DIFFERENCES IN SELECTED DIETARY INTAKE AND CLINICAL PARAMETERS OF DIABETIC AND NONDIABETIC OKLAHOMA PLAINS INDIANS

By

MARILYN LOUISE MARTIN

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1971

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1977

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AND CLINICAL PARAMETERS OF DIABETIC
AND NONDIABETIC OKLAHOMA
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Thesis Approved:

Bernice Kopel
Thesis Adviser

Esther Winterfeldt

Fred Owens

Norman N Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

I am indebted to a number of individuals who have contributed much to the final realization of this investigation.

Sincere appreciation is given to Dr. Bernice Kopel for her guidance and interest in this thesis. She was of invaluable assistance in helping me complete this research project and complete requirements for graduation.

Special thanks are given to the members of my committee, Dr. Esther Winterfeldt and Dr. Fred Owens, for their advice and encouragement in the completion of this project.

Gratefully, I acknowledge the assistance of Dr. Kelly West and his nurse, Mrs. Mary Ellen Sanders, for their helpful advice and insight which contributed greatly to the successful completion of this study.

Also, I would like to acknowledge the subjects of this study who consented to participate. Their cooperation was an added encouragement in the completion of this study.

Finally, I want to thank my friends and family especially my parents, Mr. and Mrs. J. A. Ligon, whose understanding and patience has made this research and the past year and one half of graduate school possible. It is to them I dedicate this thesis.

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CHAPTER I

INTRODUCTION

The year 1977 marked the 56th anniversary of the discovery of insulin by Banting and Best. This medical milestone constituted a major breakthrough in the treatment of an ancient disease. Diabetes mellitus has a well-known history. Countless man-hours of research and writing have been invested in seeking its cause and cure.

There are many ways used to express the magnitude of diabetes mellitus as a public health problem. One author states that there are over four million U. S. citizens with diabetes, but that over two million of these people are unaware that they have the disease (28). The American Diabetes Association (25) is much stronger than this in their estimate (1967):

Known diabetics in U. S. population	2,600,000
Unknown diabetics	1,600,000
Total diabetics	4,200,000
Additional potential diabetics	5,600,000
Actual and potential diabetics	9,800,000

In June of 1968, the Committee on Public Education and Detection of the American Diabetes Association concluded that the above estimates were minimal. According to the committee, one person in 20 is either an actual or potential diabetic, even though only one in every 50 is a known diabetic. Among the American Indians, the incidence is even higher. The Pima Indians on the Gila River Reservation near Phoenix, Arizona, have a rate of diabetes 25 times greater than that of the American population (9).

Today, with advanced and effective methods that are available, the control of diabetes is possible. The basic objective of an effective program of diabetes control is to decrease the time interval between the onset of diabetes and its diagnosis, and to establish proper and adequate early treatment. Achieving this should reduce the number and severity of acute complications, delay the onset of chronic complications, decrease the number of deaths due to diabetes, and decrease the periods when the disease is not under the best control (58, 60).

The treatment, control, and prevention of diabetes should be physiologically important to the citizen of Oklahoma because as Etzwiler (24) stated, statistics show Oklahoma to have more Indian citizens than any other state. The diabetic status of the many Oklahoma Indian tribes is of particular interest because they represent seven of the eight major linguistic groups of North American Indians, having originated in very diverse parts of the continent. One of the causes of concern is that rates of diabetes occurrence are high in all Oklahoma Indian tribes. The available evidence does not rule out the possibility that genetic factors play an important role in determining inter-tribal differences in prevalence and manifestations of diabetes. But it is also clear that environmental factors such as dietary intake play an important role in the diabetic's life.

Food plays many roles and has various meanings. The varied meanings and symbolism of foods are an important part of each person's culture. Culture has been defined as the design for living developed by a group of a set of rules governing the conduct of individual members (76). Through his culture a person perceives his food, his own body and the world. Understanding various cultures is important for three kinds of nutrition research: (1) dietary surveys, (2) human clinical studies, and (3) malnutrition causes. Considering individuals' cultures is essential for effective nutrition education. The roles played by foods may be sociological, psychological or physiological. Anthropologists have directed their attention to the cultural meanings of foods and have been able to show that food habits are vital to any culture.

Projects have been designed to study food preferences, food acceptance, nutrient content of food intake and various factors which influence food habits. In 1941, the National Research Council organized a committee to study food habits. The committee planned to study deficiencies in diets consumed in the United States, how poor food habits could be improved and the best media to use for improving diets. Although the objectives formulated by that committee were very worthwhile, their goals were never attained.

Of the few studies which attempted to relate nutritional status to dietary intake in the American Indians, the need for additional knowledge in this area was identified. It is known that nutrition education may not be the complete answer in changing food habits for better health; however, effective nutrition education for the Indian population should be partially based on knowledge of diet.

Statement of the Problem

The purpose of this study is to examine the dietary intake, cholesterol and triglyceride serum levels and the presence or absence of obesity in selected Plains Indians of Oklahoma (Kiowa-Comanche) and to determine the differences in the components in the dietary intake (percentage of carbohydrate, protein, saturated and unsaturated fats) and selected anatomical factors between a group of diagnosed diabetic Oklahoma Plains Indians and a group of nondiabetic Oklahoma Plains Indians.

Significance

According to the 1970 U. S. Bureau of the Census report, 827,000 of the U. S. population are American Indians. The Bureau of Indian Affairs reports that Oklahoma has 115,358 residents that meet the government definition of an American Indian. In the past decade, it has been recognized that numerous North American Indian tribes have an unusually high prevalence of diabetes mellitus (84). The disease appears to be extraordinarily common among some of the tribes living in the Southwestern United States.

A high incidence of diagnosed diabetes in Oklahoma Plains Indians exists and since there has been little research done in this population, dietary intake and anatomical factors need to be obtained, correlated, and evaluated. It was anticipated that the analysis of variables would be useful in explaining the high incidence of diagnosed diabetes that exists.

The belief of the researcher was that the findings of a study designed to obtain the components of the diet, cholesterol and triglyceride serum levels and height-weight ratio of diagnosed diabetics and nondiabetics belonging to the Plains Indians of Oklahoma would be of value in identifying implications for nutrition education with the Indians. A review of the literature has revealed no studies which were related to dietary intake and diabetes in Oklahoma Indians.

Objectives of the Study

The objectives of the study were:

1. to identify the percentage of calories obtained from carbohydrates, protein, saturated and unsaturated fats in a 24-hour dietary recall of the subjects,
2. to determine the relationship of the percentages of calories obtained from carbohydrates, proteins, saturated and unsaturated fats and degree of obesity to the triglyceride and cholesterol serum levels of the subjects,
3. to identify and relate dietary factors and cholesterol and triglyceride serum levels to the presence or absence of diabetes, age, and sex of the subjects,
4. to determine the relationship of the duration of the diabetic condition to dietary intake of calories from carbohydrates, protein, saturated and unsaturated fats, and
5. to make suggestions and recommendations for planning nutrition education programs for the Oklahoma Plains Indians.

Assumptions

The study was planned and conducted on the basis of the following underlying assumptions:

1. All Plains Indians in Oklahoma had an equal opportunity to volunteer for the group studies at Lawton, Oklahoma on Indian Health and Nutrition.

2. The implications of the findings could be applicable to the total tribal population.
3. The 24-hour dietary recall is a valid method for assessing the food consumption of the Oklahoma Plains Indians.
4. The dietary intake of the subjects could be typical of the food pattern of the Oklahoma Plains Indians.
5. The diabetic subject's food intake was prescribed and followed.
6. The analysis of variables will be useful in identifying possible causes for diabetes.

Definition of Terms

The following terms are identified for this study:

Adequate diet: A diet which meets two-thirds or more of the 1974 Recommended Dietary Allowance (R.D.A.).

Adult: A male or female 20 or more years old.

American Indian: A native of the United States of America that has been identified by genetic lineage to be at least one-quarter Indian blood or more.

Diabetes mellitus: A metabolic disorder in which the ability to oxidize carbohydrate is more or less completely lost, usually due to faulty pancreatic activity, especially of the islet of Langerhans, and consequent disturbance of normal insulin mechanism (64).

Diagnosed diabetic: An individual who has been tested for glucose tolerance and has an abnormal glucose tolerance to a value of > 160 mg./100 ml. of blood at two hours or a value of > 180 mg./100 ml. of blood one hour after the individual has been given 100 grams of glucose in 300 milliters of water (54).

Nondiabetic: An individual who has been tested for glucose tolerance and has a normal glucose tolerance value in a fasting state not exceeding 110 mg./100 ml. of blood, or not exceeding 170 mg./100 ml. of blood in the first hour, 120 mg./100 ml. of blood in the second hour or 110 mg./100 ml. of blood in the third hour. The individual is also free of any of the symptoms associated with or classed as typical with diabetes mellitus (54).

Obesity: A term applied to persons 20 percent or more over desirable weight by using the Metropolitan Life Insurance Company desirable height-weight tables (54).

Plains Indians: American Indians living in Oklahoma belonging to the Kiowa or Comanche tribe.

Recommended Dietary Allowance (R.D.A.): The R.D.A. used in this research were those established by the National Research Council in 1974. They are the suggested daily nutrient intakes which are judged to be adequate for maintenance of nutritional status in the population of the United States (53).

Twenty-four hour recall: A method of dietary study in which a person is asked to recall his food and beverage intake of the past 24 hours.

Tribe: A tribe is a group of people who speak the same language and have a strong sense of difference and isolation from the rest of humanity.

Limitations

1. The participants selected in the study were adults over the age of 20. The diabetic subjects were diagnosed after the age of 20. This

was done to eliminate juvenile diabetic individuals from the sample for the study.

2. The sample population was taken from the Lawton, Oklahoma area and consisted of Kiowa-Comanche Plains Indians who were known to be at least half-blood by genetic lineage.

3. The sample population was selected from a group of Plains Indians in Oklahoma who volunteered to participate in studies of American Indians' health and nutritional status.

Hypotheses

For this study, the following hypotheses were made:

1. There will be no significant difference in the diagnosed diabetic and nondiabetic Oklahoma Plains Indians as to percentage of total calories derived from carbohydrates, protein, saturated and unsaturated fats.
2. There will be no significant difference in the diagnosed diabetic and the nondiabetic Oklahoma Plains Indians as to actual weight and the desirable weight.
3. There will be no significant difference in the diagnosed diabetic and nondiabetic Oklahoma Plains Indians as to cholesterol and triglyceride serum levels.

Procedure

Selection of the Sample

The subjects were obtained from two volunteer groups, 350 diagnosed diabetic and 200 nondiabetic Oklahoma Plains Indians that were at least half blood Indians be genetic lineage from the Lawton, Oklahoma area. All the Plains Indians in Oklahoma had an equal opportunity to volunteer for group studies conducted at the Lawton Indian Health Clinic in Lawton, Oklahoma. The diabetic subjects were diagnosed after the age of 20 and all had their diabetes controlled by diet and insulin. After limiting the two volunteer groups, by lineage and diabetes, each group was then stratified on the basis of sex and age (20 to 39, 40 to 59, and over 60 years of age). The final selection of the 90 subjects, 30 diagnosed diabetics and 60 nondiabetics, was based on convenience and availability after the above criteria was used. The nondiabetic sample size was twice the diabetic sample size because it was felt by the researcher that less dietary restriction would be present in the nondiabetic's diet and a larger sample would need to be obtained for more accurate results. Group division was as shown in Table I.

TABLE I

AGE DISTRIBUTION OF DIABETICS AND NONDIABETICS

Diabetic (N = 30)			Nondiabetic (N = 60)		
Age	Male	Female	Age	Male	Female
20-39	5	5	20-39	10	10
40-59	5	5	40-59	10	10
60+	5	5	60+	10	10

N = number of subjects.

Development of the Instrument

A modification of the Dietary Recall Instrument used in Oklahoma State University Food, Nutrition and Institution Administration Course 1113 was used by the researcher. The Four Food Groups were omitted from the instrument as this analysis was not included in the study. Questions were added to the instrument to obtain information concerning the presence or absence of diabetes in the subjects and their blood relatives. Questions regarding the length of time the subjects had diabetes and the type and amount of insulin were included. Additional questions regarding health and nutrition were included (see Appendix A).

Collection of the Data

The interviews were conducted at the Lawton Indian Health Clinic in Lawton, Oklahoma on Tuesday through Friday. In this study, Saturday and Sunday were not considered to have typical food or eating patterns. The researcher then conducted a private 30-minute interview with each participant. It was felt by the researcher that the answers obtained by the personal interview method would be more accurate on a one-to-one basis rather than with family or friends present. At the beginning of each interview, the participant was told the purpose of the study and how the information obtained by the questionnaire would be useful. In the interview, each statement from the questionnaire was read aloud by the researcher.

In the interview, a 24-hour recall of all food and beverages consumed during the past 24-hour period was administered. To aid in the recall accuracy of the amounts of the items consumed, portioned plastic food models, standard sized eating and drinking utensils were used. The items were coded for computer usage after the interview was concluded.

The physiological parameters of serum cholesterol and triglyceride levels were obtained from the subject's medical records. These values were collected from a study conducted by Dr. Kelly M. West, Professor at the Oklahoma University Medical Center, Oklahoma City, Oklahoma, during October and November, 1975. The answers given by the subjects in the interview for age and history of diabetes and diabetic treatment were checked for agreement with their medical records. The subject's height, without shoes, and weight was obtained on the day of the interview. Height values were then adjusted for use of the Metropolitan Life Insurance Company Table (see Appendix B).

Analysis of Data

Responses to questions asked during the interview were analyzed as to the frequency of response in the diabetic and the nondiabetic group. The number of responses obtained in each category was divided by the sample size of the group to obtain a percentage. In addition to frequency and percent, a mean of the grade level of the diabetic and nondiabetic group was obtained from the responses to the questionnaire.

The information from the dietary recall was placed on 80 column computer data sheets and then keypunched for a program written in Fortan Computer Language. The food items were coded in accordance with the Home and Garden Bulletin Number 72 (74). The amounts of food consumed by each subject was converted to a multiple of the amount listed in Bulletin Number 72 and coded. The calories and selected nutrients of foods eaten by the subject were the items used in this study. The nutrients considered were in grams of carbohydrate, protein, saturated and unsaturated fat consumed. The computer was programmed to give a percentage of the four nutrients--carbohydrate, protein, saturated and unsaturated fat--as they related to the total intake of calories. The computer analysis also compared the 24-hour recall of food and beverage intake of each subject with the 1974 Recommended Daily Allowances (R.D.A.) according to age and activity. A standard 16 hours of light activity and eight hours of sleep was used as normal in the computation of energy needs of the subjects. The R.D.A. of Calories to maintain the individual's present weight was calculated by the computer. Caloric deficit or excess was determined by subtracting the intake from the R.D.A. for Calories.

