good diet and a poor diet. The sample had 48.8 percent with a good diet, 49.4 percent with a diet in between, and 1.8 percent were classified as having a poor diet. The highest mean HEI component scores were for cholesterol and meat, with scores of 9.3 and 8.9, respectively. The sample scored lowest for the components variety and milk, with a score of 5.9 for both.

Hann et al. (2001) found that the HEI component for variety strongly correlated with the HEI scores ($r = 0.71$; $p<0.001$). The amount of different foods consumed over a period of three days almost doubled when going from a poor diet to a good diet. HEI scores also correlated well with fruit intakes ($r = 0.57$; $p<0.001$), but only moderately with total energy intake ($r = 0.21$; $p=0.05$). High HEI scores were also correlated with higher plasma concentrations of all carotenoids, except lycopene. Plasma α-carotene concentrations increased significantly ($p<0.001$) when going from a poor to a good diet. Plasma concentrations of β-carotene improved significantly ($p<0.001$) from 0.49 μmol/L to 0.85 μmol/L when going from a poor to a good diet. High HEI scores were significantly correlated with higher concentrations of β-carotene ($p<0.001$), as well as lutein ($p<0.001$), and vitamin C ($p<0.001$).

Food and Nutrient Assessment Methods

There are several techniques used to estimate nutrient intake. The 24-hour recall, food frequency, food records and weighed food records are all ways to estimate nutrient intake of individuals (Block, 1982). A 24-hour food recall is a quick, easy and inexpensive method to estimate dietary intake (Block, 1989). A trained interviewer uses a series of questions to help the respondent recall in detail all the food and drink consumed in a 24-hour time period. The respondent is asked to recall the diet from waking up to the time of the interview and then from 24 hours previously until going to sleep (Block, 1982). Time and effort are minimal to the respondent. The 24-hour recall can be used to estimate average intake of groups (Block, 1982). For example, the CSFII and NHANES nutrient intakes were collected using the 24-hour recall method. Multiple 24-hour recalls may provide an estimate of mean intake for a group (Block, 1982).

However, there are several limitations to the 24-hour food recall method. One 24-hour period is not representative of usual intake of an individual. The 24-hour recall does not provide a reliable estimate of an individual's diet because of the day-to-day variation (Feskanich and Willet, 1993). Underreporting and over reporting of foods can occur, and data entry is intensive (Bingham et al., 1991). "Flat-slope syndrome" may be exhibited with this method. Flat-slope syndrome is when subjects with low food intake report higher than usual intake, and subjects with true high food intake report lower than usual intake. The 24-hour recall may provide a glimpse of an individual's diet, but may not be the most reliable method of estimating nutrient intake.

A semi-quantitative food frequency questionnaire (FFQ) is another method used to estimate nutrient intake. The FFQ estimates energy and nutrient intake by ascertaining how often an individual consumes a limited amount of foods that are sources of nutrients (Block, 1982; Feskanich and Willett, 1983). Respondents indicate how many times a day, week, month or year they consume the listed foods. The food frequency method can be uniformly administered, low cost if self-administered, and capable of being given to a large number of people (Bingham et al., 1991; Block 1982). It puts a modest demand on the respondent and can be self-administered. The FFQ can be used to classify participants into nutrient intake quartiles, or ascertain if nutrient intake is high or low (Green et al., 1998). However, the questionnaire may not represent usual foods or portion sizes of the respondent and depends on the ability of the respondent to describe their diet (Block 1982). The questionnaire may be limited by not being culturally sensitive to the population. By not listing foods commonly eaten by various groups, energy intake as well as other nutrients may be over or underestimated.

Food records are considered to be the standard survey tool for measuring food intake (Becker et al., 1960). There are two different kinds of food records, an estimated food record and a weighed food record. An estimated food record has a respondent record everything eaten and drank for a period of time, usually ranging from 1 to 7 days (Block 1982). Portion sizes can be recorded in household measures, using measuring cups and spoons (Cleveland et al., 1997; Green et al., 1998). The respondent does not have to rely on memory and can provide a detailed intake.

A food record does require a high amount of cooperation from the subject, as it requires training of the individual on how to correctly fill out the food record and estimate food portions. Mertz et al. (1991) conducted a study comparing estimated energy intake as recorded by individuals with intake determined to maintain body weight. Two hundred and sixty-six subjects participated in this study. Dietitians met with groups of 10 or less and instructed the subjects on how to use scales and household measures to determine food portions. They were also instructed on how to estimate portion size when away from home. The records were reviewed daily to eliminate vague or incomplete entries.

The participants only consumed food and drink provided by the study, except for non-caloric soft drinks, tea and coffee (Mertz et al., 1991). If sweetener or milk was added to the last two, it was supplied by the study. All diets met or exceeded the RDA. Energy level, weight and height of the subjects were used to estimate energy intake for the experimental diets. Participants ate breakfast and dinner in the dining room of the facility during the week, and were provided frozen food for the weekends.

Eighty-one percent of participants reported their intake 700 ± 379 kcal below the energy intake calculated to maintain body weight (Mertz et al., 1991). Eight percent reported their energy intake within 408 ± 257 kcal than the calculated energy intake and 11 percent reported their energy intake within 100 kcals of energy needs. The mean difference between recorded and calculated energy intake for both women and men was an underreporting of 18 percent. There was no significant difference in reported energy intake due to sex, age, or weight. However, BMI was inversely proportionate with the reporting error ($r = -0.24$, $p = 0.0001$). Mertz et al. (1991) concluded that no matter how motivated and trained subjects may be in recording food intake, the majority would underestimate intake. It was also concluded that caution should be taken when interpreting dietary intake data.

Daily variation in the food intake is one of the main factors that may reduce the accuracy of food records to assess the usual diet (Bingham et al., 1991). More than one day should be used for reliability as well as to decrease error associated with estimating food amount (Bingham et al., 1991). As the number of days of food records increase for an individual, the lower the error will be for estimating food intake. Bingham et al. (1991) stated that a 3 to 4 day record appears to be the ideal length. Balogh et al. (1971) found high day-to-day variation within individuals by repeating 24-hour recalls over a 12 month time period. Balogh et al. (1971) found that to have a 95 percent possibility of being within ± 20 percent of a person's true energy intake, it would be necessary to obtain 4 days of food records. Rebro et al. (1998) found that subtle changes in eating patterns occur the longer the subject keeps the food record. The subjects reduce the amount of snacks and foods eaten and replace complex foods with foods easier to record. Thus, most studies use a 4 day food record to keep respondent burden low, to not change food intake of the participant, and to keep costs low (Craig et al., 2000).

The weighed food record (WFR) has been considered the gold standard of estimating dietary intake (Bingham et al., 1991). All food and drink consumed by the individual is weighed using scales. Leftover food weight is recorded as well. The weighed food record allows for a more precise determination of portion sizes, does not rely on memory and is not limited to selection from a predetermined list (Green et al., 1998). However, the WFR requires training and involved participation from the respondent (Briefel and Sempos, 1992). Briefel and Sempos (1992) stated that the level of effort needed for this method could cause participants to change their dietary eating habits during the recording period, which can affect dietary intake results. Analyzing the record is also time consuming.

Even with these limitations, the weighed food record has been shown to be one of the most accurate methods of dietary assessment (Bingham et al., 1991). Bingham et al. (1991) stated that portion estimation, rather than direct weighing, is responsible for imprecision at the individual level when using other methods such as the food record. The weighed food record has been validated against independent biological markers to determine accuracy of the weighed food record.

Green et al. (1998) validated the use of a three-day weighed food record and a semiquantitative food-frequency questionnaire in assessing folate and vitamin B_{12} intake. Venous blood was drawn from the participants after an overnight fast. Blood concentrations of serum folate and serum B_{12} were measured and correlated to the folate and vitamin B_{12} intake using the two dietary measures. Folate intake estimated by the weighed food record correlated highly with the serum folate ($r=0.65$, $p< 0.01$) but not as well with the folate intake from the estimated FFQ ($r=0.48$, $p=0.017$). There was "poor agreement" between median folate and vitamin B_{12} intake as measured by the FFQ versus the 3-day weighed food record. The median folate intake as estimated by the FFQ was 1.5 times greater than estimated folate intake by the food record ($p<0.001$). The median intake of B_{12} assessed by the FFQ was 2.5 times greater than estimated B_{12} intake by the weighed food record ($p<0.001$).

Bingham et al. (1995) used the 24-hour urine nitrogen technique and blood samples to validate the weighed food record, the 24-hour recall, FFQ, and estimated food records in 160 women. One hundred and fifty-six women completed the study. Each individual was interviewed in her home four times over the course of one year. At each visit the subjects were asked to complete a four-day weighed food record using portable scales, as well as provide two 24-hour urine collections and an overnight fasting venous blood sample. Thus, over the year, the individual provided 16 days of weighed food records and eight 24-hour urine collections.

The distribution for the urine N: dietary N ratio was not normal, thus the subjects were divided into five groups. Correlations between urine N and dietary N were 0.98 to 0.99 in the lower four quintiles, but were lower, 0.78, in the top quintile. Individuals in the top quintile had a larger BMI and body weight and reported no weight gain or loss over the year. Individuals in the top quintile also reported lower intakes of energy, protein, starch, sugars, calcium, and potassium than those in the other quintiles. It was concluded that the top quintile were not reporting their usual intake and thus were separated from the rest of the subjects (Bingham et al., 1995).

Bingham et al. (1995) concluded that the weighed food record was the best method to use in estimating nutrient intake. The weighed food record correlated the highest with dietary N intake ($r=0.87$, $p<0.001$, for lowest four quintiles). Correlations for the 24-hour recall and the food frequency questionnaires correlated poorly within the lower four quintiles, with dietary urine N and 24-hour urine N ranging from 0.10 to 0.20. This study showed that despite the limitations of the weighed food record, it is still the most accurate estimate of dietary intake.

History of the Native American Diet

Prior to contact with Western civilization, Native Americans lived in a different manner. There was increased variability in diets across the tribes before Western contact, due to geographic location. Some Native Americans were primarily hunters and gatherers, and some tribes cultivated gardens (Berg, 1994; Ballew et al., 1997; Vaughan et al., 1997; Vennum, 1998). At times there were seasonal macronutrient shortages and famines due to depletion of game (Ritenbaugh and Goodby, 1989). Increased energy was needed to cope with extreme temperatures and strenuous physical activity of daily living (Grittelson et al., 1998). Diets before contact with Western Civilization were high in plant foods, low in total fat and saturated fat, and high in complex carbohydrates (Berg, 1994; Vaughn et al., 1997; Grittleson et al., 1998).

Detailed dietary intake information is lacking for many Indian tribes. The traditional diet of the Pima Indians consisted of low-fat, high carbohydrate foods (Swinburn et al., 1991). The Pima Indians were hunters and gatherers, and their diet was supplemented with plant foods grown themselves. Game, fish, squash, corn, melon, and legumes all contributed to the Pima diet. The Pima gathered desert plants for food as well. Ojibwe Indians in Canada had a traditional diet high in protein, low in fat and low in carbohydrates and fiber (Berkes and Farkas, 1978). The Ojibwe were hunters and gatherers as well, using natural resources such as lakes and streams to supply them with food.

In the mid-1800s, many Native Americans were forced from their resource-rich land and placed in areas dissimilar to their homeland (Ritenbaugh and Goodby, 1989). In some cases, homelands were burned, animals killed, and fields destroyed (Lightfoot, 1983). Their new homes were remote from established civilization and in locations where subsistence living was difficult. The establishment of state boundaries, the fencing of land, and reallocation of land for mining and timber resources affected the Native American diet (Vennum, 1998; Teufel et al., 1990). Usual subsistence activities could not be relied on for food, and the Native Americans had to rely on other food sources. For example, according to a report written on the Mille Lacs Band of Ojibwe Indians in Minnesota and Wisconsin, the Ojibwe were prohibited to hunt and fish off of reservation lands (deGonzague et al., 1999). Lippencott's geological survey in 1900 found that the Pima Indians farming was hindered due to diverting their water supply to other places (Smith et al., 1996). Southwest Native Americans survived by eating small game, collecting wild plants and adapting to military rations (Lightfoot, 1983). With the movement of Native Americans to reservations or permanent settlements, the traditional diet began to change and shift to a more Westernized diet, higher in fat and low in complex carbohydrates (Young, 1988; Berg 1994; Harrison and Ritenbaugh, 1992).

