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**STUDY OF DIETARIES AND NUTRITIONAL STATUS OF
ADOLESCENT INDIAN GIRLS IN BOARDING
SCHOOLS OF THE DAKOTAS**

BY

MARGARET I. TALCOTT

**A thesis submitted
in partial fulfillment of the requirements for the
degree Master of Science, Department of
Foods and Nutrition, South Dakota
State College of Agriculture
and Mechanic Arts**

December 1960

**STUDY OF DIETARIES AND NUTRITIONAL STATUS OF
ADOLESCENT INDIAN GIRLS IN BOARDING
SCHOOLS OF THE DAKOTAS**

This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and acceptable as meeting the thesis requirements for this degree; but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Advisor

head of the Major Department

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M.I.T.

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CHAPTER I

INTRODUCTION

The adolescent period is recognized as a crucial one in the development of individuals. This study is centered around the nutritional status of girls who are in this stage of development. For that reason the study should be expected to increase the total amount of information in regard to their nutrition and dietary practices, and in addition may assist in predicting the general health of a coming generation.

Cooperative regional studies by experiment stations and school lunch studies in several states have covered many phases of nutritional status for various population groups in recent years. A Survey of the Nutritional Habits of South Dakota School Children (1) reports dietaries of a generous sampling of children in the first through the twelfth grades during the 1946-47 school year. Check type questionnaires were used in public schools and included adolescents, but the number of Indian children was small.

Investigators agree that there is need for further information in regard to the dietary practices and nutritional status of adolescents, and there appears to be the greatest concern with respect to adolescent girls. In general, dietary needs for adolescents must meet the needs for the spurt in growth, and be sufficient to overcome adverse influences due to the emotional stresses of the period.

Though the association of nutrition and tuberculosis is not clear, it is being given careful study among adolescents because of the high morbidity rates for the disease within this age group (18). Dr. Genevieve Stearns, a well known research professor in the pediatrics department of the University of Iowa, states, "Good nutrition during childhood and adolescence is particularly important for girls, for the childbearing age begins in adolescence." She maintains too, that, "In order to assure the birth of healthy infants, carried to term, the mother's diet should be nutritionally adequate from early childhood so that she enters pregnancy with a full store of nutritional essentials." (37) Evidence from continued research in this field shows that faulty diets of teenage mothers have led to a high incidence of complications of pregnancy and to the birth of defective infants (2).

The average annual birth rate for Indians in the United States was shown in a Public Health Service report as 32.1 per 1,000 population as contrasted to the 24.5 births for all races in the United States in the years 1949-53. This same report indicated a larger proportion of children among the Indian population which in turn brought the birth rates when calculated per 1,000 women of childbearing age to a figure 50 per cent higher than for the general population. These statistics per 1,000 females 15-44 years of age are 137.2 for Indians and 106.2 for non-Indian population groups (16). The implication here is that adolescent girls in the Indian population will probably be bearing children more, frequently, and over a longer period of years than girls of corresponding ages in the general population.

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Anthropological, sociological, and general health studies among Indian population groups have pointed up the importance of additional information about dietary practices and nutritional status. Dr. Bertlyn Masley, who heads the Nutritional and Dietetics Branch of the Division of Indian Health has underlined the relationship of nutrition and health by saying, "Nutritionists as well as other members of the health profession should be concerned about a death rate among Indian infants approximately three times that of the infants of the rest of the United States, and the fact that the life expectancy for Indians is approximately ten years less than for non-Indians" (3). In connection with establishing a program for her group she poses several questions which she feels must be answered as a basis for action. Two of these are particularly pertinent to this study: "What are the present dietary practices of the Indians living on the reservations and in the villages? What is the nutritional status of Indians living on the reservations and in the villages?" (3)

The present study is part of a larger one on dietary intake and certain physical and biochemical measures of 7 to 14 year old boys and girls in Indian boarding schools. The purpose of the study was to obtain information which would enable investigators to assess the nutritional status of the Indian children.