The physiological parameters studied included cholesterol and triglyceride serum levels and how they related to obesity. The normal range of cholesterol used was 150 to 250 mg./100 ml. The normal range of triglyceride used was 30 to 130 mg./100 ml. The actual value of the subject's cholesterol and triglyceride was compared to the range. The actual weight of each subject was compared to the height-weight-age tables to determine the presence of obesity and how this related to their cholesterol and triglyceride values.

The ideal weight for each subject was determined by using height-weight-age tables of the Metropolitan Life Insurance Company issued in 1959 (21, 44) (Appendix B). In defining desirable weight for girls 18 to 25 years of age, one pound was subtracted for each year under 25. Obesity was calculated by dividing the subject's weight by the ideal weight. In order to compute the percentage of subject over and under-weight, the average desirable weight in the medium body build category was used. An obese individual was considered as a person 20 percent or more over the desirable weight.

The statistical analysis of the physiological and dietary measurements of the diabetic and nondiabetic subjects and the relation of sex and age was done according to the procedure established by Snedecor and Cochran (61). The level of significance was established as $P < .01$. The level of significance for the interaction of the three variables--diabetes, age and sex--was established as $P < .05$. Comparisons of means used the protected least-significant-difference contrast as suggested by Snedecor and Cochran (61). Subsequently, data from diabetics was subgrouped by those who had diabetes 0 to 3, 4 to 8, and more than 8 years. Physiological and dietary measurements for these groups were analyzed. Finally, correlations of the parameters (age, obesity, cholesterol, triglyceride, dietary intake) for all 90 participants and for the 30 diabetics were identified and analyzed.

CHAPTER II

REVIEW OF LITERATURE

Introduction

At the beginning of the twentieth century diabetes ranked twenty-seventh as a cause of death by disease. Today, it ranks eighth, as reported by Sharkey (60), and diabetes is the third ranking cause of blindness. Only about 55 percent of diabetics are recognized. Of the remaining 45 percent only 1 to 1.5 percent are diagnosed each year. This research study was conducted to determine the dietary intake of carbohydrate, protein, saturated and unsaturated fat and the cholesterol and triglyceride serum levels in diabetic and nondiabetic Oklahoma Plains Indians. Therefore, the researcher reviewed the literature relating to the historical perspective of diabetes, American Indians, American Indian food habits, diabetes in American Indians, serum lipids, nutritional status studies, methods of conducting a dietary survey, usage of food consumption tables and computer usage in calculating dietary surveys.

Historical Perspective of Diabetes

Many people think of diabetes mellitus as a modern disease. Indeed it is widespread in the twentieth century, affecting men, women, and children alike. Diabetes is found in the old and young, in the rich and poor, and in all races of all countries. However, medical literature presents historical evidence that diabetes mellitus is probably as old as the human race.

We find the earliest medical records of diabetes in the literature of ancient Egypt. These records showed that the early Egyptian physicians recognized and described diabetes thousands of years ago, even as early as 1550 B.C. Although early descriptions did not refer to the disease by its modern name, Egyptian writings mention its symptoms.

Records dating back to 1000 B.C. describe an affliction of persons who passed large amounts of sweet, honey-colored water. Many of these afflicted persons were obese, lassitude among them was common, and their thirst was unquenchable. The recommended treatment was weight reduction and exercise.

Aretaeus of Cappadocia, 30 to 90 A.D., describing a condition characterized by polyuris, gave it the name diabetes. The word diabetes comes from a Greek word which means "to pass through a siphon." Mellitus is a Latin word meaning "sweetened with honey." Hence diabetes mellitus means "sugar passing through the body" (73).

Aretaeus described diabetes as being a "melting down of the flesh and limbs into urine." He believed the kidneys and bladder to be the primary causes of the diabetic condition because the patient never stopped passing water. He observed that the lives of these patients were "painful and disgusting" (11).

Today, diabetes mellitus is described as a disorder characterized by hyperglycemia, attributed to a relative or absolute deficiency of insulin, and by certain characteristic symptoms and pathologic manifestations. Classical symptoms include polyuria, polydipsia, and weight loss, but these occur only with moderate or marked elevation of the blood glucose. A substantial percentage of untreated diabetics have mild hyperglycemia without these classical symptoms. Both mild and severe diabetics are, however, prone to develop morbid changes in small and large arteries and in nerves (82). Complete failure of beta-cell function if untreated or inadequately treated, leads to profound hyperglycemia, ketonemia, acidosis, negative nitrogen balance, dehydration, and other severe aberrations in the intermediary metabolism of carbohydrates, lipids, proteins, and electrolytes. Untreated severe diabetes eventually leads to coma and death.

Many different factors can produce diabetes or increase risk of the disease. It has long been suspected that nutritional factors affect the risk of diabetes. More recent investigations elucidate further the nature and strength of these relationships. Changing dietary patterns in Japan (70), Israel (19), and Africa (20) have been associated with an increase in the incidence of diabetes. Studies by West and Kalbfleisch and other collaborators in 13 societies of 11 countries indicated a strong relationship of diabetes prevalence and nutritional factors (83, 84). A recent review of available data on diabetes in aboriginal populations of the New World, Indians, Eskimos, Polynesians and Micronesians, also suggested a strong relationship of diet and a risk of diabetes (77).

The factor most strongly and consistently associated with prevalence of adult-onset diabetes is the degree and the duration of adiposity. Arguments have also been advanced that dietary sugar (19, 81) and fat (78) are especially diabetogenic. Although data is available that shows a positive association between the rates of diabetes and the consumption of both sugar and fat, Himsworth (34) reviewed evidence that dietary carbohydrate protects against diabetes. In general, rates of diabetes are low where starch consumption is high (81).

In reviewing available laboratory and epidemiologic evidence, it was suggested that the most important dietary factor in increasing the risk of diabetes is total calorie intake irrespective of source (68, 82). This still leaves open the question of the relative importance of specific nutrients such as fat and sugar in inducing excessive caloric consumption.

Obesity in man and other animals has been produced with varied combinations of nutrients. By United States standards, the very fat sumo wrestlers of Japan consume diets very high in starch and low in sugar. The obese women of Tokelau eat very little sugar and much fat (80). The obese Oklahoma native Americans consume a diet high in fat (77, 84). By Asian standards, obese whites of northern Europe and the United States eat diets very high in sugar, protein, and fat and low in starch and total carbohydrate. Despite these marked differences in sources of calories, each of these groups has a high rate of occurrence of diabetes and each is related genetically to lean groups among whom diabetes is uncommon (78).

American Indians

American Indians have been mentioned repeatedly as sites of poverty and hunger. Incidence of disease is high and the average age at death is 55 and is younger than that of the general population. Diseases of the cardio-vascular system are and have been a leading cause of death among the American Indians. Malignant neoplasms, cirrhosis and diabetes follow these as the leading causes of death.

Niswander suggests "that virtually all Indians may be of a genetic constitution that is especially susceptible to diabetes and its expression is the result of dietary and nutritional factors associated with present day life" (46, p. 18).

Niswander's study indicated a higher incidence of diabetes among tribes which had the most highly developed agriculture prior to European contacts. Their diet for many years has been of a higher carbohydrate content than the Indian of the North Central region.

There are many health problems among the Indians but how much is due to food habits, poor housing or other factors is not known. Canosa (13) says that the nutritional status of a population can be defined adequately by factors of production distribution, availability, and consumption of nutrients or food. All of these factors are entwined in social and economic status of the people (13). In 1970, the average per capita income of all Indians in the United States was $1,573, according to the U. S. Bureau of the Census. The average per capita income for rural Indians was $1,140. The average per capita income for urban Indians was $2,108 (4).

Some health problems of the American Indians may be food related, but without some indication of the nutrient intake and of the food being consumed by the people at present, it is difficult for the leaders in the tribe to plan effective programs of aid and education (39).

American Indian Food Habits

Most of the early observations concerning food intake patterns of the Indians say that there were no regular hours for meals; however, Nurge (48) says that there was a general pattern and that the meals were more or less tied to the camp and the women. The men might go hunting without breakfast and carry light storage food for a noonday meal, having most of their food in the evening in the village. The Indians were adapted to a scarcity of food or engorgement. As with all other people, some foods were eaten in time of famine and not when there was a choice of food available. Acorns, the vines of the bittersweet and the stems of prickly pears are mentioned as being consumed when other food was scarce (48).

For most people, food has been an important item in festivals over the years. Hickerson (31) mentions the Feast of the Dead of the Minnesota Indians and notes that Sioux were in attendance. Many writers (10, 23, 38, 51) including Lewis and Clark (67) noted that upon arriving at a particular Indian camp, they were treated to a feast of whatever food was available. The fur traders and cowboys observed that the Indian feasts, first were of typically Indian foods, and then as white man's foods were introduced, these were added (10, 51). Food in great abundance has been an important part of the Pow-Wows and the Give-Aways, a feast during which the family gives away quilts and other goods, celebrating important events (48).

Influence of White Man's Culture

After 1875, there were attempts to change the cultural patterns of the Indians to fit those of the white's conception of culture including eating patterns. Some foods were labeled as being unacceptable to eat although they provided needed nutrients. Dog and raw meat of any kind were in this category. Farming and ranching were instigated by the Commission of Indian Affairs to replace hunting and gathering (48). These were not considered successful economic ventures for many reasons including culture persistence.

In 1903, the Bureau of Indian Affairs decided to lease the land west of the Missouri River for the Indian owners. Many huge land and cattle companies moved to the area and much was leased to white cattlemen. This was the era of the cowboy and Indian and they learned much from each other. Attitudes toward food and the sharing of food are discussed in many books written by cowboys. Ike Blasingame (10, p. 34) described a church Christmas dinner with the Indians in 1904. "The table was a great long affair with benches on both sides. It was stacked with food. Dishes of fruit, cake, pies and bread of all kinds, bowls of meat and other foods I didn't recognize." Missionaries and cowboys were guests of the Indians on this day and it is reasonable to assume that these were the Indians who had accepted the white man's religion and way of life to some extent.

Some aspects of the white man's food ways were more readily accepted than others. Alex Hrdlicka (37), a physical anthropologist with the Smithsonian Institution, observed that large quantities of coffee were consumed by Indians of all ages, when he investigated health conditions of five tribes for the Indian Office and the Smithsonian Institution in 1908.

The fur trader (23), the missionary (51), the cowboy (10), and the Bureau of Indian Affairs all contributed to the food habits of the Indians. Although they accepted many of the white man's foods they retained much of the meaning of their customs and traditions despite the external pressure. The American Indians have had a pattern of sharing with each other any worldly goods, particularly food. In 1972, Stene (63) studied the diets of 67 families of Sioux Indians on the Crow Reservation. She noted "it seems to be a rule in many Indian families never to remove the soup kettle or the coffee pot from the stove in the event a hungry guest stops by" (63, p. 21).

Diabetes in American Indians

Apparent racial differences in incidence of diabetes among race were commonly attributed to genetic factors. It is now clear among different societies of the same race, the rates of occurrence of diabetes may differ as much as tenfold depending on environmental circumstances (77, 84).

Diabetes is very common in certain population groups of whites, blacks, Indians, native Americans, Chinese, Japanese, Polynesians, and Jews, while it is quite rare in other groups of people of the same ethnic backgrounds who live under different circumstances (80, 81). Table II shows the aboriginal populations with high and low rates of diabetes.

Low incidences of diabetes have been observed in Athapascan tribes and in some Shoshonean tribes. Diabetes was also rare prior to 1940 in Athapascan and Shoshonean Indians of Oklahoma. But diabetes has recently become common in these Oklahoma tribes. The status of the many Oklahoma tribes is of particular interest because they represent seven of the eight major linguistic groups of North American Indians, having originated in very diverse parts of the Continent. Rates of diabetes

TABLE II

ABORIGINAL POPULATIONS WITH HIGH AND LOW RATES OF DIABETES

High Rates	
Cherokees (North Carolina)	Maricopas (Arizona)
Alabama-Coushattas (Texas)	Omahas (Nebraska)
Choctaws (Mississippi)	Mojaves (California)
Choctaws (Oklahoma)	Sioux (Montana and Dakotas)
Kiowas (Oklahoma)	Assiniboines (Montana)
Comanches (Oklahoma)	Passamaquoddy (Maine)
Pimas (Arizona)	Cherokees (Oklahoma)
Papagos (Arizona)	Creeks (Oklahoma)
Yumas (Arizona)	Chickasaws (Oklahoma)
Hualapis (Arizona)	Cheyenne-Arapahos (Oklahoma)
Havasupis (Arizona)	Osages (Oklahoma)
Cocopahs (Arizona)	Sauk-Foxes (Oklahoma)
Chemehuevis (California)	Kickapoos (Oklahoma)
Pawnees (Oklahoma)	Shawnees (Oklahoma)
Seminoles (Oklahoma)	Polynesians
Seminoles (Florida)	Hawaiians
Washoes (Nevada and California)	Maoris (New Zealand)
Paiutes (Nevada and California)	Rarotongans
Caddo (Oklahoma)	Micronesians
Senecas (New York)	Chamorro females (Guam)
Winnebagos (Nebraska)	Chamorro females (California)
Rates Probably High	
Poncas (Oklahoma)	Delawares (Oklahoma)
Otoes (Oklahoma)	Wichitas (Oklahoma)
Potawatomies (Oklahoma)	Kiowa-Apaches (Oklahoma)
Ft. Sill Apaches (Oklahoma)	Umatillos (Oregon)
	Zunis (New Mexico)

TABLE II (Continued)

Low Rates

- Eskimos
  - Eastern and Western Greenland
  - Eastern, Central and Western Canada
  - Alaska
- Navajos (Arizona)
- Hopis (Arizona)
- Apaches (Arizona)
- Western Shoshones of Nevada (1954 report only)
- Chippewas (North Dakota)
- Athapascan Indians
  - Canada
  - Alaska
- Micronesians
  - Truk and Marshall Islands
  - Gilbert Islands
  - Paluans of Peleiu and Ngerchelong (Western Caroline Islands)
  - Chammorro males of Rota (Marianas)
- Polynesians
  - Ellice Islands
  - Pukapukans
  - Western Samoans
  - Tongatapuns
  - Tahitians
- Melanesians
  - Fijis
  - Natives of New Hebrides
  - New Caledonia and the Solomon Islands
- Central American Indians
  - Guatemala
  - El Salvador

Source: K. M. West, Diabetes in American Indians and other native populations of the New World, Diabetes (1974).

are now high in all Oklahoma tribes (77). These values are shown in Table II.

