A STUDY OF NUTRITIONAL PARAMETERS AMONG NAVAJO CHILDREN

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CHAPTER I

INTRODUCTION

The Native American population has been disease sensitive since the Columbian era (1). This same situation remains true today among the Navajo tribe who live on a 27,000 square mile reservation in the Four Corner area of New Mexico, Arizona and Utah (2,3). Communicable diseases have been largely eliminated through extensive governmental vaccination programs, but infectious diseases today account for high morbidity rates among infants and children. Infections alone are responsible for a Navajo infant mortality rate six times greater than the rest of the United States (4). Evidence suggests that improper nutrition is greatly responsible for the infants' and children's susceptibility to infections, and for the high rate of mortality and morbidity from conditions which well-nourished children would resist (4,5,6).

On the Navajo reservation a unique set of environmental conditions exist as well as an economy which differs greatly from the general United States. Treaties have supplied the Navajos with educational programs and medical care and their economic condition has qualified them for federal food programs and community development assistance. The Navajos utilize these services extensively. These same federal and tribal services also constitute the major source of employment on the

reservation (7). The traditional subsistence ways remain intact with water hauling and wood cutting being important life style activities. Sheep herding, weaving, and silversmithing continue as elements of this unique way of life. Navajo is the primary language of the reservation. There is a fine blending of modern medical services and the traditional Navajo ways of healing. Two percent of the population use no modern medical services and more than 50% combine traditional methods with modern medicine (8). Epidemiological trends illustrate the reservation is in a transitional stage as the number of deaths related to degenerative and societal causes increase (9).

Problem Statement

Neither intensive health care follow-up for healthy at birth infants, improved sanitary conditions or supplemental food programs have changed the unhealthy factors of high infectious disease morbidity and mortality, growth stunting, and overweight among Navajo children (10,11). The high percentage of morbidity found in the infants from birth to nine years of age could be evidence of the interaction between infection and nutrition which is illustrated by: (1) continuous infections due to a reduced response of the immune system resulting from a lack of protein and certain essential vitamins and minerals (12), and (2) chronic infections which cause growth stunting in children receiving dietary protein at a marginal level (13,14).

Another indicator of nutritional need is shown by the Navajo childrens' growth-for-age as reported by WIC program data which support the low growth rate for age (15). Researchers have reported finding

children with only marginal food supplies who are below average in stature but overweight (16,17). It is possible that this condition of marginal food supply could exist among the Navajo children, since the Navajo Reservation is reported to be an area of subsistence living. This overweight condition is possibly the result of the current transitional life style of the reservation (7,5).

There are three factors present which indicate the liklihood of nutritional inadequacies: (1) a low growth rate for age, (2) a high percentage of infectious disease, and (3) an overweight for height condition. In this study, the food intake and growth rate of healthy children will be investigated in an effort to isolate eating patterns and dietary intakes which could contribute to nutritional inadequacies.

Purpose and Objectives

The purpose of this study is to investigate selected indicators of nutritional status among first grade Navajo children who live in the Window Rock Public School District of Arizona. The children studied will be those attending the Fort Defiance Elementary school in Fort Defiance, Arizona. Since the school is both on the Navajo Indian Reservation and a part of the Arizona Public Schools, 95% of the student body is Indian. The school receives both Federal and State monies for support (18).

The specific objectives are as follows:

1. To assess nutritional intake as compared to the National Research Council's Recommended Dietary Allowances for children of this age.

2. To assess heights and weights of boys and girls of this age as compared to the reference standards of the National Center for Health Statistics and the Boston Growth Charts to determine if a relationship exists between nutritional intakes and clinical measures.

3. To estimate the proportion of daily food intake that is supplied by the school lunch program.

4. To make recommendations regarding nutritional status and nutrition education based on the findings.

Hypotheses

The hypotheses to be tested are:

1. There will be no differences between Navajo children and and the National Council's Recommeneded Dietary Allowances for children of this age. The nutrients to be considered are calories, protein, calcium, phosphorus, iron, vitamin C, vitamin A, thiamin, riboflavin and niacin.

2. There will be no differene between the NCHS national dietary intake data and the Navajo children's dietary intake for the following nutrients: calories, protein, fat, carbohydrate, calcium, phosphorus, iron, potassium, vitamin C, vitamin A, thiamin, riboflavin and niacin.

3. There will be no difference regarding stature or weight among Navajo children compared to other children of the same age.

4. There will be no relationship between nutritional intakes and clinical measures for either boys or girls. The nutrients considered are calories, protein, calcium, phosphorus,iron, vitamin A,

vitamin C, thiamin, riboflavin, thiamin and niacin. The clinical measures considered are wrist circumference, skinfold thickness, skinfold thickness percent, arm circumference, arm circumference percent, muscle and percent of muscle, muscle area and percent of muscle area, fat area and percent of fat area.

Assumptions and Limitations

The assumption has been made that the methodology available for various parts of the study would be applicable to the location and the subjects studied.

The nutritional assessment possible in the school situation has some limitations that need to be recognized:

1. Biochemical evaluations are not possible since this type of data gathering is not permitted in the school.

2. Medical records or a history of infectious disease were not available. These are Public Health Service records and were investigated but were not accessible to the researcher.

3. Not all of the first graders questioned have the cognitive development to recall what they have eaten during the past 24-hours.

The findings of this study cannot be generalized to include the entire first grade population of the Navajo Reservation due to the diversity of the reservation's economic base and living conditions. It is possible to say that the nutritional condition found among the children is likely to be the same as the adult group of which they are a part.

Definitions

The following definitions of terms are used throughout this study.

Anthropometry: "the science dealing with measurement of the size, weight and proportions of the human body" (19, p 45).

Infectious disease: the International Classification of Diseases, Amended (ICDA) establishes the disease categories used by the U.S. Public Health Service. Infectious diseases contain gastroenteritis, diarrhea, bacillary dsysentary, influenza, pneumonia, upper respiratory infections, streptococcus, impetigo, conjunctivitis, otitis media, trachoma, septicemia, hepatitis, salmonellosis and plague (4).

Morbidity: defined as visits to obtain medical care. In-patient morbidity is hospitalized time. Out-patient/ambulatory morbidity means seen by health care staff (4).

Nutritional deficiencies: are the clinical conditions resulting from inadequate amounts of essential nutrients being provided to body tissues (20,21).

Reservation: to mean the Navajo Reservation as established by the treaty of 1886 and the amendments (2).

Subsistence living: In the Navajo economic structure refers to livestock, farming, weaving and silverwork (5,7).

Under-nutrition or over-nutrition: "are part of malnutrition as both affect health". This study will be concerned with "primary

malnutrition" which is the lack of food or over abundance of food. There will be no data gathered to identify "secondary malnutrition that is due to faulty utilization of food" (21, p 3).

CHAPTER II

LITERATURE REVIEW

The current public health data indicate nutrition as a significant health factor among Navajo children (22). In order to make an assessment of health related parameters of this particular population group's children, previous studies relating to present knowledge of the nutritional status of children, and to Native American children and particularly Navajo children were investigated.

Nutritional Status Determinations

Nutritional status is described as the state of nutritional achievement of individuals or groups of individuals. Among individuals or groups a minimal screening program requires knowledge of the community as well as food intakes and physical findings of the children for comparison against a standard (20,23).

Information about food intake is mandatory in screening for nutritional status. The validity of food intake methods has caused concern among researchers for some 30 years. Recent work by Gladys Block(24) has led to some clarification of the reliability and validity of the methods used. Consideration needs to be given first, to group vs. individual methods and secondly, to quantitative precision vs classification or ranking of individuals. A single 24-hour recall of intake has been found to be valid for establishing the average intake

levels of groups (25,26). Food frequency lists or questionnaires have been found reliable as qualitative indicators of intake.

The 24-hour recall has the great advantage of simplicity. It can be completed in 20-25 minutes by personnel with relatively little technical nutritional training (27). Less than 20 minutes with a child tends to diminish the relative reliability of information gathered (20). The 24-hour recall is the dietary method used for nutritional assessment by Public Health and the National Center for Health Statistics (28,23).

Food intake variations occur in a community due to cyclical income, seasonal food variations, daily food in-take variations and cultural differences. Food frequency lists are another means of collecting information concerning food patterns. Variables affecting the availability of food represent only part of the effect of environment in most settings. Food ideology or belief about food affect the desire of families to use particular foods. In a community undergoing change, there are many sources of variation in food ideology (29). Education, work habits and newly acquired life styles are contributing sources of new ideology. By distinguishing between the environmental factors which affect food availability and those which affect food ideology, it is possible to set up analytic models that are capable of showing the relative importance of these factors. Identifying the effects of diet variation due to food availability and food ideology determines to a significant degree the nutritional strategy to be followed by health care programs (30).

Nutritional Standards for Children

The Food and Nutrition Board of the National Research Council defined the Recommended Dietary Allowances (RDA) as "intake levels of the essential nutrients judged by the Committee on Dietary Allowances of the Food and Nutrition Board, using scientific knowledge, to be adequate to meet the known nutritional needs of nearly all healthy Americans" (31). The RDA were not designed to estimate an individual's requirements but were to be used as allowances for average needs of population groups. These needs should be met by a varied diet and not through supplementation. The "Minimum Daily Requirement" as distinct from the RDA, is the minimum amount of a nutrient that maintains health. In children, the minimum requirement is the amount which promotes growth. The RDA was designed to include this minimum amount, plus an added "margin of safety" to cover variability, and absorption and utilization for practically all members of the population group. However, energy recommendations were based on the average need with no margin of safety. For children, these allowances of average intakes were developed from longitudinal studies of children in Boston, Denver and Iowa City (31,p.8). Energy allowances for children are based on the same longitudinal studies which are consistent with the later National Health and Nutritional Examination Survey data.

Few studies have been done to specifically identify nutrient requirements for children. Some nutrient requirements have been interpolated from identified needs of adolescents, adults and among infants from known nutrient levels in human milk. Estimates for children's requirements were based on the identified nutrient function

plus a "margin of safety" to meet the estimated needs for most individuals in the population group. Those nutrients whose estimated needs were based on growth rates include protein, Vitamin C, Vitamin D, Vitamin E, calcium, and magnesium. Those interpolated from levels in breast milk include vitamin B12 and niacin. Vitamin A and riboflavin recommendations were based on adult studies. The thiamin, iron and zinc allowance were based on research with children while folacin was interpolated from infant and adolescent data. The B6 recommendation was based on food consumption data (31).

Growth Standards for Children

The National Center for Health Statistics' growth charts are used to clinically detect nutritional and growth deviations among infants and children and to assess the comparative growth status of defined populations of children with the rest of the U.S. child population of like age and sex (32). Abnormal size and growth are commonly associated with malnutrition and disease.

In 1975, the National Center for Health Statistics combined data from the Fels Research Institute, Yellow Springs, Ohio and from the NHCS Health Examination Surveys to construct new growth charts for infants and children in the United States. The results are 14 smoothed growth charts with seven percentile curves in each chart. The eight charts for children ages 2 to 18 years include body weight by age and stature by age, and weight by stature for prepubescent children. Charts for 2-18 year olds were based on data collected from 1962 to 1974 from three separate surveys: (1) HANES data for 2-5 years of age,(2) the pooled HANES and HES Cycles II, and (3) III data for ages 6-17 years. The basic

scaling of the charts are metric, but for additional convenience, designations in pounds and inches are also provided (32,33).

Earlier growth assessments were determined using the Stuart-Meredith Charts from the 1940s. These charts were based on the combined data collected from 100 girls and 100 boys of Northern European ancestry living under normal conditions of health and home life in Boston, Massachusetts and Iowa. Repeated measures at selected ages were taken to determine weight and standing height for children 6-13 years of age. The charts for both boys and girls were developed by the Department of Maternal and Child Health, Harvard School of Public Health, for use at the Children's Hospital Medical Center, Boston (34). These charts were considered to represent optimal growth standards and were used almost exclusively prior to 1976 at which time the National Health Statistics Center published new smoothed growth curves based on the Health and Nutrition Examination Survey data (32).

Skinfold Thickness and Arm Circumference as Growth Indices

Skinfold thickness appears to be well correlated with the fat content of the body. The relation of weight to height does not detect the child who is heavy due to large muscle mass and one who is heavy due to obesity. The amounts of subcutaneous and intra-abdominal fat are more closely related in children than in adults (20).

In 1980, skinfold thickness percentiles were developed for children 2 to 18 years old on data collected between 1963 and 1974. The same three NHCS surveys used to determine the growth curves were merged to

determine skinfold thickness percentiles using the same statistic approach to smooth the data.

Studies show that between 27 and 42 percent of the body fat is located in subcutaneous tissue. It can be assumed that thickness of subcutaneous fat reflects long term net energy balance. Differences of fatness reflecting socioeconomic, and racial differences are obscured within the NCHS percentiles. Some of these differences in relative fatness reflect differences in maturation. Various racial or ethnic groups are included in the NCHS skinfold percentiles in keeping with national probability samples used. White children tend to be fatter than black children between ages 3 through 17 years. For all children within any racial or ethnic group, those of higher socioeconomic status are fatter with the exception of black girls and girls of lower socioeconomic status who also tend to be fatter. NCHS skinfold percentiles provide a distribution of these measures among the American childhood population. Owens recommended that these percentiles may be used as reference data but should not be considered as "standards or norms or ideals"(35,p 634).

Frisancho (36) recommended that assessment of nutritional status be made on the basis of areas of fat and areas of muscle rather than direct skinfold thickness and arm circumference. The triceps skinfold thickness and muscle circumference underestimate the actual tissue changes in the upper arm. In other words it takes more fat to cover a larger limb with a given thickness of subcutaneous fat than it does a smaller arm with a comparable fat thickness. Studies in children and adults indicate that fat areas are better estimators of weight of fat than skinfold thickness.

Friscancho presents tables for percentiles of triceps skinfold thickness, percentiles for arm circumference and estimated arm muscle circumference, and estimated arm fat and muscle area. These percentiles are based on the HANES I study of 1971-1974, and should be used with the weight and height percentiles for children and adults published by the National Center for Health statistics (33). Both of these percentiles are based on the same samples and use the same age and percentile groups to provide a uniform reference.

Increasing attention is being given to the analysis of growth and development within an ecological perspective. The growth patterns of children provide a record of their nutritional history. Growth reflects the outcome of a set of interactions among biological, demographic, cultural and natural components of the ecosystems. Viewed in this manner, the growth of children of a population becomes a measure of the success of the population in coping with the stresses of the environment (37,38).

Du Rant,et al (39) tried to identify the prevalence of obesity and thinness in children from lower socioeconomic populations who received comprehensive health care. He also analyzed were the effects of age, sex and race. It was suggested that important social and/or environmental factors within this socioeconomic group were interacting with biological processes to influence the prevalence of obesity and thinness within each group.

Native American Nutritional Status

Native Americans have been targeted as a special population group at risk with respect to nutritional status and need. In 1979, Arnold

Schaefer wrote:

> The population groups most vulnerable to problems of malnutrition are the hard-core poor, migrant workers, and Native Americans. Within these groups priority for prevention of malnutrition (over and under nutrition) must be given...The findings of the 10-State Nutritional Survey of 1968-70 clearly reveal consistent socio-economic effects on size, growth, and development (40,p. 419).

The Pediatric Nutrition Surveillance System for the Center for Health Promotion and Education, Center for Disease Control, Atlanta tabulated the data supplied by 32 states participating in the publicly supported health and nutrition programs (15). The data on height and weight show stunted growth and obesity to be highest among Hispanic and Native Americans when compared to the NCHS reference population. Prevalence of both stunting and obesity exceeds the five percent which would be expected below the 5th percentile or above the 95th percentile.

The National Center for Health Statistics growth curves show these average figures for the Native American groups served by the WIC programs for the period of 1976-1980. Indian children served through 9 years of age were found as a group 8.7% shorter in stature for age, 12.0% were overweight and 3.8% were underweight for height and age when compared with the NCHS reference population (15).

Trowbridge (41) summarizes the results of the Pediatric Surveillance data for 1982 by stating that the Native American and Hispanic children most probably received adequate quantities of food but that the nutrient quality of the food eaten was inadequate. His interpretation of the

data is supported by the fact these ethnic groups have the highest prevalence of growth stunting which tends to increase with age as well as a high proportion of obese children.

Nutritional status and growth studies conducted in third world areas indicate an increased weight-for-height among those children. Anderson (16) in comparing five developing countries, found malnourished children with normal weight-for-height and thus concluded that...where stunting is common in a population, weight-for-age may lead to inaccurate diagnosis of current malnutrition.

Adrianzen T.,et al (17) working with poor Peruvian families in Lima, observed that at nearly all times boys and girls could be classified as over- weight for height, leading the casual observer to believe them healthy. Researcher's observations indicated underdevelopment in height started in infancy, but that the opposite was true for weight. This study was done to characterize the growth pattern of children from extremely poor families.

Navajo Nutritional Status

The Ten-State Nutritional Survey and the Pediatric Surveillance System draw together data on the Native American ethnic groups. The population of particular interest in this study are the Navajo people living on the reservation. The Navajo Health Systems Agency, which helps monitor the entire reservation's health care programs, likens the area's problems to the "third world syndrome" with unsanitary living conditions, poor economic base, and limited food supplies.

Environmental Factors

Environmental factors or conditions of living for the reservation Navajo have been documented. Geographically the reservation is situated on the semi-arid Colorado Plateau at an average elevation of 6000 feet above sea level. The reservation is approximately 16 million acres (24,700 square miles) in the Four Corners Region of northeast Arizona, northwest New Mexico, and southeast Utah (2). This area is comparable to the size of West Virginia. It is the largest federal Indian Reservation in the contiguous United States and equals one-fifth of all Indian lands. More than half of the land is classidfied as desert, and two-fiths (37%) is semi-arid land used only for grazing. The remaining land (8%) is forest and mountain country, primarily used for wood products and recreation. Large coal deposits, along with gas and oil resources are within the reservation (42).

Water resources are scarce, the growing season short, and the annual rainfall varies from five to twenty-four inches per year. Agriculture and livestock production is dependent for the most part on the average rainfall per year. The soil is often alkaline and heavily eroded (43). Much of the land is inaccessible, except by foot, horseback and some fourwheel drive vehicles. The area has an estimated 5000 miles of road of which some 1500 miles are paved. There are about 40,000 telephones or one phone for every four homes. The majority of these phones, however, are business telephones (44).

Many of the individual homes and camp sites of family groups lack the utilities necessary for heat, lights and sanitation. The U.S. Public Health Service reports 32% of the homes do not have water, while

the Navajo Health Systems Agency says 55% of the homes are without water (45,04). The difference in percentages reported by these agencies may be due to different assessment criteria and to the fact that the people are very mobile, making surveys difficult. Many families are known to haul water from community well sites which provide domestic water as well as stock water for the livestock of family groups in an area. It is not unusual for a family to haul water eight to ten miles. Other families have water piped to their home but do not have sanitary facilities.

The same situation exists for electrical power. A home or camp site may have a yard light for security but will not have electricity wired inside the dwelling. Records are inaccurate because they show yard light customers as having electricity even though many of these customers are not using the energy for light, heat or refrigeration (46).

Most families cut and haul wood for heating and cooking. The road system over which wood is hauled is made up of long rutted trails which make transportation of wood and other supplies very difficult. These same unimproved trails lead to the few major paved roads of the reservation.

Economic Changes

There has been a rapid change from a subsistence economy to an increased dependence on wage labor. Federal monies and corporate funds have come in great quantities effecting rapid changes in the entire Navajo economical system. The 1970 census reported the per capita income of Navajos at $800. In 1980, the Navajo tribe reported the

amount had risen to $2,300. This change is variable and only affects certain aspects of the Navajo society. Wool production, rug weaving, and silversmithing still figure in the local economy, although these activities are not thought of as wage earning by the Navajos (47).

Subsistence living takes on a new perspective when considered in terms of the Navajo reservation. Sheepherding for wool production and rug weaving along with silversmithing are intregal parts of the life style, as are cutting wood and hauling water. However, these traditional subsistence living activities are aided by "checks" from various sources in every camp (7). Wage earning, social security, subsistence checks, WIC vouchers, food stamps, insurance payments from unemployment or social security and death benefits add greatly to the subsistence living. A job or work is associated with a regular pay check which is usually earned off the reservation.