This study includes observations on Indian girls 12 to 14 years old only.

CHAPTER II

REVIEW OF THE LITERATURE

A study to define characteristics and origin of the moderate anemia previously observed over a widespread area among Alaskan Eskimos, was carried out in four villages in the early 1950's by workers of the Arctic Research Center of the Public Health Service in Anchorage. Group dietary practices were studied in conjunction with hematological work and iron therapy. Some striking differences in eating habits were noted as between villages only short distances from each other. All school children in the study were receiving breakfasts at their schools and it was pointed out that they exhibited more nearly normal hemoglobin levels than did any of the adults. The usual breakfast was one of soup, beans, rice or oatmeal. The mean value for the 128 school children of all ages included from each village ranged from 11.79 to 13.21 gram-per cent. The investigators report further findings which do not substantiate low dietary iron intake as the only cause for the "wide-spread moderate anemia", however. They summarize by saying that iron deficiency and another factor were responsible for low hemoglobin levels found in Eskimos (36).

Presently Dr. Christine Meller, a research nutritionist from the Arctic Research Center, is at work in the same general area; gathering more specific information on dietary practices, preparing food samples for analysis, and obtaining additional blood samples and urine samples

for biochemical determinations. In the villages where she is working, an Interdepartmental Committee on Nutrition for National Defense team has conducted a medical nutritional survey of individuals (3).

A homemaking teacher in the Federal Indian schools with many years of experience among the North Carolina Cherokees (9) wished to determine the degree to which homemaking experience in the school programs had affected the dietary habits and living conditions of these people as of the late 1930's. Her method of study was to interview with a questionnaire and to make observations during home visits in a total of ninety-nine households, thirty-three of which were in each of three generations. The families included in her study were chosen on the basis of being as nearly full-blood Indians as was practicable. All those in the study were in the pattern of first, second, and third generation Cherokee women and most of them were actually in the grandmother, mother, and daughter categories.

The three generations ranged in schooling from very little (first generation), through those with schooling of from 1 to 10 years with no specialized home economics (second generation), to those with from 3 to 13 years including an average of 5.4 years of home economics (third generation).

The author uses several means to compare the relationship of formal training to changes in dietary habits and living conditions among these women. In each case the women studied had homes of their own and were responsible for the dietary habits of the family. The family sources

of food supply varied: 39 per cent of the first generation families, only one per cent of the second generation, and none of the third generation families were receiving "rations." These "rations" were made up of staple foods supplied by tribal funds to those too old or sick to work or to raise their own food. Second generation families were in the majority as far as owning milk cows and raising chickens, and practically all families studied produced a garden of some kind, along with the gathering and using of native greens, fruits and nuts. A few more families in the second and third generations produced their own fruit and preserved foods by both canning and drying. The author shows that those homemakers who had home economics in the schools raised a greater variety of vegetables with high nutritive value in their gardens, and that they canned a larger percentage of produce than did the others.

In addition to comparing food sources, the author compared daily dietary habits by checking on number of meals served per day, types of foods served, methods of preparation, and the feeding of babies and young children. It appears generally true that the greatest improvement was made in types of gardens, care of fruit trees, and care of chickens, by women in the third generation. It was in these families that much more milk was used, and the variety of foods preserved increased. Also the so-called "native" foods were being replaced by less starchy ones, and regular meals three times a day were more prevalent. Less coffee was being used and none was served to babies

among third generation homemakers as opposed to the first generation group who gave coffee but no milk to babies and infants when breast feeding terminated. The author states that breast feeding of babies was almost universal among Eastern Cherokee women, but that supplementary feedings showed differences as between the two younger generations. Here third generation mothers gave babies cereals, milk, egg, cooked vegetables and fruits, orange juice and cod liver oil than did any of these in the second.