An extensive review of medical reports by the civilian and military physicians serving the Oklahoma Indians between 1832 and 1939 revealed no evidence of the presence of diabetes (32). In contrast to the situation in many native populations, the Oklahoma tribes had, for the most part, considerable medical attention in the nineteenth and early twentieth century, often by the same physicians who were finding diabetes common in their white patients. In 1928, Hoffman (36) indicated that diabetes was believed to be rare in North American Indians. In 1933, Hamlin (30) conducted a health survey in the Seminoles of Oklahoma and Florida. A long list of disease problems did not include diabetes.

In a detailed account of the diseases of Southwestern Indians written in 1915, Geare (77) did not mention diabetes. In 1933, Hancock (31) reported the results of two years of experience in the Indian Health Service serving Indians of Arizona. In his report he stated that he saw only one case of diabetes (31). In 1937, Salsbury (55) reported that only one case had been observed in a hospital serving Navajos. In 1960, there were 62 Alabama-Coushattas with clinical diabetes, but no cases had been found prior to 1943. In 1973, there were more than 2,000 outpatient clinic visits for diabetes to the Lawton Indian Hospital, Lawton, Oklahoma, by approximately 700 diabetic patients. None had onset of diabetes prior to 1940 (77).

The very low rates of diabetes in the various aboriginal groups were accounted for in part by the infrequency with which blood glucose and glucose loading tests were performed. Although occult diabetes is common in Oklahoma Indians, a majority of those with known diabetes have glycosuria most of the time even under treatment. In one study, approximately 81 percent had polyuria and polydipsia at the time diabetes was discovered. Prior to 1940, urine glucose tests were performed very commonly in the local clinics and routinely in local hospitals; but positive tests were very rare (83).

In 1954, Cohen (20), in a landmark paper, summarized data gathered in Arizona. These observations showed moderately high prevalence in Pimas and the Colorado River tribes, and low rates in Apaches. Cohen's analyses also suggested that rates were low at that time in Papagos, Paiutes, Utes, and Shoshones. In Navajos, diabetes was roughly one-tenth as common as in Pimas. None of the cases reported by Cohen in 1954 had known diabetes more than 15 years. In 1954, there were 94 cases of diabetes in Pima population of about 6,000. By 1971, a survey by Parks and Waskow (50) showed that the number of Pima known diabetics had increased from 94 to 283 and the population was estimated to be roughly 6,975. Only one of the 382 had been a known diabetic more than 15 years.

As recently as 1955, there was no significant difference between Indians and whites of the United States in the rate at which diabetes was assigned as a cause of death (26). By 1967, diabetes-related death rates in U. S. Indians were 2.3 times as high as in whites (33). An "in-house" report of the Division of Indian Health for 1963 showed that the diabetes-related death rate in persons between 45 and 54 years of age was 12.1 per 100,000 while in Indians the rate for this age group was 59.3 (4). A substantial portion of this increase was probably attributed to more thorough screening and diagnostic programs, but there is considerable evidence to suggest that this was an actual increase.

One of the most interesting findings has been the marked differences in prevalence of diabetes among Indian tribes. Incidence of diabetes in several tribes still seems to be substantially lower than in the white population of the United States and Canada. This included Navajos (43, 47, 56, 59), Hopis (47, 52, 59) and the Athapascan Indians of Canada and Alaska (72, 80). Seivers (59) confirmed in 1966 that rates of diabetes in patients admitted to the Phoenix Indian Hospital varied markedly by tribe. In Pimas, the rate was 45 percent; in Colorado River tribes, 33 percent; in Papagos, 32 percent; in Havasupis, 28 percent; and in Navajos, 1 percent. The rate of clinical diabetes in adults of several Oklahoma Indian tribes exceeded 30 percent.

Prevalence in Oklahoma Tribes

The Oklahoma tribes are of particular interest because of the great diversity of their geographical, cultural, and genetic origins. These tribes originated from all parts of the continent. Some of these Oklahoma tribes are related to tribes elsewhere in which rates of diabetes are high, and some are related to those in which diabetes is uncommon. Before their arrival in Oklahoma in the nineteenth century some had been nomadic hunters and meat eaters who had been on low carbohydrate diets for centuries, while others had derived a substantial majority of their calories from starches for centuries. Prior to the twentieth century, Indians were very lean. Today, the Indian children are still relatively lean, but middle-aged men now tend to be obese, and middle-aged women are frequently very obese. Clinicians serving in the Indian hospitals began to note the increasing prevalence of diabetes about 20 years ago. In 1964, diabetes was mentioned on death certificates more than twice as frequently in Indians as in age-matched whites. On the other hand, juvenile diabetes seems to be exceptionally rare in Oklahoma tribes (80).

The first general Census of Indian diabetes in Oklahoma was performed in 1967 by Charles P. Bailey, who was chief statistician for the Oklahoma City Area Office of the Indian Health Service. A total of 2,016 cases were counted. At that time it was estimated that about 65,000 Oklahoma Indians received their outpatient and inpatient care from these facilities of the Indian Health Service, about half of whom were over 20 years of age. Today there are 115,358 Indians in Oklahoma. By 1969, 2,558 diabetics had been identified; and by 1972, 4,234 cases had been reported (4). Today, it appears that there are now about 5,000 to 6,000 Oklahoma Indians with known diabetes. This represents only about five to six percent of all Oklahoma Indians, but 46 percent of this population is under 20 years of age. More than 95 percent of the diabetics have been detected in the last 20 years. Roughly 15 percent of those over 34 years of age have known diabetes. Rates are somewhat higher for full bloods, who represent about one-half of this Indian population. However, incidence of known diabetes is probably not over 25 percent in full bloods of all ages in any of the larger Oklahoma tribes. The ratio of prevalence by sex has not been established with precision in any tribe, but the ratio of male to female patients is roughly 4:6 in clinics that serve Plains Indians and those that serve the Five Civilized Tribes (77). Appendix C shows the population in the state of Oklahoma as to the number of Indians living in each county.

A higher incidence of diabetes and its complications is thought to be associated with dietary intake leading to obesity and higher serum levels of cholesterol and triglyceride. The diet has a great potential for reducing the extent of the atherosclerotic lesions associated with diabetes.

Serum Lipids

The dietary factor most impressively associated with the dramatically lower rates of coronary disease in populations of diabetics is a low level of dietary saturated fat. Coronary disease is 2 to 10 times more common in diabetics in North America than in diabetics in certain societies of Asia, Africa, or Latin America (42, 80).

A tremendous number of epidemiological studies have investigated the relationship between levels of serum lipids and dietary habits of people with different food consumption patterns. For instance, there was a marked difference in the levels of cholesterol among people in prosperous communities in the United States and Northern Europe compared with those in poorer communities in Southern Europe (42). The life of the prosperous people in the United States and other affluent societies is in many ways quite different from that of the poorer communities in Southern Europe. The richer nations get about 40 percent of the total calories in their diet from fat, whereas, the less prosperous get about 20 percent or less. As an example, Chandrasekhran et al. (14) investigated the dietary intake of more than 500 female students of different ethnic groups at the University of Malaya. The results showed that carbohydrates made up nearly 60 percent of the energy mainly from rice and small amounts of wheat and sugar; fats contributed 24 percent and were derived from meat products, fish, butter, and cooking oil; and protein made up 12 percent mainly from animal sources. Since relatively few studies have been conducted to assess the levels of blood lipids of different population groups in Malaysia, it can be assumed that the levels are not hazardous as evidenced from relatively few incidences of heart diseases reported in that country.

Very few studies have been carried out relating serum cholesterol and triglyceride levels with race. In a study by Baker et al. (5), it was found that no significant difference in levels of serum cholesterol and triglycerides existed among the Caucasian, Negro, Chinese or Puerto Rican. However, all groups studied showed distinct serum lipid patterns. Twenty-six percent of the Chinese and 18 percent of the Puerto Rican had cholesterol levels of less than 113 mg./100 ml. while 25 percent of the Caucasian and 22 percent of the Negroes were in the upper level with 174+ mg./100 ml. of cholesterol. Characteristic low triglyceride levels were also indicated in 28 percent of the Negroes whose levels were less than or equal to 52 mg./100 ml., while 22 percent of the Puerto Rican, 16 percent of the Chinese, and 16 percent of the Caucasian had triglyceride levels of 108+ mg./100 ml.

Another study was also conducted by Chong et al. (15) with different ethnic groups including the aborigines in Malaysia. Serum cholesterol and triglycerides of over 300 clinically healthy subjects were determined. Although no ethnic difference was found in the cholesterol and triglyceride values among the Malays, Chinese or Indians, their mean serum cholesterol and triglyceride values were significantly higher than the means for the aborigines.

A recent study in Iowa (35) proposed that the United States teenagers with a serum cholesterol level above 200 mg./100 ml. should be considered hypercholesterolemic. According to the above criterion, about 13 to 15 percent of the teenagers in Iowa and Vermont were classified as hyperlipemic (18, 35). From the observations of pupils in Wisconsin (27), approximately 33 percent of the subjects would fall into the Iowa hypercholesterolemic category. This evidence supported the idea that cholesterol patterns for a given population are developed early in childhood and these patterns do not undergo appreciable changes during the early school years.

Since total serum cholesterol value is considered to be the best single chemical indicator of a potential risk for the cardiovascular system (40), a physician needs to be able to evaluate the result of the test for the serum cholesterol level. No conclusive data are available to suggest what should be the highest desirable limit of serum cholesterol or triglycerides, and their levels in the blood considered to represent hyperlipidemia have still not been established. As a guide, the National Heart and Lung Institute (22) set up a table, as shown on page 31 (Table III). It represents the upper limits of "normal" that are based simply on the upper five percent plasma lipid concentrations commonly found in Americans.

The frequency of high fasting triglyceride levels in the U. S. population is largely the result of an excessive consumption of calories (79, 82). This does not support the widely held view that hypertriglyceridemia is caused by high carbohydrate diets. Diets high in carbohydrate will indeed induce hypertriglyceridemia in susceptible individuals, but with rare exceptions an excess of calories also is required for this to happen.

Hyperglycemia also tends to induce hypertriglyceridemia and, in some cases, hypercholesterolemia (82). Thus, one of the best arguments for the mitigations of hyperglycemia is the frequency with which lower lipid levels are also achieved. In some circumstances, sucrose consumption may contribute to elevated triglyceride levels more than would equicaloric amounts of starch (78). On the other hand, postprandial triglyceride levels are generally higher after fat ingestion than after sugar ingestion (57). It is not clear that hypertriglyceridemia itself constitutes an independent risk factor involving atherosclerotic lesions associated with diabetes (3, 62, 69). It is known that for the diabetic and nondiabetic population differences in the rates of coronary disease are impressively related to levels of serum cholesterol (40, 77, 83, 84).

TABLE III

UPPER LIMITS OF NORMAL PLASMA LIPIDS

Age	Plasma Total Cholesterol (mg./100 ml.)	Plasma Triglycerides (mg./100 ml.)
1-19	230	140
20-29	240	140
30-39	270	150
40-49	310	160
50-	330	190

Source: Dietary Management of Hyperlipoproteinemia (1971).

Nutritional Status Studies

Food and nutrient intakes are currently being examined for possible relationship to the occurrence or the progression of diabetes. Only a few medical studies of nutritional status have been conducted on a national or even a regional basis. These extend back less than two decades. Dietary information is available back to the 1930's.

The past four decades have seen a dramatic turnaround in the overt nutritional health problems experienced earlier in the century. At the turn of the century, and again today, deaths from pellagra were almost unknown in this country. Yet, in the late 1920's and 1930's, there was a very high death rate, particularly in the Southern states. Large numbers also died from scurvy due to a deficiency of vitamin C. Doctors then could readily find cases of beriberi due to thiamine deficiency, cases of xerophthalmia from a deficiency of riboflavin, or cases of rickets due to a vitamin D deficiency. Today these major vitamin deficiency diseases have been eradicated so successfully in the United States that many doctors never see them and would not recognize them.

Poor nutrition is now more frequently seen in the many health problems where nutrition has a more subtle involvement but is at least implicated in playing a role. Diet, and especially the lipid components, is one of the identified factors in serum lipid levels that are listed as a major risk factor in heart disease. Diet, and particularly the caloric intake, is clearly implicated in the major health problem of obesity in our population.

During the period from 1947 to 1958 a sizeable number of regional nutritional status studies were sponsored by the United States Department of Agriculture (USDA). The biochemical, clinical, and dietary studies indicated that the average nutritional health for various population groups was good. Less than recommended dietary intakes were most frequently found for both children and adults for vitamin A, ascorbic acid, and iron. Rural, low-income families had diets containing the lowest nutritive value. Adolescent girls and especially older people tended to be overweight, and Spanish American and Indian children frequently had lower heights than average for the population. The hemoglobin content of the blood in nearly all the people examined was fair to excellent (41).

In 1968 to 1970, the Federal Government conducted a nutritional status survey encompassing all age groups, using a sample drawn from the lowest average income districts in 10 states (85, 86). One major finding in the Ten-State Survey was a high prevalence of low vitamin A values among Mexican Americans. There was a greater prevalence of unsatisfactory nutritional status among adolescents, whereas the elderly showed evidence of general undernutrition. Obesity was very frequently observed, and in some age groups more than 50 percent of adult women were found to be obese. Iron deficiency anemia was identified as a widespread problem. Such nutrients as vitamin C, thiamine, and iodine did not seem to pose a major problem among any of the groups studied.

In 1971 to 1972, a nationwide survey, Health and Nutrition Examination Survey (HANES) of the nutritional status of the United States population, ages 1 through 74 years, was undertaken (1). The early, still preliminary data that have been reported gave evidence of iron deficiency at all age levels. A few population groups, especially children, showed some biochemical evidence of inadequate vitamin A. For the most part, however, all age groups (and for both race and income levels) had apparently adequate intakes of protein, calcium, vitamin A, and vitamin C.

Because of the close geographical location and a similarity of eating habits and life style of Canadians to population groups in the United States, it is interesting to note the recent Nutrition Canada National Survey (49). Some similarities and some differences are seen as compared with similar surveys in the United States. The problem of overweight was evident in a large proportion of adults. Moderate iron deficiency was also widespread and was observed as a problem for men as well as for infants and women. Some biochemical evidence of a protein deficit was seen in pregnant women. Moderate deficits of calcium, vitamin A, and vitamin C were particularly noted in the Eskimo and Indian populations. By contrast, one of five Eskimo adult men were receiving approximately four times the protein intake considered to be adequate.