As part of the economic change occurring on the reservation, large shopping centers are replacing the time honored trading posts. This change brings about the cash and carry type of buying. The credit and trade offered by traders made the unique subsistence life style possible on this high, harsh arid land mass. This is not true with the new shopping centers.

A large proportion of the reservation economy is based on services. Services are provided by federal treaty and legal mandates. Educational institutions are state and federally funded. Day schools and boarding schools are funded by the Bureau of Indian Affairs (BIA). Health services are provided by Indian Health Service of the Public Health Service. (IHS) All of these federal and state service institutions hire employees under Indian preference specifications. It has been from this

provision of services that most of the employment on the reservation results. Natural resources provide a limited number of jobs in mining and timber production (48,08).

Population and Demographics

Several federal agencies serve Indian people and are responsible for collecting demographic,social and economic information. The Bureau of Indian Affairs (BIA), Indian Health Service (IHS), Department of Housing and Urban Development (HUD), and the Bureau of the Census all collect data on Indian people. BIA maintains an official census list for each tribe to determine eligibility for Indian Services. The population data used by these agencies comes from the 1980 census. Age and sex distribution data is based on tribal enrollment statistics compiled by the Navajo tribe (49)

Mortality and natality data for Navajos are compiled by Indian Health Service (IHS) from death and birth certificates. Vital statistics are tabulated for the United States by National Center for Health Statistics. IHS obtains data for communities within its jurisdiction. Navajo Health Systems Agency compiles the Navajo data from all these sources, including tribal sources, IHS sources and census data.

The NHSA (04) sources show a reservation population in 1980 of 146,366 people and an off reservation population of ten percent of that figure for a total Navajo Tribal enrollment of 162,303. Of this number, 48% are male with a life expectancy of 58.8 years. The female Navajo population accounts for 52% of the population and has an average life span of 71.8 years. The average U.S. male lives to an age of 70.0,

11.2 years longer than the Navajo male. The U.S. female life expectancy is 77.5 years or 5.7 years greater than the Navajo female. The Navajo population has an average life expectancy of 64.9 years as compared to the general U.S. life expectancy of 73.7 years.

The birth rate for the Navajo people is high. Women 15-44 years of age have 142.4 live births per 1,000 as compared to the entire U.S. female population who have 68.4 births per 1,000. On the average, a Navajo woman will give birth to 3.7 children as compared to 1.8 children per woman for the general U.S. Teenage Navajo mothers (under 19) contribute 20.6% of the births as compared to 15.6% in the U.S. generally (8,4).

Infant mortality for the Navajo reservation in 1980 was 13.3 per 1,000 births or just a little above the 12.6 deaths per 1,000 in the U.S. population. When broken down into neonatal and post-neonatal, 60% of all Navajo infant deaths occur in the post-neonatal period (28 days to 1 year). The Navajo post-neonatal death rate is 8.1 as compared to the U.S. rate of 4.1 per thousand. The leading cause of post-neonatal death among Navajos is listed as "all other causes" followed by congenital anomalies, gastrointestinal disease, influenza and pneumonia respectively (4).

Navajo mothers produce healthy babies when weight is used as an indicator. The percentage of total Navajo births less than 2,500 grams was 5.9% as compared to 6.8% of U.S. births. The greatest number of low birth weight infants occur in mothers less than 19 or more than 35 years of age. Birth rates among Navajo females under age 19 were 20.6% and 7.9% of the mothers were more than 35 years old (50).

About 85% of Navajo women give birth in the hospital, subsequently being exposed to active maternal and infant care programs. Despite this, maternal mortality was the fourth most common cause of death for Navajo women (7.2% reported deaths) in 1974. Stillbirths, miscarriages or any condition other than normal full-term live births are considered sensitive and reflect substantial under-reporting (51).

Brenner, et al (11) found the primary cause of infant mortality to be infectious diseases which accounted for two-thirds of the postneonatal deaths. Aggressive medical attention to the infants did not change the mortality rate caused by the high rate of infection which supported the fact that medical care was only part of the determinant of poor infant health. The researchers concluded that better nutrition, improved sanitation and sanitation education were also needed. Stewart (51) found evidence to support the need cited by Brenner in his study concerning the use of health care facilities. The data obtained from the Stewart health care survey reinforced the fact that many home sites are without water, toilet facilities or electricity. It was also apparent that health education efforts in regard to basic health principles of disease prevention, such as safe water storage and use of out houses or privies, have not been particularly effective (51).

Kuntiz in 1983 reported that Navajo mortality differed from the U.S. population in these ways: (1) accidents of all types, particularly those involving motor vehicles , are greater with 31.4%/100,000 of all Navajos being involved in accidents vs 6.9% nationally,and (2) deaths resulting from influenza, pneumonia, and gastroenteritis are greater (05). Infections of otitis media, streptococcal infections and gastroenteritis/diarrhea are limited almost entirely to the pediatric

population. Seventy-nine percent of the out-patient visits in the 0-9 year age group are for treatment of these infections (04).

In a 1983 tabulation of leading causes of Navajo outpatient morbidity among IHS clinics, the causes were ranked by frequency, percent distribution of the population and age. This tabulation ranked the 5-9 year olds thus (4, Fig. 4.5):

Outpatient Morbidity Among 5-9 Year Olds

Skin and subcutaneous tissue.....13.8%

Infective, parasitic disease.....13.4%

Respiratory system.....11.5%

Eye diseases.....10.9%

Accidents, poisonings,violence.....10.4%

Ear diseases.....9.5%

Symptons ill defined.....7.9%

Further ranking from selected diagnoses of outpatient visits showed that 25.9% of the impetigo infections were among 5 to 9 year olds, moreover this age group had the highest incidence of infectious hepatitis cases at 27.4% and have 18.6% of the streptococcal throat infections. These communicable infections were determined as multicausal with both a behavioral and nutritional etiological component. Upper respiratory infections are often due to a poor nutritional host state and susceptibility to the virus, and are exacerbated by crowded living conditions and poor personal hygiene. The streptococcal throat infections, gastroenteritis, impetigo, trachoma and conjunctivitis are all related to poor sanitary conditions (4).

The Navajo death rate in 1980 was 5.7 per thousand population as compared to 8.7 per thousand for the U.S. The median age of the Navajo population was between 18.8 and 19.9 years as compared to the older U.S. population with a median age of 30.0 years (52). This young Navajo population is depleted by accidents rather than health related deaths (8,53).

Cultural Transition

Navajo society is in the midst of changes occurring both socially and economically. These changes affect demographic and epidemiologic data illustrating a transition (9). The Navajo population is growing rapidly, four times as rapidly as the general U.S. population. The younger Navajo women are not producing as many children which means fertility rates have declined but still remain twice as high as U.S. rates. Regular utilization of Western medicine has become increasingly insitutionalized; and many Navajos residing on the reservation have advanced educational degrees. It is also true that most Navajos still speak Navajo as their primary language and that their traditional medicine and beliefs thrive. The contrasts between traditional values and modernization are seen throughout the reservation (51).

Broudy (8) found while studying the epidemiological transition of the Navajo that death rates from degenerative diseases have not yet become a great problem. In both rankings and rates, the Navajo were much less afflicted by degenerative diseases than the U.S. population. Infectious diseases are not less important as a factor in mortality, but remain higher than the general U.S. population. Mortality from social pathology (accident, alcoholism, suicide, homicide and cirrhosis of the

liver) remains considerably higher than that in the U.S. Many disease patterns exist which are influenced by older traditional patterns and conditions of social life and values. The new patterns of death emerging are man-made and a result of modernization and the existing mix of socio-cultural elements and values in contemporary Navajo life. The fact that accidents lead all causes of death suggests that the Navajo people are beginning the last stage of transition in which man-made and degenerative diseases will predominate.

Navajo Nutritional Studies

One of the earliest nutritional studies among the Navajo was conducted in 1955 by Darby (54). The low incidence of cancer among the Navajo people at that time prompted the researcher to study approximately 1200 Navajos from two diverse areas of the reservation in Arizona: Ganado (acculturated) and Pinon (traditional). The study showed no overt nutritional disease deficiencies evident in either area. Darby stated that the Navajos seldom show clinical evidence of gross nutritional deficiency. The calorie intake in general appeared to be acceptable. He found the elderly to be lean and the females of childbearing age to be obese. Anemia and protein malnutrition were not found to be health problems. The vitamin A intake was directly related to the visceral meats eaten due to the minimal amount of the vitamin found in the plants being eaten. The vitamin C nutriture was found to be low producing physical findings to support this fact.

In 1961, at the Public Health Indian Hospital in Tuba City, Arizona, Wolf (55) found three cases of kwashiorkor in which the child was underweight in the presence of the edema. The cases were diagnosed

as "typical" kwashiorkor similar to cases seen in other areas of the world. In 1969, Van Duzen (56), found a high incidence of low protein and caloric intakes among children under the age of five in the Tuba City, Arizona area. For a five year period from 1963 to 1967 the hospital records in the Tuba City Public Health Hospital were surveyed to supply Van Duzen with the information. The records of 4,355 children admitted for pediatric service were examined and it was found:(1) 616 of the children had been diagnosed as having malnutrition; (2) 15 had kwashiorkor;(3) and 29 had marasmus. The remainder of the malnourished group were below weight norms for their chronological ages. Nearly 15% of all pediatric admissions had some form of associated malnutrition.

Van Duzen (56) also obtained the heights and weights of 944 Navajo Head Start children between the ages of four and seven years attending school the fall of 1967 and winter of 1968. The purpose of this data was to determine the prevalence of protein and caloric malnutrition in the overall population of Navajo preschoolers. Compared with the Boston growth curves, nearly one-third of the children fell below the third percentile with regard to height, and one-tenth were below the third percentile with regard to weight. Van Duzen concluded this was probably the end result of chronic caloric and protein malnutrition acting in synergism with repeated bacterical and viral infections, causing many episodes of gastroenteritis and respiratory infections.

Van Duzen (57) did a follow-up study from 1969-1973 after the advent of various feeding programs by the Indian Health Service and United States Department of Agriculture. It was concluded that infant and child feeding programs had contributed to improved growth among Navajo Preschool children. The results supported the conclusion showing

an 18% reduction in the total number of patients under five years of age admitted to the hospital and a 39% reduction in the number of patients admitted with deficits in weight for their chronological ages. In 1973, 1462 Navajo Head Start children from 84 reservation locations showed a definite improvement in their health, which was especially noticeable with respect to increased height. In 1969, 30% of the children were below the 3rd percentile for height on the Boston growth curve. In 1973, however, only 11% of the girls and 16% of the boys fell below the 3rd percentile.

In 1968, Reisinger,et al (58) did a nutritional survey of families in the Greasewood Chapter of the Navajo reservation. This isolated area was considered to have a population at risk for nutritional disease due to its isolation and poor land. The study indicated a need for higher dietary iron intake, more protein and ascorbic acid for adults, and an increase of total calories for children and elderly persons in this area of the reservation. A slower rate of growth and development was found among these Navajos as compared with middle class whites.

Navajo Food Consumption Patterns

In the 1955 study, Darby (54) collected dietary background information on two Navajo groups; the acculturated group of Ganado (645), and Pinon (595) the unacculturated area representing those who had less contact with the Anglo. This study showed that their diet had once conntained corn, wild game, mutton or goat meat, and a large variety of wild plants. This traditional diet had been replaced by trading-post foods of wheat flour instead of corn, and the herb beverages by coffee, tea and soft drinks. Mutton, either roasted, fried

or stewed, with potatoes and onions, bread and coffee or tea had become the basic menu items.

In 1972, a survey of Navajo households receiving USDA-donated foods showed that only 47% of those surveyed used one native food occasionally. Of the thirteen native dishes reported, only two-corn mush and blue corn bread- were used to any significant degree. According to the dietary recalls, fry bread and mutton stew were eaten although not specifically indicated as native foods. The basic meal pattern of these families receiving USDA-donated foods had not changed greatly from the earlier patterns reported by Darby (54,59). Menus listed in food recalls reflected similar composition. Breakfast generally was a heavy meal, especially if only one meal was eaten during the day. Foods included eggs and cooked cereals which were made of rolled oats, rice, or cornmeal. Tortillas and fry bread were the breads eaten most frequently. Pancakes, mutton stew, and fried potatoes were used frequently. Donated fruit juices were the type reported being used most often (59). The noon and evening meals were similar and usually included a meat item, a vegetable, a bread, and a beverage. The vegetable was most often potatoes but other vegetables were used occasionally. Coffee was the most popular beverage. The Navajo dietary pattern remains more traditional than that of other Indian groups (60).

In 1980, Wolfe (59) did a study to determine the nutritional value of traditional Navajo foods and to record knowledge of traditional food preparation and the frequency of their use today. In contemporary Navajo diets, traditional foods appear to be used infrequently although mutton is frequently consumed along with home cultivated foods. Of the home cultivated foods, blue corn foods were most frequently used. These had

a high mineral content, especially when culinary ash was added. The ash was derived from sifting the burned green Cedar or Juniper branches. The alkaline ash turns the blue corn anthrocyanin pigment a distint greenish-blue color. Corn mush was frequently utilized along with hominy corn and blue corn dumplings. The knowledge of wild plant foods and their preparation seems to be more difficult to pass down through the generations than that of some of the corn and sheep foods. Thus,the preparation of these foods is being lost quickly. A dryer climate than in the past and the over-grazing of vegetation by sheep have been detrimental to the growth and use of wild food plants on the reservation.

Women, Infant and Children Supplemental Food Program (WIC)

The Special Supplemental Food Program for Women, Infants and Children (WIC) administered by the U.S. Department of Agriculture's Food and Nutrition Service (FNS) authorized payment of cash grants to State agencies which in turn administer the program through local agencies. The local agencies delivering these services on the Navajo reservation has been the Indian Health Service Units.

The purpose of the WIC program was to furnish supplemental foods and nutrition education to pregnant, postpartum and breastfeeding women, infants and children under five from families with inadequate income and at nutritional risk as determined by a competent professional authority. "Nutritional risk means in part deterimental or abnormal nutritional conditions detectable by biochemical or anthropometric measurements" (61,p 202).

The Navajo WIC program, operating as an Indian State agency since 1980, has been in the Department of Food and Nutrition Services in the Health Improvement Division of the Navajo Tribe. The program receives funding from two sources:(1) the U.S. Department of Agriculture and (2) the Navajo Tribe's General Fund. In 1985, USDA provided administrative funding for the WIC program of approximately $1.8 million and food vouchers in the amount of $7.8 million accompanied by Tribal funds of approximately $9,8 million (04). These funds support the 18 major clinics and 68 satellite clinics throughout the reservation.

Goals of the Navajo WIC program in 1981 were to increase the growth rate of children in the birth to five year old group, reduce the overweight condition of the 0-23 month old age groups and improve the overweight condition for the total Navajo WIC population. Data gathered at screening visits of applicants for the Navajo WIC program in 1979-80 identified 21.8% as overweight and 13.8% as short in stature. These were the two major nutritional problems occurring among the Navajo population (22).

Utilization of Health Services on the Navajo Reservation

Three sources of health care are currently available to the Navajo people on their reservation:(1) their traditional system of healing,(2) the Indian Health Service as part of the U.S. Public Health Service and (3) privately operated health facilities. As an area seeking third world identity of poverty and poor living conditions, the Navajo system of health care and use of available services are not reflective of the typical third world situation.

Health care for the Navajo people living on the reservation was provided by the Bureau of Indian Affairs until 1955 when the Indian Health Service (IHS) of the U.S. Public Health Service assumed the health care responsibility. In 1976, Public Law 93-641 expanded services to the current level of health care when it recognized the reservation as a single health agency. The Navajo Indian Health Service maintains five hospitals, eight service units and extensive community health nursing programs (4).

Private non profit facilities such as the Presbyterian Medical Services (Ganado, Arizona), Monument Valley Adventist Hospital (Goulding, Arizona), Rehobeth Christian Hospital (Gallup, New Mexico), and the Navajo National Health Foundation (Farmington, New Mexico) have served the reservation since as early as the 1930's. These facilities provide health care free or at a minimum cost and are available to anyone on the reservation while being funded and staffed through religious groups.

Stewart (51) did a health consumer survey patterned after the Health Interview Series conducted by the Census Bureau. Three geographic areas of the reservation the eastern (Crownpoint, NM), central (Fort Defiance, AZ) and western (Kayenta, AZ) portions of the reservation were surveyed and the populations interviewed in 1976-1977. Consistent sampling techniques were used to make comparisons with selected national data and other family studies of specific subcultures. The extreme isolation of the Navajo population is no longer evident; the wage economy, resource exploitation, manpower development and other aspects of modernization have forced rapid change. Navajo utilization of private physicians off the reservation appears to be at a rate of about

five percent. Twenty-two percent of the surveyed population reported having third-party insurance coverage.

Stewart (51) shows consistent use of Indian Health Service providers by the Navajos. The clinic nurses are the health care providers most often seen in that they account for 81% of the contacts. The pharmacists made 76.8% of the contacts while physicians accounted for 53.2% of the contacts. Two percent of the Navajos reported never having contact with a physician. The Navajo people surveyed suggested that two of the problems in the IHS medical system were long waiting periods and the translation from English to Navajo. Of those surveyed, 94% said they always waited in excess of 30 minutes for health care. They also indicated that translation from English to Navajo is usually done by a nurse. A large percentage of the people felt that federal treatment was a treaty right, but that they received better care when they paid for it. Even when excellent services are offered, the consumer's attitude that free care is second-rate prevailed 40% of the time.

Traditional Navajo Medicine practitioners are used consistently. Approximately 52% of the survey population use traditional practitioners. The services of these traditional practitioners are expensive. Fees include such possessions as jewelry and rugs and require the patients and their families to provide food for the many people participating. The Navajos freely utilize both methods of health care.

National Health Survey comparisons show 75.5% of the American population visit a physician in any year as compared to the Navajo population among whom 53.2% visit a physician yearly. When compared to consumers and individuals in Nashville, Tennessee, in 1968; a smaller

number of Navajos reported never seeing a doctor (2%) than did blacks and whites in lower socioeconomic status areas of Nashville. In a comparison with West Virginia hollow residents, one-third of the Navajos reported contact with Public Health nurses where as the West Virginia residents reported only 2.3% contacted the nurses (51).

The data obtained from this survey reinforced the fact that many home sites are without water, toilet facilities or electricity. It was also apparent that health education efforts in regard to basic principles of prevention, such as safe water storage and use of out houses or privies, have not been particularly effective (51).

Nutrition and Infection

Nutrition and infectious disease have both been identified as health factors associated with the American Indian population and the Navajos specifically. The link between the physiology of the host and the resistance of the host to infection has been documented. Scrimshaw (6) discusses the interaction of the host and infection using the terms 'antagonism' for the situation occurring when a nutritional deficiency results in decreased frequency of an infection, and the term 'synergism' in reference to deficiency causing an increase in infectious activity. According to Scrimshaw,'synergism' results when the main impact of nutritional deficiency is on the host; 'antagonsim' results when the main impact is on the infectious agent. Nutritional deficiencies influence infection in at least four ways: (1) through action on the host to facilitate invasion, (2) through effect on the agent once established in the tissue, (3) though favoring secondary infection,(4) and by retarding convalescence after infection.

The body is protected against disease by the rapid acting immune response system. Immune responsiveness is shown to be a complex interactive function of the lymphoid organs and the secretory products of these cells and organs. Mucosal secretions protect the body from foreign invasions. Lysozyme, an enzyme in the mucosal secretions, has an early role in bacterial destruction. Lysozyme has been shown to be reduced in children suffering from protein energy malnutrition. The antibody, secretory immunoglobulin A (sIgA) is decreased in children with protein energy malnutrition thus contributing to increased frequency of mucosal infections in these children. Total energy restriction is not as destructive to the immune system of the child as the deficiency of protein (12).

Deficiency of iron, Vitamins A and E, essential fatty acids and pyridoxine impair antibody production by the splenocytes. The immune response is a rapidly acting system in which the cells and secretory products have short life spans, therefore nutrient functions have immediate effects on the responsiveness of the system (06,12).

Infection has an adverse affect on the nutritional status. Infections cause nitrogen loss. Increased urinary nitrogen excretion occurs with malaria, pneumonia and streptococcal infections along the with milder infections of chicken pox, measles, middle ear disease and tonsillitis. This urinary nitrogen loss is partially from greater energy requirements caused by increased body temperatures, and from the toxic destruction of protein (14,62).