When the Native Americans first arrived at the reservations, their diets were primarily lacking in energy, and in some cases, protein, vitamins and minerals (Teufel, 1996). Settlement on the reservations, as well as changing ecological conditions led to decreased variety in the Native American diet as well as nutritional inadequacy (Teufel, 1996). The 1926-1927 Indian Affairs survey found that Native Americans had poor diets and a limited food supply (Merian, 1928). In a survey of 55 out of 95 Indian Affairs jurisdictions, the diet was predominately made up of meat or fish, bread, beans, sugar, and coffee or tea (Merian, 1928). Some tribes used vegetables and fruits, and milk and eggs were almost non-existent. Survey authors concluded that the diet of Native Americans was low in quantity as well as nutritional quality. Many Indian families did not have enough to eat, and "altered from gormandizing to starving" (Merian, 1928). Availability of food, especially quantity, was a problem for this population. Malnourished children were typical among the Indian population (Mountin and Townsent, 1936). The physical appearance of the Indian children showed a "winged scapulae, pot belly, stooped shoulders and lack of tone" indicating malnutrition (Merian, 1928).

In the 1930s, provisions of food such as bacon, cheese and beans were provided to the Native Americans through federal and state administered programs (Smith et al., 1996). After World War II, the USDA and Indian Tribal Organizations expanded the food provided to include canned meats, vegetables, fruits, dry cereals, and milk and is considered the beginning of The Food Distribution Program on Indian Reservations (FDPIR). The FDPIR is currently serving the Indian population. The FDPIR program provides commodity foods to low-income Native Americans and is an alternative to the Food Stamp Program in locations where grocery stores are not easily accessible (Health Services for American Indians, 1957).

Changes to the commodity program occurred in 1955, after Indian Health was transferred from the Department of the Interior to the Department of Health, Education and Welfare's Public Health Service (Jackson, 1986). Nutritional status of the American Indian in the 1950s was basically unknown. Diets appeared to be deficient in protein, and anemia and poor musculature were found in Indian babies (Health Services for American Indians, 1957).

The 1969 Conference on Nutrition, Growth and Development of North American Indian Children looked at the health and nutritional status of North American Indian and Alaska Native children (Moore et al., 1972). Moore et al. (1972) found sub-optimal nutritional status among the children in these populations. Available studies showed that most children from the Navajo, White Mountain Apache, Blackfeet, Gros Ventres, and Assiniboine children in Montana had mild to definite dietary deficiencies in vitamin A, vitamin C, calcium, and iron, as well as protein intakes bordering on deficient (Moore et al., 1972; Carlile et al., 1972).

A nutritional study was conducted in 1969 and in 1976 with White Mountain Apache preschool children. Owen et al. (1981) found in 1969 that dietary intakes for vitamin A, vitamin C, energy, calcium, iron and riboflavin were low for many children. About one-fifth of the children were anemic and about 15-22 percent had low plasma levels of iron, vitamin A and vitamin C. In 1969, 38 percent of the preschool children had low intakes of iron and 23 percent had low intakes of calcium. In 1976, 22 percent of the children had low serum ferritin levels. Thus, the children in 1976 had higher intakes of energy and specific nutrients than the children surveyed in 1969.

Little research could be found on historical diet quality or the history of nutritional status of Indian adults. Food and nutrition intake studies show that the nutritional sufficiency of this population differs from tribe to tribe based on demographic factors, such as income, as well as food availability and preferences. A few nutritional studies have been conducted in specific geographical areas, and the majority of past research focused on nutritional status of children and not diet quality.

Diet and Chronic Disease in Native Americans

The incidence of diabetes in Native Americans has increased since World War II (Broussard et al., 1995). In an early report, Salsbury (1937) found only one case of diabetes mellitus out of 6000 Navajo hospitalizations. However, in the early 1960s, investigators began to discover that the number of patients with diabetes admitted to clinics and hospitals on the Navajo reservation was increasing (Saiki and Rimoin, 1968). The Navajo people were not the only ones with an increased rate of diabetes mellitus. African Americans, Alaskan Natives, Mexican Americans, Hispanics and all Native Americans have seen an increased rate of diabetes mellitus (Welty 1991; Costacou et al., 2000). However, American Indians/Alaska Natives have about three times the occurrence of diabetes than non-Hispanic whites (US Dept of Health and Human Services, 1996).

Mortality rates of heart disease and diabetes for American Indian women have increased over the past decades (Strauss et al., 1997). From the Navajo Health and Nutrition Survey, it was revealed that a large number of Navajo women were overweight, an aspect that increases risk of heart disease and diabetes (Strauss et al., 1997). Over a 30-year period, the rate of diabetes of Native Americans in New Mexico increased 550 percent for women in comparison with 249 percent for men (Carter et al., 1993). It is thought that these increases may be associated with concurrent rises in obesity in this population as well as poorer diet quality.

Boyce and Swinburn (1993) believe that certain Western-style food components may contribute to nutritional problems in Native Americans, such as type 2 diabetes and obesity. Murphy et al. (1995) suggested that increased consumption of commercial sodas and non-indigenous meats, such as beef and chicken, along with decreased activity, has lead to a rapid increase in the rate of cardiovascular disease, diabetes, and obesity in Native Americans and Alaska Natives.

Researchers from the Harvard School of Public Health conducted a study following 42,000 men over a 12-year period (Nagourney, 2002). They divided the men into two groups: those that follow a "prudent diet", consisting of fruits, vegetables, whole grains, fish and poultry; and those that followed a more westernized diet containing foods high in red meat, processed meat, high-fat dairy products, refined grains, and dessert. During the time of the study, 1,321 new cases of type 2 diabetes were diagnosed. The subjects following the westernized diet were found to be 16 percent more at risk in developing diabetes than those following the healthier "prudent diet" which is lower in fat and energy.

Nutrient Intake of Native American Women

The diet of the Native American has changed a great deal over the past 80 years. This population evolved from not having enough to eat, or erratic sources of food, and a high incidence of malnutrition to a high incidence of chronic disease that may be caused by increased food availability and over consumption (Byers, 1992). The use of butter, lard, whole milk, fry bread, fried meats and vegetables; the addition of fat when preparing dried beans; and increased consumption of sugared beverages contribute to obesity and are used in place of more nutritious foods (Broussard et al., 1995). McMurry et al. (1991) believed that this shift to a more westernized diet, high in fat, low in fiber, and low in complex carbohydrates, has altered nutrient intake of the Native American.

Wolfe and Sanjur (1988) surveyed 107 Navajo women living on the Navajo reservation to describe and evaluate the present-day Navajo diet. One 24-hour recall was obtained from the Navajo women, using dishes and utensils to help estimate dietary intake. The mean age for the Navajo women was 47 years old. The women had attended school for an average of six years, with 28 percent having received no formal education. Sixty-three percent of the sample was overweight, defined as more than 120 percent of their ideal body weight. The mean household income was $6,000 per year.

Nutrient intake was calculated using the Ohio State University nutrient data bank (Wolfe et al., 1988). The mean energy intake for the Navajo women was 1632 kilocalories, with 31 percent energy coming from fat, 54 percent energy from carbohydrates, and 16 percent energy from protein. Mean calcium intake for this sample was 574 mg. Sixty-one percent of the Navajo women consumed less than 2/3 of the RDA (9th edition) for calcium. The mean nutrient intake for vitamin A, vitamin C, and iron were below the RDA (9th Edition) for women.

Teufel and Dufour (1990) studied nutrient intake of free-living Hualapai Indian women living in northwest Arizona. The sample consisted of 14 obese and 14 non-obese women between the ages of 18 and 35 years old currently living on the reservation. Subjects were matched for age within 5-year intervals and for percent of Hualapai ancestry. Subjects were classified as obese by having a triceps plus subscapular skinfold measurement at or above the 90th percentile of the U.S. Department of Health and Human Services (USDHHS) health statistics (DHHS Publ. No (PHS) 83-1680). The obese subjects also had a weight 20 percent or more above the desirable weight for height of large framed women indicated on the 1983 Insurance tables (1983 Metropolitan height and weight tables). Women with measurements below the 85th percentile of the USDHHS Health Statistics were classified as non-obese. The non-obese women also had a body weight less than 20 percent above desirable weight for height. Energy and nutrient intake were obtained from 24-hour recalls collected over seven consecutive days (Teufel et al., 1990). The subjects' dietary intake was analyzed using a project-generated computer program with food composition values from standard tables.

The obese and non-obese women were not significantly different in age, education, percent of Hualapai ancestry, marital status, household composition or income (Teufel and DuFour 1990). The mean years of attendance in formal educational programs was about 13 years. Twenty women out of the sample of 28 were employed. Eleven women were single, 11 were married and 6 were divorced. The median household income for a Hualapai family of five was $13,000.

Mean energy intake and carbohydrate intake of the obese women was significantly greater than the non-obese women ($p<0.001$) (Teufel et al. 1990). Mean protein intake, crude fiber and fat intake did not differ significantly between the groups. However, the obese group consumed more fat ($p<0.05$), saturated fat ($p<0.01$) and polyunsaturated fat ($p<0.01$) per kilogram body weight than the non-obese group.

The 1991-1992 Navajo Health and Nutrition Survey interviewed 556 women, stratified across four age groups: 12-19 years, 20-39 years, 40-59 years, and 60 and older (Ballew et al., 1997). A single 24-hour recall was used to estimate nutrient intake. Intakes of total fat, vitamin A, beta-carotene, vitamin C, folate, and calcium significantly decreased with increasing age. Median intakes of vitamin A, vitamin E, vitamin B_6, folate, calcium, and magnesium were below the RDA (10^{th} edition) for all four age groups. Vitamin C intake was below the RDA for women 20 years and older. Median iron intake was below the RDA for all women under 60 years. Fruits and vegetables, as well as milk products were consumed less than once a day.

Bell et al. (1995) compared dietary intake data for Lumbee Indian women in North Carolina to data from the second National Health and Nutrition Examination Survey (NHANES II) (Dietary Intake Source Data, 1983) and RDAs (10^{th} edition) for similar sex and age. The women who participated in this study were between 21 and 60 years of age, an enrolled member of the Lumbee tribe, not pregnant, had no chronic diseases, and not following a medically prescribed diet. Each individual was asked to complete a three-day food record and one 24-hour food recall. One hundred and seven Lumbee women completed the food records.

Demographic data showed that the mean age for Lumbee women sampled was about 40 years old (Bell et al., 1995). Sixty percent of the sample was married and 89 percent of the women were employed. Ninety-seven on the Lumbee women had a high school education. About 50 percent of the Lumbee women were overweight or obese.

Mean energy intake for the Lumbee women (1,538 kcals) were similar to women in NHANES II (1,401 kcals), but were less than the RDA of 1,900 kcals, but not significantly (Bell et al., 1995). Fat intake of 62 grams was similar to NHANES II fat intake of 57 grams. Percentage of fat from kilocalories was similar for the Lumbee women (36 percent), compared to NHANES II (35.7 percent). None of these values were significantly different.

The Strong Heart Dietary Study (SHDS), conducted from 1988-1991, looked at diets of 10 different American Indian tribes in three areas of the country (Zephier et al., 1997). The SHDS is an ancillary study of the Strong Heart Study (SHS), funded by the National Heart, Lung, and Blood Institute. The SHS was the first population based dietary study that looked at cardiovascular disease and risk factors among tribes in Arizona, Oklahoma, and North and South Dakota. For this review, only data from Oklahoma Indian women were reviewed.

The subjects were recruited from those involved in the SHS (Zephier et al., 1997). Women aged 45 to 74, identified from tribal rolls were invited to participate in the study. One 24-hour food recall was collected from each subject. One hundred and seventy-three women from Oklahoma participated in the study. The collected dietary information was compared with Phase I of NHANES III, which was conducted about the same time.