The major sources of data on diets of various United States population groups have been the studies conducted by the USDA and DHEW. The DHEW data represent dietary intake information taken during the three major nutritional status surveys, two of which were previously mentioned; the Ten-State Survey, and the HANES survey, the third study was the survey of preschool children.

Two different approaches have been followed by USDA. Using a food balance sheet, the Economic Research Service regularly makes national per capita estimates of food disappearing into United States consumption is one method. The other source of data is the periodic nationwide food consumption surveys conducted by the USDA's Agricultural Research Service. The first such nationwide survey based on a statistical sampling of households was made in 1936 to 1937. Since then four large scale studies were made in 1942, 1948, 1955, and 1965 to 1966 (17). Currently, plans are being made for the next survey, possibly in 1977 to 1978. All of these surveys have included assessing food used by households, and the most recent survey also developed information on the food intake of individuals in the household (2). Data were thus provided on the total nutritive value of the diets and on the contribution of major food groups to the total of both households and individuals. The sampling allowed a breakdown into subgroups of different incomes, different regions of the United States, and the rural and urban people.

The trends in food uses of protein, fat, and carbohydrate during the past 60 years are shown in Table IV. The available supply of calories shows minimal change, and the proportion of this derived from protein also has not changed much. What is clear is that we have steadily been consuming more fat and less carbohydrates in the United States.

The declining intake of carbohydrate was also accompanied by a shift in the nature of the carbohydrate. Starch has dropped off at a much more rapid rate than the total carbohydrate during these six decades. The rather marked rise in sugars and in refined sugar that occurred during the 1920's has, after a decline during World War II, been maintained in the years subsequent to this.

Similarly, we find that the increased amount of fat in our food balance sheets has been accompanied by a shift in the type of fat consumed. These values are shown in Table V. There has been only a small change in saturated fatty acids in the food supply during the past several decades. A rather modest increase in polyunsaturated fatty acids, especially linoleic acid, as seen prior to 1940, and a noticeable

TABLE IV

NUTRIENTS CONTRIBUTING FOOD ENERGY AVAILABLE FOR CONSUMPTION PER DAY--1909-1974

			Protein			
Year	Food Energy (calories)	Carbohydrate (g)	Total (g)	Animal (g)	Vegetable (g)	Fat (g)
1909	3530	497	104	54	50	127
1910	3490	495	102	52	50	124
1911	3470	488	101	52	48	126
1912	3470	490	102	53	49	124
1913	3460	489	100	52	48	125
1914	3440	483	98	51	47	127
1915	3430	481	97	50	47	126
1916	3380	470	96	50	46	126
1917	3330	469	96	50	46	122
1918	3380	464	97	52	45	129
1919	3440	478	97	52	45	130
1920	3290	457	93	51	43	123
1921	3200	441	91	50	41	122
1922	3430	480	94	51	42	129
1923	3440	466	96	53	43	135
1924	3460	474	96	53	43	135
1925	3450	474	95	52	43	134
1926	3460	478	94	52	43	133
1927	3470	477	95	52	43	134
1928	3490	482	94	51	43	135
1929	3460	471	94	51	43	137
1930	3440	474	93	51	42	134
1931	3390	460	92	50	42	135
1932	3320	448	91	50	41	133
1933	3280	436	90	51	39	133
1934	3260	429	91	52	39	134
1935	3200	436	88	48	39	127
1936	3290	438	91	51	40	133

TABLE IV (Continued)

Year	Food Energy (calories)	Carbohydrate (g)	Protein Total (g)	Protein Animal (g)	Protein Vegetable (g)	Fat (g)
1937	3260	433	90	51	39	133
1938	3260	433	90	51	40	133
1939	3340	439	92	53	39	139
1940	3350	429	93	54	39	143
1941	3410	443	94	55	39	144
1942	3320	425	97	56	41	140
1943	3360	428	100	59	41	142
1944	3350	426	99	60	39	142
1945	3300	418	102	62	40	138
1946	3320	412	102	63	39	143
1947	3290	412	97	62	35	143
1948	3200	397	94	60	34	140
1949	3200	399	94	60	34	140
1950	3260	402	94	60	34	145
1951	3160	391	93	59	34	139
1952	3190	389	94	61	32	143
1953	3170	386	95	62	32	142
1954	3150	380	94	63	32	142
1955	3180	378	95	64	32	146
1956	3180	378	96	65	31	146
1957	3110	372	95	64	31	141
1958	3120	375	94	63	31	142
1959	3170	376	95	64	31	147
1960	3140	375	95	64	31	143
1961	3120	374	95	64	31	142
1962	3120	373	94	64	31	142
1963	3140	371	96	65	31	145
1964	3180	374	97	66	31	147
1965	3140	371	96	65	30	145
1966	3170	371	97	67	30	147

TABLE IV (Continued)

Year	Food Energy (calories)	Carbohydrate (g)	Protein Total (g)	Protein Animal (g)	Protein Vegetable (g)	Fat (g)
1967	3210	373	98	68	31	150
1968	3260	378	99	69	31	154
1969	3280	381	100	69	31	154
1970	3300	380	100	70	30	157
1971	3320	380	101	71	30	158
1972	3320	381	101	71	30	158
1973	3300	385	99	68	31	155
1974	3350	388	101	70	31	158

Source: W. A. Gortner, Nutrition in the United States, 1900 to 1974, Cancer Research (1975).

increase in the polyunsaturated fatty acids during the last 20 years related to the increase in our comparison of edible oils, margarine, and shortening.

There are now data showing who is taking this fat into the day's diet. Dietary fat is peaking at the age 12 to 14 group for women and falls fairly steadily thereafter throughout life. By contrast, men do not reach their maximum fat intake until near the end of adolescence, the amount dropping off only after age 20.

Cholesterol appears to have risen to a currently level only 10 percent above that in United States diets at the turn of the century (Table IV). During the past 25 years there has been a declining use of eggs, lard, butter, and various dairy products but an increased intake of various meat and poultry products; thus the cholesterol level has remained fairly steady during this period.

TABLE V

CRUDE FIBER AND FOOD LIPIDS AVAILABLE PER CAPITA PER DAY IN THE UNITED STATES FOOD SUPPLY

Years	Total Nutrient Fat (g)	Fatty Acids			Cholesterol (mg)	Crude Fiber (g)
		Saturated (g)	Oleic Acid (g)	Linoleic Acid (g)		
1909-1913	125	50.3	51.5	10.7	509	6.1
1925-1929	135	53.3	55.2	12.5	524	5.8
1935-1939	133	52.9	54.5	12.7	493	5.5
1947-1949	147	54.4	58.0	14.8	577	4.9
1957-1959	143	54.7	58.2	16.6	578	4.4
1965	145	53.9	58.8	19.1	540	4.2
1970	157	55.9	63.1	23.3	556	4.2
1974	158	56.0	62.9	24.2		4.3

Source: Gortner, Cancer Research (1975).

The two major studies conducted on the Indian population are the Bass Study on the Standing Rock Reservation in North and South Dakota and the Watt Study on the Peruvian Quechua Indians.

Of the 94 women interviewed by M. A. Bass (6) concerning food intake patterns, their mean age was 40. The mean nutrient intake for the group was 1,497 calories; of this 14.4 percent was protein, 36.7 percent was carbohydrate and 50.8 percent was total fat.

Watt (75) studied Quechua Indian men with a mean age of 33. The mean nutrient intake for the group was 2,486.5 calories; of this 15.4 percent was protein, 58.6 percent was carbohydrate and 26.3 percent was total fat. Also studied were cholesterol and triglyceride serum levels. Serum cholesterol was 153.5 mb./dl. and triglyceride was 106 mg./dl.

Methods for Conducting Dietary Surveys

The methodology used in diet surveys has increasingly come under scrutiny as to its reliability and validity. When food and nutritive intake derived from diet surveys is used to generate policy decisions and statements about nutritional status of groups, it is important that the sampling techniques have a reasonable degree of accuracy and precision if erroneous conclusions are to be avoided.

Three methods that have been studied and compared in detail are the seven-day record, the dietary interview and the 24-hour recall. The method used depends on such factors as the type of data to be collected, individual or group, the amount of information that is needed, the scope of the problem and the competence and number of the staff.

For individual studies, the dietary history, which requires an experienced interviewer, is preferred since it reveals previous and present food practices. For a group study, the 24-hour recall can be of infinite value if a large enough sample is used.

Young (87), in a frequently cited study, compared the 24-hour dietary recalls with a seven-day record and diet history to assess the amount of variation in nutrient intake between these three dietary sampling techniques. The results indicated that none of the three gave similar values for individual intake, but that the 24-hour recall would yield approximately the same values as the seven-day record when used with groups of 50 persons or more. The shorter, more economical 24-hour method has become the most frequently used dietary survey technique (45, 65).

According to V. A. Beal (7) none of the techniques used to determine dietary intakes are totally satisfactory. Each has its limitations (8). The perfect method would be to weigh or measure all food consumed over a period of time and to analyze each food sample. However, the amount of money and personnel that would be required for such a project would not make this method feasible (8). The dietary history which covers the frequency and amounts of food eaten over a period of time is of value only if the interviewer is skilled, if the history itself is detailed enough and if the subject is cooperative and intelligent (7).

Food Composition Tables

There are several food tables that can be used for the assessment of diets. One of these is Bowes and Church (16), Food Values of Portions Commonly Used. Food values have been calculated for standard portions. Also, each food is listed according to the nutrients it contains. There are 26 possible nutrients included in the table.

Another table, the USDA, Composition of Foods--Raw, Processed, and Prepared (74), covers 2,500 food items. This publication is often called Handbook No. 8. The data is presented in two tables, one of which is the amount of nutrients for 100 grams of edible portion of food, and the other is the amount of nutrient in the edible portion of one pound of food "as purchased." The information on the nutrient content of foods has been derived chiefly from chemical analysis of the different food items. This booklet is currently being used as the basis for the computer program at Oklahoma State University which analyzes the composition of food.

The United States Department of Agriculture has also published a pamphlet called the Nutritive Value of Food. Common household measurements are used. The food values for 615 foods are represented (74). The foods are listed according to food groups with additional columns for sugars and miscellaneous items.

Computer Usage in Calculating Dietary Intakes

The use of the computer in many hospitals, clinics and in dietary surveys has proven to be very satisfactory (12, 66, 71). Hand calculating the nutrients in dietary recall (food consumed) is a time-consuming process that is subject to human error. With the development of data processing and the use of computers, the nutritive values of food can be determined quickly and accurately (12). Although the initial cost of programming the computer with the necessary information is relatively high, the information can be used many times. When compared to the cost of hand calculating the nutrient values of food, the savings gained by using the computer exceed the cost involved (71).

Summary

Diabetes mellitus has been recorded as early as 1500 B.C. However, it was not until after 1940 that diabetes became a prevalent disease in the American Indian population. Prior to the twentieth century, Indians were very lean. Today, Indian children are relatively lean, but middle-aged men now tend to be obese and middle-aged women are frequently very obese. Obesity and elevated serum levels of cholesterol and triglyceride is thought to be associated with a higher incidence of diabetes and its complications.

CHAPTER III

METHODS AND PROCEDURE

In Oklahoma Plains Indian population, there is a high incidence of diagnosed diabetes. However, there has been little research done on this population regarding the dietary intake and clinical parameters of this tribe.

The major concern of this study was to obtain the components of the diet, compare the cholesterol and triglyceride serum levels to the components of the diet and determine a height-weight ratio of the 90 diagnosed diabetic and nondiabetic Plains Indians of Oklahoma in the Lawton, Oklahoma area. It was the belief of the researcher that these selected parameters of nutritional status could aid in the explanation of the incidence of diagnosed diabetes. On the basis of the findings, implications could be useful in nutrition education for American Indians.

Selection of the Sample

The first criteria used for the selection of the participants to be interviewed was that the individuals be selected from a group who had volunteered for group studies conducted at the Lawton Indian Health Clinic in Lawton, Oklahoma. All the Plains Indians of Oklahoma had an equal opportunity to volunteer for the studies that were being conducted to determine Indian health and nutritional status. The second criteria was that Oklahoma Plains Indians were to be at least half blood Indian by genetic lineage and they were to be from the Lawton, Oklahoma area. The Lawton area was defined as a section in southwestern Oklahoma within a 30 mile radius of the Lawton Indian Health Clinic (see Appendix C). The third criteria was that the sample include an equal number of males and females. The fourth criteria in selection of the participants was age. The diabetic subjects were to be diagnosed after the age of 20. The fifth criteria was that the diabetic individuals all had their diabetes controlled with diet and insulin. This was done to establish a standard method of control rather than introducing an additional variable.

After limiting the volunteer group of Plains Indians by the above criteria, the volunteer group was divided into two groups. The groups consisted of 350 diagnosed diabetic and 200 nondiabetic individuals. The two groups were then stratified on the basis of sex and age (20 to 39, 40 to 59 and over 60 years of age).

After the volunteer group was limited by the criteria established by the researcher and stratified by sex and age, selection of the sample was based on convenience and availability of the subjects interviewed. Ninety Oklahoma Plains Indians were included in the study, 30 diagnosed diabetics and 60 nondiabetic. The diabetic group of 30 subjects included five males and five females in each of the three age groups. The nondiabetic group of 60 subjects included 10 males and 10 females in each of the three age groups. The nondiabetic sample size was twice the size of the diabetic group because it was felt that the variable of less dietary restriction would exist in this group.

Development of the Instrument

A modification of the Dietary Recall Instrument used in Oklahoma State University Food, Nutrition and Institution Administration Course 1113 was used by the researcher. The Four Food Groups were omitted from the instrument as this analysis was not included in this study. Questions were added to the instrument to obtain information concerning the presence or absence of diabetes in the subjects and their blood relatives. Questions regarding the length of time the subjects had diabetes and the type and amount of insulin were also included. Additional questions regarding health and nutrition were included (see Appendix A).

To aid in the comparison and accuracy of the information given by the subject, the Indian Health Service (IHS) Number was included on the instrument along with the subject number. The researcher was given access to all the health files of the participants in the study and the IHS Number was necessary for obtaining the records. The IHS Numbers ranged from three digits to five digits and were not in alphabetical or sequential order, therefore, it was necessary to assign each participant in the study a number separate from their IHS Number for the purpose of classifying individuals in this study.