Nitrogen loss in children with infections has greater significance because of the high requirement for protein per kilogram of body weight in growing children. Chronic infections keep a child in a negative

nitrogen balance which reduces the normal growth rate. Children on low protein diets have been shown to have reduced growth after periods of respiratory infections (06,62) In areas of unsanitary living conditions, children suffer even greater growth reduction due to a quick succession of infections along with the marginal dietary intake (13).

The most common infections found among poorly nourished children are upper respiratory disease, diarrhea, impetigo and chronic otitis. Cold months bring about the greater number of upper respiratory infections, while warmer weather increases the incidence of diarrhea. Often these infections cause a decrease in appetite or changes in the family feeding practices which further inhibit the nutritional status. Common feeding practices for the sick, are to "starve a fever" and reduce liquid intake for those with diarrhea, actions both detrimental to the healing of the ill child (63,14).

School Nutrition Programs

The School Lunch Program was initially authorized by public law in 1946. The School Lunch Program had two objectives: (1) to provide nutritious foods to the nation's children as a safeguard of their health and (2) to support farm prices by creating a market for domestic agricultural products. In further support of these two objectives the Child Nutrition Act of 1966 established the Special Milk Program and the School Breakfast Program. Through these programs, participating schools offer milk and serve meals designed to meet one-third of the Recommended Daily Requirements for children. Five percent of the public schools do not participate in the School Lunch program which results in three percen of the nation's school children not having the programs available (64).

Some changes in the progrm have occurred since 1946. The Omnibus Budget Reconciliation Act of 1981 limited the Special Milk Program to those schools which did not offer the National School Lunch or Breakfast Programs. The Special Milk Program provides milk to students who meet the national eligibility criteria. The Federal Government reimburses participating states, which in turn reimburse participating schools for each half pint of milk and each meal served.

The U. S. Department of Agriculture administers the School Lunch and Breakfast Programs distributing cash payments to states as reimbursements for meals served. In addition, federally donated school-bound agricultural commodities are distributed. The School Lunch Program served as the outlet for approximately 98% of the surplus commodities donated in 1981 (65).

The assessment of school children's dietary intake must include the contributions made by the Lunch and Breakfast Programs to the children's total food intake. In 1980, a National Evaluation of School Nutrition Programs was undertaken. Several findings from this study concerning nutrient intake, energy intake, and anthropometric measures of the children participating in these national feeding programs are as follows: (1) The effects on nutrient intake from the School Lunch and Breakfast Programs show increased energy intake and increases for all nutrients examined except iron and vitamin C. School Lunch participants received less vitamin C at lunch than those who do not participate. (2) Almost all schools in the United States offer the School Lunch, and 33% offer the School Breakfast Program. The presence of the Breakfast Program increases the number of students eating breakfast to about 85%.

However, the Breakfast Program, independently, has no direct effect on the nutrient intake of the student. Compared with students who eat the School Lunch and a non-USDA breakfast, and students who eat both a USDA breakfast and lunch, the latter have greater intakes of calcium and magnesium. Milk, as the major food contributing calcium and magnesium, is a significant factor in the intakes. Thirty-one percent of the school-aged population still received less than two-thirds of their RDA for calcium (66,67). (3) Family food purchasing was not shown to change when children participated in the school lunch and/or breakfast programs. These programs supplement the children's nutrition by increasing the quality of food intake. Long term participation in the School Lunch Program has no relationship to height, but it does have a relationship to weight, showing an increase in body fat stores according to Vermeersch (68). The school feeding programs are obviously an important factor in nutritional assessment but other variables, such as ethnic background, parents' height and weight, education and family income can have an even greater influence than the School Lunch Program.

CHAPTER III

RESEARCH PROCEDURES

This descriptive research study will be undertaken to assess the current nutritional status of the first graders at the Public Elementary School in Fort Defiance, Arizona and determine if a relationship exists between nutritional status and certain clinical measures. An effort wil be made to identify factors which might make this group more susceptible to disease and inhibit growth. Certain demographic data, dietary intake data and physical measures will be collected.

Population and Sample

The target population for this study was the Navajo first grade students enrolled in the Window Rock Public School District #8, Fort Defiance, Arizona for the 1985-1986 school year. The sample population was the entire group of Navajo first graders enrolled by October 1, 1985 in the Fort Defiance Elementary School. Ideally the target population would have been the first grade population of the Navajo Reservation; however, the accessible group was the one within the Window Rock School District at the Fort Defiance Elementary School as the researcher is a teacher in the district.

The first graders select their own food from school lunch and breakfast programs, they are old enough to express their needs and desires for food items, and they are beginning to prepare individual

food items for their own consumption. In addition, this is a particularly vulnerable age group from a nutritional standpoint due to childhood growth and development. The children's food choices are made within the confines of the foods available to them making their intake and choices very similar to those of the adult population.

The Fort Defiance Elementary school was chosen because the researche was readily available to answer questions for the interviewer and enlist the continued staff cooperation. The Fort Defiance campus is the location of the school district's health clinic where the necessary equipment to weigh and measure the children as part of the anthropometri data collection is located. The school also provides access to healthy children where parental bias concerning proper feeding is not a factor.

The enrollment list of the children came from the elementary school' principal and was based on pre-enrollment from the kindergarten. The list changed as children enrolled or withdrew. The actual count of 121 was based on the number enrolled as of October 15, 1985. The anticipate number of students was 126. The Window Rock Public School District enrollment figures for the Arizona Department of Education in 1984-1985 show 97% of the students are Indian and 3% are Asian, Black, Hispanic or White (69).

Procedures

After obtaining the cooperation of the school administration and the faculty, the School Board also gave permission to conduct the research. Schedules were to be developed to interview and take the anthropometric measurements of the children with as little inconvenience and disruption as possible.

Pilot Study

In March and April of 1985, a pilot study was conducted by the researcher using a first grade class at the Fort Defiance Elementary School. The intent of the pilot study was to evaluate the instruments an identify any confounding problems which might occur.

The 24-hour intake and the food frequency questionnaire were taken from Screening Children for Nutritional Status: Suggestions for child health programs (Fomon, 1976)(20). The original instruments were developed for use with the mothers of children; in this case the childre were interviewed directly. The date of birth, a sex indicator and student control numbers were items added to the 24-hour recall form. The 24-hour recall form was lengthened to allow sufficient coding space for computerized food codes. (See Appendix for instruments)

The food frequency lists were modified by removing items known not t be consumed in the area and adding certain ethnic items specific to the area such as fry bread, tortillas and stew. The number line was used to help the children determine how many times a week they had eaten specifi food items. The food frequency questionnaire was organized by beverages meats and a variety of other foods. The questions were read to the children and their responses recorded. Following the pilot study, changes were made in the questionnaire in an effort to assure an accurat record of intakes.

Determining actual birth dates required a combined effort of the teacher, the school secretary and the school nurse because past health and physical records were not available to the researcher.

Training the Interviewer

The selection and training of the interviewer was seen as critical to the success of the project. A college graduate was hired who knew th area, could communicate with the children and could be impersonal enough not to influence the results. She had no experience with collecting dietary data but understood scientific data management. She was taught how to question the children without leading or being suggestive, and to determine the kinds and amounts of food they were reporting. The trainin consisted of three steps:

(1) The first step was to fill out her own 24-hour recall, followed by a review with the researcher to assure accurate and complete information was obtained. The process was to make her aware of the kind of questions she would have to ask the children.

(2) The next step was to tailor the questioning technique to the first graders who are very perceptive and want to please. It was important to avoid suggesting the name of the food item, yet to elicit all the intake information possible including amounts eaten.

(3) The third training step was to code the food items from the interviewer's recall along with the amounts eaten and and any other pertinent intake information. To help determine the amounts eaten, different sized glasses, cups, bowls and plates were marked with serving sizes. Marks were put on the various pieces to indicate four ounces or one-half cup, one-third cup, and one-fourth cup. Coding the food items pointed out the many variations of a single food item that may be

available and alerted the interviewer to the need for specificity in varieties and forms of food.

Dietary Intake Records

After meeting with the elementary principal and getting a current list of the enrolled first graders, the five first grade teachers were contacted for their class schedules and a quiet area was found to be use during the interviews. The actual interviewing time was about 25-30 minutes per child. However,to establish trust and a good rapport timing was flexible. The selection of the children's interview time was coordinated with the individual teachers and their classroom activities. A child was not taken out of class when "on-task" educational activities were being presented.

The dietary interviewing took place from October,1985 through January, 1986. The interviews were conducted Monday through Friday for the previous 24-hour periods. Some of the students interviewed had been absent the previous day due to illness, or a family trip, or some other special activity and the foods for those special days and occasions were included.

Clinical Measures

The children were taken to the school health clinic to be individually weighed and measured. Mid-arm circumference and triceps skinfolds were also recorded at the same time. These measurements were taken the week before the intake interviews were started and were taken again in May, 1986, at the end of the school year.

Heights and weights were measured using the school health clinic's Toledo scale. All children were weighed and measured barefoot with light clothing. The Lange caliper was used to measure skinfold thickness. The procedures used were those given by Foman(1976) for skinfold thickness and height and weight. These measures were individually recorded on an anthropometric data sheet for each child.

School Lunch Intake

A plate waste study was done to determine the amount of food the school lunch contributed on a given day. Oklahoma State University faculty provided the technical assistance, personnel and scales needed to conduct the study which took place in March, 1986.

The food service personnel were not given prior notice about when the plate waste study would occur. The food service director supplied disposable trays which permitted the collection of data without interrupting the food service operation. Each first grade teacher was asked to respond as they normally would during the lunch period which is to encourage the children to eat or at least taste everything.

Each child's finished tray was weighed and an assessment made and recorded of the foods eaten. Plate waste data was identified by stickers showing the class and the individual student. Final tray weights did not include the napkin or flatware, but did include the milk carton. During the serving time for the first graders, six trays were randomly sampled to determine full tray weight and the weight of individual food items.

Analysis of Data

Dietary Analysis

The food items for each child's 24-hour recall were coded and sent to Dietary Analysis and Prescription Services, Incorporated in Las Cruces, New Mexico(70) for analysis. The USDA Nutrient Data Base #6 for standard reference is the primary source of this nutrient data analysis system. Fifteen nutrients were calculated as well as the total energy intake and expressed as percentages of the contributing nutrients. The Recommended Dietary Allowances (31) were calculated based on the age and sex of each child. The mean percentages of the individual RDA's were used to determine the frequency of distribution and correlations were calculated between the percents of RDA and the clinical measures. The statistical calculations were made using the SAS program at Oklahoma State University.

The food frequency questionnaire which was a part of the 24-hour recall interview was summarized as to foods eaten either one to three times per week or, four to seven times per week. These totals were then compared to the frequency of foods reported on the 24-hour recall.

Anthropometric Analysis

The two sets of measurements taken approximately six months apart were used to calculate rate of growth and weight gain for each subject. Frequency distributions by percentile ranking were plotted using the National Center for Health Statistic (NCHS) growth curve percentiles(33)

and then again with the Boston Growth Curve (34) for comparison with earlier studies. The deviation from the NCHS growth curves was determined using a t-test with the initial heights and weights by age and sex.

Percentile rankings of the skinfold thickness measurements were determined using NCHS skinfold thickness percentiles (32). Using Frisancho's (35) charts, the percentage of muscle and fat by arm circumference was determined. This comparison was used to determine the percentage of fat found among these children as compared to the NCHS population group. Regression analysis was used to determine any significant relationships between dietary intake and the clinical measurements were calculated.

Plate Waste Analysis

For each student's school lunch the amount of food eaten and its nutrient content was determined using the same dietary data base as was used for the 24-hour recall. An average nutrient intake figure for the school lunch was determined from this analysis as well as the percentage of RDA contributed by the average amount of school lunch eaten on this day. This analysis of the lunch was then compared to the National Evaluation of School Nutrition Programs (67).

CHAPTER IV

RESULTS AND DISCUSSION

Nutrition has been identified as a factor in the high incidence of disease and the short but heavy stature among the Navajo population. This study was undertaken to identify nutritional factors which might be correlated to these previously identified health conditions. The selected population was from a public elementary school located in the central area of the Navajo reservation. The majority of these students (95%) are bused to school. As an economic indicator, all of the children met the requirements to receive a free lunch and breakfast from the federally funded school feeding program. Commodity foods were reported to be used in 45% of the homes and 61% reported grocery shopping in Gallup, a border town.

The intent was to draw a cross section of the various economic and living conditions existing within this area of the reservation. None of the children were identified as having a chronic disease condition or metabolic disorder although three children were identified as having been diagnosed with fetal alcohol syndrome as infants. Some of the sample group had been participants in the WIC program either as infants fed by the program or as being parented by a mother participating in the program. Exact figures concerning participation were not available due to privacy guidelines by the administering agency. All of these children have had access to free health care provided by the Indian

Health Service and had received the childhood immunizations for communicable diseases.

The entire first grade at Fort Defiance participated which included five classrooms of children. Enrollment on October 15, 1985 was 124 students. Three of these students were identified as not being Navajo so the sample started with 121. This number had changed by the time the survey was complete in May, 1986. Absenteeism and the child's inability to remember the foods eaten were considered as non-responses. The children in special education programs as well as withdrawals and transfers were also considered as non-responses. The sample included an age range from 5.8 to 8.3 years old with a mean age for boys and girls of 6.7 years.

Four sets of data were gathered. Anthropometric measurements were first taken near the beginning of the school year. Dietary intake interviews were done over the following four months. A noon meal plate waste study was conducted in the spring. The second set of height and weight measurements were taken before the end of the school year in May. The school nurse provided the scales for weight and height and assisted by providing the health information about the children.

Anthropometric Measurements

Height and Weight Measurements

The first contact with the children was to take height, weight, arm circumference and skinfold thickness measurements. Small groups of five or six children were taken to the school clinic for measurement. The small groups allowed individual attention and close supervision.

Measurements were recorded on an individual chart prepared for each child. These data were gathered during the same time of day over a period of approximately two weeks during which 121 students were measured for height and weight and 116 measurements of clinical data were completed.

The initial heights of the sample group were not significantly different ($t=-0.92, df=120, p=0.36$) when compared by age and sex to the NCHS growth curves for height and age, nor were the initial weights ($t=1.15, df=120, p=0.25$) significantly different when compared to the weight for age curves using a t-test (71). Therefore, the Navajo children were no different in height or weight for their ages than the NCHS population.

The second set of measurements were taken near the end of the school year approximately six months later. The skinfold thickness measurements had to be eliminated due to time pressures from both the classroom activities and the health clinic's year end schedule. The second set of data resulted in 111 complete sets of data.

The boys grew on the average 1.96 inches during the six month period and increased in weight by 5.35 pounds. The girls grew 1.84 inches and gained 5.37 pounds in the same length of time. (Table 1) When compared to the NCHS Growth Curves (32) data on growth for boys and girls at 6.7 years old, the Navajo boys grew approximately twice (1.84) as fast and the Navajo girls one and a half times (1.57) as fast as the population represented by the growth curve. Weight gain for both the boys and girls was approximately one and a half times the NCHS average for the same age group.

The percentile changes of weight and height to age over the six month period are shown in Figures 1-3. For the total group, boys and girls, the first height for age percentile ranking showed 8% to be at or below the 5th percentile and 8% at or above the 95Th percentile. (Figure.1) By the second height measurement, 4% were below the 5th percentile and 11% were above the 95th percentile for height to age. Weight to age percentile changes are shown in Figure 2. The first weight at age 6.7 showed 4% at or below the 5th percentile and 12% at or above the 95th percentile. By the second weigh-in six months later 4% remained at or below the 5th percentile and 14% were now in the 95th percentile for weight to age. Figure 3 shows the frequency distribution for height and weight for the two measurements based on the NCHS growth percentiles.

Both boys and girls gained weight during the school year. (Table 1) The boys gained a greater percentage of weight, as 17% of them were in the 95th percentile or above at the end of school. (Figure 4) Both boys and girls tend to be heavier and taller than the NCHS growth curves for 7.2 year olds. The Navajo boys weigh 13% more per inch than the national group, they are also 1.2 of an inch taller and grew .9 of an inch more in the six month period. The Navajo girls are .77 inch taller than the national group and their average weight to height is 11% above the national average, making them at this age (7.2) heavier and taller than the NCHS population averages.