The mean energy intake for women in Oklahoma was 1,431 kilocalories (Zephier et al., 1997) and was significantly less than the mean energy intake found in NHANES III ($p \leq 0.01$) (1,609 kilocalories). Protein, fiber, and carbohydrate intake of Oklahoma women were also significantly lower ($p \leq 0.01$) than NHANES III values. Energy from total fat and saturated fat were significantly higher in Oklahoma women than in NHANES III ($p \leq 0.01$). Percent energy from total fat ranged from 33-39 percent, based on age. Percent energy from total saturated fat ranged from 11-13 percent, based on age. All subjects from the SHDS study showed high risk of cardiovascular disease as well as other chronic diseases due to diet.

Vaughan et al. (1997) surveyed the Havasupai community in Supai, Arizona to estimate their nutrient intake. Vaughan used the 24-hour recall method to obtain dietary intake from 60 women. The women were divided into two age groups, younger (18-59 years) and older ($\geq$ 60 years). The mean age for the younger group was 34 years old and the mean age for the older group was 72 years old. The mean BMI for the younger and older group was 34 and 32, respectively. Twenty-four percent of the pooled sample was classified as overweight (BMI of 27-30) and 56 percent of the pooled sample was classified as obese (BMI $\geq$ 30). There was no significant difference between the age groups for BMI.

Vaughan et al. (1997) found that the macronutrient distribution of the diet for Havasupai women, aged 18-59 years old, was 35 percent of energy from fat (12 percent saturated), 49 percent of kilocalories from carbohydrates, and 14 percent from protein.

For the older group, 36 percent of energy was from fat, 46 percent of kilocalories from carbohydrates, and 17 percent kilocalories from protein. There was no significant difference between the groups in macronutrient intake. In this study, two-thirds of the RDA (10^{th} edition) was used as the cutoff for adequate intake. Fifty-two percent of Havasupai women consumed less than two-thirds of the RDA for folate (180 μg) and calcium (800 mg). Zinc, vitamin A, and vitamin B_6, were found to be inadequate as well.

Ikeda et al. (1998) examined dietary intake of Native American women living in rural California. One 24-hour recall was administered to 198 women. The percentage of the 10^{th} edition of the RDAs was calculated for fifteen nutrients. Due to large standard deviations in nutrient intake, diets were classified on the number of nutrients present at two-thirds or more of the RDA to see if a more accurate description of dietary intake could be obtained. Diets that consisted of more than two thirds of the RDA for 12 out of 15 nutrients were classified as "more adequately nourished" (MAN). Diets that provided less than two thirds of the RDA for 3 or more nutrients were classified as "less adequately nourished" (LAN).

The mean age for the women interviewed was 32 years (Ikeda et al., 1998). Eighty-five percent of the women had finished high school. In the sample, 67 percent of the women reported incomes at or below the Federal poverty level, and an extra 11 percent reported incomes below 125 percent of the poverty level.

Of the 198 women interviewed, 39 percent had MAN diets and 61 percent had LAN diets (Ikeda et al., 1998). There was no significant difference between the MAN and LAN groups in nutrient intake. Women classified with MAN diets had a mean energy intake of 2,357 kcals and mean intakes greater than two thirds of the RDA for all

15 nutrients. Women classified with LAN diets had a mean energy intake of 1,412 kcals and mean intakes less than two thirds of the RDA for vitamins A, C, and B_6; and iron, magnesium, and zinc.

Women from two Ojibwe communities, Mile Lacs, Minnesota and Lac Courte Oreilles, Wisconsin, were interviewed using 24-hour recalls and a food frequency questionnaire to assess current dietary intake (deGonzague et al., 1999). Twenty-nine women from Lac Courte Oreilles and 28 women from Mille Lacs participated in this study. Mean BMI for the women from the two Ojibwe communities was 26.9. Forty-three percent of the sample was overweight. Energy intake for the women in the two communities was approximately 1,850 kilocalories. The macronutrient distribution for the women was about 40 percent of energy from fat (13 percent saturated), 43 percent from carbohydrates, and about 17 percent from protein. Calcium intake was 480 mg, which was below the Adequate Intake (AI) of the 1997 Dietary Reference Intake (DRI) for women (1000 mg to 1300 mg, depending on age). Folate intake was about 150 μg, less than the RDA (10th Edition) for folate (180 μg). Mean intakes of vitamin A, calcium, iron and zinc were below the RDA (10th edition).

Bell et al. (2002) looked at dietary and supplemental intake of calcium and vitamin D among older Native American, white (European American) and African American women in rural North Carolina. Women 60 years and older were recruited for this study. The women also had to be a resident of Robeson County, live in the community, stand without assistance for height and weight measurements, and be able to answer interviewer-administered questions. For this review, only data from Native American women were reviewed.

Eighty Native American women participated in this study (Bell et al., 2002). Calcium intake was estimated using the Oregon Dairy Council Calcium Score Sheet (Oregon Dairy Council, 1994). The score sheet contains a list of 25 food entries, with foods listed by seven levels of calcium content, ranging from 25 to 400 mg/serving. Participants estimated how many servings of these foods they consumed weekly. The average daily intake of calcium was estimated from average weekly servings from the seven categories. Women also informed the interviewers if they were taking supplements, such as a multivitamin or a calcium supplement. However, calcium from the multivitamin was not used in the estimation of daily calcium intake.

The mean age for the Native American women was 71.6 years (Bell et al., 2002). The mean BMI for this sample was 29.8, falling into the overweight category for BMI. Forty percent of the sample graduated from high school. The mean dietary calcium intake was 471 mg per day. Almost half (47 percent) of the Native American women regularly took a multivitamin and twenty-nine percent regularly took a calcium supplement. Bell et al. (2002) stated that although there is insufficient data available on osteoporosis among Native American women, they are not consuming enough calcium relative to what is recommended by the Institute of Medicine (1998). The Dietary Reference Intakes recommend 1,000-1,500 mg per day.

The paucity of data available is a limitation in presenting an overall picture of nutrient intake. However, it is possible to determine that nutrient intake of the American Indian women needs improvement. It is unknown if current dietary trends among this population, such as large intakes of commercial sodas and foods available from supplemental food programs high in fat and sodium, contribute to the compromised diet as well as to increased risk of cardiovascular diseases, diabetes and obesity (Murphy et al., 1995, Schraer et al., 1996).

Diet Quality of Native Americans

Few studies were found on overall diet quality of Native Americans (Jackson, 1986; Story et al., 1998). Studies are available on diets of individual tribes, but not for the general Native American population. Articles describing the diets of Native Americans are usually small in sample size and focused on particular groups, such as children, pregnant women, or adolescents (Teufel et al, 1990; Owen et al., 1981).

Basiotis et al. (1999) evaluated overall diet quality of 107 male and female American Indians in the 1994-1996 CSFII survey, a nationally representative study containing information of people's consumption of foods and nutrients. Using the HEI as the measure of diet quality, only 10 percent of American Indians had a good diet; 16 percent had a poor diet and 74 percent had a diet that needed improvement. In comparison, in the overall US population, 12 percent have a good diet using HEI, 17 percent had a poor diet, and 71 percent of the US population had a diet that needed improvement (Bowman et al., 1998).

American Indians scored best on the cholesterol component of the HEI and worst on the fruit component. This poor diet quality, in addition to other risk factors, such as obesity and genetic predisposition to diabetes mellitus, make Native Americans more at risk for chronic disease, such as diabetes and cardiovascular disease (Welty 1991; Wolfe et al., 1988; Vaughan et al., 1997).

Nutrient Intake and Diet Quality of Individuals with Diabetes

There is little research available focusing on nutrient intake and diet quality of individuals with diabetes mellitus. Cook et al. (2002) conducted a study looking at nutrient intake of adolescents with diabetes and comparing the results to national results of adolescents without diabetes. A 24-hour food recall was conducted with 61 adolescents from three diabetes clinics in the Chicago area. The adolescents ranged from 13 to 17 years and had either type 1 or type 2 diabetes mellitus for more than a year. Sixty-one percent of the sample was female, 78 percent was Caucasian, 11 percent was black, and 7 percent was Hispanic. For this review, only female adolescents were considered for this study.

Cook et al. (2002) found that the adolescents with diabetes had similar dietary intakes. Energy intake from carbohydrate was 55 percent for adolescent females aged 13-14 years. Energy intake from total fat and saturated fat was 29 and 10 percent, respectively. This is similar to what was found for females 11-14 years without diabetes. Energy from carbohydrate, total fat and saturated fat was 54 percent, 34 percent and 13 percent, respectively. Females aged 15-18 years consumed 59 percent energy from carbohydrate, 28 percent energy from fat and 10 percent energy from saturated fat. This is similar to what was consumed by females 15-18 years of age without diabetes. Energy intake from carbohydrate was 53 percent, energy intake from total fat was 33 percent and energy intake from saturated fat was 12 percent.

Calcium intake for females with and without diabetes was similar as well (Cook et al., 2002). Females aged 11-14 without diabetes averaged at 87 percent of the RDA

(10th edition) for calcium (Food and Nutrition Board, 1989). Females with diabetes in the same age range averaged 91 percent of the RDA for calcium. Females aged 15-18 years with diabetes consumed 85 percent of the RDA for calcium. This is similar to what was consumed by females of the same age range without diabetes (80 percent).

CHAPTER III

METHODOLOGY

Research Overview

This research was part of a larger project funded by the Oklahoma Center for the Advancement of Science and Technology (OCAST). The overall goal of the aforementioned project was to identify health concerns, attitudes, and beliefs regarding diabetes among Native American women as well as assess diet quality in this group. Instrument administration was used for this study. Three interviews were conducted with each participant to obtain information for this study. The first interview involved signing the consent form, completing the demographic form, ranking life order concerns and training participants how to conduct a 4-day weighed food record. The completed food record was obtained at the second interview. At the second interview, participants also completed the cultural structure of health and diabetes interview as well as a food sort. The weight valuation and cultural definition of obesity interview was conducted at the third and last interview as well as a second food sort. Participants were then compensated at the last interview. The results of this study will be used to guide future diabetes research and education programs among Native American women in Oklahoma.

All information gathered and analyzed was shared with each health clinic and tribe. Only the results of the four-day food record will be presented in this report.

Research Design

The research design for this study was a non-experimental correlational design. The research was descriptive of the dietary quality and nutrient intake of Native American women. The unit of analysis was the individual and the time dimension for the study was a cross-sectional design. Dietary intake was conducted at a single point in time using the weighed intake method to measure four non-consecutive days of intake. The research procedures were reviewed and approved by the Institutional Review Board at Oklahoma State University (Appendix A).

Selection of Subjects

The target sample was Native American women between the ages of 18-65, at least 25% Native American blood, and not pregnant or lactating. Subjects were not excluded from the study for a chronic disease, such as type 2 diabetes mellitus. The subjects were recruited from three different Native American health clinics: Iowa Tribe Clinic in Perkins, Oklahoma; Pawnee Tribe Clinic in Pawnee, Oklahoma; and Kaw Tribe Clinic in Newkirk, Oklahoma. Women did not need to belong to the specific tribe to participate (i.e. Ponca women). An attempt was made to have half of the sample with and half without diabetes. The sampling unit was the Native American woman. Convenience sampling was used for this study.

Key informants, such as the director of the health clinic, and hired interviewers assisted in recruitment of subjects. Articles about the study were published in the Iowa and Pawnee tribal newsletters to aid recruitment. In addition, fliers were sent to the diabetes education clinics and general health clinics to advertise the study. An attempt was made to recruit twenty-five to thirty Native American women from each of the three clinics. To increase participation, compensation was offered to the participants. The participants received the following: 3-dimensional food portion models, measuring cups and spoons, and $125 for completing all phases of the study.

Informed consent was obtained from the participants before the data was collected (Appendix B). The participants were informed that participation was voluntary and they could decline to participate at any time. The participant name was cut off the top of all forms after the participant number was assigned and data entered and verified. Subject numbers were used on all forms to identify the subjects and data in the data files. Only the research staff saw the forms and was involved in data entry. All completed data entry forms were kept in a locked file cabinet to ensure confidentiality. Five years after data collection, all data entry forms will be destroyed by shredding.