Collection of the Data

The interviews with the Oklahoma Plains Indians were made by the researcher from August 3 through August 13, 1976. The interviews were conducted at the Lawton Indian Health Clinic in Lawton, Oklahoma on Tuesday through Friday. In this study, Saturday and Sunday were considered to have atypical food patterns. Mrs. Mary Ellen Sanders, R.N.

at the Indian Health Clinic, aided the researcher in identifying individuals who were at the clinic and who were qualified to be a participant in the study. The researcher then conducted a private 30-minute interview with each participant. It was felt by the researcher that the answers obtained by the personal interview method would be more accurate on a one-to-one basis than with family or friends present. At the beginning of each interview, the participant was told the purpose of the study and how the information obtained by the questionnaire would be useful. In the interview, each statement from the questionnaire was read aloud by the researcher. Any statement not fully understood was explained or expanded. The answer given by the subject was recorded by the researcher. Any additional comments from the subject that related to the study were also recorded.

In the interview, a 24-hour recall of all food and beverages consumed during the past 24-hour period was administered. To aid in the recall accuracy of the amounts of the items consumed, portioned plastic food models, standard sized eating and drinking utensils were used. As the subject recalled the food and beverages consumed during the prior 24 hours, the researcher wrote down the item and amount consumed by the subject. The items were coded for computer usage after the interview was concluded.

The physiological parameters of serum cholesterol and triglyceride levels were obtained from the medical records. These values were collected from a study conducted by Dr. Kelly M. West, Professor at the Oklahoma University Medical Center, Oklahoma City, Oklahoma, during October and November, 1975. The answers given by the subjects in the interview for age and history of diabetes and diabetic treatment were checked for accuracy in the medical records. The subject's height, without shoes, and weight were obtained on the day of the interview. The subject's shoes were removed due to a variation of heel height. Height values were then adjusted for use of the Metropolitan Life Insurance Company Table (see Appendix B). The height for men had one inch added to allow for one inch heels as stated by the table and the height for women had two inches added to allow for two inch heels as stated by the table.

Analysis of Data

Responses to questions asked during the interview were analyzed as to the frequency of response in the diabetic and the nondiabetic group. The number of responses obtained in each category was divided by the sample size of the group to obtain a percentage of each group. A mean of the grade level of the diabetic and nondiabetic group was also obtained from the questionnaire.

The information from the dietary recall was placed on 80 column computer data sheets and then keypunched for a program written in Fortan Computer Language. The food items were coded in accordance with the Home and Garden Bulletin Number 72 (74). The amounts of food consumed by each subject was converted to a multiple of the amount listed in Bulletin Number 72 and coded. The calories and selected nutrients of foods eaten by the subject were the items used in this study. The nutrients considered were in grams of carbohydrate, protein, saturated and unsaturated fat consumed. The computer was programmed to give a percentage of the four nutrients (carbohydrate, protein, saturated and unsaturated fat) as they related to the total intake of calories. The computer analysis also compared the 24-hour recall of food and beverage intake of each subject with the 1974 Recommended Daily Allowances (R.D.A.) according to age and activity. A standard 16 hours of light activity and eight hours of sleep were considered as normal in the computation of energy needs of the subjects. Recommended Daily Allowances of Calories to maintain the individual's present weight was calculated by the computer. Caloric deficit or excess was determined by subtracting the intake from the R.D.A. for Calories.

The physiological parameters studied included cholesterol and triglyceride serum levels and how they related to obesity. The normal range of cholesterol was established as 150 to 250 mg./100 ml. The normal range of triglyceride was established as 30 to 130 mg./100 ml. The actual value of the subject's cholesterol and triglyceride was compared to the range. The actual weight of each subject was compared to the height-weight-age tables to determine the presence of obesity and how this related to their cholesterol and triglyceride values.

The ideal weight for each subject was determined by using the height-weight-age tables of the Metropolitan Life Insurance Company issued in 1959 (21, 44) (Appendix B). The chart displays desirable body weight in relation to age, sex, body build, and height and presents a range from low to high weights which are acceptable for a specific body height, heel height and body frame. In defining desirable weight for girls 18 to 25 years of age, one pound was subtracted for each year under 25. Obesity was calculated by dividing the subject's weight by the ideal weight. In order to compute the percentage over and under weight, the average desirable weight in the medium body build category was used. An obese individual was considered as a person 20 percent or more over the desirable weight.

The statistical analysis of the physiological and dietary measurements of the diabetic and nondiabetic subjects and the relation of sex and age was done according to the procedure established by Snedecor and Cochran (61). The level of significance was established as $P < .01$. The level of significance for the interaction of the three variables, diabetes, age and sex, was established as $P < .05$. Comparisons of means used the protected least-significant-difference contrast as suggested by Snedecor and Cochran (61). Subsequently, data from diabetics was subgrouped by those who had diabetes 0 to 3, 4 to 8, and more than 8 years. Physiological and dietary measurements for these groups were analyzed. Finally, correlations of the parameters, age, obesity, cholesterol, triglyceride and dietary intake, for all 90 participants and for the 30 diabetics were identified.

After identifying the relationship of the dietary intake and cholesterol and triglyceride serum levels to the presence or absence of diabetes, age and sex of the subjects; the implication of these relations were used to help identify nutrition education areas that needed to be strengthened. Suggestions and recommendations for planning nutrition education programs for the Oklahoma Plains Indians were made.

CHAPTER IV

RESULTS AND DISCUSSION

The 90 participants in the study were Oklahoma Plains Indians between the age of 20 and 80 from the Lawton, Oklahoma area. Thirty subjects were diagnosed diabetic and 60 were nondiabetic as established by glucose tolerance tests. Both groups were stratified by age and sex. Each subject was interviewed to obtain a 24-hour recall of all food and beverages consumed for one day. The interviews were conducted on Tuesday through Friday as Saturday and Sunday were considered to have atypical intakes. The levels of serum cholesterol and triglyceride of each subject were obtained from their medical records. Information on each subject is listed in Appendix D.

This chapter presents a brief medical description of the participants. In addition, the dietary intake of calories obtained from carbohydrate, protein, saturated and unsaturated fat and the physiological parameters of cholesterol and triglyceride serum levels were related to the presence or absence of diabetes in the subjects by age and sex. Also presented is the relationship of the duration of diabetic condition upon the dietary intake. Finally, the relationships of the percentage of dietary intake and degree of obesity to the serum cholesterol and triglyceride levels of the subject are presented.

Characteristics of Participants

The health data about the participants were obtained from the responses to the questionnaire. Medical data were checked for accuracy by comparing each subject's responses to his medical records. In all instances, responses proved accurate.

The nondiabetic subjects studied ranged in age from 20 to 80 years with a mean age of 48.9. Diabetics ranged from 21 to 78 years of age with a mean age of 49.4. Weight for all subjects ranged from 104 to 312 pounds with a mean of 186.8 pounds. Nondiabetics ranged from -10 to 138 percent overweight with a mean of 41.7 percent compared with diabetic subjects which were overweight from -13 to 117 percent with a mean of 43.8 percent. Hence, age, weight and obesity of the two groups were quite similar (see Table VI).

As indicated by medical history of the subjects, incidence of eye disorders from myopia to blindness was lower among the diabetics (37 percent) than the nondiabetics (90 percent). Severe handicaps, one amputation and one case of total blindness were only noted among the diabetics. Hypertension was also lower (26.67 percent) among diabetics than for the nondiabetics (36.67 percent). This may be attributed to the more frequent medical care of the diabetics than nondiabetics. If dietary or physical habits were modified following diabetes, this may have reduced the prevalence of certain medical problems among the diabetics. Yet, medical records were screened for 5 to 10 years prior to the study for each subject and these records included a period prior to diagnosing diabetes for many of the diabetics. Frequent medical care alone may not explain the lower incidence of hypertension among diabetics.

TABLE VI

RANGE AND MEAN OF AGE, WEIGHT AND OBESITY OF DIABETIC AND NONDIABETIC RESPONDENTS

Parameters	Groups Nondiabetic N=60	 Diabetic N=30	$SE_{\bar{x}}$[a]
Age, years			
Range	20-80	21-70	
Mean	48.9	49.4	0.8
Weight, pounds			
Range	104-312	110-307	
Mean	186.8	193.9	6.1
Obesity and overweight			
Range	-10 to +138	-13 to +117	
Mean	41.7	43.8	4.3

[a]Standard error of the mean.

Altered dietary pattern of the diabetic is reflected by the high frequency of the habitual consumption of three or more meals per day (76.67 percent for diabetics and 18.33 percent for nondiabetics) and infrequency of alcohol consumption (0 percent for diabetics and 46.67 percent monthly or more frequently for nondiabetics). Frequent meals and alcohol abstinence, whether instigated by the physician or dietitian or through personal initiative, should prove useful for the control of diabetes. Vitamin supplements were prescribed more frequently for diabetics (13.33 percent for diabetics and 5 percent for nondiabetics) but the percentage that consumed vitamin medications varied little between groups, 16 percent for diabetics and 11 percent for nondiabetics (see Table VII).

TABLE VII

GENERAL HEALTH AND DIETARY PATTERNS OF DIABETIC AND NONDIABETIC SUBJECTS

	Group			
	Diabetic N=30		Nondiabetic N=60	
Parameter	N[a]	Percent	N	Percent
Eye disorders	11	36.37	54	90.00
Hypertension	8	26.67	22	36.67
Liver disorders	1	3.33	2	3.33
Lung disorders	2	6.67	0	0.00
Amputation	1	3.33	0	0.00
Vitamins				
Prescribed by physician	4	13.33	3	5.00
Purchased at drug or grocery store	1	3.33	4	6.67
Meal pattern				
Eats three meals daily	23	76.67	11	18.33
Skips at least one meal	7	23.33	49	81.67
Imbibes alcohol				
Twice daily	0	0.00	2	3.33
Twice a month	0	0.00	21	35.00
Once a month	0	0.00	5	8.33
Less than monthly	14	46.67	11	18.33

[a]N = number of subjects.

Influence of Diabetes on Physiological and Dietary Parameters

The physiological and dietary parameters of the diabetic and nondiabetic American Indians in this study are presented in Table VIII. The percentage of total calories consumed by subjects for protein was 17.3 percent for the nondiabetic and 17.6 percent for the diabetic. Carbohydrates were 37.2 percent for the nondiabetic and 34.7 percent for the diabetic; saturated fat intake was 18.0 percent for the nondiabetic and 19.0 percent for the diabetic; and unsaturated fat was 27.4 percent for the nondiabetic and 28.7 percent for the diabetic. Diabetics had received insulin treatment for a mean of 7.3 years. Serum cholesterol was nonsignificantly lower for the diabetics, 207.9 mg./dl., than for the nondiabetics, 212.2 mg./dl., but the serum triglyceride level was 71.0 percent greater for diabetics, 295.3 mg./dl., than nondiabetics, 172.2 mg./dl. This was significant at the .01 level. Many investigators have reported that triglyceride levels are, generally, higher in diabetics.

Despite dietary recommendations for control of diabetes through reduced obesity, diabetic patients were 43.8 percent overweight as compared with 41.7 percent overweight for the nondiabetic, with a standard error of the mean of 4.3. This difference was not significant at the .05 level. The diabetic subject consumed more total calories, 2,639 calories per day, than the nondiabetic group, 2,460 calories per day. Diabetics were probably more obese at the onset of diabetes. Diabetes often causes loss of weight and dietary therapy is intended to advance this objective. The high incidence of obesity of the American Indian

TABLE VIII

PHYSIOLOGICAL AND DIETARY PARAMETERS OF DIABETIC AND NONDIABETIC SUBJECTS

Parameter	Group: Nondiabetic	Group: Diabetic	$SE_{\bar{x}}$[a]
Diabetic time, years	0.0	7.3	0.7
Serum parameters			
Cholesterol, mg./dl.	212.2	207.9	6.8
Triglyceride, mg./dl.	172.5[b]	295.3[c]	20.1
Diet parameters			
Calorie source, %			
Protein	17.3	17.6	0.8
Carbohydrate	37.2	34.7	2.0
Saturated fat	18.0	19.0	1.0
Unsaturated fat	27.4	28.7	1.0
Caloric balance, kcal			
Intake	2460	2639	210
Requirement[d]	3304	3429	109
Deficit[e]	844	791	235

[a]Standard error of the mean.

[b,c]Means in a row with different superscripts differ statistically ($P < .01$).

[d]Calories required to maintain present weight.

[e]Difference between caloric requirement and caloric intake.

has been suggested by authorities as one factor responsible for the high incidence of diabetes in this group.

Physiological and Dietary Parameters

Physiological and dietary parameters for all diabetic and non-diabetic men and women of the study are presented in Table IX. The mean weight of all women in this study was 163.9 pounds which was 38.4 percent overweight. Men in the study had a mean weight of 214.5 pounds which indicated that they were 46.4 percent overweight. The standard error of the mean was 4.3 which showed that the women were nonsignificantly less obese than the men at the .05 level. For women, the serum cholesterol mean was 207.3 mg./dl., and serum triglyceride mean was 218.3 mg./dl. For men, the serum cholesterol mean was 214.2 mg./dl., and serum triglyceride mean was 208.6 mg./dl. The standard error of the mean for serum cholesterol was 6.8 mg./dl. and for serum triglyceride was 20.1 mg./dl. which was nonsignificantly different at the .05 level.

In comparing sex and dietary factors it was found that the women had a mean caloric intake of 2027 calories per day which consisted of 17.2 percent protein, 39.3 percent carbohydrate, 17.3 percent saturated fat and 26.2 percent unsaturated fat. The men had a mean calorie intake of 3012 calories per day which consisted of 17.6 percent protein, 33.5 percent carbohydrate, 19.4 percent saturated fat and 29.5 unsaturated fat. This showed that the diet consumed by women was significantly higher in carbohydrate ($SE_x = 2.0$, $P < .05$) and not significantly different at the .05 level ($SE_x = 0.8, 1.0, 1.0$, respectively) from the men's diet in protein, saturated and unsaturated fat. Total

TABLE IX

PHYSIOLOGICAL AND DIETARY PARAMETERS
ACCORDING TO SEX OF SUBJECTS

Parameter	Group Men N=45	 Women N=45	SE_x^a
Age, years	48.8	49.3	
Weight, pounds	214.5[b]	163.9[c]	6.1
Obesity, % overweight	46.4	38.4	4.3
Serum parameters			
Cholesterol, mg./dl.	214.2	207.3	6.8
Triglyceride, mg./dl.	208.6	218.3	20.1
Diet parameters			
Calorie source, %			
Protein	17.6	17.2	0.8
Carbohydrate	33.5[d]	39.3[e]	2.0
Saturated fat	19.4	17.3	1.0
Unsaturated fat	29.5	26.2	1.0
Caloric balance, kcal			
Intake	3012[b]	2027[c]	210
Requirement[f]	3851[b]	2841[c]	109
Deficit[g]	838	814	235

[a]Standard error of the mean.