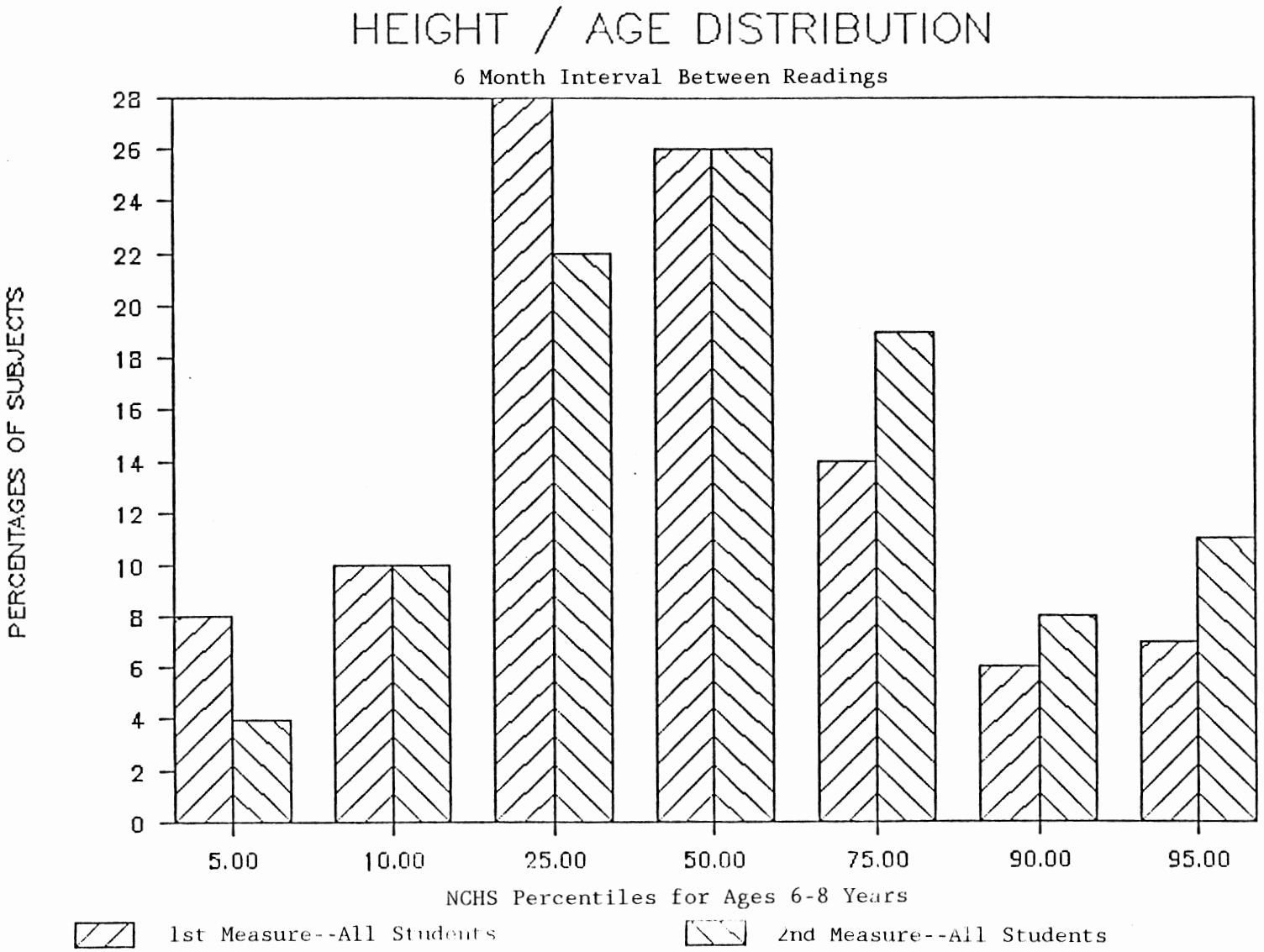

Figure 1. Distribution of Height to Age

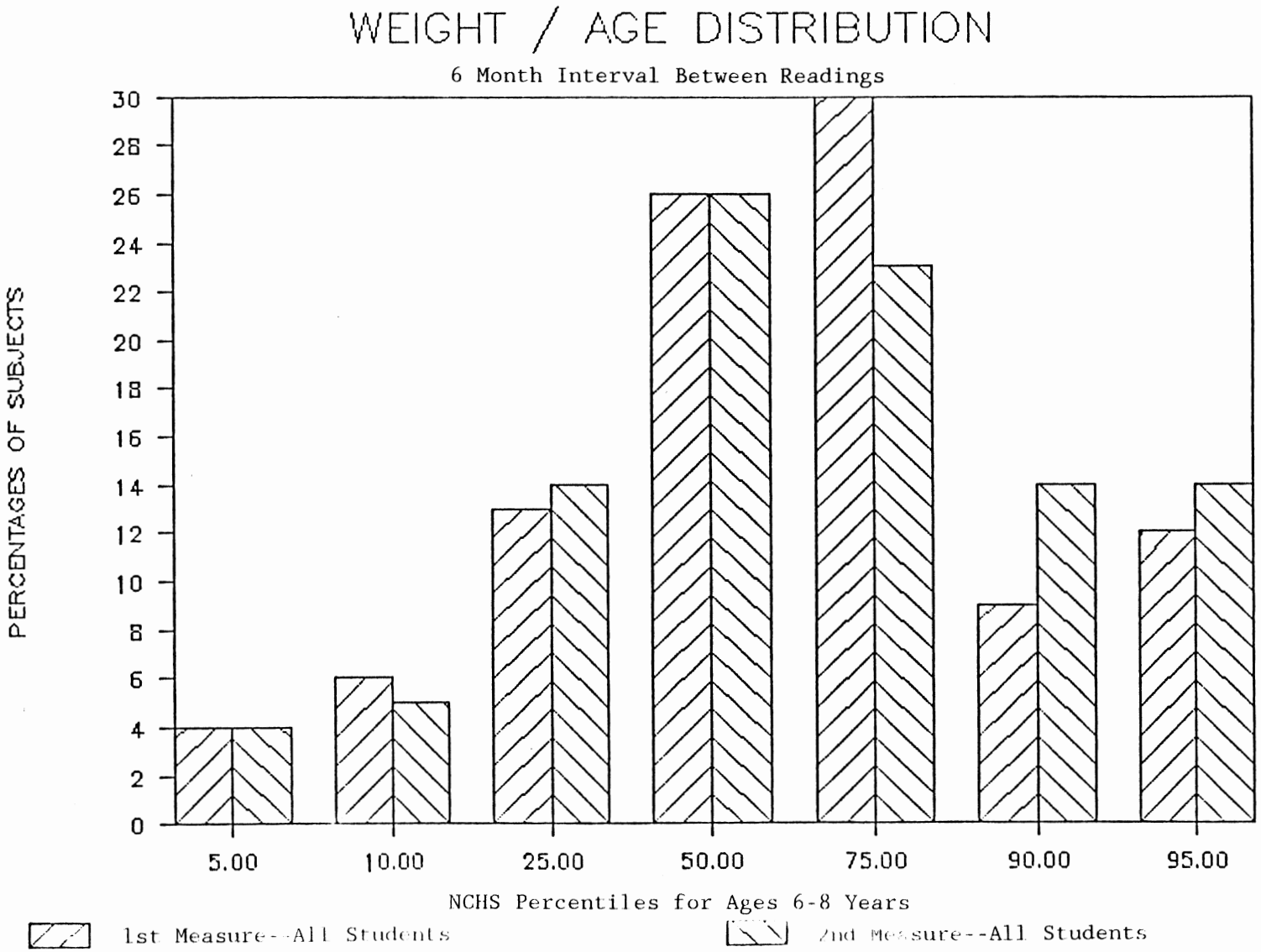

Figure 2. Distribution of Weight Change Between Measurements

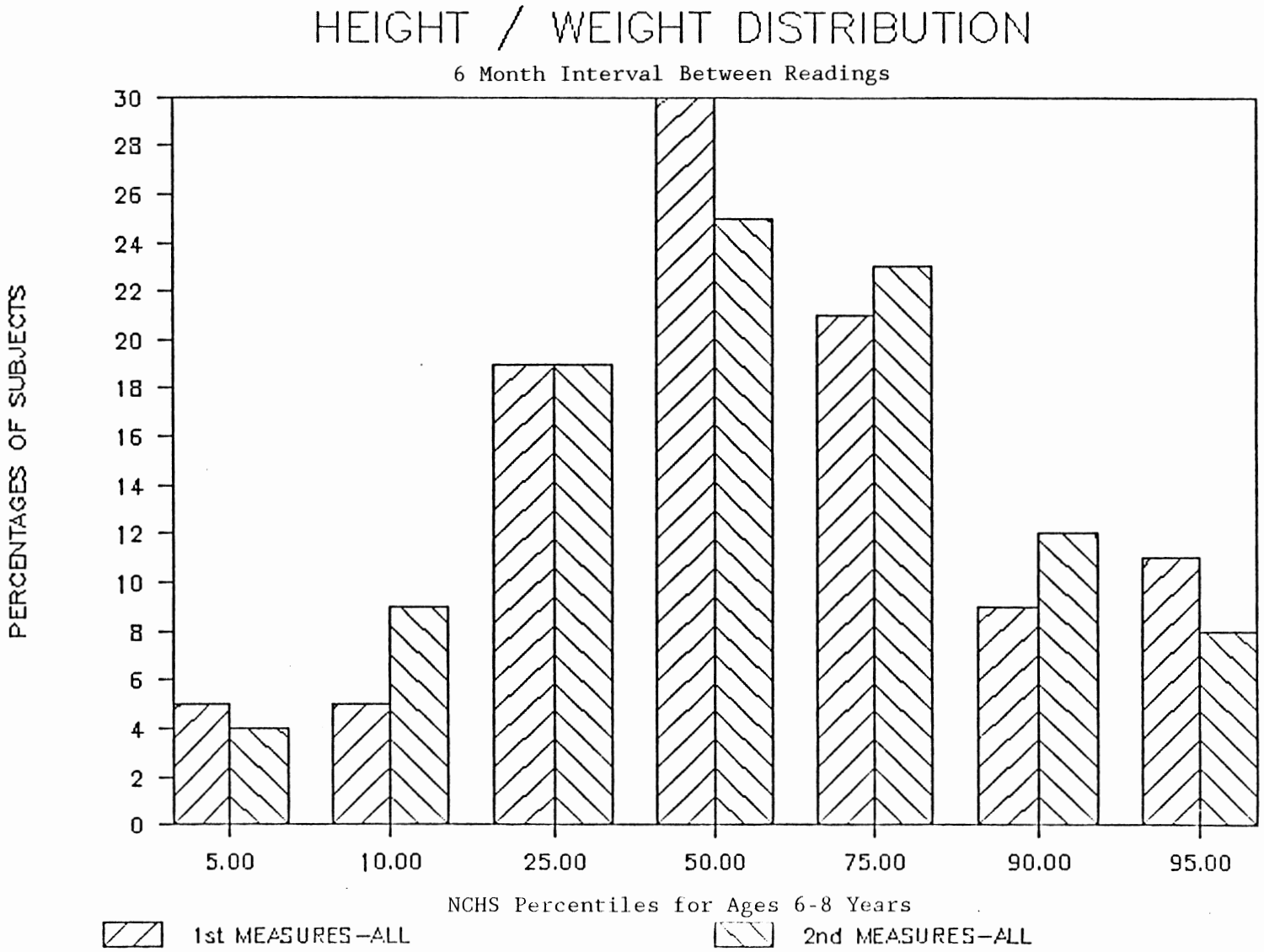

Figure 3. Height to Weight Distribution for First and Second Measures

TABLE 1

MEAN HEIGHTS AND WEIGHTS OF SUBJECTS

	*NCHS Growth Curve			Navajo Data	
Males:	Ht	Wt	Males:	Ht	Wt
Age 6.7 yr	47.27"	48.92#	Age 6.7 yr	47.57"	54.31#
7.2 yr	48.33"	51.42#	7.2 yr	49.53"	59.66#
Difference	1.06"	2.50#	Difference	1.96"	5.35#
Females:	Ht	Wt	Females:	Ht	Wt
Age 6.7 yr	46.78"	46.53#	Age 6.7 yr	46.88"	50.35#
7.2 yr	47.95"	49.41#	7.2 yr	48.72"	55.72#
Difference	1.17"	2.88#	Difference	1.84"	5.37#

*Reference norms by National Center for Health Statistics

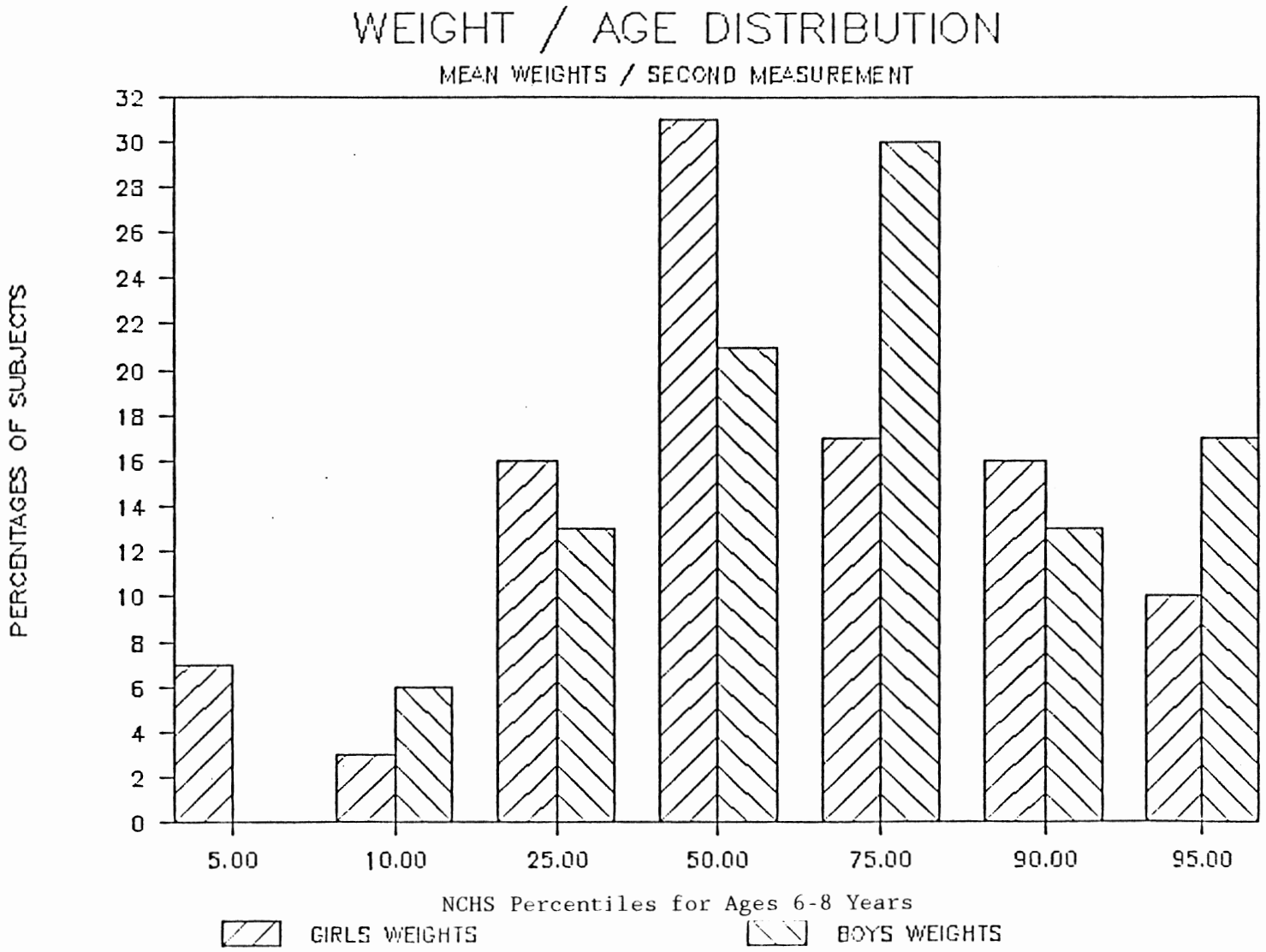

Figure 4. Distribution of Second Weight to Age

The rate of growth and weight gain for the six month period of the study was fairly rapid for both the boys and girls. This may have been the result of a natural growth spurt for this age, or it may be reflecting the schedule and dietary intake changes of these children brought about by the starting of school and the school feeding programs. The influence of the school regime and the school feeding programs on the change in growth appeared to be major factors in this growth among both boys and girls.

The Nutritional Surveillance Summary by CDC (15) includes anthropometric data on the Native American population served by the nutritionally oriented federal feeding programs. In the 6-9 year age group, the percentages for 1980 show 2.7% of the Native American group to be below the 5th percentile for height to age. (Table 2) This Navajo sample demonstrated that 3.5% of the children were below the 5th percentile, indicating many of these children are shorter than other Native American children. The CDC Native American population had 0.9% who were below the 5th percentile for weight to height as compared to 2% of the Navajo group who were small. For the group that is heavy for their height, the CDC Native Americans had 5.3% above the 95th percentile, and this Navajo sample had 3% who were heavy for their height.

TABLE 2

COMPARISON OF NATIVE AMERICANS IN THE CDC NUTRITION SURVEILLANCE SYSTEM TO NAVAJO SUBJECTS

	Height-for-Age	Weight-for-Height	
	% Below 5th Percentile	% Below 5th Percentile	% Above 95th Percentile
CDC Native Am.*	2.7	0.9	5.3
Navajo	3.5	2.0	3.0

*children through 9 years of age - 1980. (15)

Figure 5 shows the percentile ranking for weight measurements for boys and girls as compared to the Boston growth curves. At the beginning of school 12% were in the 97th percentile for weight to age and 5% were in the 3rd percentile. Six months later the 97th percentile increased to 16% of the sample and the 3rd percentile had 6%. In 1973, Van Duzen found among the Navajo head start children on the reservation that 11% of the girls and 16% of the boys were below the 3rd percentile for height. In the current group of Navajo children from the Fort Defiance area 7% of the girls and 2% of the boys are below the 3rd percentile, or shorter than the rest of the sample. This decrease in the percentage of small children could be the result of the federal feeding programs on the reservation providing nutritional education as well as a

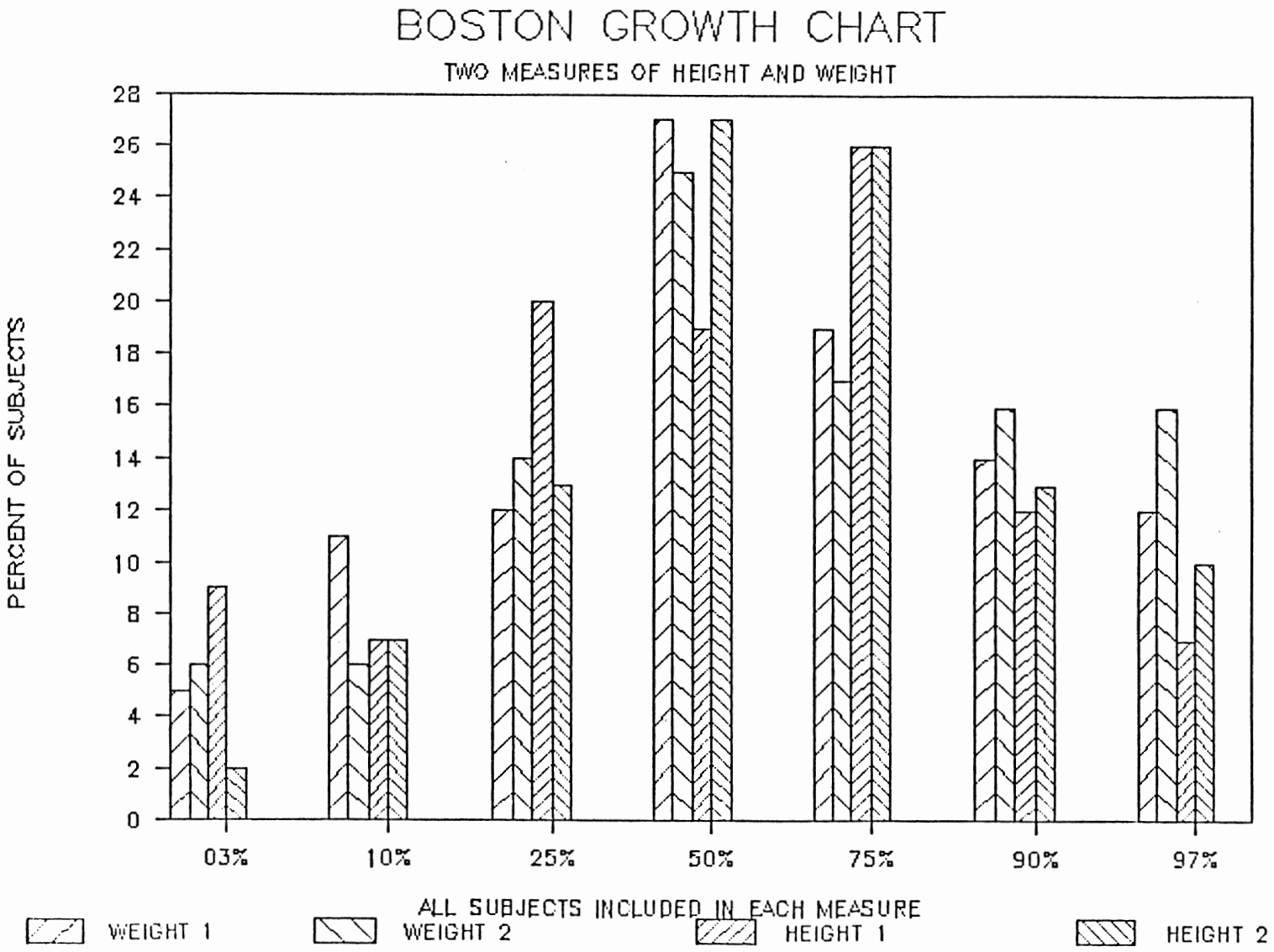

Figure 5. Height and Weight Comparison to Boston Growth Chart

source of nutritious food. This sample group is from the area of the headquarters for these special services.

Skinfold Thickness

More girls fell within the 25th percentile as shown in Figure 6. Eight percent are in the 5th percentile and 2% are above the 95th percentile according to NCHS triceps skinfold percentiles (32). The majority of the boys are in the 50th percentile with 4% below the 5th percentile and 11% above the 95th percentile.

The boys have a greater percentage of muscle mass than the girls with none below the 5th percentile and 49% at the 95th percentile or above. The majority of the sample group had a muscle mass falling in or above the 75th percentile range as shown in Figure 7. The greatest portion of the sample were in the 50th percentile for fat mass as Figure 6 illustrates. This would indicate that the average child in this sample had a greater percentage of muscle mass than fat mass at the beginning of the study. However, 11% of the boys are above the 95th percentile indicating a group that are large. Whether weight gained during the six months was muscle mass or fat, or a combination of both could not be determined, however it could be assumed the added weight was both muscle and fat.