Training the Interviewers

Burhansstipanov (1995) and Sherwood et al. (2000) recommend that Native Americans be used in all phases of research and have shown that this population responds more positively to interviewers of the same race. Two female interviewers from the Pawnee and Kaw tribal health clinics, and one interviewer from the Iowa tribal health clinic were recruited to conduct the in-depth interviews. Interviewers were at least 25% Native American blood with a valid driver's license and reliable transportation. No previous interviewing experience was needed.

Job descriptions (Appendix E) were created to assist with advertising the interviewer position and distributed to the key informants at the clinics, as well as application forms. The key informants circulated the job announcements and applications to potential candidates. Upon receipt of the application forms, the research team reviewed them and selected the five interviewers from the respective clinics. Letters were drafted representing an official offer of hire on contractual basis to complete the interviews. An acceptance letter was requested from the candidate for acknowledgement of hire and a contract signed (Appendix F).

An all-day training was held to instruct the interviewers in listening and directive interviewing skills. The interviewers were trained in how to operate the scale used for the weighed food record as well as how to correctly record foods in the weighed food record booklet. To ensure quality of the data, the weighed food record was piloted with each interviewer. This insured that the interviewers understood the importance of detail, correct measurement and recording of foods on the food record. Procedures for subject recruitment, completion of paperwork and turning in completed interviews were explained during the training. The interviewers were paid $100 for the training and $125 for each completed interview on a contract basis.

Research Instruments

Demographic Form

All participants completed demographic questions (Appendix C). Demographic information included marital status, tribal affiliation, education, employment, income, food sources, physical activity, age, and self-reported weight and height, and how they learned about the study. All answers were recorded by the interviewer on the demographic form and returned to the research team.

Weighed Food Record

A weighed food record booklet (Appendix D) was used to record dietary intake data. The booklet contained written instructions on how to weigh and record foods. A portable digital scale (Ohaus Compact Scale, model number 80010096 CE or Ohaus Portable Standard, model number LS5000; Ohaus, Pine Brook, NJ) was provided to the participants to record their intake in grams. The Ohaus Compact scale has a weight capacity up to 2000 g and is readable to one gram or 0.05 ounces. The Ohaus Portable scale had a weight capacity of 5000 grams and is readable to two grams or 0.1 ounce. If the participant was away from home, they recorded the food items in common household measures. Each participant was given a food portion kit to assist in estimating food servings away from home. The kit consisted of measuring spoons, measuring cups, a model of a three-ounce portion of meat, and beanbags representing ¼ cup, ½ cup, and 1-

cup servings. Participants were also provided with Styrofoam plates to lessen the burden of multiple dish use when weighing leftovers. Food records were excluded if the participant did not record any food in gram weights or weights recorded were not realistic.

Data Collection and Procedures

Data collection began April 2001 and continued until February 2002. The interviewers trained the participants to weigh food and complete the food record. The participants completed the 4-day weighed food record by weighing and recording all foods and beverages consumed, and weighing the amount of food not eaten. The interviewers also instructed the participants how to estimate food intake with the provided food portion kit.

The researchers reviewed the food records for inappropriately recorded gram weights and proper recording of food items. If inconsistencies were discovered, the interviewers were asked to question the participant on the accuracy of the item. The food record was corrected as needed. The researchers worked closely with the interviewers to make sure that the data collection was conducted according to protocol and that there were no problems with the scales.

Analysis of Dietary Data

Each participant's completed weighed food record was entered into Food Processor (version 8.1, ESHA, Salem, OR) by individual day. All data were re-checked by the investigator to ensure accuracy. Excessive energy intake, the type of preparation of the food entered, i.e. dry or condensed, and appropriate weights of the food were all checked for correctness. All food record data were exported as delimited files into Excel 10.0 (Microsoft Corporation, Redmond, WA). The delimited files were converted into Excel files and exported into SPSS (version 10.0, SPSS Inc., Chicago, IL) for further analysis.

Nutrient Analysis of Food Records

Dietary folate, calcium, total fat, saturated fat and total energy were estimated from the 4-day weighed food record using Food Processor (version 8.1, ESHA, Salem, OR). Nutrient values of foods not included in the Food Processor database were compiled from the United States Department of Agriculture (USDA) database and manufacturers nutrition facts.

The dietary standards of the Dietary Reference Intakes (DRI) were used to evaluate estimated adequacy of folate and calcium intake. The Recommended Dietary Allowances (RDAs) for folate for women ages 14 and older is 400 μg per day. The Adequate Intake (AI) for calcium for women 19-50 years old is 1000 mg per day. Women 51 years and older have an AI of 1200 mg per day.

Diet Quality

Overall diet quality was assessed using the Healthy Eating Index (HEI) (Kennedy et al., 1995). More detailed information regarding the HEI is found in Chapter II. As mentioned in Chapter II, the HEI is comprised of 10 components, with each component scored separately and then summed for a final score of 100 (Table 1). The first five components represent the food groups from the Food Guide Pyramid (FGP): grains, fruits, vegetables, milk, and meat. The sixth and seventh components measure the percentage of total energy intake from total fat and saturated fat. Component 8 measures total cholesterol intake. Component 9 measures total sodium intake and component 10 measures the amount of variety in the subject's diet. More information regarding the calculation of Food Guide Pyramid servings can be found in Appendix G.

For each component a score from 0 to 10 was possible. The score that the subject received in the food group categories was determined by the appropriate number of servings for a given energy intake level and age group, based on one day. Table 2 shows the minimum servings needed to obtain a score of 10 for each group. A score of 10 for components 1-5 indicated that the respondent met the recommended minimum number of servings for that food group for one day. Subjects do not receive additional credit for exceeding the recommended amounts. A subject that did not consume any servings of the food group received a score of 0. If the amount consumed was between 0 and minimum number of servings, the score was calculated proportionately. The HEI score for the proportional food group servings was calculated accordingly:

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# of servings consumed / maximum servings x 10 = HEI score.

Components 6 to 10 were scored differently. For component 6, the participant received a score of 10 if their total fat intake was 30% or less of total energy intake for one day. The score was 0 if their total fat intake exceeded 45%. If fat intake fell between the 30 and 45%, the score was calculated proportionately. The intermediate percent of total fat consumed was subtracted from the maximum amount that can be consumed, 45 percent. This result was then divided by the range of the component, 15, and then multiplied by 10:

(Maximum of range – amount consumed) / range x 10 = HEI.

Component 7 was scored in the same manner; however, the percentage for saturated fat was 10% total energy intake. The maximum score of 10 was assigned for less that 10% saturated fat from total energy intake in the diet, and the minimum was 0 for more than 15% saturated fat from total energy intake. Intermediate amounts were scored the same as for total fat intake, with the range being 10 instead of 15.

Components 8 and 9 were scored based on milligrams of cholesterol and sodium consumed in one day. To obtain a 10 for cholesterol and sodium, the diet must have no more than 300 mg of cholesterol and 2,400 mg of sodium. The maximum amounts for these components were 450 mg and 4,800 mg, respectively. If the participant exceeded these values, a score of zero was allocated. Proportionate amounts were scored the same way as total fat and saturated fat. For components 1 through 9, the score for each component was calculated for each day and then the mean was determined for the 4 days.

To calculate the variety score of the diet, the number of different foods eaten by a person that contributed to a serving in a FGP group was counted (Bowman et al., 1998).

For a food to be counted as a different food, they needed to contribute at least one half of a serving in a food group. Several servings in a food group consumed in less than one-half servings amounts throughout the 4 day period, when combined, could be summed to achieve the one-half serving minimum. Food mixtures were divided into their food ingredients and assigned to the appropriate food group. Foods that differed by preparation were grouped together and counted as one type of food. For example, fried chicken and baked chicken were not considered two different foods. Different forms of the same vegetable were grouped together. For example, a baked potato and French fries were grouped together and not considered as two different foods. Different forms of the same meat were grouped together, except ham and organ meats. Each type of fish was considered a different food, but different cooked or processed forms of the same fish were grouped together. Most forms of fluid milk were grouped together. Most cheeses were grouped together, except cottage cheese. All white breads were grouped together, but whole wheat breads were grouped differently from products made with refined flour. Ready to eat cereals were grouped based on the main grain in the cereal. Those made with separate grains were grouped separately, for example corn cereal and cereals made from rice were two different foods. In the HEI, a person received a score of 10 for eating 21 or more different foods over four days. A score of 0 was given if 7.77 or fewer different foods were consumed over four days; scores that fell in between were calculated proportionately. An HEI score was determined for the 4 days.

Hypotheses

Hypothesis One:

There will be no significant difference in nutrient intake among the tribal health clinics.

Hypothesis Two:

There will be no significant difference in nutrient intake by diabetes status.

Hypothesis Three:

There will be no significant difference in diet quality by tribal health clinic.

Hypothesis Four:

There will be no significant difference in diet quality by diabetes status.

Statistical Analysis

Means and frequencies for demographic data were generated using the Statistical Package for Social Sciences (SPSS, version 11.0, Chicago Ill, 2002). Mean nutrient intake for 71 women was determined by Food Processor (version 8.1, ESHA, Salem, OR) and checked for skewness and kurtosis using SPSS.

Chi Square analysis was used for categorical data to measure the association among the three health clinics. Independent 2-tailed t-test was used to determine mean nutrient differences by diabetes diagnosis. One-way ANOVA with Scheffe post hoc was used to determine differences in HEI scores among the tribal health clinics.

Correlation analysis was used to determine the association between total HEI score and estimated energy intake. Means and frequencies were generated for the five food groups from the FGP, as well as for sugar and discretionary fat.

Table 1. Components of the Healthy Eating Index and scoring system

	Score Ranges	Criteria for Maximum Score of 10	Criteria for Minimum Score of 0
Grain consumption	0 to 10	6 – 11 servings	0 servings
Vegetable consumption	0 to 10	3 – 5 servings	0 servings
Fruit consumption	0 to 10	2 – 4 servings	0 servings
Milk consumption	0 to 10	2 – 3 servings	0 servings
Meat consumption	0 to 10	2 – 3 servings	0 servings
Total fat intake	0 to 10	30% or less energy from fat	45% or more energy from fat
Saturated fat intake	0 to 10	Less than 10% energy from saturated fat	15% or more energy from saturated fat
Cholesterol intake	0 to 10	300 mg or less	450 mg or more
Sodium intake	0 to 10	2400 mg or less	4800 mg or more
Food variety	0 to 10	8 or more different items in a day	3 or fewer different items in a day

Table 2. Recommended number of USDA Food Guide Pyramid servings per day, by age/gender categories

	Criteria for Maximum Score of 10		Criteria for Minimum Score of 0
Age/ Gender category	Females 25-50	Females 51+	
Energy (kcal)	2200	1900	
Grains	9	7.4	0 servings
Vegetables	4	3.5	0 servings
Fruits	3	2.5	0 servings
Milk	2	2	0 servings
Meat[1]	2.4	2.2	0 servings
Total Fat Intake	$\leq$ 30% kcal from fat	$\leq$ 30% kcal from fat	45% or more kcal from fat
Sat Fat Intake	$\leq$ 10% kcal from saturated fat	$\leq$ 10% kcal from saturated fat	15% or more kcal from saturated fat
Cholesterol Intake	300 mg or less	300 mg or less	450 mg or more
Sodium Intake	2400 mg or less	2400 mg or less	4800 mg or more
Food Variety	21 different foods eaten over a 4 day period	21 different foods eaten over a 4 day period	7.77 or fewer different items in a day

[1]One serving of meat equals 2.5 ounces of lean meat

CHAPTER IV

RESULTS

Demographic Data of Native American Women

Seventy-one Native American (NA) women completed the 4-day weighed food record. Nine women were excluded from the data analysis for filling out the food record incorrectly (i.e. no foods recorded in gram weights). The mean age for the total sample was 44 years (Table 3). The mean percent of Indian blood was 64 percent. Women from sixteen different tribes made up the sample. The tribes represented were Cheyenne Arapaho, Chickasaw, Choctaw, Iowa, Kaw, Muscogee (Creek) Nation, Navajo, Omaha, Osage, Otoe Missouria, Pawnee, Ponca, Potawatomi, Sac and Fox, Seneca Cayuga, and Tonkawa. The mean Body Mass Index (BMI) for the total sample was 32.4. The majority of the pooled sample (62 percent) was classified in the obese category for BMI (BMI>30). Twenty-six percent of the women were overweight (BMI 25-29) and 12 percent were classified as healthy weight (BMI 18.5-24.9). There was no significant difference among the health clinics for the demographic characteristics mentioned above.