In summarizing her thesis, Flanagan indicates that all the changes for the better in dietary practices and living conditions as shown in her study could hardly be attributed to home economics in the schools, but does conclude that knowledge and understanding of the nutritive value of foods in addition to experiences in preparing and preserving a variety of different foods might well have some bearing on these changes.

The Hopi Way (40) is one in a series of reports on interdisciplinary studies conducted among several Indian tribes during the early nineteen-forties. In the section dealing with health, food and sickness, Dr. Alice Joseph discusses the results of her medical examination of 153 school children from two separate Hopi villages, who ranged in age from six to 18 years. She states that, "looking for children in good health according to medical standards, we find an extremely low percentage even if we include those who show a few decayed teeth or very slight shortsightedness." Her findings do not

include any obtained by biochemical methods or x-ray, but weights and heights were taken and special attention was given to possible manifestations of nutritional deficiencies. She refers to earlier work by Watson and Pijon in which some quantitative data on winter and spring diets of households in the same two villages are combined with the results of Dr. Pijon's clinical examinations of 56 children. These physical examinations included bone and chest x-rays and emphasized evidences of specific vitamin and other nutritional deficiencies. Dr. Joseph quotes from the dietary analysis made by these authors, "The Hopi diet is notably deficient in protein, somewhat less deficient in fats, and perhaps in certain cases or at certain times of the year slightly deficient in carbohydrates;" the caloric intake is just "adequate and no more" for adults, and less than normal for children; and the estimated average vitamin consumption is considerably below established recommendations. These statements about observed diets presumably were supported by the findings of Dr. Pijon's medical examinations of children from one of the villages represented. Dr. Joseph says regarding her results, "The kinds of disorders which we find prevalent . . . may . . . very well point to a dietary influence on the actual physiological conditions. Apart from real undernourishment, many of the children show one or the other sign of a vitamin deficiency, as cracked lips, inflamed tongue, bleeding gums, etc., which even if their weight is adequate, indicates malnutrition".

A study (2) reported in the Proceedings of the Oklahoma

Academy of Science in 1953, was done in 1951 among Kiowa Indians living in a community where there was very little admixture with white people. The investigation was a joint project of the Medical Division of the United States Indian Service, the Oklahoma State Health Department, and the School of Home Economics at the University of Oklahoma, with the consent of the tribal leaders. A random selection of approximately 25 per cent of the 107 families was made to include a total of thirty families composed of eighty-one individuals who ranged in age from five to 78 years.

The procedure was to obtain 24-hour dietary recall histories from the families by use of a nutritional questionnaire developed by Dr. Burton of the University of Oklahoma, before and after they were scheduled for physical examinations where "physical signs usually associated with Nutritional deficiencies" were emphasized. In order to evaluate the dietary history for each family, the information on the number and size of servings of eight food groups was recorded. These groups were: meat, fish and poultry; milk; eggs; fruit (to include an ascorbic acid source plus other); vegetables (green or yellow, potatoes, legumes, etc.); cereals (whole grain or enriched as well as refined); fats (butter, fortified margarine, etc.); and bread. All the food groups had a previously assigned numerical value to be used in determining the scores by families. The final score for each family reflected both the presence of recommended food groups and the degree to which each family member consumed the

recommended amounts of those foods.

In the physical examinations all individuals were checked for 74 symptoms of nutritional deficiencies. Many of these dealt with dental and mouth conditions, and these difficulties were reported as most prevalent, though excessive subcutaneous fat is mentioned as occurring in more than one individual. The authors state that 27 persons had at least one symptom, and that 13 had combinations which indicated two or more deficiencies. The fasting venous blood of all individuals was tested for whole blood and plasma specific gravity, plasma proteins, ascorbic acid, and pyruvic acid. The mean figures for specific gravity were on the low side of the normal range. Fifty per cent of the subjects had hemoglobin values below the normal means, though only 40 per cent of the children had values less than 12 grams/100 ml. Mean values for pyruvic acid of the blood were high at every age level, and for ascorbic acid the mean values were only slightly above a suggested minimum of 0.5 mg./ml.