Dietary Intake Information

To reduce the interaction between the children and create a serious but non-threatening atmosphere, the children were interviewed in the teacher's work room. Each interview took approximately 30 minutes or more, as the amount of time was not limited. The child's full attention

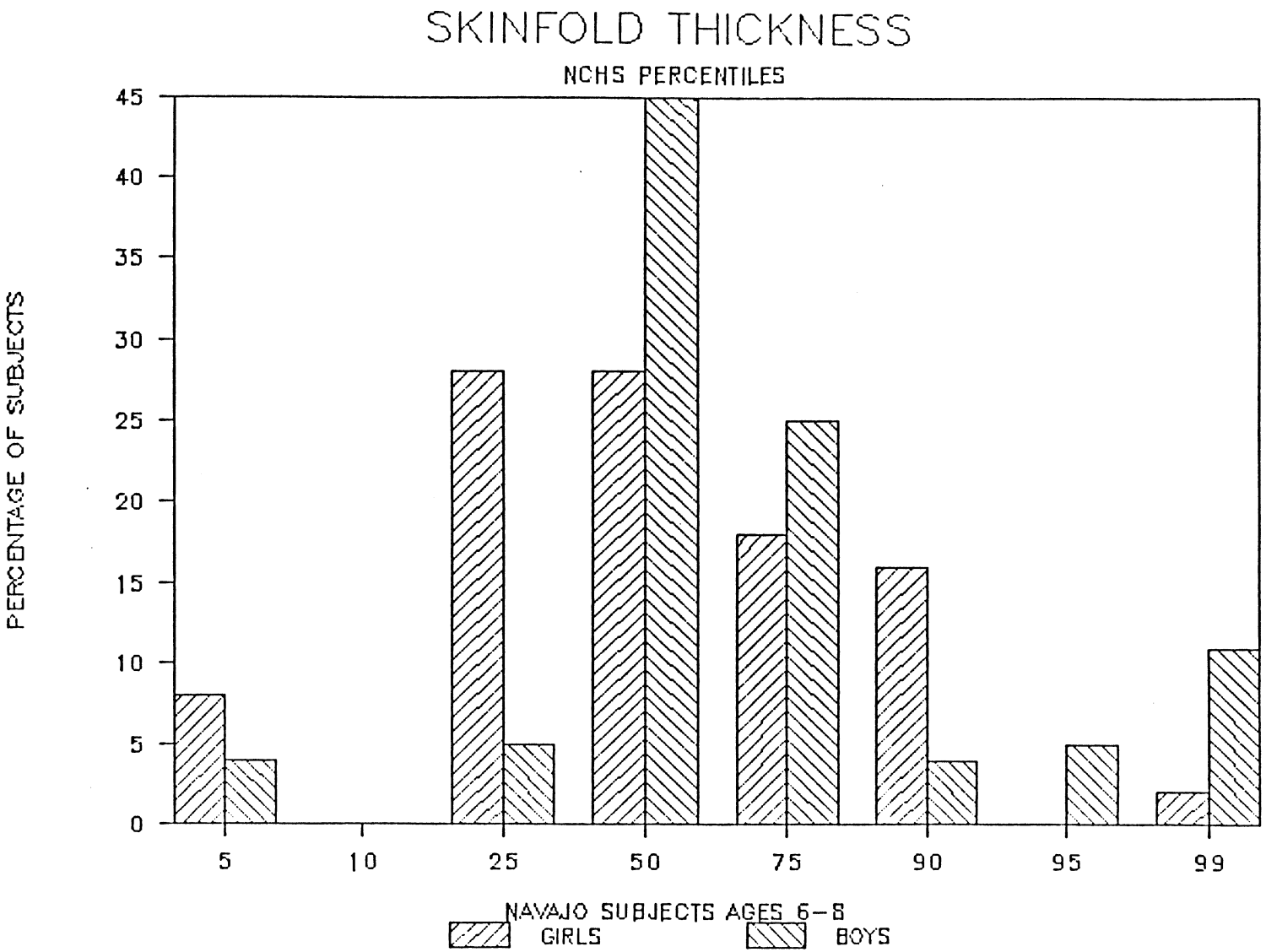

Figure 6. Skinfold Thickness

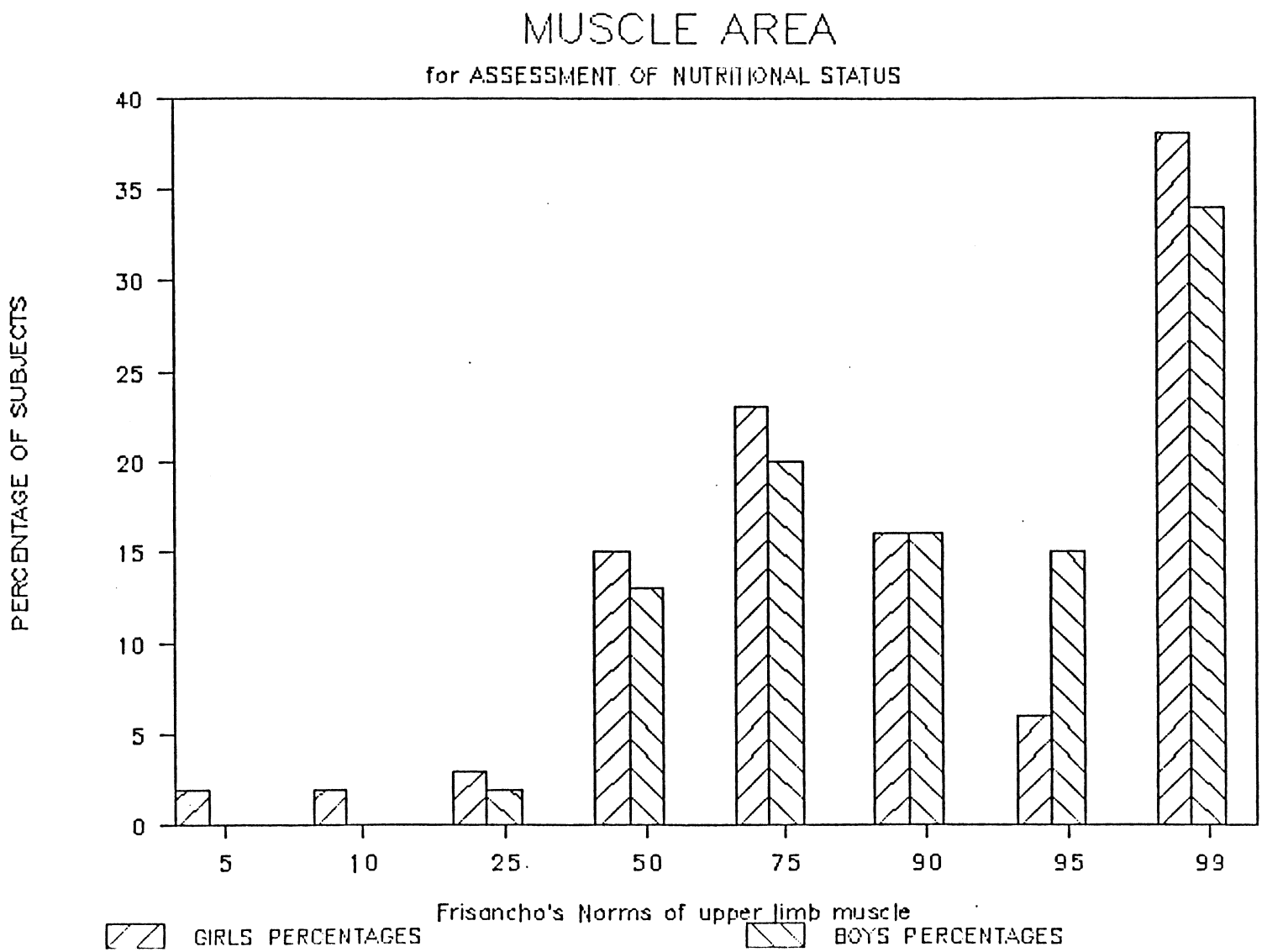

Figure 7. Arm Muscle Area for Navajo Children Ages 6-8 Years

was essential; to get it, discussing a new pair of shoes or some other important event in the child's life was often necessary.

After the first morning of interviews, it became clear that more specific product information was needed concerning the juice drinks and breakfast foods being reported. In the largest nearby market, samples which appeared to match the children's food descriptions were purchased. These were not displayed, but were shown to the children to verify their descriptions. In the interviewing process, the interviewer was very careful not to be suggestive or lead the children in their responses. No food models were used, nor were suggestions made to help name a food item, however, drawing a plate of food, or an item in question was used to identify the kinds of pizza, vegetables and meat selections. Dishes typical of the local households were used to determine the quantities of food eaten. Because these children share easily, it was important to determine how much of the food item they actually ate themselves.

The interviewing was done in the morning before lunch on Monday through Friday over a period of four months which included two holiday periods. Most income cycles were reflected in that period of time. One hundred and sixteen 24-hour recalls were taken.

Dietary Analysis

The average daily dietary intake determined from the 24-hour recall shows all the nutrients evaluated except calories were consumed in a quantity of one hundred percent or more of the Recommended Dietary Allowance. Calories were consumed at 91% of the RDA. There was a range sizable of intakes as indicated in Table 3. The intakes of iron, protein and vitamin C are shown to be consumed in the largest quantities

TABLE 3

NUTRIENT ANALYSIS FOR THE 24-HOUR DIETARY INTAKE

Nutrient	BOYS Range	BOYS Mean	BOYS %RDA	GIRLS Range	GIRLS Mean	GIRLS %RDA
Calories	382-3925	1766.0	89.3	259-3539	1843.8	92.5
Protein	12-164	71.0	224.5	9.9-127	65.7	206.1
Fat	12-225	82.6		13-167	78.2	
Carbohydrate	39-389	188.0		25-422	224.1	
Calcium	98-2793	836.8	104.6	131-1518	804.5	100.6
Phosphorus	240-3450	1141.5	142.7	243-2088	1074.7	134.3
Iron	1.8-101	23.4	234.4	.66-100	23.2	232.4
Sodium	484-6386	2353.3		119-4315	2216.3	
Potassium	368-5618	2491.2		368-4845	2414.5	
Vitamin A	168-14487	4319.8	149.9	337-77305	5538.5	188.4
Vitamin C	4.97-417	96.2	213.7	3.59-347	93.2	207.0
Thiamin	0.31-2.98	1.2	114.8	0.17-3.06	1.3	123.2
Riboflavin	0.37-3.45	1.7	146.1	0.44-8.13	1.9	159.2
Niacin	1.35-27.46	14.4	110.5	0.86-36.0	115.1	115.2

TABLE 4

LEVEL AT PERCENT OF RDA FOR NUTRIENTS

Nutrient	100+%	99-67%	66-33%	<33%
Calories	45	45	19	8
Protein	106	3	7	1
Calcium	58	36	14	9
Phosphorus	91	15	9	2
Iron	79	22	10	6
Vitamin A	68	22	18	9
Thiamin	74	27	12	4
Riboflavin	97	11	8	1
Niacin	71	25	16	5
Vitamin C	84	15	14	4

Illustrates the number of students in each percentage level

in terms of the RDA requirements. This is a very important finding as these nutrients are often found to be below recommended levels of intake among children. Calcium intake was above the 100% of RDA, and the frequency of milk consumption as compared to other beverages is high. The boys consume approximately 4% more calcium than the girls. The average intake for calories reflects the great variation in daily intake found on Sundays and days absent. In some cases a child consumed between 300-500 calories for the day and met their RDA in vitamin C or protein.

Examining the caloric distribution among the energy yielding nutrients shows that carbohydrate contributes 45.5% of the calories, fat contributes 39.6% and protein 14.9% for the sample. Girls averaged approximately 67 grams a day more carbohydrate than the boys, and 4 grams less of fat, which resulted in a greater calorie intake for the girls. When compared to the Dietary Guidelines for caloric distribution the sample diet's protein is comparable, the fat intake is high (30-35 % of calories is recommended) and carbohydrate is low (50-55% of calories is recommended).

Those subjects receiving 100% or more of all the identified nutrients and calories numbered 24 or equaled 20% of the sample. Of those remaining students, seven had eaten 100% of their daily RDA without meeting the mean determined caloric quantity. The RDA for each nutrient including calories was shown to have been eaten in quantities of two-thirds or more by 73 (63%) of the 116 subjects. Table 4 (p. 62) indicates the frequency distribution of the number of students meeting 100+%, 100%-67%, 66%-33%, and less than 33% of the RDA allowances for each nutrient.

Protein was the nutrient most frequently consumed at 100% or more of the RDA. One hundred and six students (91.4%) received this amount of protein. Phosphorus, riboflavin and vitamin C were the next nutrients consumed by the greatest number of subjects above the 100% level of the RDA. Calcium, vitamin A and niacin were the three nutrients representing the lowest frequency of consumption above 100%. All nutrient intakes are significantly above 100% of the RDA for boys and girls with the exception of calories and calcium, and niacin for the boys.

In comparison with the NCHS Dietary Intake Averages (Table 5), the percentage of calories represented by fat intake is greater among the sample than nationally by 2.7% and the boys of the sample consumed significantly greater amounts of fat based on the percentage of calories. The boys in the sample consumed less carbohydrate by percentage of calories than the national average by 7.67% which was significantly below the NCHS level and the gram intake of carbohydrate was significantly less for the boys. The girl's percentage of carbohydrate intake, though greater than the sample boys, was significantly less than the national average for girls. The boys intake of protein was significantly greater than the national average boy.

Another evaluation of the Navajo dietary intake can be made by comparing the average daily intake of nutrients for the sample to the NCHS Dietary Intake for children six to eight years old for any differences. Table 6 shows a comparison of the NCHS average dietary intake with the mean intake for the sample population and statistical significance for the comparison. In that comparison, the sample boys intake of the B-vitamins fell into the 25th percentile for thiamine,

riboflavin and niacin which were statistically less than the national average intakes. The girls were in the 75th percentile for vitamin A intake, this did not prove to be significant. Both the boys and girls were above the 95th percentile for their iron intake, making the iron intake significantly greater than the national average. The average iron intake is approximately 11.56 mg for NCHS as compared to the sample population's average of 23.3 mg per day. Calcium and phosphorus intakes were significantly below the NCHS dietary intake level with both the boys and girls being in the 30% range.

TABLE 5

DISTRIBUTION OF CALORIES AMONG ENERGY YIELDING NUTRIENTS

NUTRIENT	MALES		FEMALES		MEAN
	NCHS	NAVAJO	NCHS	NAVAJO	NAVAJO INTAKE
Protein	14.74%	15.96%	14.17%	14.10%	14.94%
Fat	36.81%	41.78%	36.86%	37.78%	39.58%
Carbohydrate	49.92%	42.26%	50.91%	48.11%	45.48%

* NCHS (72)

The comparison indicated that the boys were consuming significantly less thiamine, niacin and riboflavin than boys nationally. The decreased amount of thiamine intake could be due to the infrequent intake of dark

TABLE 6

COMPARISON OF NCHS MEAN DIETARY INTAKE LEVELS
WITH MEAN NAVAJO INTAKE LEVELS
AND THE p VALUE

Nutrient	Sex	NCHS Mean	NAVAJO Mean	COMPUTED p Value
Calories	Male	1981	1766	0.0518
	Female	1807	1844	0.8954
Protein	M	73	71	0.6672
	F	64	64	0.7161
Fat	M	81	82	0.8020
	F	72	78	0.2066
Carbohydrate	M	244	187	0.0001
	F	230	224	0.4339
Calcium	M	1074	836	0.0003
	F	978	804	0.0001
Phosphorus	M	1321	1141	0.0231
	F	1180	1075	0.0189
Iron	M	12.53	23.40	0.0045
	F	10.58	23.23	0.0002
Sodium	M	2683	2353	0.0691
	F	2510	2216	0.0277
Potassium	M	2386	2491	0.5577
	F	2201	2414	0.1198
Vitamin A	M	4892	4319	0.2845
	F	4877	5539	0.6521
Thiamin	F	1.43	1.169	0.0020
	M	1.23	1.285	0.5161
Riboflavin	F	2.24	1.697	0.0001
	M	1.99	1.871	0.3225
Niacin	F	17.78	14.426	0.0007
	M	14.99	15.112	0.9335
Vitamin C	F	105	96.1	0.4596
	M	109	93.1	0.0043

Male = 54, Female = 63 significant p = <.05

green vegetables. The difference in riboflavin intake can be associated with the lower intake of calcium and phosphorus. All three of these nutrients are present in milk, and would indicate a need for increased use of milk or milk products. The niacin intake may not be as different as it appears. The dietary analysis considers only the preformed niacin in foods, but the amino acid tryptophan is converted to niacin in the body. The percentage of protein intake for the boys was significantly greater than the NCHS boys, and therefore it was reasonable to assume the Navajo boys got sufficient niacin through the protein conversion.

The girls' vitamin C intake was statistically less than the national intake. The food frequency lists indicate the girls consumed less fruit juice and vitamin enriched drinks than the boys which probably identifies the difference.

Both boys and girls consumed less sodium by percentage of total food intake than the national group of children. The Navajo girls consumption of sodium was significantly less than the national average for girls.

Meal Pattern

Breakfast at home appeared to be the most frequently eaten meal among this group of children. Ninety-one percent reported eating breakfast (Table 7). This is consistent with earlier studies that show eating breakfast to be a part of the meal pattern for Navajo families (54,60). Five of the sample ate breakfast twice on the day of the recall once at home and then again at school. Breakfast was the most frequent meal for Sunday with Father reported to be the cook.

TABLE 7

MEAL DISTRIBUTION - 116 SUBJECTS

Meal	Number Eating	Percent
BREAKFAST	106	91%
LUNCH	103	89%
SUPPER	105	90%
SNACK	77	66%

Lunch was reported by the average student to supply the greatest number of calories contributing 34% of the average daily intake. Supper contributed 26% and breakfast and snacks contributed 20% each. In the terms of the percentage of calories contributed, fat is highest at breakfast, protein greatest at supper and the carbohydrates are greatest at snack times. The average girl ate more calories (1844) per day than the average boy (1766).

Protein was shown to be the nutrient most frequently eaten at 100% RDA. The protein foods most frequently served were beef contributing 27% of the meat servings, eggs 25%, and pork 21% of the day's total.

Lettuce, tomatoes and celery were the fresh vegetables reported most frequently. Potatoes, pinto beans and carrots were the cooked vegetables most frequently eaten. Apples, oranges and bananas were the fresh fruits most likely to be eaten. In the bread and cereal food group, rolled or puffed oats were the most popular. White bread and

toast along with tortillas and fry bread contributed the greatest number of bread servings.

Milk was the most frequently mentioned food item at each eating time, followed by bread. Orange juice was the second most popular drink with Koolade and carbonated beverages contributing approximately the same same number of servings. Milk contributed 69% of the beverages reported by boys and 62% of those reported by girls. Fruit drinks, Koolaid and carbonated beverages were reported to make up 17% of the boys drinks and 21% of the girls drinks.

School Lunch Intake and Plate Waste Study

One hundred and twenty-four lunch plates from the first graders were studied. (Table 8) The only change made in the lunch procedure was to shorten the eating time. Generally, the children were allowed to sit and eat until everyone had finished eating, which allowed time for trading various food items. To determine more accurately how much food each child consumed, the children were not allowed to sit long enough to begin to share their food. On the day of the survey, 70 (56%) children ate everything on their lunch tray.

The school lunch program is designed to supply one-third of the Recommended Dietary Allowance. The intakes at lunch on this day did meet the requirements in every area except calories (29%) and vitamin C (19%). When the amounts eaten from each tray were averaged, the lunches provided less than one-third the RDA in calories (27%), niacin (30%) and vitamin C (17%). The caloric variation for the plates eaten was 577 calories for maximum to 263 for the minimum calories eaten.

TABLE 8

COMPARISON OF NUTRIENT ANALYSIS OF
SCHOOL LUNCH PLATE STUDY AND
AVERAGE SCHOOL LUNCHES

	LUNCH PLATE STUDY ANALYSIS			
	Served Plate		Eaten Lunches	
Nutrient	Mean	%RDA	Mean	%RDA
Calories Kcal	577.25	28.90	524.87	27.14
Protein gm	27.37	86.30	24.69	77.16
Fat gm	23.38		21.286	
Carbohydrate gm	68.19		62.44	
Calcium mg	535.91	67.00	476.29	59.54
Phosphorus mg	640.21	80.00	575.33	71.92
Iron mg	3.60	36.10	3.32	33.20
Sodium mg	1373.54		1253.24	
Potassium mg	1002.58		904.96	
Vitamin A IU	2738.01	93.50	2533.74	84.46
Thiamin mg	0.48	46.10	0.43	47.64
Riboflavin mg	0.65	55.70	0.58	48.33
Niacin mg	4.27	32.50	3.93	30.23
Vitamin C mg	8.35	18.60	7.62	16.89

School lunch plate study = 124 lunches on same day

	AVERAGE SCHOOL LUNCH ANALYSIS		
	Mean Intake	%RDA	%Day
Calories Kcal	732.40	36.89	37.53
Protein gm	28.91	91.08	41.53
Fat gm	31.01		38.53
Carbohydrate gm	86.10		38.54
Calcium mg	380.80	47.60	43.74
Phosphorus mg	460.28	57.53	40.21
Iron mg	18.07	180.73	47.84
Sodium mg	1005.63		39.45
Potassium mg	1219.11		45.84
Vitamin A IU	2286.82	79.06	41.55
Thiamin mg	0.43	41.22	35.13
Riboflavin mg	0.67	57.86	37.43
Niacin mg	5.93	45.52	39.49
Vitamin C mg	31.39	69.76	38.61

Average school lunch = 81 meals from dietary intakes

Compared to the average school lunch of the surveyed students, the plate waste lunch provided more calcium, phosphorus, thiamin and vitamin A and provided fewer calories less protein, iron, niacin and vitamin C than the average school lunch that had been reported. The average school lunch reported supplied 38% of the days calories, 38.6% of the vitamin C as well as 39% of the niacin for the day. The average daily school lunches served met the requirement of providing one-third of the daily nutrient requirement for the children as shown in Table 8.