Sixty-one percent of the NA women were not married. Only 15 percent of the pooled sample had a college degree. Fifty-six percent of the NA women had attended some college and 28 percent had a high school degree or less. Education was not significantly different across the clinics. Forty-three percent of the pooled sample had an annual household income less than $15,000. About 26 percent had an annual household income between $15,000 and $24,999. Income was significantly different across the three tribes, using Chi square analysis ($p<0.05$). Sixty-two percent of Pawnee clinic women but only 26 percent of Iowa clinic women had household incomes below $15,000.

Thirty-five percent of the pooled sample reported they had diabetes mellitus. A small number of women reported they had heart disease (15 percent) and almost 18 percent self-reported they had high blood cholesterol. Only 9 percent of the NA women reported receiving food stamps, and 14.5 percent of the NA women received commodities. Over half of the pooled sample (65 percent) reported that they were trying to lose weight. These demographics were not significantly different among health clinics.

Estimated Nutrient Intake of Native American Women

The mean estimated energy intake for the pooled sample over four days was about 1887 kcals (Table 4). Mean protein intake over four days was 64 grams and mean fiber intake was 12 grams for the pooled sample. Mean carbohydrate intake for the women from the Pawnee health clinic was greater ($p<0.05$) than carbohydrate intake for Kaw or Iowa Health clinic women. Women from the Pawnee clinic ate more sugar ($p<0.05$) over four days than the Iowa clinic women, but did not eat more than the Kaw clinic women.

Mean fat intake over four days was 76.7 grams, 36 percent of energy from total fat with mean saturated fat intake being 24 grams. Cholesterol intake for the pooled sample was 283 mg. Mean folate intake was 193 μg per day. Calcium intake for the pooled sample was 480 mg per day and sodium intake was 3,304 mg per day. Since the majority of nutrients were not significantly different among clinics, the remaining nutrients across the three tribal clinics were pooled together for analysis.

Estimated Nutrient Intake by Diabetes Status

Table 5 summarizes mean estimated nutrient intake of NA women by diabetes status. The results indicate that women with diabetes ate significantly less sugar and more folate than those who reported they did not have diabetes ($p<0.05$). No significant differences existed by diabetes status for the other nutrients.

Dietary Quality of Native American Women

The HEI scores were not significantly different across the three tribal health clinics for diet quality (Table 6), so the results were pooled. The mean HEI score for the pooled sample was 61.3 (HEI range from 1 to 100). The lowest component scores were milk and fruit, both with an HEI score of 3.1. The highest component score was the meat component, with an HEI score of 9.1. Mean component scores for grain, vegetables, and sodium were similar, ranging from 6.5 to 6.6. The mean variety score for the pooled sample was 7.8. There was a positive and significant correlation between total HEI score and kilocalories (r=0.24, p=0.046).

The HEI score range for needs improvement was 51-80 (Kennedy et al., 1995). Ninety-four percent of the pooled sample had a diet that needed improvement. The remaining 6 percent had a poor diet with an HEI score less than 50. There was no one in the pooled sample that had a HEI score 80 or above, to be categorized as a good diet.

Table 7 shows the mean number of food guide pyramid servings consumed by the pooled sample. About 5 servings of meat per day were consumed by the sample. The milk and fruit group were the lowest groups consumed, with an average of 0.7 and 0.9 servings consumed per day by the Native American women.

Dietary Quality of Native American Women by Diabetes Status

Table 8 shows the mean total and component HEI scores by diabetes status. The mean total HEI for NA women with diabetes was 61.2. This was not significantly different from women reporting that they did not have diabetes (61.0). Women with and without diabetes scored highest in the meat component. Women with diabetes scored lowest in the milk component, with an HEI score of 2.5. Women without diabetes scored lowest in the fruit component, with an HEI score of 2.5. Both groups had similar HEI component scores for saturated fat, sodium and variety components.

Table 3. Demographic characteristics of Native American women, pooled sample and by clinic.

Characteristics	Pooled Sample (n=71)		Iowa (n=23)		Kaw (n=27)		Pawnee (n=21)	
Age (y)	43.9 ± 11.2[1]		41.4 ± 11.9		46.3 ± 11.4		43.4 ± 9.9	
Degree of Indian Blood(%)	64.3 ± 28.7		71.4 ± 30.3		55.2 ± 27.5		68.1 ± 26.5	
Body Weight (kg)	88.0 ± 19.3		86.5 ± 16.9		88.2 ± 10.1		89.3 ± 22.7	
BMI (kg/m^2)[2]	32.4 ± 6.9		31.7 ± 5.7		32.4 ± 6.5		33.0 ± 8.7	
	n	%	n	%	n	%	n	%
BMI Categories								
Healthy (18.5-24.9)	8	12.1	2	9.5	3	12.0	3	15.0
Overweight (25.0-29.9)	17	25.8	5	23.8	5	20.0	7	35.0
Obese (≥30)	41	62.1	14	66.7	17	68.0	10	50.0
Marital Status								
Married	27	38.6	7	30.4	14	51.9	6	30.0
Not Married	43	61.4	16	69.6	13	48.1	14	70.0
Education								
High School or Less	20	28.2	5	21.7	12	44.4	3	14.3
Some College	40	56.3	12	52.2	13	48.1	15	71.4
College Degree	11	15.5	6	26.1	2	7.4	3	14.3
Annual Household Income (US Dollars)								
≤15,000	30	42.9	6	26.1[a]	11	42.3	13	61.9
15,000 –24,999	18	25.7	5	21.7	7	26.9	6	28.6
≥25,000	22	31.4	12	52.2	8	30.8	2	9.5

[1] Mean ± Standard deviation
[2] Body Mass Index
[3] Hypertension
[4] Chi square analysis was conducted but cannot be interpreted because of small sample size in some cells.
[a] Percents are significantly different by tribal clinic using Chi square analysis at p =0.043.

Table 3. Continued.

Characteristics	Pooled Sample (n=71)		Iowa (n=23)		Kaw (n=27)		Pawnee (n=21)	
	n	%	n	%	n	%	n	%
Employment								
Employed	45	63.4	17	73.90	17	63.0	11	52.4
Not Employed	26	36.6	6	26.1	10	37.0	10	47.6
Diagnosed with Diabetes	24	35.3	9	39.1	8	32.0	7	35.0
Diagnosed with HTN[3]	21	30.9	10	43.5	4	16.0	7	35.0
Diagnosed with Heart Disease	10	14.7	4	17.4	3	12.0	3	15.0
High Blood Cholesterol[4]	12	17.6	0	0	9	36.0	3	15.0
Receiving Food Stamps[4]	6	8.7	1	4.3	1	4.0	4	8.7
Receiving Commodities[4]	10	14.5	3	13.0	2	8.0	5	23.8
Trying to Lose Weight	45	65.2	17	73.9	17	68.0	11	52.4

[1] Mean $\pm$ Standard deviation

[2] Body Mass Index

[3] Hypertension

[4] Chi square analysis was conducted but cannot be interpreted because of small sample size in some cells.

[a] Percents are significantly different by tribal clinic using Chi square analysis at $p = 0.043$.

Table 4. Estimated nutrient intake of Native American women, pooled sample and by clinic.

Nutrient	Pooled Sample (n=71)	Iowa (n=23)	Kaw (n=27)	Pawnee (n=21)
Energy (kcal)	1886.5 ± 592.4[1]	1766.5 ± 620.6	1773.5 ± 517.0	2163.1 ± 585.8
Protein (g)	64.0 ± 22.5	62.6 ± 28.0	61.3 ± 19.2	69.0 ± 19.7
Fiber (g)	12.0 ± 4.6	11.7 ± 5.0	12.0 ± 4.8	12.2 ± 4.2
Carbohydrate (g)	238.3 ± 86.3	220.1 ± 75.8[a]	219.2 ± 62.2[a]	282.9 ± 108.3[b]
Percent kcal from Carbohydrate	50.6 ± 8.3	50.1 ± 6.0	50.0 ± 8.5	52.1 ± 10.3
Sugar (g)	110.8 ± 67.1	87.2 ± 50.7[a]	103.2 ± 56.0[a,b]	146.4 ± 82.6[b]
Fat (g)	76.7 ± 29.6	72.0 ± 29.6	74.2 ± 29.1	85.1 ± 30.0
Saturated Fat (g)	24.2 ± 9.9	23.1 ± 10.2	23.1 ± 9.9	26.6 ± 9.8
Percent kcal from Fat	36.4 ± 7.0	36.6 ± 5.4	36.9 ± 6.3	35.6 ± 9.3
Cholesterol (mg)	283.1 ± 136.3	262.0 ± 111.4	283.0 ± 143.3	306.5 ± 153.6
Folate (μg)	193.0 ± 110.1	198.2 ± 121.1	178.9 ± 83.0	205.5 ± 129.9
Calcium (mg)	480.2 ± 234.7	460.9 ± 217.3	451.4 ± 251.4	538.5 ± 231.6
Sodium (mg)	3303.7 ± 1334.0	3230.4 ± 1102.9	2969.1 ± 895.2	3814.4 ± 1848.7

[1]Mean ± Standard deviation
[a]Means across clinics with different superscripts are significantly different using ANOVA and Scheffe post hoc at $p<0.05$

Table 5. Estimated nutrient intake of Native American women by diabetes status.

Nutrient	With Diabetes (n=24)	Without Diabetes (n=44)
Energy (kcal)	1837.2 ± 649.6[1]	1926.2 ± 578.2
Protein (g)	65.6 ± 22.6	63.2 ± 23.1
Fiber (g)	13.0 ± 5.0	11.3 ± 4.3
Carbohydrate (g)	230.0 ± 101.0	244.6 ± 80.8
Percent kcal from Carbohydrate	49.4 ± 6.9	51.2 ± 8.9
Sugar (g)	87.3 ± 65.1[a]	125.5 ± 66.5[b]
Fat (g)	75.5 ± 29.4	78.0 ± 30.4
Saturated Fat (g)	23.7 ± 10.8	24.6 ± 9.8
Percent kcal from Fat	37.2 ± 6.2	36.1 ± 7.4
Cholesterol (mg)	315.0 ± 142.7	64.4 ± 131.8
Folate (μg)	228.4 ± 138.1[a]	168.0 ± 86.1[b]
Calcium (mg)	463.0 ± 244.0	492.3 ± 236.9
Sodium (mg)	3419.9 ± 1313.9	3276.4 ± 1394.3

[1] Mean ± Standard Deviation

[a] Means with different superscripts are significantly different using independent two-tailed t-test at $p<0.05$.

Table 6. Mean total and component subscores of the HEI[1] of Native American women, pooled sample and by clinic.

HEI Scores	Pooled Sample (n=71)	Iowa (n=23)	Kaw (n=27)	Pawnee (n=21)
Total HEI[2]	61.3 ± 7.5[3,4]	60.8 ± 6.7	61.8 ± 8.2	61.2 ± 7.5
Food Score[5]				
Grain	6.5 ± 2.1	6.5 ± 2.1	6.4 ± 2.0	6.7 ± 2.3
Vegetables	6.6 ± 2.1	6.5 ± 2.2	6.6 ± 2.3	6.9 ± 2.0
Fruits	3.1 ± 3.0	2.5 ± 2.5	4.0 ± 3.4	2.6 ± 2.8
Milk	3.1 ± 2.3	2.9 ± 2.0	2.9 ± 2.3	3.5 ± 2.6
Meat	9.1 ± 1.1	8.8 ± 1.4	9.2 ± 1.0	9.2 ± 0.8
Nutrient Score				
Total Fat	5.4 ± 2.6	5.4 ± 2.4	5.2 ± 2.5	5.5 ± 3.1
Saturated Fat	6.1 ± 2.6	6.1 ± 2.0	6.1 ± 2.6	6.2 ±3.1
Cholesterol	7.1 ± 2.7	7.6 ± 2.1	6.8 ± 3.2	6.8 ± 2.7
Sodium	6.5 ± 2.5	6.6 ± 2.6	6.9 ± 2.3	6.1 ± 2.8
Variety Score	7.8 ± 1.8	7.8 ± 2.0	7.8 ± 1.8	7.7 ± 1.5

[1] HEI = Healthy Eating Index
[2] HEI scores range from 1 to 100 (highest)
[3] Mean ± Standard deviation
[4] Means are not significantly different using ANOVA at $p<0.05$.
[5] Individual HEI component scores range from 1 to 10 (highest).