[b,c]Means in a row with different superscripts differ statistically ($P < .01$).

[d,e]Means in a row with different superscripts differ statistically ($P < .05$).

[f]Calories required to maintain present weight.

[g]Difference between caloric requirement and caloric intake.

caloric requirement of women was 2841 calories per day and for men it was 3851 calories per day. Standard errors of the means for caloric intake and caloric requirement were 210 and 109 calories per day, which indicates that caloric intake and need were significantly higher at the .01 level for men than for women.

Physiological and Dietary Parameters

Relationship of Age

The relationship of age on physiological and dietary parameters is presented in Table X. Individuals over 60 years of age had a mean weight of 170.4 pounds which identified that they were 30.4 percent overweight. Individuals under 60 years of age had a mean weight of 198.6 pounds which identified that they were 48.3 percent overweight ($SE_x = 5.3$). This showed that individuals over 60 years of age weighed significantly less ($SE_x = 7.5$, $P < .05$) and were significantly less obese ($SE_x = 5.3$, $P < .05$) than those under 60 years of age. Reduced obesity may be characteristic of aging, associated with environmental history of the subjects or attributed to a higher survival rate of less obese individuals. Relative importance of these factors were not identified by this research. Individuals over 40 years of age had a serum cholesterol level of 218.5 mg./dl., and a triglyceride level of 222 mg./dl. with an intake of 2185 calories per day. Individuals over 40 years of age had a serum cholesterol level of 194 mg./dl. and triglyceride level of 196 mg./dl. with an intake of 3188 calories per day. This showed that individuals over 40 years of age had significantly higher serum cholesterol ($SE_x = 8.3$, $P < .05$) and triglyceride levels ($SE_x = 24.6$, $P < .05$) than people under 40 years of age despite their

TABLE X

PHYSIOLOGICAL AND DIETARY PARAMETERS RELATIONSHIP OF AGE

Parameter	Age Group 20-39 N=30	40-59 N=30	60+ N=30	SE_x^a
Mean age, years	31.3	49.1	66.8	
Weight, pounds	203.4[b]	193.8[b]	170.4[a]	7.5
Obesity, mean % overweight	51.0[b]	45.8[b]	30.4[a]	5.3
Serum parameters				
Cholesterol, mg./dl.	194.0[a]	219.0[b]	218.0[b]	8.3
Triglyceride, mg./dl.	196.0	225.0	219.0	24.6
Diet parameters				
Calorie source, %				
Protein	14.8[a]	18.3[b]	19.2[b]	1.0
Carbohydrate	39.9	35.3	33.9	2.5
Saturated fat	17.5	18.4	19.1	1.5
Unsaturated fat	27.8	28.0	27.8	1.3
Caloric balance, kcal				
Intake	3188[a]	2126[b]	2244[b]	257
Requirement	3595[a]	3429[a]	3013[b]	133
Deficit[e]	407		770	287

[a]Standard error of the mean.

[b,c]Means in a row with different superscripts differ statistically ($P < .05$).

[d]Calories required to maintain present weight.

[e]Difference between caloric requirement and caloric intake.

lower percent overweight and lower calorie intake. Cholesterol levels have been widely associated with age and caloric intake. In this group of subjects, cholesterol level increased with age of subject despite decreased caloric intake and decreased obesity.

Individuals over 40 years of age consumed a mean of 2185 calories consisting of 18.8 percent protein, 34.6 percent carbohydrate, 18.8 percent saturated fat and 27.9 percent unsaturated fat. Individuals under 40 years of age obtained their 3188 calories per day from 14.8 percent protein, 39.9 percent carbohydrate, 17.5 percent saturated fat and 27.9 percent unsaturated fat. This showed that individuals over 40 years of age consumed diets higher in protein and lower in carbohydrate than those under 40. This could reflect preference due to age, income or environmental factors. Mean daily protein intakes for the three age groups were 119, 90, and 103 grams, all of which far surpass the estimated protein requirement of 46 grams of protein for women and 56 grams of protein for men recommended by the National Research Council in 1973. Mean daily total fat intakes for the three groups were 45.3, 46.4 and 46.9 respectively, which showed that the intake of fat was similar for the three age groups.

Total caloric intake was greater for subjects under 40 than over 40 years of age. Caloric requirement to maintain the individual's current body weight was also greater for subjects under 40, being 3595 calories per day, than subjects over 40 years of age, which was 3221 calories per day, due primarily to heavier weight for the younger individuals. The difference between reported intake of caloric and estimated caloric requirement was substantial in each of the three age groups.

Physiological and Dietary Parameters Interaction of Diabetes, Age and Sex

Several interrelationships of diabetes, age and sex with diet composition were statistically significant at the .05 level. The diet of nondiabetic women consisted of 16.2 percent protein, 42.3 percent carbohydrate, 16.4 percent saturated fat and 25.1 percent unsaturated fat. The diet of diabetic women consisted of 19.1 percent protein, 33.4 percent carbohydrate, 19.1 percent saturated fat and 28.4 percent unsaturated fat. Diabetic women chose diets significantly higher in protein ($SE_x = 3.6$, $P < .05$) and significantly lower in carbohydrate ($SE_x = 8.5$, $P < .05$) than nondiabetic women. The diet of nondiabetic men consisted of 18.4 percent protein, 32.2 percent carbohydrate, 19.5 percent saturated fat and 29.9 percent unsaturated fat. The diet of diabetic men consisted of 16.1 percent protein, 35.9 percent carbohydrate, 19.0 percent saturated fat and 29.0 unsaturated fat. This evidence showed that nondiabetic and diabetic men were nonsignificantly different at the .05 level in their percentage of dietary intake from protein, carbohydrate, saturated fat and unsaturated fat (see Table XI).

Caloric intake of nondiabetic subjects was not influenced markedly by age. Intakes were 2574, 2225, and 2582 calories per day for subjects 20 to 29, 40 to 59, and over 60 years of age, respectively. Diabetics, in contrast, had higher intakes when under 40 years of age, with 4418 calories per day, as compared with 1749 calories per day for diabetics over 40 years of age with a standard error of the mean of 385 calories. This difference was significant at the .05 level. There are several possible explanations. The older subjects may take diabetes more seriously and consider caloric restriction to a greater degree than the younger diabetics. Alternatively, diabetes through time may precipitate anorexia (see Table XII).

TABLE XI

DIET COMPOSITION OF MALE AND FEMALE NONDIABETIC AND DIABETIC

	Group				
	Nondiabetic		Diabetic		
Parameter	Male N=30	Female N=30	Male N=15	Female N=15	$SE_{\bar{x}}$[a]
Caloric contribution (% of calories):					
Protein	18.4	16.2	16.1	19.1	3.6
Carbohydrate	32.2[b]	42.3[c]	35.9[bc]	33.4[b]	8.5
Saturated fat	19.5	16.4	19.0	19.1	4.3
Unsaturated fat	29.9	25.1	29.0	28.4	4.3

[a]Standard error of the mean.

[b,c]Means in a row with different superscripts differ statistically ($P < .05$).

N = number of subjects.

Physiological and Dietary Parameters According to Duration of Diabetes

Individuals who had diabetes for 11 or more years had significantly lower (SE_x = 734, $P < .05$) caloric intake, 974 calories per day, than those with less than eight years of diabetes, 3252 calories per day. Individuals having had diabetes for over 11 years were -0.3 percent overweight as compared with those having had diabetes for less than 11 years, who were 48.8 percent overweight, with a standard error of the mean of 9.9. This difference was significant at the .05 level. Serum cholesterol was higher for individuals who had been diabetic from 8 to 11 years, 247 mg./dl., than from 3 to 8 years, 188 mg./dl. Blood serum triglycerides and sources of calories were not statistically different between age groups (see Table XIII).

TABLE XII

CALORIC INTAKE OF DIABETICS AND NONDIABETICS ACCORDING TO AGE

	Group						
	Nondiabetic			Diabetic			
	Age Group						
Parameter	20-39 N=20	40-59 N=20	60+ N=20	20-39 N=10	40-59 N=10	60+ N=10	SE_x^a
Intake, kcal/day	2574^c	2225^{bc}	2582^c	4418^d	1930^{bc}	1568^b	385
Caloric deficiency, kcal/day	966^{cd}	1072^{cd}	494^{bc}	-712^b	1764^d	1321^{cd}	431

[a]Standard error of the mean.

[b,c,d]Means in a row with different superscripts differ statistically ($P < .05$).

TABLE XIII

PHYSIOLOGICAL AND DIETARY PARAMETERS ACCORDING TO DURATION OF DIABETES

Parameter	Years Diabetic <3 N=8	3-8 N=10	8-11 N=9	>11 N=3	SE_x[a]
Age, years	37.6[b]	50.8[c]	55.4[c]	57.7[c]	5.0
Obesity, % overweight	50.5[b]	40.9[b]	46.9[b]	-0.3[c]	9.9
Serum parameters					
Cholesterol, mg./dl.	193[bc]	188[b]	247[c]	198[bc]	19.3
Triglyceride, mg./dl.	305	247	360	236	76.6
Diet parameters					
Calorie source, %					
Protein	16.9	18.2	18.6	14.7	2.6
Carbohydrate	40.0	33.6	30.6	36.3	5.4
Saturated fat	16.2	19.3	20.9	20.0	2.4
Unsaturated fat	26.9	28.9	30.0	29.0	3.1
Caloric balance, kcal					
Intake	3075[b]	3428[b]	1928[bc]	974[c]	734
Requirement[d]	3854	3499	3312	2417	351
Deficit[e]	779	71	-1384	-1343	

[a]Standard error of the mean.

[b,c]Means in a row with different superscripts differ statistically ($P < .05$).

[d]Calories required to maintain present weight.

[e]Differences between caloric requirement and caloric intake.

Several explanations are possible for the anorexia following use of insulin for several years. Diabetes may cause greater or earlier mortality among obese individuals so that only less obese diabetics survive. Secondly, insulin administration continued over a period of years may cause diabetics to lose weight due to nitrogen and glucose being excreted in the urine. In some diabetics, lipid mobilization is evident at insulin injection sites. If indeed, long term insulin treatment causes anorexia, insulin therapy may enhance morbidity and mortality. Third, the diabetic may learn to live with his diabetes and learn to follow his diet and lose weight after 10 years of diabetes. Further research of insulin induced anorexia is warranted.

Correlation of Parameters

Correlations for all parameters measured for all subjects were calculated. Obesity was negatively correlated with age ($r = -0.23$, $P < .05$). Serum levels of cholesterol and triglycerides were positively correlated ($r = 0.40$, $P < .01$). Whether calories were obtained from protein, carbohydrate, saturated or unsaturated fat had no significant effect on triglyceride and cholesterol levels (maximum $r = 0.07$, nonsignificant at .05 level) (see Table XIV).

As caloric intake increased, protein in the diet decreased ($r = -0.22$, $P < .05$) and unsaturated fat increased ($r = 0.23$, $P < .05$). This substitution of unsaturated fat for protein may be attributable to taste patterns of subjects. High protein diets are often employed for weight loss. Yet, cause and effect cannot be determined from simple correlations. As carbohydrate content of the diet increased, intake of protein and saturated and unsaturated fat declined ($r = -0.47$, $r = -0.81$,

TABLE XIV

CORRELATION COEFFICIENTS OF PHYSIOLOGICAL AND DIETARY PARAMETERS FOR ALL SUBJECTS*

Parameter	Obesity	Cholesterol	Triglyceride	Percent Protein	Percent Carbohydrate	Percent Saturated Fat	Percent Unsaturated Fat	Calorie Intake
Age, years	-0.23+	0.16	0.09	0.34+	-0.22+	0.16	0.02	-0.16
Obesity, % overweight		-0.12	0.05	0.16	0.16	0.07	0.12	0.11
Blood parameters								
Colesterol, mg./dl.			0.40++	0.02	-0.04	0.04	0.03	0.10
Triglyceride, mg./dl.				-0.05	-0.04	0.07	0.06	0.11
Diet parameters								
Calorie source, %								
Protein					-0.47	0.09	-0.01	-0.22+
Carbohydrate						-0.81++	-0.79++	-0.12
Saturated fat							0.55++	0.20
Unsaturated fat								0.23

+(P < .05).

++(P < .01).

*Number of subjects = 90.

$r = 0.79$, $P < .01$). Saturated and unsaturated fat varied together ($r = 0.55$, $P < .05$). This means that one is not substituting for the other in the diet. Such a relationship may result from selection by certain individuals of diets high in total fat. Diets increased in protein ($r = 0.34$, $P < .05$) and decreased in carbohydrate ($r = -0.22$, $P < .05$) as subjects increased in age.

Correlations of physiological and dietary parameters for diabetic subjects were calculated (see Table XV). Correlation coefficients for parameters were similar in magnitude for all diabetic subjects (Table XV) with two exceptions. First, the correlation of caloric intake with percent of calories from unsaturated fat was lower for diabetics ($r = 0.10$, nonsignificant at the .05 level) than for all subjects measured ($r = 0.23$, $P < .05$). Secondly, caloric intake declined more with age for diabetics ($r = -0.55$, $P < .01$) than for all diabetic subjects ($r = -0.16$, $P < .05$).

Blood serum concentrations of cholesterol and triglyceride were not significantly correlated with obesity among diabetics ($r = 0.12$, nonsignificant at the .05 level) or all subjects ($r = 0.12$, nonsignificant at the .05 level). Although serum cholesterol and triglyceride levels of all diabetic subjects were correlated with each other, no significant relationship at the .05 level was apparent between these levels and any diet parameter measured.

TABLE XV

CORRELATION COEFFICIENTS OF PHYSIOLOGICAL AND DIETARY PARAMETERS FOR DIABETIC SUBJECTS*

Parameter	Obesity	Cholesterol	Triglyceride	Percent Protein	Percent Carbohydrate	Percent Saturated Fat	Percent Unsaturated Fat	Calorie Intake
Age, years	-0.29	0.17	0.10	0.34+	-0.30	0.30	0.00	-0.55++
Obesity, % overweight		0.12	0.10	0.11	-0.13	-0.02	0.15	0.29
Blood parameters								
Cholesterol, mg./dl.			0.52++	0.16	-0.04	-0.16	0.05	-0.21
Triglyceride,mg./dl.				-0.14	0.29	-0.24	-0.19	0.10
Diet parameters								
Calorie source, %								
Protein					-0.43+	-0.03	-0.06	-0.35
Carbohydrate						-0.78++	-0.81++	0.16
Saturated fat							0.63++	-0.10
Unsaturated fat								0.10

+(P < .05).

++(P < .01).

*Number of subjects = 30.