The National Evaluation of School Nutrition Programs (NESNP) found the school lunches served nationally contributed less than one-third of the RDA for iron and vitamin C (66). This was partially the case on the day of this lunch evaluation as iron (33%) met the requirement and vitamin C was below the desired intake level with 17% of the RDA.

Discussion

A Pearson correlation between clinical measurements and the average nutrient intakes was calculated with the SAS program at Oklahoma State University to determine if significant relationships existed between nutrient intake and body growth or weight. Fourteen nutrients and the three percentages of energy distribution were compared with the clinical measures of skinfold thickness, percentage of skinfold thickness, arm circumference, percentage of arm circumference, muscle area of the arm, percentage of muscle area, fat area of arm, percentage of arm fat area and the wrist measurement.

Five significant correlations were found to exist. Niacin had a negative correlation to the skinfold thickness, the percentage of skinfold thickness, the fat area of the arm and the wrist circumference.

The percentage of protein consumed had a positive correlation to the skinfold thickness percentage or the estimated percentage of body fat. This indicates that within this sample the low niacin intakes were found in the children with the smaller skinfold thickness or less body fat and a smaller wrist. The greater percentage of protein intake was found in the children with larger skinfold thickness. (See appendix B)

The same correlation testing method was used with the percentage of RDA for ten nutrients and the same clinical measurements as previously used. The mean RDA percentages for calories, protein, calcium, phosphorus, iron, vitamin A, thiamin, niacin and vitamin C were used as comparisons with the clinical measures and no significant correlations were found to exist. Therefore, it appeared the percentage of nutrient intake based on the RDA consumed for this 24-hour period by these children did not have an effect on their body fat mass or muscle development in either a positive or negative manner. This correlation would indicate that the sample's food intake is adequate, not causing statistically obvious changes in the body that could be detected by the physical parameters used. (See appendix B)

Many of these children have been participants in the WIC program. The number of children eating cereal and drinking milk and fruit juice could well be the result of the parental training received through WIC and the other tribal nutrition programs on the reservation. It appears that conscious food choices are being made to provide these children with nutritious foods.

The lower intake of sodium may be attributed to the nutritional programs presented by the tribal commodity food distribution program over the years. The commodity foods program has encouraged the

homemakers not to heavily salt the foods they prepared, and encouraged the eating fry bread without heavily salting it. This same group has taught the use of hydrogenated fats for the frying of fry bread rather than using the preferred lard. A need for a decrease in total fat intake remains evident by the high percentage of fat calories eaten by the sample. Various health related organizations are suggesting that no more than 30% to 35% of the total calorie intake come from fat. Therefore, a decrease of approximately 10% of the fat calories would be wise. This dietary change will require special effort. Fry bread, as well as many other fried food items are a part of the majority of the meal plans. Frying has some advantages hard to replace, such as being quick and fuel efficient, along with the fact that it is a traditional cooking method. Aside from these factors, judicious purchasing and food preparation techniques could help reduce the excess fat intake of these children. It seems only prudent to make every effort possible to help reduce the intake of fat especially as the focus of health care on the reservation begins to move from communicable diseases to combating degenerative health problems.

Given the high incidence of infectious disease among these children, they appear to be receiving sufficient protein to prevent the effects of nitrogen loss due to infection. Life style and living conditions appear to have a greater influence on continual infections than the nutritional intake for this group. A consideration to be made concerning the high incidence of infection, may be the available free medical care, and thus the reporting of infectious disease that might go unreported in the general population which does not have the same access to free medical care.

The kind of foods eaten are likely reflected in the geographic location of the study group. Green vegetables other than the most commonly found salad vegetables (lettuce,tomatoes,celery) were not mentioned frequently, nor did ice cream appear to be eaten frequently. This may reflect the difficulty in transporting frozen and fresh food items. Salads appeared to be eaten most frequently at school or away from home.

Testing of the Hypothesis

1. Hypothesis one stating that there will be no differences between Navajo children and other children of the same age in regard to nutritional intakes can not be accepted. Significant differences were found when the nutrient intakes of Navajo children were compared to the mean intake levels of the NCHS children for nutrients except calories, protein, fat, carbohydrate, potassium, vitamin C, thiamin, riboflavin, Vitamin A, and the percentage of carbohydrate for girls. No differences were found for the boys in calories, protein, fat, sodium, potassium, vitamin A or vitamin C when compared to the HCHS boys.

Significant differences were also found between the nutrient intake levels of these Navajo children and the Recommended Dietary Allowances for their age and sex. Table 9 summarizes the results of the t-test to determine if the Navajo RDA percentages were significantly above 100% of the RDA for age and sex. Calories were tested as being significantly less than 100% of the RDA.

TABLE 9

COMPARISON OF NAVAJO PERCENT OF RDA TO 100% RDA

	Females			Males		
Nutrient	Mean	(t)	Prob	Mean	(t)	Prob
Calories	91.1	-2.280	.013*	89.3	-1.848	.035*
Protein	204.0	11.131	<.001	244.5	8.604	<.001
Calcium	100.3	0.060	.476 NS	104.6	0.596	.277 NS
Phosphorus	133.3	5.674	<.001	142.7	4.452	<.001
Iron	230.2	4.082	<.001	234.4	3.660	.003
Vitamin A	184.8	1.933	.029	149.9	2.671	.005
Thiamin	122.1	3.459	.005	114.8	1.807	.038
Riboflavin	158.3	5.010	<.001	146.0	5.356	<.001
Niacin	113.7	2.090	.020	110.5	1.451	.076 NS
Vitamin C	197.9	6.569	<.001	213.7	4.316	<.001

*< 100% RDA for calories only. (p=<.05)

2. Hypothesis two can not be rejected as no differences were found between the Navajo children's heights and weights and the NCHS means for heights and weights for age and sex. These Navajo children meet the norms for age to height and weight established by the National Center for Health Statistics.

3. Hypotheses three to test for relationships between nutritional intakes and clinical measures for boys and girls can not be rejected. No significant relationships were identified between these Navajo children's clinical measures and their nutrient intakes except for niacin and protein. Niacin was found to significantly correlate with the wrist, skinfold, skinfold percentage and fat area of the arm. The percentage of protein intake and percent of skinfold thickness had significant correlations. No signficant relationships were indentified between the Navajo children's clinical measures and their nutrient intake expressed as a percentage of RDA intake for age and sex.

Statistically these Navajo children are shown to consume highly nutritious foods in quantities sufficient to promote optimal growth and development. The growth of these children is consistent with the norms for age and sex. Statistical differences ocurr when comparison is made with the national population, but not when these Navajo children are compared to the established RDA levels.

CHAPTER V

SUMMARY AND CONCLUSIONS

This study was undertaken to collect dietary intake data and anthropometric information on Navajo Indian first graders on the reservation at Fort Defiance, Arizona. One hundred and twenty-one children enrolled in the first grade were studied from October, 1985, to May of 1986. All the children appeared to be healthy with an age range from 5.8 to 8.3 years.

When the sample's average daily nutrient intake levels are compared with optimal RDA standards, calories (Kcal) were below 100% of the RDA, and the other nine nutrients analyzed were above the 100% level of the RDA. Iron (233%), protein (214%), and vitamin C (210%) were at twice their optimal RDA levels. Calcium intake for both boys and girls was not found to be significantly greater than 100% of the RDA, and niacin was found to be less for the boys. Caloric intake was significantly less than 100% for both boys and girls. The nutrient content of the foods eaten is high, but not necessarily high in calories.

Compared to the HANES data in the NCHS dietary intake information for 6-8 year olds these Navajo children consumed twice as much iron a day which was significantly more than the US children. The Navajo children's intake of calcium, phosphorus and sodium were significantly less than the national intake level. The girls intake of vitamin C was significantly less than the US girls. The Navajo boys intake of niacin,

riboflavin, and thiamin were significantly less than the boys in the NCHS group. Both the boys and girls intake of carbohydrates as a percentage of the daily caloric intake were significantly less than the national intake means. The boys also had a significantly smaller total gram intake of carbohydrate. The percentage of calories received from fat and protein were significantly greater than the national average for boys.

The initial set of anthropometric measurements indicated a slightly taller and heavier group, however statistically the difference was not significant. These children were no different than the children of the NCHS growth curves for the same ages and sex. The growth and weight gain over the six month period of the study were rapid for both boys and girls. Statistical correlations between the percentage of the RDA consumed and the NCHS Dietary Intake averages with the clinical measures related to muscle and fat area did not reveal a correlation between dietary intake and muscle or fat areas of the body.

There is no way to identify the influence of the school feeding programs on the changes in growth, but it is reasonable to suspect they did have an influence. The school lunch program meets the requirement of providing one-third of the RDA for these students, and provides 47.6 percent of the RDA for calcium.

Conclusions

1. Nutritionally, this sample of Navajo first graders from Fort Defianc Elementary School are well nourished by the NRC-RDA standards for optimal health.

2. These Navajo children's dietary intake when compared to the national dietary intake of children the same age show very similar intakes.

3. The heights and weights to age of the Fort Defiance Navajo children fall within normal ranges of the NCHS growth curves. The school lunch feeding program appears to have a sizable effect on intakes and therefore growth rates.

4. The average to above average growth rates of the Navajo children indicates a positive relationship between dietary intakes and physical development.

Recommendations for Nutritional Education

1. In addition to information about the usage of saturated fats, information on purchasing and food preparation techniques to decrease the total amount of dietary fat should be emphasized in the nutritional programs on the reservation.

2. Educational information on the benefits of cereal and grain products for fiber and additional complex carbohydrate intake should be disseminated though the commodity food programs, and simple single fact posters in the health clinics and chapter houses.

3. A public service announcement series concerning the issues of dietary fat, fiber and complex carbohydrates should be initiated through the Navajo radio programs. The Navajo Tribal radio station and the stations in the border communities should be utilized.

Recommentations for Further Research

1. Nutritional intake studies should be conducted throughout the reservation to determine if all the Navajo children are as well nourished as the children in the Fort Defiance area.
2. Data should be collected and analyzed through the Navajo Health Program to determine if the growth cycles of Navajo children are consistent with the NCHS growth curves.
3. A study using glycosolated hemoglobin and lipid profile tests should be undertaken to determine the effects of high fat and low carbohydrate intake percentages among the Navajo children.

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APPENDICES

APPENDIX A

INSTRUMENTS USED FOR DATA COLLECTION

CLASSROOM: _____

TEACHER: _____

ANTHROPOMETRIC DATA

NAME: _____ SEX: _____

ST. CODE: _____ DOB: _____

DATE: _____ DATE: _____

BODY WEIGHT: _____ BODY WEIGHT: _____
without shoes without shoes

HEIGHT: _____ HEIGHT: _____
without shoes without shoes

ARM
CIRCUMFERENCE: _____ ARM
CIRCUMFERENCE: _____

_____
6 months later

SKINFOLD THICKNESS:

1. _____

2. _____

3. _____

_____
Average

WRIST: _____

ANTHROPOMETRIC DATA

1. HEIGHT: - Without Shoes

Heels together
Back straight
Buttocks and shoulders against vertical measuring stick
Eyes horizontal (right angle firmly lowered on head - right angle to measuring stick)
Child takes breath - exhales as reading occurs

2. WEIGHT: Using beam scales, calabrated to nearest 20 grams.
Use Boston Charts to determine percentiles.
Directions taken from Nutritional Assement In Health Programs. ed. Cristakis, George, American Public Health Assco, Inc. Washington, D.C., 1973.

3. TRICEPTS SKINFOLD THICKNESS:

(1). Left Arm

(2). Mid-Point between scapula and olecranon process of elbow is determined using Ross Lab Tape.

(3). Skinfold gently pulled away from underlying muscle tissue.

(4). Adipometer placed over skinfold at mid-point mark while maintaining skin grasp.

(5). Exert force with thumb/forefinger untill lines of Adipometer are alinged.

(6). Reading taken to nearest 1.0 millimeter 2 to 3 seconds after aligning the lines.

(7). Three readings taken and averaged.

Taken from "Guidlines For Anthrometric Measurement", Ross Laboratories, Cloumbus, Ohio, Oct, 1978.

24 HOUR INTAKE RECORD

ST.CODE:_____

NAME:_____ DOB:_____

Date and time of Interview: _____

Length of Interview: _____

Date of Recall: _____

Day of the week of Recall: _____

1-M 2-T 3-W 4-TH 5-F 6-SAT 7-SUN

I would like you to tell me everything you ate and drank from the time you got up in the morning until you went to bed at night and what you ate during the night. Be sure to mention everything you ate or drank at home, at work (school), and away from home. Include snacks and drinks of all kinds and everything else you put in your mouth and swallowed. I also need to know where you ate the food, and now let us begin.

QUESTIONS TO ASK:

What time did you get up yesterday? _____
What is the usual time? _____
What was the first time you ate or had anything to drink yesterday morning? (list on form that follows)
Where did you first eat? (list on form that follows)

Now tell me what you had to eat and how much.

(occasionally the interviewer will need to ask:)

Did you have anything to eat during the night?
Do you always eat like this? YES____ NO____
(If answer is No) Why?_____
In what Way?_____
Who fixed dinner last night?_____
What time did you go to bed last night?_____
Do you take vitamin or mineral supplements?_____
YES_____ NO_____
(if answer is yes) How many Per Day?_____
Per Week?_____
Do you take other medication daily?_____
(if answer is yes)
What do you take it for?_____
What is it?_____

ST.CODE:_____

NAME:_____ DOB:_____

Day of the week recall:_____

RECORD OF FOOD INTAKE

TIME	WHERE EATEN	FOOD	TYPE AND/OR PREPARATION	AMOUNT	FOOD CODE	AMOUNT CODE

+CODE:

H-Home
R-Restaurant (fast food, Circle K, Trading Post, Restaurant).
CL-Carried lunch from home.
CC-Chapter House.
OH-Other home (friend, baby sitter, relative, ect).
S-School, Office, Plant or Work.
GR-Gallup-Fast Food, Restaurant, Movie.

Taken from: Screening for Nutritional Status: Suggestions For child health programs, Wash., D.C., US Govt printing Office, P. 13, 1971.

DIETARY QUESTIONNAIRE FOR CHILDREN

NAME: _____ ST.CODE_____
DATE: _____ DOB: _____

1. Do you eat at regular times each day? _____

2. How many days a week do you eat?
   A morning meal? _____
   A lunch or mid day meal? _____
   An evening meal? _____
   Snack after school? _____

3. When do you snack?
   In mid morning? _____
   In mid afternoon? _____
   In the evening? _____
   During the night? _____

4. Which meals do you usually eat with your family?

   NONE _____ BREAKFAST _____ NOON MEAL _____
   EVENING MEAL _____ SNACKS _____

5. Do you eat lunch at school? Yes____No____ Usually_____

6. Do you eat breakfast at school? Yes____No____Usually____

7. Do you drink milk at school? Yes____ No____ Usually_____

8. At what time of the day are you most hungry?
   Morning_____ Noon_____ Evening_____

9. Do you eat at home whenever you want to? Yes_____No_____

10. What foods do you like best? _____

11. What foods do you dislike most? _____

12. Are you on a special diet?
    If yes;
    _____ For weight reduction (own prescription)
    _____ For weight reduction (doctors prescription)
    _____ For gaining weight
    _____ For allergy, specify _____
    _____ For other reason, specify_____

13. What do you drink most often at home?
    _____TEA _____ Pop, kind_____
    _____Juice, kind_____ _____ Milk
    _____Koolaid, _____ Other

14. How many times per week do you eat the following foods (at any meal or between meals)?
Circle the appropriate number:

Bacon	01234567 7+,	Specify_____
Sausage	01234567 7+,	Specify_____
Lunchon Meat	01234567 7+,	Specify_____
Hot Dogs	01234567 7+,	Specify_____
Poultry-Chicken, Turkey	01234567 7+,	Specify_____
Pork or Ham	01234567 7+,	Specify_____
Meat in Mixtures: (stew tamales, casseroles,ect)	01234567 7+,	Specify_____
Beef or Veal (hamburger, meatloaf)	01234567 7+,	Specify_____
Other meat	01234567 7+,	Specify_____
Fish	01234567 7+,	Specify_____

15. How many times per week do you eat the following foods (at any meal or between meals)?
Circle the appropriate number:

Fruit Juice	01234567 7+,	Specify_____
Fruit	01234567 7+,	Specify_____
Cereal - Dry	01234567 7+,	Specify_____
Cereal cooked or instant	01234567 7+,	Specify_____
Fry Bread	01234567 7+,	Specify_____
Eggs	01234567 7+,	Specify_____
Pancakes or waffles	01234567 7+,	Specify_____
Cheese	01234567 7+,	Specify_____
Potato	01234567 7+,	Specify_____
Other cooked vegetables	01234567 7+,	Specify_____
Raw vegetables	01234567 7+,	Specify_____
Dried beans or peas (pinto beans)	01234567 7+,	Specify_____
Macaroni, spaghetti,rice or noodles	01234567 7+,	Specify_____
Ice Cream, milk pudding custard or cream soup	01234567 7+,	Specify_____
Peanut Butter or nuts	01234567 7+,	Specify_____
Sweet rolls or doughnuts	01234567 7+,	Specify_____
Crackers or pretzels	01234567 7+,	Specify_____
Cookies	01234567 7+,	Specify_____
Pie, cake,brownies	01234567 7+,	Specify_____
Potato chips or corn chips	01234567 7+,	Specify_____
Candy	01234567 7+,	Specify_____
Soft drinks, popsicles or koolaid	01234567 7+,	Specify_____

16. How many servings per day do you eat of the following foods?
Circle the appropriate number:

Bread (including sandwich), toast, rolls muffins, fry bread and tortillas (1 slice or 1 piece 1 serving)____01234567 7+, Specify_____
Milk (including on cereal or other foods) (8 oz. 1 serving) serving_____ 01234567 7+, Specify_____
Sugar, jam, jelly syrup (1 tsp 1 serving)_____ 01234567 7+, Specify_____

17. What specific kinds of the following foods do you eat most often?

Fruit Juices _____
Fruit_____
Vegetables_____
Cheese_____
Cooked or instant cereal_____
Dry Cereal_____
Milk_____

18. Who cooks most often at where you eat?

_____Father _____Sister _____Grandparent
_____Mother _____Brother _____Me _____Other

19. Can you fix things to eat at home? Yes_____ No_____
Can you open the refrigerator? Yes_____ No_____
Can you open the freezer? Yes_____ No_____
Can you use the stove? Yes_____ No_____
What kind is it?
_____Gas
_____Electric
_____Wood / Coal
_____I don't know
Do you have running water? Yes_____ No_____

20. Where does your family buy groceries?
_____Fed-mart
_____Gallup, Store_____
_____Other, _____

21. Does your family use food stamps? Yes_____ No_____
Commodity foods Yes_____ No_____
If yes what are your favorite commodity foods_____

22. Who is usually home when you get home from school?_____

SUMMARY DATA SHEET

FORT DEFIANCE SCHOOL LUNCH STUDY

CODES for percentage of food eaten:

(1) = 100%, (2) = 75%, (3) = 50%, (4) = 25%, (5) = 0%

STUDENT CODE	BREAD	HAM	CHEESE	TATER TOTS	RAW CARROTS	CANNED PEACHES	2 FAT MILK

SCHOOL LUNCH PLATE SURVEY

TRAY NAME:_____ MEAL TRAY WEIGHT (filled)_____

ST. CODE:_____ TRAY WEIGHT (returned)_____

WEIGHT of FOOD EATEN_____

MENU ITEM	PORTION GONE FROM TRAY					
	ALL GONE	3/4 GONE	1/2 GONE	1/4 GONE	NONE GONE	COMMENTS
HAM & CHEESE						
BREAD (2 SLICES)						
POTATOES						
CARROT STICKS						
CANNED PEACHES						
MILK						

APPENDIX B

COMPUTERIZED STATISTICAL DATA

DATA ON INITIAL HEIGHTS AND WEIGHTS, NCHS MEAN HEIGHTS AND WEIGHTS, AND DEVIATIONS BETWEEN NAVAJO AND NCHS VALUES
DEVIATIONS = NAVAJO (INITIAL) VALUE - NCHS MEAN