Table 7. Mean number of Food Guide Pyramid servings consumed per day by Native American women, pooled sample. n=71

Food Group	Criteria for Maximum Score of 10		Mean	Standard Deviation
	Females 25-50	Females 51+		
Grains	9	7.4	6.4	4.0
Vegetables	4	3.5	3.3	2.8
Fruits	3	2.5	0.9	1.5
Milk	2	2.0	0.7	0.9
Meat	2.4	2.2	5.1	3.6
Added Sugar (tsp)			21.9	20.1
Discretionary Fat (g)			58.5	34.4

Table 8. Mean total and component subscores of the HEI[1] by diabetes status.

HEI Scores	With Diabetes (n=24)	Without Diabetes (n=44)
Total HEI[2]	61.2 ± 7.6[3,4]	61.0 ± 7.3
Food Score[5]		
Grain	6.9 ± 2.5	6.3 ± 2.0
Vegetable	7.0 ± 1.9	6.4 ± 2.3
Fruit	3.7 ± 2.7	2.5 ± 2.9
Milk	2.5 ± 2.3	3.4 ± 2.2
Meat	9.2 ± 1.1	8.9 ± 1.1
Nutrient Score		
Total Fat	5.1 ± 2.6	5.4 ± 2.6
Saturated Fat	6.1 ± 2.7	6.1 ± 2.6
Cholesterol	6.3 ± 3.0	7.5 ± 2.5
Sodium	6.4 ± 2.7	6.6 ± 2.5
Variety Score	7.9 ± 1.8	7.8 ± 1.8

[1] HEI = Healthy Eating Index

[2] HEI scores range from 1 to 100 (highest).

[3] Mean ± Standard deviation

[4] Means are not significantly different using independent 2-tailed t-test by diabetes status at $p<0.05$.

[5] Individual HEI component scores range from 1 to 10 (highest).

CHAPTER V

DISCUSSION

Demographic Data of Native American Women

The majority of Native American women in the present study were overweight and obese (Table 3). This finding is consistent with other studies that found a high percentage of Native American women to be overweight and obese (Teufel and Dufour, 1990; Broussard et al., 1991; Vaughan et al., 1997; deGonzague et al., 1999). DeGonzague et al. (1999) found forty-three percent of Ojibwe women from Mile Lacs, Minnesota and Lac Courte, Minnesota were overweight. Sixty-three percent of Navajo women surveyed by Wolfe et al. (1988) were overweight. Bell et al. (1995) found about 50 percent of Lumbee Indian women in North Carolina to be overweight or obese.

The average household size for the present study was 3.2 persons per household. The 2001 Health and Human Services Poverty Guidelines for a family unit size of 3 was 14,630 (USDA, 2001). The sample from the present study was almost at 100 percent of the 2001 poverty level. Almost 50 percent of the sample from the present study had a household income of less than $15,000 per year. This is consistent with women living on the Navajo reservation as well as Hualapai women and Native American women living in rural California, both who did not reside on reservations (Wolfe et al., 1988; Teufel and Dufour, 1990; Ikeda et al., 1998). The majority of households from these studies reported incomes less than $13,000 per year.

Wolfe et al. (1988) found that Navajo women, living on a reservation, attended school for an average of six years, with 28 percent receiving no formal education. Over 50 percent of the Native American Women in the present study had some college education. Fifteen percent of the women in the present study hold a college degree. Women from the Hualapai tribe had about 13 years of formal education (Teufel and Dufour, 1990). Only 33 percent of women from the Hualapai tribe had some college or post secondary school. Women from the Hualapai tribe did not live on a reservation. It is unknown why a large number of women in the present study are educated, but have a household income of less than $15,000. It may be because the majority of women interviewed were in a single income-earning household. Less than 40 percent of the Native American women in the present study were married.

Estimated Nutrient Intake of Native American Women

Estimated macronutrient intake of Native American women in the present study was similar to studies conducted with Navajo and Ojibwe women (Table 4) (Wolfe et al., 1988; deGonzague et al., 1999). Mean energy, fat and protein intake for Ojibwe women was 1837 kilocalories, 81 grams, and 79 grams, respectively. Native American women from the present study consumed 36 percent of energy from fat, compared to the 40 percent energy from fat for Ojibwe women. Mean energy, fat and protein intake of

Navajo women was 1632 kilocalories, 65 grams and 56 grams, respectively (Wolfe et al., 1988). The Navajo women consumed 34 percent of energy from fat, which is similar to the percent energy from fat consumed by women in the present study. The mean estimated energy intake from the present study was lower than what was found by Teufel and Dufour, (1990). Teufel and Dufour (1990) found that women from the Hualapai tribe had a mean energy intake of 2,986 kilocalories. The Hualapai women consumed about 35 percent of kilocalories from fat, similar to what was consumed in the present study. Estimated energy intake for this present study was higher than what was consumed by individuals 20 years and older from the 1994-1996 CSFII (1609 kcal). Women from the present study had a higher percent of energy from fat of 36 percent than individuals 20 years and older from the 1994-1996 CSFII (32.5 percent).

There did not appear to be a difference in estimated nutrient intake among women that lived on reservations vs. those that did not. Women from the Navajo reservation, had a similar intake of energy, percent energy from fat, total fat and protein to Native American women in the present study, as well as women from the two Ojibwe communities.

Estimated mean folate intake of Native American women in the present study was below the folate RDA of 400 micrograms per day. Ninety percent of Native American women in the present study consumed less than the Estimated Average Requirement (EAR) for folate of 320 μg. Folate intake for the present study is similar to folate intake of Havasupai women, Native American women in California, and Ojibwe women (Vaughan et al., 1997; Ikeda et al., 1998; deGonzague et al., 1999). Folate intake for Ojibwe women, Havasupai, and Native American women in California was 150 μg, 200 μg, and 200 μg, respectively. Folate intake for women in the present study, not living on reservations, was similar to women from the Havasupai tribe, who resided on a reservation.

The mean calcium intake of Native American women in the present study of 480 mg was below the Adequate Intake (AI) (1300 mg) for women 18 years, 1000 mg for 19-50 years as well as for women over 50 years old (1200 mg). Ninety-five percent of women from the present study were below the AI for calcium. Calcium intake from the present study was similar with findings found in a study of Ojibwe women as well as a study of Lumbee women in North Carolina (deGonzague et al., 1999; Bell et al., 2002). Calcium intake for Ojibwe women was 480 mg. Calcium intake for Lumbee women of 466 mg was estimated using a calcium score sheet. Havasupai women had a higher intake of calcium, ranging from 575 to 651 mg per day (Vaughan et al., 1997). A possible reason for this difference is that Vaughan et al. (1997) reported that the Havasupai have a high consumption of cheddar cheese. Cheddar cheese ranked as one of the top five frequently consumed foods for the Havasupai. There was also frequent consumption of fluid milk. Calcium intake for the Havasupai women, who lived on a reservation, was higher than calcium intake for women from the present study, as well as Lumbee, and Ojibwe women, who did not live on reservations.

Women from the present study had a mean estimated added sugar of 21.9 teaspoons per day. This is higher than what was consumed by all individuals 20 years and older from the 1994-1996 CSFII (15.5 teaspoons) (Food Surveys Research Group, ARS, 1994). Mean estimated discretionary fat intake for women from the present study was higher (58.5 g) than intake for all individuals 20 years and older from the 1994-1996

CSFII (45.0 g). Data was not reported on discretionary fat or added sugar for American Indians in the 1994-1996 CSFII because of the small sample size.

Possible reasons for differences in estimated nutrient intake are that the present study used the weighed food record to estimate nutrient intake. The weighed food record is considered the gold standard of estimating dietary intake (Bingham et al., 1991). Twenty-four hour dietary recalls were used to estimate nutrient intake for the Hualapai, Havasupai, Native American women in California women, and Ojibwe women (Teufel and Dufour, 1990; Vaughan et al., 1997; Ikeda et al., 1998; deGonzague et al., 1999). The 24-hour recall has been shown to be not as accurate in determining dietary intake when compared to independent biological markers (Bingham et al., 1995).

Age may have caused a difference in estimated nutrient intake. The mean age for the Hualapai women was considerably younger than women in the present study (Teufel and Dufour, 1990). The mean age for women in the present study was about 44 years, where as Hualapai women average about 26 years. Food choices may differ because of age.

Bingham et al. (1995) found that obese subjects tend to under-report dietary intake. Over 80 percent of Native American women in the present study were overweight. Forty-three percent of Ojibwe women, 63 percent of Navajo women and 50 percent of Lumbee Indian women were overweight (DeGonzague et al.,1999; Wolfe et al.,1988; Bell et al.,1995). Teufel and Dufour (1990) chose 14 Hualapai women that were classified as obese by having a triceps plus subscapular skinfold measurement at or above the 90th percentile of the U.S. Department of Health and Human Services (USDHHS) health statistics (DHHS Publ. No (PHS) 83-1680). The purposeful selection of obese women for the study conducted by Teufel and Dufour (1990) may be a reason for differences in estimated energy intake. The present study may be a more accurate estimate of nutrient intake because the weighed food record was used. The prior studies mentioned used 24-hour recalls, and more under-reporting of food intake may have occurred.

Dietary Quality for Native American Women

Total HEI score for the pooled sample was 61.3 (Table 6), which falls in the category "needs improvement" (Kennedy et al., 1995). The total HEI for this study was similar to what Basiotis et al. (1999) found among male and female American Indians surveyed in the 1994-1996 CSFII survey data (65). Ninety-four percent of the present study had a total HEI score that fell in the category "needs improvement." The remaining six percent scored in the category "poor." No Native American women in the present study had a "good diet." This is different than what was found by Basiotis et al. (1999); they found that 10 percent of the American Indian men and women surveyed had a good diet. Seventy- four percent of the sample surveyed by Basiotis et al. (1999) had a diet that needs improvement and 16 percent had a poor diet.

Basiotis et al. (1999), however, did not state age or separate the HEI scores by sex. This may be a reason for the differences in the two studies. Basiotis et al. (1999) found that American Indians scored best or highest on the cholesterol component (7.8). In the present study, the Native American women scored similar (7.1) to the American Indian CSFII sample of 7.8 on the cholesterol component. The Native American women from the present study scored highest on the meat component (9.1). Native American women in the present sample scored poorest on both fruit and milk components, with a score of 3.1. Basiotis et al. (1999) found that the American Indians scored 4.7 on the fruit component and 5.2 on the milk component.

Ikeda et al. (1998) found that Native American women in rural California had an average daily intake, as defined by the USDA Food Guide Pyramid, of 1.6 servings of vegetables and 1.0 serving of fruit. Native American women from the present study had a higher intake of vegetables, but a lower intake of fruit (Table 8). Differences in location and tribe may be reasons for the different dietary intakes. The average age for women in California was 32 years, younger that the average age for Native American women in the present study, at 44 years.

Ballew et al. (1995) found that Lumbee women consumed less than one serving a day of vegetables, fruits, and milk products. This is consistent with the present study for fruits and milk, with the Native American women consuming 0.9 servings of fruit, and 0.7 servings from the milk group. The higher intake in the present study of about 3 servings of vegetables may be due to the high intake of potatoes in this sample.

CHAPTER VI

CONCLUSION, IMPLICATIONS, AND RECOMMENDATIONS

The objectives of this study were to describe the nutrient intake and dietary quality of Native American women in Oklahoma as a whole and by diabetes status. Conclusions were made for each of the hypotheses.