The diet deficiencies as shown in the dietary studies were marked in milk, vegetables and fruits, and meat, fish, and poultry, indicating diets low in mineral elements (especially calcium), vitamins (the B vitamins and ascorbic acid in particular), and fairly low in proteins. The authors point out that these lacks show up in the results of the various tests, with 90 per cent of the group showing some signs of poor nutrition.

In a report (7) published in 1956, Darby et al., presented a

very comprehensive picture of the present day nutrition of the Navajo. Two areas of the reservation were chosen for study because of their wide differences in degree of isolation from influences of the "white man's culture". The investigators did dietary appraisals, biochemical assessments, and physical examinations on 1,246 subjects. In dealing with the subject of dietary patterns, the authors refer to numerous earlier studies on specific plants and particular foods in the Navajo diet. They note that in a 1939 report Carpenter and Steggarda list many such items which were analyzed for moisture, fat, nitrogen and caloric content. Of all the previously reported wild plants characteristic of the Navajo diet, nineteen examples were found in use in one of the regions of this study, but these were not considered significant quantitatively at the present time. In fact in the final interpretation of the study, Darby, McGinity and Bridgeforth state that the Navajo, "Lives by combining home-produced meat and a few other products with flour, shortening, coffee, potatoes, sweets, some milk and fruits and a limited variety of other foods purchased at the trading post". The use of wild game has become quite negligible, and the home-produced meat is primarily sheep or goat. Qualitative information was secured in regard to food production, storage, and frequency of certain items in the diet through: purchase lists obtained at trading posts, direct inquiry made of families in the survey about frequency of eating and source of foods, discussions held with various workers in the area; and some observations in hogans, at ceremonials, and gatherings such as

sheep dippings and redeos. School feeding data were obtained also, but results are not available.

In reporting biochemical assessments and physical examinations, results are given by age and sex groups, and the findings on those comparable to the group described in this study will be discussed later.

In summarizing results, the authors conclude that there is little clinical evidence of gross nutritional deficiency. There was acceptable caloric nourishment, no problem of anemia or protein malnutrition, though some poorly fed infants were noted in the most isolated area. They stated that "No certain cases of diagnosable rickets were seen". Dental caries was variable, no widespread severe vitamin B-complex deficiency was noted, and there was a high degree of protection against clinical avitaminosis A. But there was evidence of "low vitamin C nutriture". They advised caution in educating for future dietary acculturation to guard against lessening the quantity of such items as potatoes and the visceral meats available when home butchering is done, since these two foods alone appear to be the major sources of vitamin C and A respectively. They also acknowledge the effect of the altitude at which these people live in contributing to the "higher-than-usual" hemoglobin concentrations.

Another tribal group, the Papago located in the Southwest, has come in for a considerable amount of study. Dr. Pijon, who was quoted in The Hopi Way regarding Hopi diets and health status, has also

reported on ascorbic acid deficiency among the Papago. A report of some of this work (33) published in 1943, describes the low plasma levels which he found among 28 school children in that area. These included one of 0.660 mg.%, two of 0.528 mg.%, and the remainder from 0.264 to 0.396 mg.%. In the U. S. Indian Service Nutrition Laboratory at the University of New Mexico the predominant foods in the Papago diet were assayed for ascorbic acid. Included were many varieties of beans, garden peas, corn, pumpkin, dried chili, native spinach, wheat, and available varieties of cactus. From the results which showed only negligible amounts in foods ordinarily occurring in the diets, the authors state that, "In a diet consisting essentially of cooked carbohydrate, where chili and other ascorbic acid-containing foods are only incidental, the ascorbic acid content never exceeds 15 mg. a day and is, generally speaking, on an average of about 5 mg. a day." The use of milk, after breast feeding is terminated, is very rare, as is the inclusion of animal protein from any source.