OBS	CODE	SEX	AGE	HT1	HTNCHS	HTDEV	WT1	WTNCHS	WTDEV
1	2102	M	5.80593	48.50	44.3	5.20	47.50	43.7	3.80
2	1418	F	5.87830	46.75	43.9	2.85	50.50	43.2	7.30
3	1502	F	5.92055	42.00	43.9	-1.90	36.50	43.2	-6.70
4	1411	F	5.95890	46.50	43.9	2.60	53.00	43.2	9.80
5	1415	F	6.00935	46.25	46.6	-0.35	54.65	48.8	5.85
6	2403	M	6.00935	45.25	47.0	-1.75	46.75	50.6	-3.85
7	2311	M	6.02853	45.25	47.0	-1.75	42.40	50.6	-8.20
8	1421	F	6.03676	45.00	46.6	-1.60	50.75	48.8	1.95
9	2303	M	6.03676	44.00	47.0	-3.00	43.25	50.6	-7.35
10	2519	M	6.05045	47.00	47.0	0.00	49.50	50.6	-1.10
11	1406	F	6.05593	46.50	46.6	-0.10	47.75	48.8	-1.05
12	1217	F	6.05867	46.75	46.6	0.15	47.50	48.8	-1.30
13	2425	M	6.06689	46.75	47.0	-0.25	48.00	50.6	-2.60
14	1304	F	6.08269	45.25	46.6	-1.35	44.75	48.8	-4.05
15	2206	M	6.09817	46.25	47.0	-0.75	50.75	50.6	0.15
16	1407	F	6.10913	45.50	46.6	-1.10	47.00	48.8	-1.80
17	2513	M	6.10913	44.25	47.0	-2.75	45.25	50.6	-5.35
18	2325	M	6.12556	50.00	47.0	3.00	92.00	50.6	41.40
19	2116	M	6.14201	44.50	47.0	-2.50	53.25	50.6	2.65
20	2506	M	6.14201	44.75	47.0	-2.25	50.50	50.6	-0.10
21	1404	F	6.14474	45.75	46.6	-0.85	44.50	48.8	-4.30
22	1213	F	6.15845	47.75	46.6	1.15	63.50	48.8	14.70
23	1319	F	6.16392	47.75	46.6	1.15	58.50	48.8	9.70
24	1204	F	6.18150	47.50	46.6	0.90	50.25	48.8	1.45
25	1117	F	6.18972	48.00	46.6	1.40	53.25	48.8	4.45
26	2511	M	6.20616	44.50	47.0	-2.50	41.00	50.6	-9.60
27	1210	F	6.22260	45.00	46.6	-1.60	48.00	48.8	-0.80
28	2422	M	6.24178	49.25	47.0	2.25	45.50	50.6	-5.10
29	1504	F	6.25000	44.75	46.6	-1.85	41.25	48.8	-7.55
30	2416	M	6.26484	48.25	47.0	1.25	58.50	50.6	7.90
31	1218	F	6.27306	44.50	46.6	-2.10	46.75	48.8	-2.05
32	2510	M	6.28127	47.50	47.0	0.50	54.50	50.6	3.90
33	1522	F	6.29498	46.50	46.6	-0.10	50.00	48.8	1.20
34	2521	M	6.29771	47.25	47.0	0.25	82.50	50.6	31.90
35	2112	M	6.30000	44.50	47.0	-2.50	45.75	50.6	-4.85
36	2503	M	6.30867	48.50	47.0	1.50	58.50	50.6	7.90
37	1106	F	6.31141	45.50	46.6	-1.10	42.75	48.8	-6.05
38	1107	F	6.31416	48.25	46.6	1.65	48.50	48.8	-0.30
39	1120	F	6.35913	47.25	46.6	0.65	47.25	48.8	-1.55
40	1514	F	6.35913	49.50	46.6	2.90	52.00	48.8	3.20
41	1309	F	6.36735	45.75	46.6	-0.85	48.50	48.8	-0.30
42	1307	F	6.37009	43.00	46.6	-3.60	39.75	48.8	-9.05
43	1201	F	6.37556	45.25	46.6	-1.35	47.75	48.8	-1.05
44	2207	M	6.39474	46.00	47.0	-1.00	46.25	50.6	-4.35
45	2419	M	6.39748	50.50	47.0	3.50	57.25	50.6	6.65
46	1516	F	6.41781	43.50	46.6	-3.10	42.50	48.8	-6.30
47	2324	M	6.42329	48.25	47.0	1.25	61.25	50.6	10.65
48	2512	M	6.44794	45.50	47.0	-1.50	55.25	50.6	4.65
49	1426	F	6.47260	45.75	46.6	-0.85	42.25	48.8	-6.55
50	1317	F	6.48356	48.00	46.6	1.40	50.00	48.8	1.20
51	1517	F	6.48630	44.00	46.6	-2.60	47.75	48.8	-1.05
52	2101	M	6.48904	45.00	47.0	-2.00	41.25	50.6	-9.35
53	1413	F	6.51210	51.75	46.6	5.15	75.25	48.8	26.45

DATA ON INITIAL HEIGHTS AND WEIGHTS, NCHS MEAN HEIGHTS AND WEIGHTS, AND DEVIATIONS BETWEEN NAVAJO AND NCHS VALUES
DEVIATIONS = NAVAJO (INITIAL) VALUE - NCHS MEAN

OBS	CODE	SEX	AGE	HT1	HTNCHS	HTDEV	WT1	WTNCHS	WTDEV
54	2405	M	6.55319	45.50	47.0	-1.50	40.50	50.6	-10.10
55	2505	M	6.55319	49.25	47.0	2.25	55.00	50.6	4.40
56	2123	M	6.58333	51.25	47.0	4.25	61.00	50.6	10.40
57	1216	F	6.58721	50.00	46.6	3.40	60.75	48.8	11.95
58	2125	M	6.63927	48.75	47.0	1.75	51.75	50.6	1.15
59	2113	M	6.64748	46.25	47.0	-0.75	50.00	50.6	-0.60
60	2208	M	6.65022	46.50	47.0	-0.50	56.50	50.6	5.90
61	1205	F	6.65296	46.25	46.6	-0.35	44.75	48.8	-4.05
62	2108	M	6.65570	45.25	47.0	-1.75	42.50	50.6	-8.10
63	1312	F	6.69246	49.75	46.6	3.15	50.75	48.8	1.95
64	1424	F	6.69521	46.75	46.6	0.15	54.50	48.8	5.70
65	1223	F	6.70068	50.25	46.6	3.65	64.00	48.8	15.20
66	2524	M	6.72260	48.50	47.0	1.50	58.75	50.6	8.15
67	2412	M	6.73356	43.75	47.0	-3.25	44.25	50.6	-6.35
68	1306	F	6.73630	48.00	46.6	1.40	56.50	48.8	7.70
69	1119	F	6.74178	43.00	46.6	-3.60	39.00	48.8	-9.80
70	2222	M	6.74451	45.75	47.0	-1.25	48.00	50.6	-2.60
71	1420	F	6.75388	46.75	46.6	0.15	52.25	48.8	3.45
72	1402	F	6.76210	47.75	46.6	1.15	56.00	48.8	7.20
73	2221	M	6.77306	48.50	47.0	1.50	52.75	50.6	2.15
74	1408	F	6.77579	47.75	46.6	1.15	42.00	48.8	-6.80
75	1104	F	6.78401	48.75	46.6	2.15	54.00	48.8	5.20
76	2509	M	6.82511	46.00	47.0	-1.00	48.00	50.6	-2.60
77	2515	M	6.82785	48.00	47.0	1.00	54.50	50.6	3.90
78	2316	M	6.83447	48.75	47.0	1.75	64.50	50.6	13.90
79	2310	M	6.85091	50.00	47.0	3.00	57.50	50.6	6.90
80	1121	F	6.87556	46.75	46.6	0.15	46.25	48.8	-2.55
81	2417	M	6.88105	48.25	47.0	1.25	51.25	50.6	0.65
82	1508	F	6.88927	48.25	46.6	1.65	52.00	48.8	3.20
83	1423	F	6.89201	48.25	46.6	1.65	65.00	48.8	16.20
84	2320	M	6.90000	45.75	47.0	-1.25	44.50	50.6	-6.10
85	2220	M	6.90296	46.50	47.0	-0.50	48.50	50.6	-2.10
86	1318	F	6.91119	43.50	46.6	-3.10	38.50	48.8	-10.30
87	1302	F	6.97808	48.50	46.6	1.90	52.75	48.8	3.95
88	1214	F	7.00114	48.75	48.7	0.05	48.50	54.5	-6.00
89	2410	M	7.00661	47.00	49.2	-2.20	50.00	55.3	-5.30
90	1315	F	7.01484	44.25	48.7	-4.45	43.25	54.5	-11.25
91	2314	M	7.04224	48.75	49.2	-0.45	59.00	55.3	3.70
92	1115	F	7.10000	45.25	48.7	-3.45	42.25	54.5	-12.25
93	1118	F	7.10913	47.25	48.7	-1.45	47.25	54.5	-7.25
94	1313	F	7.10913	48.50	48.7	-0.20	61.50	54.5	7.00
95	1212	F	7.12009	45.50	48.7	-3.20	44.00	54.5	-10.50
96	1103	F	7.15845	44.25	48.7	-4.45	40.25	54.5	-14.25
97	1211	F	7.16392	46.75	48.7	-1.95	49.25	54.5	-5.25
98	2501	M	7.18150	45.00	49.2	-4.20	59.00	55.3	3.70
99	1305	F	7.25000	49.00	48.7	0.30	66.25	54.5	11.75
100	2507	M	7.30000	50.50	49.2	1.30	55.00	55.3	-0.30
101	1219	F	7.37009	49.25	48.7	0.55	57.50	54.5	3.00
102	2301	M	7.37283	46.25	49.2	-2.95	51.75	55.3	-3.55
103	2401	M	7.40296	48.25	49.2	-0.95	52.00	55.3	-3.30
104	1523	F	7.51210	50.25	48.7	1.55	51.75	54.5	-2.75
105	2215	M	7.53401	51.00	49.2	1.80	66.00	55.3	10.70
106	2209	M	7.61187	52.50	49.2	3.30	64.00	55.3	8.70

DATA ON INITIAL HEIGHTS AND WEIGHTS, NCHS MEAN HEIGHTS AND WEIGHTS, AND DEVIATIONS BETWEEN NAVAJO AND NCHS VALUES
DEVIATIONS = NAVAJO (INITIAL) VALUE - NCHS MEAN

OBS	CODE	SEX	AGE	HT1	HTNCHS	HTDEV	WT1	WTNCHS	WTDEV
107	2308	M	7.61461	50.25	49.2	1.05	64.25	55.3	8.95
108	1105	F	7.61735	46.00	48.7	-2.70	46.50	54.5	-8.00
109	1110	F	7.63379	48.50	48.7	-0.20	51.50	54.5	-3.00
110	2202	M	7.70342	51.75	49.2	2.55	60.25	55.3	4.95
111	2114	M	7.76484	45.50	49.2	-3.70	42.25	55.3	-13.05
112	2525	M	7.80867	46.75	49.2	-2.45	49.75	55.3	-5.55
113	2203	M	7.84269	49.25	49.2	0.05	62.25	55.3	6.95
114	2518	M	7.91392	49.50	49.2	0.30	53.25	55.3	-2.05
115	2321	M	7.91666	48.50	49.2	-0.70	52.25	55.3	-3.05
116	1414	F	7.95068	52.25	48.7	3.55	89.25	54.5	34.75
117	1409	F	8.00000	45.50	51.3	-5.80	48.00	61.4	-13.40
118	1109	F	8.03127	46.75	51.3	-4.55	43.75	61.4	-17.65
119	1322	F	8.33333	49.00	51.3	-2.30	51.25	61.4	-10.15
120	1323	F	8.40296	49.50	51.3	-1.80	46.25	61.4	-15.15
121	2111	M	8.51210	55.25	51.2	4.05	109.25	62.3	46.95

SIMPLE STATISTICS FOR INITIAL HEIGHTS AND INITIAL WEIGHTS 21:50 MONDAY, JULY 25, 1988

VARIABLE	N	SUM	MEAN	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE	STANDARD DEVIATION	STD ERROR OF MEAN
HT1	121	5713.25000000	47.21694215	42.00000000	55.25000000	5.21452307	2.28353302	0.20759391
WT1	121	6326.55000000	52.28553719	36.50000000	109.25000000	111.09639325	10.54022738	0.95820249

SIMPLE STATISTICS FOR INITIAL HEIGHTS AND WEIGHTS ADJUSTED FOR SEX AND AGE OF CHILD!! 21:50 MONDAY, JULY 25, 1988 5

TEST HO: AVE HT = NCHS HT VS H1: AVE HT /= NCHS HT AND
HO: AVE WT = NCHS WT VS H1: AVE WT /= NCHS WT

VARIABLE	N	SUM	MEAN	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE	STANDARD DEVIATION	STD ERROR OF MEAN	T	PR>|T|
HTDEV	121	-22.75000000	-0.18801653	-5.80000000	5.20000000	5.0972510	2.25770924	0.20524629	-0.92	0.3615
WTDEV	121	130.45000000	1.07809917	-17.65000000	46.95000000	105.5619539	10.27433472	0.93403043	1.15	0.2507

DEVIATIONS = NAVAJO VALUE - NCHS MEAN (CALCULATED BY SEX)

TEST HO: AVE INTAKE = NCHS MEAN INTAKE
VS H1: AVE INTAKE /= NCHS MEAN INTAKE

VARIABLE	N	SUM	MEAN	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE	STANDARD DEVIATION	STD ERROR OF MEAN	T	PR>|T|
SEX=F										
CALDEV	62	587.785800	9.48041613	-1547.5213000	1316.134000	319560.77	565.287062	71.792799	0.13	0.8954
PROTDEV	62	64.609839	1.04209418	-54.0692810	63.245000	504.50	22.460975	2.852547	0.37	0.7161
FATDEV	62	294.751630	4.75405855	-58.8458000	85.536600	859.76	29.321737	3.723864	1.28	0.2066
CARBDEV	62	-553.527980	-8.92787065	-204.7063900	191.750800	7963.36	89.237671	11.333196	-0.79	0.4339
CADEV	62	-10879.276200	-175.47219677	-846.6679000	540.034000	110337.74	332.171252	42.185791	-4.16	0.0001
PDEV	62	-7028.329500	-113.36015323	-936.8673000	907.773000	136905.66	370.007642	46.991018	-2.41	0.0189
FEDEV	62	771.332335	12.44084411	-9.9193629	89.906700	630.87	25.117140	3.189880	8.90	0.0002
NADEV	62	-18026.564600	-290.75104194	-2390.9317000	1805.243000	1030625.00	1015.197025	128.930151	-2.26	0.0277
KDEV	62	10803.625100	174.25201774	-1832.5714000	2529.693000	756406.57	869.716372	110.454090	1.58	0.1198
VITADEV	62	34702.477700	559.71738226	-4540.2904000	72427.910000	94600076.53	9726.257067	1235.235883	0.45	0.6521
THIADEV	62	2.736533	0.04413762	-1.0579042	1.826389	0.28	0.532067	0.067573	0.65	0.5161
RIBODEV	62	-8.010979	-0.12920934	-1.5489779	6.138021	1.04	1.019929	0.129531	-1.00	0.3225
NIADEV	62	-4.243007	-0.06843560	-14.1330074	21.031090	41.30	6.426697	0.816191	-0.08	0.9335
ASCDEV	62	-1235.508668	-19.92755916	-105.4133110	106.232000	2790.89	52.828882	6.709275	-2.97	0.0043
PCPRODEV	62	23.463797	0.37844834	-7.6565590	9.855180	14.22	3.771033	0.478922	0.79	0.4325
PCFATDEV	62	59.487740	0.95947968	-13.7373500	25.248130	67.40	8.209565	1.042616	0.92	0.3611
PCCARDEV	62	-203.231340	-3.27792484	-36.0881100	14.190630	114.61	10.705555	1.359607	-2.41	0.0189
SEX=M										
CALDEV	54	-11606.868800	-214.94201481	-1599.3348000	1943.8690000	630181.34	793.839616	108.0278886	-1.99	0.0518
PROTDEV	54	-106.817580	-1.97810333	-60.4923700	90.6213000	1130.08	33.616646	4.5746461	-0.43	0.6672
FATDEV	54	86.375850	1.59955278	-68.9514300	143.5133000	2175.65	46.643904	6.3474314	0.25	0.8020
CARBDEV	54	-3025.916070	-56.03548278	-205.1920300	145.3458000	7177.05	84.717478	11.5285886	-4.86	0.0001
CADEV	54	-12807.365670	-237.17343833	-975.6551700	1718.9020000	206175.00	454.064978	61.7904170	-3.84	0.0003
PDEV	54	-9690.237700	-179.44884630	-1080.9250000	2129.4240000	317848.99	563.780977	76.7208734	-2.34	0.0231
FEDEV	54	589.147093	10.91013135	-10.7455850	88.1828000	728.20	26.985215	3.6722226	2.97	0.0045
NADEV	54	-17803.558600	-329.69552963	-2199.0669000	3703.2730000	1705427.75	1305.920268	177.7132389	-1.86	0.0691
KDEV	54	5679.703900	105.17970185	-2017.5714000	3231.9570000	1716192.75	1310.035399	178.2732373	0.59	0.5577
VITADEV	54	-30898.773900	-572.19951667	-4723.6452000	9594.8400000	15125949.23	3889.209332	529.2543537	-1.08	0.2845
THIADEV	54	-14.091676	-0.26095696	-1.1225252	1.5485790	0.35	0.590161	0.0803107	-3.25	0.0020
RIBODEV	54	-29.322015	-0.54300027	-1.8746018	1.2059910	0.53	0.726294	0.0988361	-5.49	0.0001
NIADEV	54	-181.090435	-3.35352657	-16.4270280	9.6754400	47.34	6.880564	0.9363261	-3.58	0.0007
ASCDEV	54	-476.906480	-8.83160148	-100.0233300	312.3789000	7589.52	87.117863	11.8552395	-0.74	0.4596
PCPRODEV	54	80.085759	1.48306961	-10.2789180	9.9993000	15.32	3.914174	0.5326517	2.78	0.0074
PCFATDEV	54	202.107000	3.74272222	-8.5557000	24.5240600	65.06	8.066278	1.0976814	3.41	0.0013
PCCARDEV	54	-357.792540	-6.62578778	-28.5614400	9.4817000	83.84	9.156449	1.2460349	-5.32	0.0001

SIMPLE STATISTICS FOR PCT OF RDA FOR 10 NUTRIENT INTAKES 15:26 TUESDAY, JULY 26, 1988

VARIABLE	N	SUM	MEAN	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE	STANDARD DEVIATION	STD ERROR OF MEAN
SEX=F								
PCTCAL	62	5647.9084100	91.09529694	11.25732000	161.58720000	946.031261	30.75762118	3.90622180
PCTCA	62	6219.5908000	100.31598065	16.41651000	189.75430000	1724.027689	41.52141218	5.27322462
PCTP	62	8266.4592700	133.32998823	30.37809000	260.97160000	2139.151216	46.25095909	5.87387768
PCTFE	62	14272.9233610	230.20844131	6.60637100	1004.86700000	63087.074375	251.17140437	31.89880025
PCTVITA	62	11457.6612500	184.80098790	10.61718000	2754.59900000	119379.848134	345.51388983	43.88030790
PCTHIA	62	7570.4054400	122.10331355	15.62505000	282.88120000	2531.471190	50.31372765	6.38984980
PCTRIBO	62	9814.6232600	158.30037516	30.78422000	724.06260000	8395.536614	91.62716080	11.63666107
PCTNIA	62	7048.1603950	113.68000637	5.96923500	287.43360000	2655.553927	51.53206698	6.54457805
PCTASC	62	12272.2037400	197.93877000	7.97042000	478.29340000	13782.179235	117.39752653	14.90950078
SEX=M								
PCTCAL	54	4822.7461500	89.31011389	19.16949000	233.16060000	1807.4088264	42.51363107	5.78537240
PCTCA	54	5648.5794300	104.60332278	12.29310000	349.11270000	3221.4841918	56.75812005	7.72380183
PCTP	54	7705.4708700	142.69390500	30.00938000	431.30310000	4966.3923742	70.47263564	9.59011101
PCTFE	54	12657.6710400	234.40131556	17.84415000	1007.12800000	72820.1857583	269.85215537	36.72222704
PCTVITA	54	8096.4509680	149.93427719	5.20600800	522.38210000	18871.8798278	137.37496070	18.69436429
PCTHIA	54	6198.0809600	114.77927704	27.57813000	303.79710000	3611.5840895	60.09645655	8.17809188
PCTRIBO	54	7888.6975600	146.08699185	30.52553000	276.96640000	3998.3909165	63.23283100	8.60489839
PCTNIA	54	5969.4244100	110.54489648	10.87229000	211.31750000	2852.4995477	53.40879654	7.26801663
PCTASC	54	11540.2081600	213.70755852	11.05927000	927.50870000	37479.1241372	193.59525856	26.34497778