Hypothesis One

There will be no significant difference in nutrient intake between the tribal health clinics. Hypothesis one was partially rejected. Nutrient intakes for the three tribal health clinics did not differ for total energy, protein, fiber, percent of energy from carbohydrate, fat, saturated fat, percent of energy from fat, cholesterol, folate, calcium, or sodium. There was a significant difference in carbohydrate and sugar intake of Native American women by tribal health clinic ($p<0.05$). The Pawnee health clinic women consumed more grams of carbohydrate than women from the Kaw or Iowa clinic. The women from the Pawnee health clinic also consumed significantly more grams of sugar than the Iowa clinic women, but were not significantly different from the Kaw clinic women.

Hypothesis Two

There will be no significant difference in nutrient intake by diabetes status. Hypothesis two was partially rejected. Native American women who reported they had diabetes mellitus consumed significantly less sugar and significantly more folate than women who reported they did not have diabetes mellitus ($p<0.05$). There was no significant difference by diabetes status for energy, protein, fiber, carbohydrate, percent of energy from carbohydrate, fat, saturated fat, percent of energy from fat, cholesterol, calcium and sodium.

Hypothesis Three

There will be no significant difference in diet quality by tribal health clinic. Hypothesis three was not rejected because there was no significant difference in the Healthy Eating Index score by tribal health clinic.

Hypothesis Four

There will be no significant difference in diet quality by diabetes status. Hypothesis four was not rejected because there was no significant difference in the Healthy Eating Index score by diabetes status.

Summary

Conclusions based on the hypotheses of this study show that nutrient intake and diet quality of Native American women living in Oklahoma need improvement. There was no difference in diet quality among the three tribal health clinics and no difference in diet quality by diabetes status. There was a difference by diabetes status for sugar and folate intake.

Limitations

Recruiting from the health clinics may lead to potential bias. The women that came to the health clinics may have been aware of healthy eating and the effect of nutrition on their bodies, thus, may not be representative of the population. Sending the flier to the health clinic may have also invited potential bias. The study may only attract those with transportation and those who are able to get out of the house.

Implications for Practice

The sample from this study was educated but income level was low. Nutrition educators should take the low income and educational level of the Native American women into account when developing programs and educational materials. Diet quality was poor in the sample of Native American women. Native American women in the present study consumed 36 percent of energy from fat. The HEI scores can be used to indicate where diets need improvement for Native American women in Oklahoma. HEI scores for the present population were low for total fat intake, saturated fat intake, and sodium. Education programs on how to reduce percent of energy from fat, cholesterol, total fat and sodium could be implemented to help reduce risk for chronic disease.

Native American women had low calcium and folate intakes. Nutrition educators should show this population foods that are good sources of folate and calcium to increase intake. The current population should be educated on foods with calcium, other than dairy products. Nutrition educators should address the high sugar intake of Pawnee women as well. The Pawnee women should be educated on how to substitute healthier foods for high sugar foods.

Implications for Research

Research with more representative samples of Native Americans should be conducted to further study diet quality. There are few studies identifying diet quality for this population. The present sample had a cholesterol intake of less than 300 mg, but high intake of meat, fat, and saturated fat. Fruit and vegetable servings were below the recommendations of five servings per day (USDA, 1990). It is unknown why dairy does not appear often in Native American diets. The National Dairy Council (2002) reports that 62-100 percent of Native Americans have a prevalence of lactose maldigestion. Research should be conducted to understand why there is a low intake of dairy products and fruits, as well as a low intake of folate. Ninety percent of women from the present study consumed less that the EAR for folate of 320 μg.

Further research should be conducted with this population to determine motivation behind food choices, as well as where information is obtained regarding healthy eating. Research should be conducted identifying core foods and secondary foods of Native Americans. This may show which foods play a predominant role in the diets of Native Americans, as well as to identify the main sources of energy, fat, and other nutrients. The identification of core foods for this population will help guide public health education and individualized diet counseling. Our data indicate that this practice would be advantageous to identify which foods consumed are sources of folate and calcium. Alternative sources (secondary foods) should be identified to discover what foods consumed by this population do provide folate and calcium and can be increased in the diets of this population.

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APPENDIX A

IRB APPROVAL FORM

Oklahoma State University
Institutional Review Board

Protocol Expires: 2/12/03

Date : Wednesday, February 13, 2002 IRB Application No HE00143

Proposal Title: DIABETES RISK FACTORS IN NATIVE AMERICAN OKLAHOMA WOMEN

Principal Investigator(s) :

Kathryn Keim
421 HES
Stillwater, OK 74078

Alicia Sparrer
425 HES
Stillwater, OK 74078

Chris Taylor
425 HES
Stillwater, OK 74078

Jean VanDelinder
006 CLB
Stillwater, OK 74078

Reviewed and Exempt **Continuation**

Approval Status Recommended by Reviewer(s) : Approved

Signature

Carol Olson, Director of University Research Complian

Wednesday, February 13, 2002
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modifications to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB Expedited and exempt projects may be reviewed by the full Institutional Review Board.

APPENDIX B

CONSENT FORM FOR PARTICIPANTS

Oklahoma State University

Individual's Consent to Voluntary Participation in a Research Project

I, ______________________, voluntarily consent to participate in the study entitled: Diabetes risk factors in Native American Oklahoma women, sponsored by Oklahoma Center for the Advancement of Science and Technology and the College of Human Environmental Sciences at Oklahoma State University.

PURPOSE: The purpose of this study is to learn about nutrition and health influences that affect the development of diabetes mellitus.

PROCEDURE(S) AND DURATION: I will meet with the interviewer at least three times. Each of these meetings will be audio taped for analysis by the research team. If I agree, all of the meetings will be in my home or in a clinic. I will always be aware of the times that the interviewer will visit my home. The interviewer will not drop by unannounced on any occasion.

During the first visit, I will be asked to answer background demographic questions. After that, I will be asked to weigh and record foods that I eat for four days. I will be given measuring cups, spoons, and beanbags that estimate food portions to assist me when measuring food intake. During those four days a researcher will call me to make sure that I am not having any problems with the scales. Finally, I will be asked about my priorities in life.

During the second visit with the interviewer, I will be asked questions about my health. She will then show me pictures of foods and I will give her my opinions about those foods. This interview will take about 2 ½ hours. After this interview, the interviewer may call me to ask additional questions about the answers that I have given if anything is unclear to her.

During the third visit, I will be asked to sort pictures of women of different body shapes according to my beliefs and preferences. I will also be asked about my food habits. The interviewer will show me pictures of foods again and I will be asked to give my opinions and sort the foods based on the questions that she asks me. This will take about 2 ½ hours. After this interview, the interviewer may call me to ask additional questions about the answers that I have given if anything is unclear to her.

BENEFITS: I will receive $125.00 for completing all interview and 4 days of food records. Receiving this money as compensation may conflict with my ability to receive food stamps and it is my responsibility to report this income to my caseworker. I understand that I will not receive any of the money until I have completed all parts of the study. I will receive information about my dietary intake at the end of the study if I would like this information. A trained nutritionist will explain the information from the nutrient analysis to me. This research is beneficial in that it provides information about health risks experienced by women. The information gained from this study may be useful in helping women choose nutritionally adequate diets that are beneficial in decreasing chronic disease risk

ALTERNATE TO PARTICIPATION: I have the right to withdraw from this study at any time by contacting the researchers. I may stop participating in the study at any time without penalty or loss of benefits that I am otherwise entitled to receive.

I understand that by signing this consent form I have not waived any of my legal rights or released this institution for liability or negligence.

I understand that records from this study will be held confidential and that I will not be identified by name in any report or publication resulting from this study. My food records will be reviewed and analyzed by the project director or her authorized representatives. Food records will be filed in the project director's office until completion of the study when they will be destroyed by shredding them.

I understand that if I have questions about this study, or need to report adverse effects, I may contact Dr. Kathy Keim at (405) 744-8293 or Dr. Jean VanDelinder at (405) 744-4613. If I have any question about my rights as a research subject, I may contact Sharon Bacher at the Office of University Research Services, 305 Whitehurst, Oklahoma State University, Stillwater, OK 74078 at (405) 744-5700.

SIGNATURES: I have read this consent form and understand its contents. I freely consent to participate in this study as described herein. I will receive a copy of this consent form.

Date ______________ Time_____________

Subject's Name (Please Print)____

Subject's Signature____

Permanent Address____

City ____________State________Zip Code ___________

I certify that I have personally explained all parts of this form to the subject before requesting the subject to sign it.

Signature ____________________________(Project Director or Authorized Representative)

Printed Name__________________________(Project Director or Authorized Representative)

APPENDIX C

DEMOGRAPHIC QUESTIONS

DIABETES AND INDIAN WOMEN

1. What is your current marital status? (Please circle one)

    a. Married / Not married but living with a partner

    b. Widowed

    c. Divorced / Separated, or

    d. Never married

2. What is your degree of Indian blood?

    ____

    ____

3. What which tribe are you an enrolled member?

    ____

4. Total number of persons in your household including yourself.

    _______Number of adults

    _______Number of children (under age 18)

5. What is the highest level of education you have completed? (Please circle one)

    a. Some high school or less

    b. High school graduation / GED

    c. Some college / Some technical school

    d. A 4-year college degree

    e. A postgraduate degree

6. Which category best represents your total earned household income (gross) or retirement over the past year? (Please circle one)

    a. Less than $10,000
    b. $10,000 - $14,999
    c. $15,000 - $19,999
    d. $20,000 - $24,999
    e. $25,000 - $29,999
    f. $30,000 - $35,000
    g. $35,000 - $40,000
    h. $40,000 and over

7. Please select the places where you buy or get food. (Circle all that apply).

    a. Grocery store
    b. Convenience store
    c. Home gardens
    d. Hunting / Fishing
    e. Fast Food / Restaurants
    f. Other ______________________________

8. Which of the following describes you current work status? (Circle one)

    a. Employed full time
    b. Employed part time
    c. Homemaker
    d. Unemployed (not working)
    e. Retired

9. Has a doctor ever told you that you have (Circle all that apply):

    a. Diabetes
    b. High Blood Pressure/Hypertension
    c. Heart Disease
    d. Osteoporosis
    e. High blood cholesterol
    f. Stroke

10. During this past month, did you participate in any physical activities or exercises such as running, calisthenics, gardening, or walking for exercise vigorously enough to work up a sweat? (Please circle one)

    a. Yes
    b. No
    c. Don't know/ Not sure

11. How often do you participate in physical activity vigorously enough to work up a sweat? (Please circle one)

    a. Daily
    b. 5-6 Times per week
    c. 2-4 times per week
    d. Once a week
    e. 1-3 times per month
    f. Rarely or never

16. If yes, what type of diet are you currently on? (Please circle all that apply)

a. Weight Loss or Low Calorie Diet

b. Low Fat or Cholesterol Diet

c. Low Salt or Sodium Diet

d. Low Fiber Diet

e. High Fiber Diet

f. Diabetic Diet

g. Other ____

17. I'm going to review a list of appliances. Please respond to the ones that you have and are working. (Check all that apply)

Yes	No	
☐	☐	a. Refrigerator
☐	☐	b. Microwave
☐	☐	c. Stove-top
☐	☐	d. Oven
☐	☐	e. Freezer
☐	☐	f. Toaster Oven
☐	☐	g. Hot plate

18. What is your date of birth? ________________________________

19. What is your current height? ______________________________

20. What is your current weight? ______________________________

21. How did you hear about the study? __________________________

22. Have you ever had you blood sugar tested? Yes No

APPENDIX D

WEIGHED FOOD RECORD

Food Diary

My Diary of What I Eat And What I Drink

ID #________________________

Date________________________

We would like to know what kinds of foods you eat and what you drink. For the next 4 days, please write down everything that you eat and drink. Be sure to tell us the amount that you eat and drink. Use the scales to measure what you eat and drink and follow the directions that are in this booklet.

Remember to be very specific when recording. We really appreciate your cooperation.

If you ever have trouble with the scales be sure to call us at work. You may need to leave a message and your call will be returned.