In the clinical assessments numerous avitaminoses were noted, all "superimposed one on the other". "Hemorrhagic diathesis about the ankles and heels," bleeding gums, and loose teeth were very common. Pijoan, Elkin, and Eslinger point out that the outlook is poor in regard to ascorbic acid being readily increased in the diet of these people, since very few sources of the nutrient are easily available where they live.

In The Desert People (20) published in 1949, Dr. Alice Joseph

reported her physical examinations of 113 Papago school children as part of an interdisciplinary research project. Her results indicate only seven per cent in good health, almost half appearing thin and emaciated with just about an equal number exhibiting at least one symptom of vitamin deficiency, and over 30 per cent showing acute respiratory infections. Dr. Joseph reviews earlier findings which suggest that the Papago diet, which is largely dependent upon the limited agricultural resources of the area and upon cultural traditions, is inadequate, "especially for children, who require more high-grade proteins and more vitamins than adults." From her experience with the Papago, Dr. Joseph comes to this further conclusion, "Another factor which may aggravate the conditions of undernourishment and malnutrition produced by the limitations of Papago diet is perhaps found in the general attitude of adult Papago toward their children." She continues, "Recognition of the difference between the needs and reactions of the child and the adult, as far as it is determined by such factors as the physiological process of growth, does not seem to be a part . . . of the pattern of training and guidance of children." And this deference to the child's wishes in regard to eating certain foods, or even to eating at all, very often means a "further restriction or increased imbalance of Papago diet--a restriction which favors undernourishment and malnutrition."

A more recent study (41, 28) was conducted among the Papago in the spring of 1949, by workers in the Department of Nutrition at the

University of Arizona. One hundred and fifteen boys and girls in two different types of day schools on the reservation were chosen at random for an investigation which was part of the Western Region Research Project on nutritional status of population groups. The number of children chosen was nearly equal in each type of school, and the age range was from 12 to 16 years with one child of 11 years included. Background information on dietary intake which was of a general nature corresponded closely to that reported by Dr. Pijoan, and is characterized as "submarginal according to modern nutritional standards". The noon lunches in the group of schools where they were termed "ample" were evaluated by calculation of nutrients from typical menus, and these were contrasted with lunches observed in the schools where they were considered "limited" as to amounts and variety of foods served. The assessment of nutritional status for the groups whose family backgrounds could be considered comparable, but whose dietary intake at the school lunch was thus contrasted, was carried out by physical examinations for clinical signs of nutritional deficiencies. Blood samples were analyzed for: vitamin A and carotene; ascorbic acid; riboflavin; total and free cholesterol; protein; glucose; hemoglobin; hematocrit; and sedimentation rate. Heights and weights were recorded, and bone density determinations were obtained.

The findings show significant differences in nutritional status in regard to vitamins A and C in particular, but there was no clear variation in height and weight, or in the results of the blood analyses

other than for ascorbic acid and vitamin A and carotene values, as between the "ample" and "limited" lunch groups. The bone density, among girls only, was better in the school serving the "ample" lunch. The height and weight and hemoglobin results from these groups of Papago school girls will be discussed later in this study for comparison with Indian girls of the Dakotas.

Another study (32) reported in 1944, was conducted by Pijoan and Elkin among the Shoshone of western Wyoming. Because of his wide observations of dietary deficiencies and their encompassing effects among children of school age, Dr. Pijoan planned this study to investigate the anemia which was the first deficiency to emerge among the infants of this tribe. He describes cow's milk, and milk from mothers in the general population as containing 2.4 mg./liter of iron, and explains that under normal conditions that this concentration has been proven insufficient to prevent anemia in infants if fed exclusively beyond the first few months of life. In the case of the eleven healthy lactating Shoshone Indian women the assays of iron in milk averaged approximately 1.72 mg./liter. Their diet is, "high in refined cereal carbohydrate and fat and low in meat and vegetable proteins and iron containing foods," and "might conceivably play a role in reducing the iron content of maternal milk." The hemoglobin figures given for the infants at birth varied but secondary anemia appeared during the fourth and fifth week in all infants. This situation is of great concern for in this and in other Indian tribes a continued and exclusive milk

feeding is apt to continue for one or two years.