SIMPLE STATISTICS FOR 17 NUTRIENT INTAKES FOR NAVAJO CHILDREN 21:50 MONDAY, JULY 25, 1988

VARIABLE	N	SUM	MEAN	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE	STANDARD DEVIATION	STD ERROR OF MEAN
SEX=F								
CALORY	62	112621.785800	1816.48041613	259.47870000	3123.1340000	319560.7686	565.29706223	71.79279870
PROT	62	4032.609839	65.04209418	9.93071900	127.2450000	504.4954	22.46097495	2.85254667
FAT	62	4758.751630	76.75405855	13.15420000	157.5366000	859.7643	29.32173726	3.72386436
CARBO	62	13706.472020	221.07212935	25.29361000	421.7508000	7963.3619	89.23767106	11.33319556
CA	62	49756.723800	802.52780323	131.33210000	1518.0340000	110337.7408	332.17125216	42.18579121
P	62	66131.670500	1066.63984677	243.03270000	2087.7730000	136905.6552	370.00764210	46.99101754
FE	62	1427.292335	23.02084411	0.66063710	100.4867000	630.8707	25.11714047	3.18988003
NA	62	137593.435400	2219.24895806	119.06830000	4315.2430000	1030624.9989	1015.19702467	128.93015106
K	62	147265.625100	2375.25201774	368.42860000	4730.6930000	756406.5686	869.71637250	110.45408976
VITA	62	337076.477700	5436.71738226	336.70960000	77304.8100000	94600076.5270	9726.25706667	1235.23588270
THIA	62	78.996533	1.27413762	0.17209580	3.0563890	0.2831	0.53206652	0.06757252
RIBO	62	115.369021	1.86079066	0.44102210	8.1280210	1.0403	1.01992858	0.12953106
NIA	62	925.136993	14.92156440	0.85699260	36.0210900	41.3024	6.42669655	0.81619128
ASC	62	5522.491332	89.07244084	3.58668900	215.2320000	2790.8908	52.82888216	6.70927474
PCTPROT	62	902.003797	14.54844834	6.51344100	24.1251800	14.2207	3.77103285	0.47892165
PCTFAT	62	2344.807740	37.81947968	23.12265000	62.1081300	67.3970	8.20956514	1.04261582
PCTCARB	62	2953.188660	47.63207516	14.82189000	65.1006300	114.6089	10.70555474	1.35960681
SEX=M								
CALORY	54	95367.131200	1766.05798519	381.66520000	3924.8690000	630181.3351	793.83961551	108.02788864
PROT	54	3835.182420	71.02189667	12.50763000	163.6213000	1130.0789	33.61664633	4.57464613
FAT	54	4460.375850	82.59955278	12.04857000	224.5133000	2175.6538	46.64390411	6.34743137
CARBO	54	10150.083930	187.96451722	38.80797000	389.3458000	7177.0511	84.71747829	11.52858856
CA	54	45188.634330	836.82656167	98.34483000	2792.9020000	206175.0042	454.06497800	61.79041701
P	54	61643.762300	1141.55115370	240.07500000	3450.4240000	317848.9903	563.78097728	76.72087339
FE	54	1265.767093	23.44013135	1.78441500	100.7128000	728.2018	26.98521509	3.67222264
NA	54	127078.441400	2353.30447037	483.93310000	6386.2730000	1705427.7451	1305.92026753	177.71323890
K	54	134523.703900	2491.17970185	368.42860000	5617.9570000	1716192.7457	1310.03539863	178.27323731
VITA	54	233269.226100	4319.80048333	168.35480000	14486.8400000	15125949.2280	3889.20933199	529.25435368
THIA	54	63.128324	1.16904304	0.30747480	2.9785780	0.3483	0.59016098	0.08031074
RIBO	54	91.637985	1.69699973	0.36539820	3.4459910	0.5275	0.72629431	0.09883614
NIA	54	779.029565	14.42647343	1.35297200	27.4554400	47.3422	6.88056376	0.93632613
ASC	54	5193.093520	96.16839852	4.97667000	417.3789000	7589.5220	87.11786280	11.85523952
PCTPROT	54	873.885759	16.18306961	4.42108200	24.6983000	15.3208	3.91417442	0.53265167
PCTFAT	54	2189.307000	40.54272222	28.24430000	61.3240600	65.0648	8.06627793	1.09768139
PCTCARB	54	2336.807460	43.27421222	21.33856000	59.3817000	83.8406	9.15644918	1.24603491

CORRELATIONS BETWEEN CLINICAL MEASURES AND NUTRIENT INTAKES
FOR EACH SEX

/1 PEARSON CORRELATION COEFFICIENTS /2 PROB > |R| UNDER HO:RHO=0 /3 NUMBER OF OBSERVATIONS

	WRIST	SKIN	SKPCT	ARM	ARPCT	MUSC	MUPCT	MUAR	MAPCT	FATA	FAPCT
CALORY	-0.11569	-0.16749	-0.11392	-0.05597	0.04521	0.06034	0.06134	0.05462	0.06161	-0.15565	-0.05614 /1
	0.2162	0.0775	0.2317	0.5578	0.6360	0.5274	0.5206	0.5674	0.5188	0.1013	0.5566 /2
	116	112	112	112	112	112	112	112	112	112	112 /3
PROT	-0.04878	-0.08533	0.00969	0.00541	0.09650	0.08089	0.08973	0.07417	0.08959	-0.07642	0.01950
	0.6030	0.3710	0.9192	0.9549	0.3115	0.3965	0.3468	0.4370	0.3475	0.4232	0.8383
	116	112	112	112	112	112	112	112	112	112	112
FAT	-0.07261	-0.13232	-0.07147	-0.01690	0.07770	0.08805	0.07768	0.08024	0.07939	-0.11559	-0.02966
	0.4386	0.1643	0.4540	0.8596	0.4154	0.3559	0.4156	0.4004	0.4054	0.2249	0.7562
	116	112	112	112	112	112	112	112	112	112	112
CARBO	-0.14249	-0.17556	-0.16313	-0.10022	-0.02575	0.00181	0.01313	0.00024	0.01202	-0.17124	-0.09389
	0.1270	0.0641	0.0857	0.2931	0.7876	0.9849	0.8907	0.9980	0.8999	0.0710	0.3248
	116	112	112	112	112	112	112	112	112	112	112
CA	-0.02490	-0.09564	-0.07203	-0.01756	0.01134	0.05575	0.01739	0.05345	0.01641	-0.08165	-0.06275
	0.7908	0.3158	0.4504	0.8542	0.9056	0.5593	0.8556	0.5757	0.8637	0.3921	0.5110
	116	112	112	112	112	112	112	112	112	112	112
P	-0.05994	-0.10611	-0.05107	-0.01526	0.03702	0.06810	0.05476	0.06148	0.05476	-0.08949	-0.03581
	0.5227	0.2655	0.5928	0.8731	0.6984	0.4756	0.5664	0.5196	0.5664	0.3481	0.7078
	116	112	112	112	112	112	112	112	112	112	112
FE	0.00283	0.02328	0.03976	0.04228	0.03841	0.04262	0.00985	0.05147	0.00958	0.02387	0.05809
	0.9760	0.8075	0.6772	0.6580	0.6876	0.6554	0.9179	0.5899	0.9202	0.8027	0.5429
	116	112	112	112	112	112	112	112	112	112	112
NA	-0.01485	-0.03326	0.01718	0.05471	0.11064	0.10930	0.10179	0.10908	0.10067	-0.01988	0.03655
	0.8743	0.7277	0.8573	0.5667	0.2455	0.2513	0.2855	0.2523	0.2909	0.8352	0.7021
	116	112	112	112	112	112	112	112	112	112	112
K	-0.11182	-0.17929	-0.17202	-0.10407	-0.06017	-0.00070	0.03720	-0.01212	0.03800	-0.15922	-0.13962
	0.2321	0.0586	0.0697	0.2748	0.5285	0.9942	0.6970	0.8991	0.6908	0.0936	0.1420
	116	112	112	112	112	112	112	112	112	112	112
VITA	-0.05718	-0.05156	-0.10583	-0.04392	-0.03783	-0.02089	0.08218	-0.02298	0.08254	-0.04444	-0.10443
	0.5421	0.5892	0.2668	0.6457	0.6921	0.8270	0.3890	0.8099	0.3869	0.6418	0.2732
	116	112	112	112	112	112	112	112	112	112	112
THIA	-0.17411	-0.17612	-0.15904	-0.14624	-0.08133	-0.06577	0.01770	-0.07170	0.01590	-0.17622	-0.13859
	0.0616	0.0632	0.0939	0.1239	0.3940	0.4909	0.8531	0.4525	0.8678	0.0631	0.1450
	116	112	112	112	112	112	112	112	112	112	112
RIBO	-0.14776	-0.15881	-0.16568	-0.12109	-0.07170	-0.04336	0.04502	-0.04903	0.04391	-0.15517	-0.14790
	0.1134	0.0944	0.0808	0.2034	0.4525	0.6499	0.6374	0.6077	0.6457	0.1023	0.1196
	116	112	112	112	112	112	112	112	112	112	112
[illegible]	-0.18808	-0.21275	-0.20241	-0.13519	-0.06895	-0.01812	0.06635	-0.02860	0.06529	-0.19698	-0.17151
	0.0432	0.0243	0.0323	0.1553	0.4701	0.8496	0.4870	0.7647	0.4940	0.0374	0.0706
	116	112	112	112	112	112	112	112	112	112	112

CORRELATIONS BETWEEN CLINICAL MEASURES AND NUTRIENT INTAKES
FOR EACH SEX

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=O / NUMBER OF OBSERVATIONS

	WRIST	SKIN	SKPCT	ARM	ARPCT	MUSC	MUPCT	MUAR	MAPCT	FATA	FAPCT
ASC	-0.00983	-0.09480	-0.05627	0.01279	0.10443	0.09991	0.17858	0.09428	0.17865	-0.07285	-0.01753
	0.9166	0.3201	0.5557	0.8935	0.2732	0.2946	0.0596	0.3228	0.0595	0.4452	0.8545
	116	112	112	112	112	112	112	112	112	112	112
PCTPROT	0.08709	0.13475	0.22212	0.11554	0.13423	0.05571	0.09537	0.05340	0.09425	0.12658	0.16778
	0.3526	0.1566	0.0186	0.2251	0.1582	0.5596	0.3172	0.5761	0.3229	0.1835	0.0770
	116	112	112	112	112	112	112	112	112	112	112
PCTFAT	0.06993	0.08433	0.09247	0.07644	0.06368	0.04098	0.00878	0.03614	0.01130	0.08887	0.07559
	0.4557	0.3767	0.3322	0.4231	0.5047	0.6679	0.9268	0.7052	0.9059	0.3514	0.4283
	116	112	112	112	112	112	112	112	112	112	112
PCTCARB	-0.08967	-0.11946	-0.15945	-0.10576	-0.10264	-0.05432	-0.04356	-0.04953	-0.04516	-0.12000	-0.12507
	0.3384	0.2096	0.0931	0.2671	0.2815	0.5695	0.6484	0.6040	0.6364	0.2076	0.1889
	116	112	112	112	112	112	112	112	112	112	112

CORRELATIONS BETWEEN CLINICAL MEASURES AND PERCENTS OF RDA
FOR EACH SEX

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	WRIST	SKIN	SKPCT	ARM	ARPCT	MUSC	MUPCT	MUAR	MAPCT	FATA	FAPCT
PCTCAL	-0.09800	-0.13427	-0.06420	-0.03632	0.10433	0.06101	0.14156	0.05587	0.14155	-0.12972	-0.00713
	0.2953	0.1581	0.5012	0.7038	0.2737	0.5228	0.1365	0.5584	0.1366	0.1728	0.9405
	116	112	112	112	112	112	112	112	112	112	112
PCTCA	-0.02490	-0.09564	-0.07203	-0.01756	0.01134	0.05575	0.01739	0.05345	0.01641	-0.08165	-0.06275
	0.7908	0.3158	0.4504	0.8542	0.9056	0.5593	0.8556	0.5757	0.8637	0.3921	0.5110
	116	112	112	112	112	112	112	112	112	112	112
PCTP	-0.05994	-0.10611	-0.05107	-0.01526	0.03702	0.06810	0.05476	0.06148	0.05476	-0.08949	-0.03581
	0.5227	0.2655	0.5928	0.8731	0.6984	0.4756	0.5664	0.5186	0.5664	0.3481	0.7078
	116	112	112	112	112	112	112	112	112	112	112
PCTFE	0.00283	0.02328	0.03876	0.04228	0.03841	0.04262	0.00985	0.05147	0.00958	0.02387	0.05809
	0.9760	0.8075	0.6772	0.6580	0.6876	0.6554	0.9179	0.5899	0.9202	0.8027	0.5429
	116	112	112	112	112	112	112	112	112	112	112
PCTVITA	-0.04565	-0.04066	-0.08668	-0.03620	-0.01713	-0.01578	0.10337	-0.02051	0.10372	-0.03623	-0.08557
	0.6266	0.6703	0.3635	0.7047	0.8577	0.8442	0.2781	0.8300	0.2764	0.7045	0.3697
	116	112	112	112	112	112	112	112	112	112	112
PCTHIA	-0.13695	-0.13709	-0.09778	-0.11926	-0.00843	-0.05921	0.10210	-0.06404	0.10004	-0.14622	-0.07814
	0.1427	0.1495	0.3051	0.2104	0.9297	0.5352	0.2841	0.5023	0.2940	0.1239	0.4128
	116	112	112	112	112	112	112	112	112	112	112
PCTRIBO	-0.12524	-0.12529	-0.11548	-0.09985	-0.01305	-0.04059	0.11534	-0.04549	0.11405	-0.12931	-0.09757
	0.1804	0.1881	0.2253	0.2949	0.8914	0.6709	0.2259	0.6339	0.2312	0.1742	0.3061
	116	112	112	112	112	112	112	112	112	112	112
PCTNIA	-0.16725	-0.18062	-0.15053	-0.11915	-0.00971	-0.02186	0.14335	-0.03117	0.14191	-0.17435	-0.11957
	0.0727	0.0567	0.1131	0.2108	0.9191	0.8190	0.1316	0.7442	0.1356	0.0660	0.2092
	116	112	112	112	112	112	112	112	112	112	112
PCTASC	-0.00983	-0.09480	-0.05627	0.01279	0.10443	0.09991	0.17858	0.09428	0.17865	-0.07285	-0.01753
	0.9166	0.3201	0.5557	0.8935	0.2732	0.2946	0.0596	0.3228	0.0595	0.4452	0.8545
	116	112	112	112	112	112	112	112	112	112	112

CORRELATIONS BETWEEN CLINICAL MEASURES AND PERCENTS OF RDA
FOR EACH SEX 10:52 WEDNESDAY, AUGUST 3, 1983

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	WRIST	SKIN	SKPCT	ARM	ARPCT	MUSC	MUPCT	MUAR	MAPCT	FATA	FAPCT
PCTCAL	-0.09800	-0.13427	-0.06420	-0.03632	0.10433	0.06101	0.14156	0.05587	0.14155	-0.12972	-0.00713
	0.2953	0.1581	0.5012	0.7038	0.2737	0.5228	0.1365	0.5584	0.1366	0.1728	0.9405
	116	112	112	112	112	112	112	112	112	112	112
PCTPRT	-0.03530	-0.06808	0.03501	0.01564	0.12503	0.08128	0.12378	0.07508	0.12357	-0.06327	0.04483
	0.7068	0.4757	0.7140	0.8700	0.1890	0.3942	0.1935	0.4314	0.1943	0.5075	0.6388
	116	112	112	112	112	112	112	112	112	112	112
PCTCA	-0.02490	-0.09564	-0.07203	-0.01756	0.01134	0.05575	0.01739	0.05345	0.01641	-0.08165	-0.06275
	0.7908	0.3158	0.4504	0.8542	0.9056	0.5593	0.8556	0.5757	0.8637	0.3921	0.5110
	116	112	112	112	112	112	112	112	112	112	112
PCTP	-0.05994	-0.10611	-0.05107	-0.01526	0.03702	0.06810	0.05476	0.06148	0.05476	-0.08949	-0.03581
	0.5227	0.2655	0.5928	0.8731	0.6984	0.4756	0.5664	0.5196	0.5664	0.3481	0.7078
	116	112	112	112	112	112	112	112	112	112	112
PCTFE	0.00283	0.02328	0.03976	0.04228	0.03841	0.04262	0.00985	0.05147	0.00958	0.02387	0.05809
	0.9760	0.8075	0.6772	0.6580	0.6876	0.6554	0.9179	0.5899	0.9202	0.8027	0.5429
	116	112	112	112	112	112	112	112	112	112	112
PCTVITA	-0.04565	-0.04066	-0.08668	-0.03620	-0.01713	-0.01878	0.10337	-0.02051	0.10372	-0.03623	-0.08557
	0.6266	0.6703	0.3635	0.7047	0.8577	0.8442	0.2781	0.8300	0.2764	0.7045	0.3697
	116	112	112	112	112	112	112	112	112	112	112
PCTHIA	-0.13695	-0.13709	-0.09778	-0.11926	-0.00843	-0.05921	0.10210	-0.06404	0.10004	-0.14622	-0.07814
	0.1427	0.1495	0.3051	0.2104	0.9297	0.5352	0.2841	0.5023	0.2940	0.1239	0.4128
	116	112	112	112	112	112	112	112	112	112	112
PCTRIBO	-0.12524	-0.12529	-0.11548	-0.09985	-0.01305	-0.04059	0.11534	-0.04549	0.11405	-0.12931	-0.03757
	0.1804	0.1881	0.2253	0.2949	0.8914	0.6709	0.2259	0.6339	0.2312	0.1742	0.3061
	116	112	112	112	112	112	112	112	112	112	112
PCTNIA	-0.16725	-0.18062	-0.15053	-0.11915	-0.00971	-0.02186	0.14335	-0.03117	0.14191	-0.17435	-0.11957
	0.0727	0.0567	0.1131	0.2108	0.9191	0.8190	0.1316	0.7442	0.1356	0.0660	0.2092
	116	112	112	112	112	112	112	112	112	112	112
PCTASC	-0.00983	-0.09480	-0.05627	0.01279	0.10443	0.09991	0.17858	0.09428	0.17865	-0.07285	-0.01753
	0.9166	0.3201	0.5557	0.8935	0.2732	0.2946	0.0596	0.3228	0.0595	0.4452	0.8545
	116	112	112	112	112	112	112	112	112	112	112

VITA

Karen Lee Perce

Candidate for the Degree of

Doctor of Philosophy

Thesis: A STUDY OF NUTRITIONAL PARAMETERS AMONG NAVAJO CHILDREN

Major Field: Home Economics

Biographical:

Personal Data: Arrived in Boulder, Colorado, as the daughter of Harold E. and Georgia M. Johnson.

Education: Graduated from Kersey High School, Kersey, Colorado, in 1957, received a Bachelor of Science Degree in Home Economics and Dietetics from the University of New Mexico, Albuquerque, New Mexico, in 1961; Masters of Education from the University of New Mexico, 1970. Interim education was done at Iowa State University, Ames, Iowa; University of Northern Colorado, Greeley, Colorado; Arizona State University, Tempe, Arizona, and Northern Arizona University, Flagstaff, Arizona.

Professional Experience: Home economics educator and vocational program director in secondary education for the Window Rock Public Schools, Fort Defiance, Arizona. For the University of New Mexico-Gallup Branch taught child care and development and nutrition for the nursing program as well as various clothing construction and foods classes for teacher recertification. English language coordinator for Naha Cultural Center, Naha, Okinawa; Administrator for the Machinato Nursery School, Okinawa; Program coordinator for the University of Rhyukus and Michigan State University.