CHAPTER V

SUMMARY AND CONCLUSIONS

The objectives of this study were: (1) to identify the percentage of calories obtained from carbohydrates, protein, saturated and unsaturated fats in a 24-hour dietary recall of the subjects; (2) to determine the relationship of the percentages of calories obtained from carbohydrates, proteins, saturated and unsaturated fats and degree of obesity to triglyceride and cholesterol serum levels of the subjects; (3) to identify and relate dietary factors and cholesterol and triglyceride serum levels to the presence or absence of diabetes, age, and sex of the subjects; (4) to determine the relationship of the duration of the diabetic condition to dietary intake of calories from carbohydrate, protein, saturated and unsaturated fats and (5) to make suggestions and recommendations for planning nutrition education programs for the Oklahoma Plains Indians.

The subjects interviewed by the researcher were at least half-blood Indians by genetic lineage and were from 20 to 80 years of age. Sixty were nondiabetic Oklahoma Plains Indians. Thirty were insulin dependent diabetic Oklahoma Plains Indians with 1 to 21 years of diabetes. The subjects were personally interviewed for 30 minutes by the researcher. The answers given by the subject in response to the questionnaire and the 24-hour recall of food and beverages consumed were recorded by the researcher. The cholesterol and triglyceride serum levels were obtained from the subject's medical records.

The responses from the questionnaire were analyzed by frequency and percent for diabetic and nondiabetic groups. The responses to the 24-hour dietary recall and physiological parameters of diabetic and nondiabetic subjects and the relation of sex and age were analyzed statistically by the procedure established by Snedecor and Cochran. Data from subjects were grouped according to the diabetes, age and sex and interaction for analysis, with the level of significance at $P < .05$ and $P < .01$. Comparison of means used the protected-least-significant-difference contrast as suggested by Snedecor and Cochran.

General health of diabetics appeared superior to nondiabetics as measured by the response to questions regarding disease history. Although eating patterns of diabetics and nondiabetics differed with more of the diabetic subjects eating three meals and having a lower frequency of alcohol intake, caloric intake and composition of diet consumed by diabetics was virtually identical to that of nondiabetics. The only significant physiological difference ($P < .01$) was an elevated serum triglyceride level of the diabetics, which was 295.3 mg./dl. as compared with nondiabetic serum triglyceride level of 172.5 mg./dl. Diabetics, with a mean weight of 193.9 pounds, were slightly more overweight than nondiabetics with a mean weight of 186.8 pounds.

In the study, women with a mean weight of 163.9 pounds were slightly less overweight than men with a mean weight of 214.5 pounds. Women, with a dietary intake of 39.3 percent carbohydrate, especially nondiabetics, had significantly higher carbohydrate levels in their diets ($P < .01$) than did men with a dietary intake of 33.5 percent of calories from carbohydrate.

Individuals under 40 years of age had a mean intake of 14.8 percent protein, a total caloric intake of 3188 calories and a serum cholesterol level of 194 mg./dl. and triglyceride level of 196 mg./dl. Individuals over 40 years of age had a mean intake of 18.8 percent protein, a total caloric intake of 2185 calories and a serum cholesterol level of 218.5 mg./dl. and triglyceride level of 222 mg./dl. This showed that individuals under 40 years of age, as compared with those over 40 years of age, consumed significantly less protein ($P < .01$) and more calories ($P < .05$) but had significantly lower serum cholesterol ($P < .05$) and triglyceride levels. Subjects over 60 were 30.4 percent overweight, subjects under 60 were 48.3 percent overweight. This shows that those under 60 were significantly more overweight ($P < .05$). The decline in calorie intake with age was most evident among diabetics with a significant reduction in obesity and caloric intake for subjects with over 11 years history of diabetes. Anorexia of this group may be an important health problem.

For all subjects, certain diet constituents were highly correlated. As percentage of protein in the diet increased, total caloric intake significantly decreased ($r = 0.22$, $P < .05$). As carbohydrate intake increased, protein and saturated and unsaturated fat precentages declined ($r = -0.47$, $r = -0.81$, $r = -0.79$, $P < .01$). Saturated and unsaturated fat increased or decreased together ($r = 0.55$, $P < .01$) and tended to increase with caloric intake ($r = 0.20$, $r = 0.23$, $P < .05$).

From this study it was suggested that eating patterns may be modified by diabetes but changes in obesity, caloric intake and calorie distribution were minor. Dietetic advice apparently was absent, misunderstood or unheeded. High incidence of obesity among young diabetics was especially disconcerting.

As related to the results from others, protein intake in this study was higher (17.4 percent) as compared with the Bass Study (14.4 percent), the Watt Study (15.4 percent) and the 1974 USDA Food Consumption (12.0 percent of calories). In this study, carbohydrate percentage was lower (36.4 percent) compared to other studies (36.7, 58.6 and 46.0 percent of calories, respectively). Total fat showed little difference (46.2 percent) from United States studies of Bass (50.8 percent) and the 1974 USDA Food Consumption (42.0 percent of calories. The Peruvian Indians studied by Watt had a lower fat intake (26.3 percent of calories).

Total calories per day was higher (2520 calories) than Bass and Watt had reported (1497 and 2478 calories) but consumption of calories was lower than the 1974 USDA Food Consumption (3350 calories).

It appears that the Oklahoma Indians in this study consumed a higher level of protein than had been observed in most other studies. All other Indian groups studied had lower carbohydrate intake than the 1974 USDA Food Consumption Survey.

The following recommendations are proposed by the researcher for further research to attain more complete understanding of the American Indian diet and the diabetic syndrome:

1. food composition and intake and seasonal weight fluctuation of the American Indian throughout the calendar year,
2. food habits of other tribes and races,
3. polyunsaturation of fat and complexity of carbohydrate in the American Indian diet as related to atherosclerosis and diabetes,
4. obesity of American Indians at the onset of diabetes,

5. diabetes control and prevention in the American Indian through diet modification and weight control,
6. insulin induced anorexia among diabetics,
7. high protein intake for long term weight control, and
8. racial differences in hepatic metabolism and pancreatic function with special emphasis on response to alcohol, meal infrequency and refined sugar.

For improving nutrition education of the American Indian, the researcher has the following recommendations:

1. The health profession team should emphasize the importance of applied nutrition for the American Indian.
2. The health professional must be aware of food habits of the American Indian and consider ethnic differences and customs when recommending dietary alteration.
3. All American Indian Community Health Representatives (CHR) should be trained in clinical nutrition.
4. The clinical nutrition advisor should develop and use special motivational tools emphasizing for the American Indian the dietary control of diabetes.
5. The nutrition educator should develop a multimedia system emphasizing the importance of diet modification in weight and diabetes control for the patient and the patient's family plus the elementary and secondary schools with high Indian enrollment.

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APPENDIXES

APPENDIX A

QUESTIONNAIRES

Subject No. ____________________

IHS No. ________________________

Name ____

Address ____

Today's date ____

1. Age _____________________________

2. Height __________________________

3. Weight __________________________

Do you consider your weight to be too much ____, too little ____,

just right ____

Percent above or below desirable weight ___________________________

4. Male or female __________________

Female: Pregnant ____________

Lactating ___________

Children's birth weight:

__________________________ __________________________

__________________________ __________________________

__________________________ __________________________

5. Cholesterol level ____

6. Triglyceride level ____

7. Highest grade last completed _______________________________________

8. Do you have diabetes: Yes ____ No ____

Length of time diabetic ____

Type of insulin ____

Amount of insulin ____

9. Do you have a blood relative that has diabetes: Yes ____ No ____

Mother ____________________ Grandmother ____________________

Father ____________________ Grandfather ____________________

Brother ____________________ Aunt ____________________

Sister ____________________ Uncle ____________________

10. Do you smoke: Yes ____ No ____

If yes, number of packs or number of cigarettes per day ________

11. Have you ever had a heart attack: Yes ____ No ____

12. Have you had:

hypertension ____________________

hyperlipidemia ____________________

coronary artery disease ____________

malabsorption ____________________

chronic lung disease ______________

chronic renal disease _____________

chronic liver disease _____________

blindness or eye disorder __________

amputation ____________________

other ____________________

13. Do you take vitamin or food supplements: Yes ____ No ____

Do you get them from:

your doctor ____________________

drug or grocery store ____________

health food store _______________

other ____________________

Which do you use:

multiple ______________________

B complex ______________________

iron ______________________

vitamin A ______________________

vitamin C ______________________

vitamin E ______________________

other ______________________

14. What brand of cooking oil or fat is used in food preparation ______

saturated ______________ unsaturated ______________

15. Do you imbibe alcohol: Yes ____ No ____

daily ______________________

three times a week ______________________

two times a week ______________________

once a week ______________________

twice a month ______________________

once a month ______________________

less than monthly ______________________

16. How many meals do you normally eat each day ______________________

Do you have snacks, too ______________________

17. In the past year, how many times have you completely skipped meals for a day (during or after pow-wow's or at other times) __________

Eating Place ____________________________

Name of Food and Description	Code No. Bulletin #72	A. Amount of Food Eaten	B. Amount Listed Bulletin #72	Multiple A/B
12 a.m. till breakfast				
Breakfast				
Snack--between lunch and dinner				
Lunch				

Name of Food and Description	Code No. Bulletin #72	A. Amount of Food Eaten	B. Amount Listed Bulletin #72	Multiple A/B
Snack--between lunch and dinner				
Dinner				
Snack--between dinner and 12 p.m.				

Is this a typical food pattern for each day of the week: Yes ____ No ____

If not, what would differ:

APPENDIX B

DESIRABLE WEIGHTS FOR MEN AND WOMEN

TABLE XVI

DESIRABLE WEIGHTS FOR MEN OF AGES 25 AND OVER*

Height (with shoes on) 1-inch heels		Small Frame	Medium Frame	Large Frame
Feet	Inches			
5	2	112-120	118-129	126-141
5	3	115-123	121-133	129-144
5	4	118-126	124-136	132-148
5	5	121-129	127-139	135-152
5	6	124-133	130-143	138-156
5	7	128-137	134-147	142-161
5	8	132-141	138-152	147-166
5	9	136-145	142-156	151-170
5	10	140-150	146-160	155-174
5	11	144-154	150-165	159-179
6	0	148-158	154-170	164-184
6	1	152-162	158-175	168-189
6	2	156-167	162-180	173-194
6	3	160-171	167-185	178-199
6	4	164-175	172-190	182-204

*Weight in pounds according to frame (indoor clothing).

Source: Desirable Weights for Men and Women (1959).

TABLE XVII

DESIRABLE WEIGHTS FOR WOMEN OF AGES 25 AND OVER*+

Feet	Inches	Small Frame	Medium Frame	Large Frame
4	10	92- 98	96-107	104-119
4	11	94-101	98-110	106-122
5	0	96-104	101-113	109-125
5	1	99-107	104-116	112-128
5	2	102-110	107-119	115-131
5	3	105-113	110-122	118-134
5	4	108-116	113-126	121-138
5	5	111-119	116-130	125-142
5	6	114-123	120-135	129-146
5	7	118-127	124-139	133-150
5	8	122-131	128-143	137-154
5	9	126-135	132-147	141-158
5	10	130-140	136-151	145-163
5	11	134-144	140-155	149-168
6	0	138-148	144-159	153-173

*Weight in pounds according to frame (in indoor clothing).

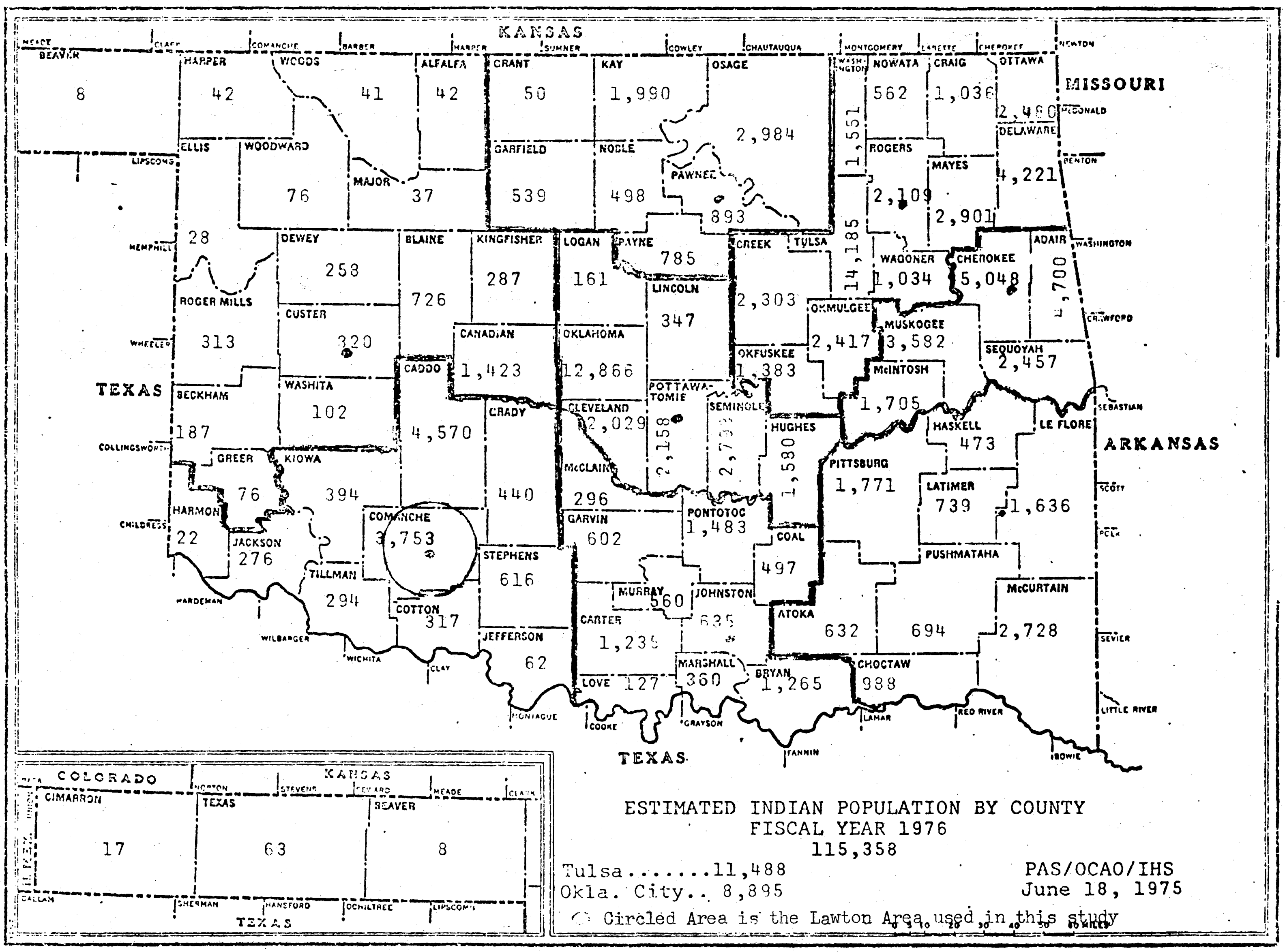
+For girls between 18 and 25, subtract 1 pound for each year under 25.