A report of a 1957 health survey (29) carried out on the Wind River reservation in Wyoming describes pediatric evaluations of both Shoshone and Arapahoe children 12 years old and younger in a sampling of 60 families. The survey was initiated at the request of the Joint Tribal Council Board of Health, and was well planned, supported, and staffed. Cooperating agencies included the Division of Indian Health, Children's Bureau, Wyoming State Department of Health, and the Department of Pediatrics of the University of Colorado School of Medicine.

Personal visits to each of the families were made by a public health nurse prior to their examination appointments, and there was a prompt follow-up on individual cases. These were considered two elements of primary importance in the total plan. The 214 children evaluated were almost equally divided as to sex and tribe represented. Final results incorporated some information on medical histories, either from available medical records or verbal explanations to the pediatrician by adults accompanying the children, or both. Height and weight information which was matched with percentile charts in use at the Colorado State Health Department indicated agreement in weight, but not in height. The authors report a significant difference when the two tribal groups are separated, in that the Shoshone children are consistently lighter in weight (40th to 44th percentile), and very considerably shorter in height "than their non-Indian counterparts". The recommendation is made that individual rates of growth be given

were attention than any comparison with existing percentiles for height and weight.

In analyzing the "diagnoses . . . requiring treatment or follow-up", two cases of malnutrition, seven of obesity, one possible pre-diabetic, and 19 cases of orthopedic abnormalities were listed. In addition there were 125 children of the 214 described as requiring dental care.

In discussing the hemoglobin levels the authors say that, "Contrary to what was expected", only seven of the 199 values were below 10 mg. per cent. Four of these were found among the 19 children one year old or less, and the other three among comparable numbers of six, eight, and eleven year old children. No differentiation is made as to sex or tribe in this summary since the "median value of the distribution . . . was essentially the same."

In the book (23) Warriors Without Weapons, published in 1946, Gordon MacGregor has brought together the results of the interdisciplinary study which was conducted among 166 six to 18 year old Sioux children from three communities on the Pine Ridge reservation. The section called "Health and Personality" is based on Dr. Dorothea Leighton's analysis of records of medical examinations made by several members of the local medical staff. The author qualifies the material in this fashion, "Because of the variations between examiners and because of the lack of any absolute standards for 'good health' or various diseased conditions that can be determined by a single routine

examination, the analysis can hardly be considered conclusive," and later he adds that the same holds true for any determination of "adequate and inadequate nutrition". The results are given as: 20 per cent in generally "good health", 40 per cent as "undernourished", 50 per cent with decayed teeth, 50 per cent with enlarged tonsils, and many having possible symptoms of vitamin deficiencies such as swollen gums, flaring ribs, and enlarged sore tongues. It is pointed out that the classification of undernourished was "determined by comparing each child's height and weight with the average for his tribal age group." From this it was found that more girls than boys were considered to be undernourished. However, fewer boys than girls were classified as having good health by examining physicians. It was also noted that the older children were judged to be in better health than the very young children.

A diet study in this area was not possible, but the authors say, "Such information as was gathered on Pine Ridge shows that average meals of the children are insufficient in caloric and vitamin content." All of the children in the study attended day schools in the three communities represented. Information gathered in a grade school home economics class, regarding home breakfasts, showed that in several days' time, "no child had milk or fruit and only one had an egg." Some children had no breakfast before coming to school, and a typical breakfast might have been: "Cake purchased at the trader's, fried bread or potatoes, or pancakes and syrup, and coffee."