Thanks,

Dr. Kathryn Keim
Work#: (405) 744-8293
Alicia Sparrer
Work#: (405) 744-5073
Chris Taylor
Work #: (405) 744-5073

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Directions for keeping your food diary

We would like you to weigh all of the foods and drinks that you eat. If you eat out, you do not have to weigh your foods unless it is convenient for you. You will write down those foods and estimate portions using the directions in this booklet.

Everything you put in your mouth and swallow is important to record. This includes all meals, snacks, nibbling, candy, drinks (including alcohol), everything. Record in your diary immediately after eating a meal, snack, or drink.

Also be very specific when you record what you eat and drink. Describe every item and how it was prepared.

- **Record one item per line**
- **Be specific about how it was prepared**
  - write fried, baked, broiled...- not just chicken
- **Be very specific when describing the item**
  - Write whole milk, skim milk, 2%...- not just milk
  - Write wheat, white, etc...-not just bread
  - Record the name brand when you know it (i.e. snickers candy bar)

Directions for how to use the scales

1. Turn the scale on.
2. Put your plate on the scale.
3. Press the "On/Off button", the scale should read 0.
4. Put the first food on the scale.
5. Record the amount in the "How much served?" column on the food record.
6. Push the button again. The scale should read 0.
7. Put the next food on the plate. Record the amount in the "How much served?" column.
8. Continue in this way until you have recorded all foods you plan to eat.
9. It is important for you to weigh leftovers, follow the instructions for leftovers if you do not eat everything on your plate.

Recording leftovers

1. Put a paper plate on the scale and press the "on/off button".
2. Scrape the first food not eaten onto the empty plate.
3. Record the amount in the "How much left?" column.
4. Press the "on/off button".
5. Scrape the next food not eaten onto the plate.
6. Record the amount in the "How much left?" column.

7. Continue this way until you have recorded all left overs.

Recording foods eaten away from home

1. If you eat out, you should use the food serving size bag.
2. The 3 oz portion should be used for estimating meats, fish, chicken, and cheese. It is the size of a 3-ounce serving.
3. Use the measuring spoons for estimating jelly, syrup, butter, gravy, salad dressing, ketchup, mustard, and other toppings.
4. Use the measuring cups and bean bags to estimate amounts for vegetables, rice, noodles, cereal, soup, stew, casseroles, ice cream, Jell-O, and canned fruits.
   - ❖ The green bean bag is 1 cup
   - ❖ The red bean bag is ½ cup
   - ❖ The black bean bag is ¼ cup.

Recording Fast Foods

If you eat out at McDonald's, Burger King, Long John Silvers, Whataburger, etc. tell us what size you ate in the column 2 marked "How much served?" See the example.

EXAMPLE Date 1/05/00 Day of week wed.

I ate and drank this:	**How much served?**	**How much left?**
Orange juice from concentrate	278 g	50 g
Eggs scrambled in margarine	92 g	
White bread toasted with margarine	142 g	
Fried pork sausage	256 g	16 g
McDonald's Big Mac	1	
Coke	1 biggie	
French Fries	1 biggie	¼ order
Snickers candy bar	120 g	
Orange soda	20 fl. oz	
2 Fried chicken thighs	172 g	
Green beans	250 g	
Mashed potatoes with milk and margarine	452 g	
Sweetened tea	300 g	10 g
Sour cream and onion potato chips	56 g	
Sweetened tea	300 g	

Food Diary

Day 1 Date______ Day of week ________

I ate and drank this:	**How much served?**	**How much left?**

Continue on the next page if needed.

Day 1 Date________ Day of week ____________

I ate and drank this:	How much served?	How much left?

Day 2 Date________ Day of week ____________

I ate and drank this:	How much served?	How much left?

Continue on the next page if needed.

Day 2 Date_______ Day of week __________

I ate and drank this:	How much served?	How much left?

Day 3 Date_______ Day of week __________

I ate and drank this:	How much served?	How much left?

Continue on the next page if needed.

Day 3 Date______ Day of week ________

I ate and drank this:	How much served?	How much left?

Day 4 Date______ Day of week ________

I ate and drank this:	How much served?	How much left?

Continue on the next page if needed.

Day 4 Date______ Day of week ________

I ate and drank this:	How much served?	How much left?

Thank You

Oklahoma State University
Nutritional Sciences Department
Stillwater, OK 74078

APPENDIX E

JOB DESCRIPTION

JOB DESCRIPTION
Qualitative Interviewer

Job Summary:
Individual responsible for conducting 3 qualitative interviews of Native Indian women according to protocols established by the researcher team

Essential Functions:
- Will complete training on interview structure, data collection, collecting 4-day weighed food records and response recording.
- Will recruit subjects for qualitative interviews.
- Will conduct audio-taped interviews with Indian women concerning sensitive areas including perceptions of food, health, body weight, and diabetes.

Qualifications:
- No previous interviewing experience required
- Indian women preferred
- Dependable transportation

Compensation:
- $125 for each completed subject (3 interviews)
- Mileage will be paid ($0.22 per mile) for travel to and from interviews
- $100 will be paid after successful completion of training

Application Procedure:
- Send letter of application business/references to ... Clinic

Different one for each clinic with the clinics address and contact person???

APPENDIX F

CONTRACT FOR INTERVIEWERS

Oklahoma State University, Nutritional Sciences Department
Project: OCAST GRANT # HR00-069 or 5736 ("Diabetes-Oklahoma Indian Women)

INTERVIEWER AGREEMENT

This Agreement is between Oklahoma State University, Nutritional Sciences Department, 425 HES, Stillwater, Oklahoma 74078-6141(hereinafter "Department") and (name of interviewer)______________________(hereinafter "Interviewer").

SECTION I - Scope of Services

1.01 The Department hires Interviewer on a contract basis to interview Indian women in Oklahoma for the above noted Project. The Project involves conducting oral interviews related to the cultural definition of diabetes, diet quality, and body image.

1.02 The Department will provide administrative supervision of the Project. Equipment and supplies for the Project, transportation excluded, will be provided by the Department. The Department graduate students and faculty will review the materials collected by the Interviewer on a weekly, or more frequent basis, as determined by the Department.

1.03 The Department will own of all materials collected by the Interviewer during or for the Project, including but not limited to oral interview tapes, field notes, documentation, data, etc.

1.04 The Interviewer will provide the following services:

A. Attend a day long training on interviewing skills and study procedures.
B. Work with the Department graduate students and faculty to identify possible participants.
C. Complete three (3) interviews per participant.
D. The collection of 3 interviews and weighed food records, with the progress in this area monitored by the Department graduate students and faculty at weekly intervals.
E. Obtain a signed consent form from all participants.
F. Keep accurate and useable notes during the interviews.
G. Provide assistance to the transcriber in deciphering portions of tapes, as necessary.
H. Label all materials in accordance with the Department's study policies.

I. Adhere to the work schedule developed jointly by the Interviewer and the Department's graduate students and faculty and provide all necessary logs and invoices in a timely fashion.
J. Adhere to the Oklahoma State University code of ethics.
K. Provide such other services for the Project as determined necessary by the Department.

SECTION II - Compensation and Expenses

2.01 Department agrees to pay Interviewer the following:

A. $100 upon completion of interviewer training.
B. $125 upon completion of 3 interviews per participant.

2.02 Payment for the interview portion is contingent on satisfactory completion of the interviews and return of all materials (food records, audio tapes) and all applicable forms, in proper order, to the Department's graduate students or faculty.

2.03 The Department will reimburse Interviewer for related Project mileage. Reimbursement of expenses can only be made with proper receipts. Mileage will be paid at $0.22 per mile and will be paid after the mileage log invoice has been submitted. Payment of mileage expenses will be made in a timely manner upon receipt and approval of the reimbursement request.

2.04 Interviewer is solely responsible for the payment of income, social security, and other employment taxes due to the proper taxing authorities on any payment received under this Agreement.

2.05 All payments hereunder will be paid in a timely manner upon of receipt of required invoices and adequate receipts and documentation as requested by the Department to support reimbursement of mileage expenses.

2.06 Each interviewer will be compensated for interviewing no more than 7 Indian women before August 31, 2001 unless prior written approval is obtained from the Department. Each interviewer will be compensated for interviewing no more than 9 Indian women from September 1, 2001 to end of this contract (August 31, 2002) unless prior written approval is obtained from the Department.

2.07 This Project is funded by the Oklahoma Center for the Advancement of Science and any payment hereunder is contingent upon receipt by the Department of monies for said Project by the funding agency.

SECTION III - Confidentiality

3.01 Interviewer agrees to keep Confidential and not disclose to third parties any information provided by the Department or obtained by the Interviewer in the performance of services under this Agreement. This provision shall survive the termination of this Agreement.

SECTION IV - Term

4.01 This Agreement shall be considered in effect from (start date) __________ until completion of the Project, but in no event later than August 31, 2001.

4.02.1 Department may terminate this Agreement for any reason upon ten (10) days written notice to Interviewer. In the event of termination by the Department under this provision, the amount of compensation, if any, to be paid Interviewer shall be determined by the Department based upon the work completed and the terms of the Project grant.

SECTION V - Interviewer's Capacity and Responsibilities

5.01 It is expressly understood that in performing the services under this Agreement, Interviewer is acting as an independent contractor and not an employee, agent, or partner of the Department or Oklahoma State University and the Interviewer is not entitled to tax withholding, Workers' Compensation, unemployment compensation, employee benefits, insurance coverage, statutory or otherwise, of Oklahoma State University.

5.02 Interviewer does not have the authority to enter into any contract or agreement or otherwise bind Oklahoma State University and Interviewer shall not represent to anyone that Interviewer has such authority.

5.03 It is the Interviewer's responsibility to obtain and/or maintain the necessary insurance to cover Interviewer's services rendered under this Agreement. Any personal injury to Interviewer or third parties or any property damage incurred in the course of performance of services under this Agreement are the responsibility of the Interviewer.

SECTION VI - Miscellaneous Provisions

6.01 This Agreement constitutes the entire understanding between the parties with respect to the subject matter of this Agreement and may not be amended except in writing signed by the Interviewer and an authorized representative of the Department.

6.02 This Agreement shall be governed by and construed under the laws of the State of Oklahoma.

6.03 This Agreement is not assignable by the parties.

Interviewer Date

Oklahoma State University, Department of Nutritional Sciences
By:

Purchasing, Date

Kathryn S. Keim, PhD, RD, LD Date
Assistant Professor, Nutritional Sciences
Project Principal Investigator

APPENDIX G

ANALYSIS OF DATA

Each food and gram weight consumed by each subject was imported into SPSS to determine Food Guide Pyramid servings for each food group following USDA procedures (Kennedy et al., 1995). Pyramid Serving Search was downloaded from the USDA/ARS website at www.barc.usda.gov/bhnrc/cnrg and used to search for Food Guide Pyramid (FGP) servings per 100 grams for all foods consumed by subjects and recorded into an Excel file. Annetta Cook provided assistance from the Community Nutrition Research Group of Agriculture Research Service. Each food and gram weight consumed by the subjects was merged with the FGP servings per 100 grams of that food in SPSS and matched to the correct food description. FGP servings were calculated for the foods consumed in SPSS.

VITA 2

Alicia Claire Sparrer

Candidate for the Degree of

Master of Science

Thesis: DIET QUALITY AND NUTRIENT INTAKE OF NATIVE AMERICAN WOMEN IN OKLAHOMA

Major Field: Nutritional Sciences

Biographical:

Education: Graduated from Oklahoma State University of Stillwater, Oklahoma in 1998; received Bachelor of Science degree in nutrition, option in Dietetics. Completed Dietetic Internship at Presbyterian Hospital of Dallas of Dallas, Texas in 1999. Completed the requirements for the Master of Science degree with a major in Nutritional Sciences at Oklahoma State University in August 2002.

Experience: Employed at Maricopa County Women's Infant and Children Program as a dietitian for high-risk nutritional counseling; employed by Oklahoma State University, Department of Nutritional Sciences as a graduate research assistant from August 2000 to present.

Professional Memberships: American Dietetic Association; Oklahoma Dietetic Association