Source: Desirable Weights for Men and Women (1959).

APPENDIX C

ESTIMATED INDIAN POPULATION BY COUNTY,

FISCAL YEAR 1976



ESTIMATED INDIAN POPULATION BY COUNTY
FISCAL YEAR 1976
115,358

Tulsa.......11,488
Okla. City.. 8,895

PAS/OCAO/IHS
June 18, 1975

○ Circled Area is the Lawton Area used in this study

APPENDIX D

INFORMATION ON SUBJECTS

Male Diabetic

Sample No.	Sex	Age	Last Grade	Height	Weight	% Obese	Chol.	Trig.	Length of Time Diabetic	Relatives Who Are Diabetic	Total Calories	Grams				%				Recm'd Daily Total
														Fat				Fat		
												Prot.	CHO.	Sat.	Unsat.	Prot.	CHO	Sat.	Unsat.	
121	M	39	12	72"	266	+64	204	610	2	M,B	7140	202	793	113	238	11	45	14	30	4771
122	M	35	12	69"	232	+56	206	191	1	M,F,B,S	2223	111	150	59	72	20	27	24	29	4161
123	M	32	8	71"	289	+83	228	463	2	M,H,U	2979	102	422	47	51	14	57	14	15	5183
124	M	21	12	70"	202.5	+32	204	224	1	M,B,GF,A,U	4704	148	578	65	135	13	49	12	26	3623
125	M	33	12	73"	289	+74	183	189	5	M,F,B	6871	240	616	153	230	14	36	20	30	5183
131	M	53	11	64"	205	+58	181	103	10	F,A	1295	81	65	35	44	25	20	24	31	3677
132	M	44	12	73"	222	+33	229	272	6	M,F,A	3241	77	416	42	99	10	51	12	27	3982
133	M	55	16	68"	230	+59	210	181	8		1862	70	166	41	61	15	36	20	29	4125
134	M	46	8	73"	182	+09	194	104	14	M,S	1544	31	184	31	45	08	48	18	26	3264
135	M	40	16	68"	307	+117	183	343	2	F	2554	131	170	49	101	21	26	17	36	5506
141	M	68	7	68"	190	+31	143	530	8	B,S	3000	156	162	85	107	20	22	26	32	3408
142	M	70	12	68"	206	+42	189	99	9		2798	136	271	59	71	19	39	19	23	3695
143	M	67	6	66"	164	+20	218	289	2		1833	97	154	37	55	21	34	18	27	2942
144	M	60	8	65"	116	-13	207	295	21	B,S,A	929	31	46	27	42	13	20	26	41	2081
145	M	61	10	67"	192	+37	271	248	9	B,S,GM	1741	72	127	40	65	17	29	21	33	3444

+ = above desired weight, - = below desired weight, M = mother, F = father, B = brother, S = sister, A = aunt, U = uncle, GF = grandfather, GM = grandmother.

Female Diabetic

Sample No.	Sex	Age	Last Grade	Height	Weight	% Obese	Chol.	Trig.	Length of Time Diabetic	Relatives Who Are Diabetic	Total Calories	Grams Prot.	Grams CHO.	Grams Fat Sat.	Grams Fat Unsat.	% Prot.	% CHO.	% Fat Sat.	% Fat Unsat.	Recm'd Daily Total
221	F	39	10	64"	189	+58	213	236	10	B	4909	143	110	174	259	12	09	32	47	3277
222	F	28	12	60"	112	+05	143	131	1	B,GM,A	1500	51	200	19	36	14	53	11	22	1942
223	F	39	11	65"	156	+27	156	189	2	M,F,GM,A,U	1670	86	120	38	56	21	29	20	30	2704
224	F	35	8	66"	212	+66	106	272	4	M,S	4895	140	636	76	123	11	52	14	23	3675
225	F	38	9	63"	146	+26	201	266	5	M,F,B,S,GF	7284	411	600	143	217	22	33	18	27	2531
231	F	45	11	64"	192	+61	197	156	10		1113	57	75	26	39	20	27	21	22	3329
232	F	50	11	62"	178	+58	238	196	5	F,B	1769	93	104	48	61	21	24	24	31	3086
233	F	52	12	65"	180	+46	210	345	8	M,S,A,U	3132	100	224	67	137	13	29	19	39	3120
234	F	50	15	65"	216	+76	405	690	4	S,A	1379	103	118	10	45	30	34	07	29	3745
235	F	59	11	66"	180	+41	264	510	10	F	1410	54	78	48	50	15	22	31	32	3120
241	F	61	13	63"	147	+27	245	359	10		1118	49	82	25	41	18	29	20	33	2548
242	F	69	6	62"	189	+67	188	141	7	M,B,S	1298	61	88	35	43	19	27	24	30	3277
243	F	64	9	63"	151	+30	172	79	6	S	927	85	59	17	22	37	26	16	21	2618
244	F	67	12	60"	110	+03	193	308	20	F,B,A	450	26	46	8	10	23	41	16	20	1907
245	F	61	9	67"	166	+22	256	840	11	F	1589	41	264	23	18	11	66	13	10	2977

Male Nondiabetics

Sample No.	Sex	Age	Last Grade	Height	Weight	% Obese	Chol.	Trig.	Length of Time Diabetic	Relatives Who Are Diabetic	Total Calories	Grams: Prot.	Grams: CHO.	Grams: Fat Sat.	Grams: Fat Unsat.	%: Prot.	%: CHO.	%: Fat Sat.	%: Fat Unsat.	Recm'd Daily Total
420	M	38	11	64"	310	+138	158	121		F	2852	110	234	51	113	15	33	16	36	5560
421	M	28	14	70"	185	+21	179	58		B,U	2842	97	267	44	110	14	37	14	35	3318
422	M	20	12	67"	203	+44	188	141		M,F	3041	62	291	80	101	08	38	24	30	3641
423	M	32	14	68"	210	+45	259	338		U	2249	90	209	41	76	16	37	16	31	3767
424	M	32	16	65"	212	+59	225	132		M,F,G,U	4604	198	368	96	164	17	32	19	32	3802
425	M	23	17	64.25"	178	+37	198	151		M,F,U,A	3264	89	304	63	125	11	38	17	34	3193
426	M	37	11	70"	289	+89	202	125		M,B,S	2622	101	289	41	77	15	44	14	26	5184
427	M	28	12	68.5"	185	+28	176	65		F,A,U	2820	122	169	85	99	17	24	27	32	3318
428	M	39	10	71.5"	289	+78	209	153		M	6229	304	326	231	181	20	21	33	26	5184
429	M	24	15	69"	312	+109	204	166			1076	45	143	11	25	17	53	09	21	5596
440	M	51	10	67"	174	+24	203	340		F	1116	61	20	45	43	22	07	36	35	3336
441	M	42	15	65.25"	161	+21	179	83		M,F,G,A,U	4191	216	348	99	116	21	33	21	25	2888
442	M	50	12	69"	210	+41	210	338			2244	57	270	21	83	10	48	09	33	3767
443	M	56	12	71"	194	+23	240	148		S,A	1759	105	67	55	64	24	15	28	33	3480
444	M	47	16+	71"	227	+45	207	225			3627	120	312	89	122	13	34	22	30	4089
445	M	55	10	69"	186	+25	170	91		M,F,S,B	4353	216	681	23	62	20	62	05	13	3336
446	M	49	8	74"	387	+127	214	266		M,GM,U	795	84	27	17	22	42	14	19	25	6941
447	M	45	12	62"	160	+30	318	120		M	1124	72	119	16	24	26	42	13	19	2870
448	M	42	16	72"	180	+11	216	140		A,U	2223	98	136	53	90	18	25	21	36	3228
449	M	50	16	68"	150	+03	240	211		M,A	2238	88	206	39	79	16	37	16	31	2690
460	M	60	9	64.25"	156	+20	463	288		B,S	8009	281	720	172	273	14	36	19	31	2798
461	M	76	8	63.5"	183	+41	210	80		S	1620	99	126	26	34	25	31	14	30	3282
462	M	74	7	66"	152	+11	294	526		B	6391	242	242	235	260	15	15	33	37	2726
463	M	64	9	69.75"	181	+18	222	85			3159	124	263	66	113	16	33	19	32	3246
464	M	65	7	68"	284	+96	199	123			2995	141	232	74	93	19	31	22	28	5094
465	M	66	16	66"	229	+69	162	102			3360	181	227	64	128	22	27	17	34	4107
466	M	67	8	70.5"	195	+22	179	124		S	1584	96	84	40	56	24	21	23	32	3498
467	M	80	8	66.5"	182	+33	240	62		B	5029	222	349	143	162	18	28	25	29	3264
468	M	61	12	66"	180	+32	210	356		B	1100	50	99	19	37	18	36	16	30	3228
469	M	70	12	68"	213	+47	216	89			2313	112	203	52	65	20	35	20	25	3820

Female Nondiabetic

Sample No.	Sex	Age	Last Grade	Height	Weight	% Obese	Chol.	Trig.	Length of Time Diabetic	Relatives Who Are Diabetic	Total Calories	Grams Prot.	Grams CHO.	Grams Fat Sat.	Grams Fat Unsat.	% Prot.	% CHO.	% Fat Sat.	% Fat Unsat.	Recm'd Daily Total
320	F	28	9	65"	180	+46	200	112		GM	964	14	137	9	31	06	57	08	29	3120
321	F	36	12	61"	207	+88	200	93		M,F,U	2543	92	150	83	92	14	24	29	33	3485
322	F	28	12	64"	120	+0.4	258	281		F	1219	48	124	28	31	16	40	21	23	2080
323	F	34	12	62"	179	+58	185	120		F,GM,U	1860	111	201	32	36	24	43	15	18	3103
324	F	24	15	63"	138	+19	167	62		GM	3621	123	411	65	100	14	45	16	25	2392
325	F	34	12	67"	159	+21	200	166		F,A,U	1464	23	244	13	31	06	67	08	19	2756
326	F	37	12	63"	180	+55	212	370		M,GM	2916	103	338	48	80	14	46	15	25	3120
327	F	20	12	63"	154	+33	170	126		M,F,A,U	1819	70	207	29	50	15	46	14	25	2670
328	F	29	16	67"	160	+22	214	132		M,F,B,GF,U	2108	71	204	35	77	13	39	15	33	2774
329	F	28	12	60"	158	+48	180	206		M,GF	1364	66	145	24	34	19	43	16	22	2739
340	F	43	15	61"	180	+64	226	325		A,U	3842	88	382	115	103	09	40	27	24	3120
341	F	46	5	62.25"	141	+25	200	114		M,S	1786	69	193	34	48	15	44	17	24	2444
342	F	43	9	64"	186	+56	190	300		M	2044	118	213	28	52	23	42	12	23	3224
343	F	44	11	64"	163	+36	195	123		F	1377	48	186	16	33	14	54	10	22	2826
344	F	55	13	64"	135	+13	200	155			1450	66	139	35	35	18	38	22	22	2340
345	F	56	10	61"	212	+93	214	319		F,GM,GF,A,U	1735	94	81	45	70	22	19	23	36	3675
346	F	47	11	62"	187	+65	221	200		M,B,S,A,U	2170	101	104	70	80	19	19	29	33	3242
347	F	58	12	66"	208	+63	174	160		A	4708	174	256	87	245	15	21	17	47	3606
348	F	51	11	60"	154	+44	192	67			947	30	155	09	14	13	65	09	13	2670
349	F	49	11	62.5"	125	+07	266	135		M,GM,GF,A,U	765	20	160	02	03	10	84	02	04	2167
360	F	66	8	65"	180	+46	164	98			1989	110	151	45	60	22	31	20	27	3120
361	F	71	8	64"	170	+42	200	182			2656	189	196	34	90	28	30	12	30	2947
362	F	69	8	60"	160.5	+50	162	79			2001	94	296	18	31	19	59	08	14	2774
363	F	70	14	63"	104	-10	224	164			1035	40	122	12	31	15	47	11	27	1803
364	F	69	15	61"	140	+27	268	320		F	1139	38	87	32	39	13	31	25	31	2427
365	F	67	16+	62"	170	+50	210	213			1315	74	59	32	55	22	18	22	38	2947
366	F	60	11	62.5"	145	+28	182	77			1388	63	140	28	36	18	41	18	23	2514
367	F	63	10	63"	154	+33	218	142		S	1192	52	147	16	28	17	49	12	22	2670
368	F	69	10	60"	138	+30	221	76		B,S	2525	78	254	72	61	12	40	26	22	2392
369	F	68	5	62.5"	165	+46	227	188		M,B,S	839	44	96	11	20	21	46	12	21	2860

VITA

Marilyn Louise Martin

Candidate for the Degree of

Master of Science

Thesis: DIFFERENCES IN SELECTED DIETARY INTAKE AND CLINICAL PARAMETERS OF DIABETIC AND NONDIABETIC OKLAHOMA PLAINS INDIANS

Major Field: Food, Nutrition and Institution Administration

Biographical:

Personal Data: Born in Wewoka, Oklahoma, April 7, 1949, the daughter of Mr. and Mrs. Henry Dale Martin.

Education: Graduated from Wewoka High School, Wewoka, Oklahoma, in May, 1967; received an Associate of Arts, Seminole Junior College, Seminole, Oklahoma, January, 1969; graduated with a Bachelor of Science in Home Economics Education from Oklahoma State University, Stillwater, Oklahoma, 1971; completed requirements for the Master of Science degree at Oklahoma State University, May, 1977.

Experience: Extension Home Economist, Pottawatomie County, Oklahoma, 1970-1973; Home Bound Teacher for Handicapped Children, Wewoka School System, Wewoka, Oklahoma, 1974-1975, Assistant Nutritionist, Family Relations and Child Development Labs, Oklahoma State University, 1975; Dietetic Trainee, Stillwater Municipal Hospital, Stillwater, Oklahoma, 1976-1977.

Professional Organizations and Honors: American Home Economics Association, Oklahoma Home Economics Association, Phi Upsilon Omicron, Omicron Nu, Kappa Delta Phi, Phi Kappa Phi, Who's Who.