In May of 1958 the Division of Indian Health in the Aberdeen

Area began using a pamphlet (19) about the Pine Ridge reservation in the orientation of employees assigned to duty there. The Health Educator and the Research Analyst for the area had compiled the information, and divided it into narrative and statistical sections. The statistics "regarding health" include two phases of particular interest, the "principal causes of death," and the "major items of daily diet." The causes of death are listed in this order: pneumonia, wounds-accidents, etc., tuberculosis, malnutrition-diarrhea for small babies, old age. The diet items listed include: "Mush, Potatoes (Irish), Dried Beans, Indian Bread or Baking Powder Bread, Light Bread, Rice (stewed or other), Some cheese, Some dried fruit (Wajapi), Coffee, Beef (heart, kidney, ribs, hamburger), Smoked Bacon, Fat Back, Bologna and Frankfurters, Some canned milk, Some canned fruit, Cabbage." Obviously, a nutritional evaluation of this listing would be impossible without much more information. However, of the four food groups generally considered essential because of their key nutrients, the milk and vegetable-fruit groups are clearly lacking.

Jessie Anderson Stene, studying with Dr. Lydia J. Roberts in the Department of Home Economics and Household Administration at the University of Chicago, prepared a "dissertation" (38) about the Sioux Indians of the Crow Creek reservation in 1927. She described the "Diets, Methods of Living, and Physical Conditions" found among this group of Sioux who live along the Eastern bank of the Missouri river in South-central South Dakota. The author indicated at the outset that the

study was implemented to a great extent because of her own background of acquaintance and experience in the immediate area.

Of the total population (approximately 900), she was able to gather information on 323 individuals comprising 67 families on the reservation. Her classification of "adult" apparently applied to those 21 years of age and above, and it included 131 individuals. The "children" category totaling 192 included only 16 under two years of age, with "about" one-third falling in each of the preschool age, school age, and over eighteen years age groups.

Results of her survey are based primarily on a very comprehensive questionnaire which she took to the homes and completed by asking questions of an adult in the family, and by making personal observations. English was not spoken by the adults in about one-fourth of the families visited, so that it was necessary to have an interpreter during all the family interviews. In order to verify and supplement the information obtained at the home, she studied official records on family and medical histories which were made available to her. In addition to this she consulted storekeepers as to buying practices, the Agency Issue Clerk as to "Ration Rolls", government physicians as to health and home conditions, and school teachers in regard to "cleanliness and physical condition of the children in school."

The entire survey was completed during the summer months, and though there was a reference to the boarding school at Pierre in connection with health conditions, no mention was made of a school

feeding program of any kind.

At the time of her study, the "Ration Roll" had, with some exceptions, been reduced so that it included only the older Indians with no other means of obtaining subsistence. Of the 67 families in the study 24 received rations for at least one member, 13 of these for more than one member. The rations were issued monthly to each eligible individual. The following items in the given amounts were included: Beef, 25-40 pounds; Salt Pork instead of beef twice a year, 10 pounds; Flour or Hard Tack (alternated), 15 pounds; Sugar 2 1/2 pounds; Coffee, 2 1/2 pounds; Rice or Beans (alternated), 2 1/2 pounds; Baking powder, 1/4 pound; Laundry soap, 1 pound; and a 15 pound bag of cornmeal if subsistence ran out before the next ration issue.

The author discussed other intermittencies of food supplies along with other aspects of what she termed "faulty food habits" as factors contributing to malnutrition. She considered malnutrition from the standpoint of "faulty diet" also, and gave the following figures on milk consumption among the children. Of the 94 children between one and 12 years of age, only 38 drank milk, while 56 did not, and of the 68 children under seven years of age, 46 were drinking coffee. Results from another area of inquiry showed that in 48 of the families, children had candy soon after they were a year old, and in 24 families infants of less than a year were given candy.

In evaluating the adequacy of the diets as reported, Stone classified them in this order: 1, those containing meat or egg, and

small amounts of milk, vegetables and fruits; 2, those like the former but lacking either vegetable or fruit; 3, those containing bread, coffee, meat and potato or beans; and 4, those consisting largely of bread and coffee. It could probably be assumed that the first two categories contained bread also. As to findings, she reported that only five families with a total of 10 children had diet 1, 19 families with 44 children had diet 2, 28 families with 106 children had diet 3, and 15 families with 32 children had diet 4. The author questioned too, whether the vegetables and fruit would be available to even this extent during the winter months. She explained that of the vegetables (other than beans and potatoes) which were in use, the home-grown were limited to squash and corn, and that of the canned vegetables purchased tomatoes and peas were about the only ones reported. Wild turnip digging was referred to, but "there had not been any the last year or two." Vegetables were used mainly as soup ingredients, and the home-grown corn and squash were dried for this purpose. The fruit purchases appeared to be mainly "dried raisins, peaches, and prunes," with small quantities of oranges or bananas obtained occasionally. Of the wild fruit gathered, the wild chokecherries, grapes, and plums were sometimes made into jelly or sauce and canned by the younger women, but the older women preferred to preserve them by drying.

In discussing the quantity of meat in the diet, the author pointed out that the desire for this diet item was universal and that intake was limited only by its availability. When butchering was done, full

utilization was made of the carcasses in its entirety, and those receiving ration meat were expected to divide it with other people.

One of the means Stene used in judging physical condition was the apparent relation between the height and weight of each individual. She says that of the 192 children, 52 appeared thin, 22 appeared fat, and 118 were considered medium in weight with relation to their height.

The medical histories and vital statistics records available for 58 of the families showed that out of 325 children born, only 161 were still living. Of the 164 children reported dead only two were from families with diet 1 which was considered adequate, 38 were from families with diets approaching adequacy, 2, 78 were from families on a diet of bread, coffee, meat and starchy vegetable, 3, and 52 were from families on diet 4 made up largely of bread and coffee. The author explained, however, that there were nine families from which data on deaths were not available and that these were ones with diets which were largely bread and coffee, or with diets only slightly better.

In regard to observations other than apparent weight in relation to height, Stene noticed that sore eyes and blindness were prevalent, that bow legs and poor teeth were very common, and although her opinion and that of the agency physician did not coincide in regard to incidence of tuberculosis, she felt that there was a very low rate of resistance to respiratory infections. In this opinion she was well supported by the data on deaths of children from known causes which showed that 55 of the 107 deaths had been from tuberculosis, and 35 had died from

pneumonia, flu.

This study covered living conditions and general hygiene as thoroughly as it did the subject of diet, but the author concluded with this statement, "Although the sanitary conditions . . . are such as to give ample opportunity for the dissemination of disease germs, the diets themselves are of such a degree and type of inadequacy as to make them alone sufficient to account for the physical deterioration found." She named diet as the "biggest responsible factor."

In the report (1) of a survey of the nutritional habits of South Dakota school children during December 1946 and January 1947, all children attending both grade and high schools in seventeen counties of the state were included. The South Dakota State Nutrition Committee conducted the investigation through the cooperative efforts of its members who represented the State College, the State University, the Extension Service, the Farm Home Administration, the U. S. Department of Agriculture, the South Dakota Department of Education, Board of Health, Social Security, and the American Red Cross.

The counties chosen for study were scattered throughout the state to insure a representative sampling from somewhat diverse areas. The number surveyed was approximately 26,700, which comprised about one-fourth of the school population. The check-list type questionnaire which was used showed a variety of foods in each of three columns titled "Breakfast, Lunch (noontime), and Dinner (evening)," with

additional space allotted for other foods which may also have been eaten at these or other times. The questionnaires were given to the children immediately after the noon meal, and teachers assisted them in the recalling of foods eaten for the preceding 24-hour period. The committee evaluated the results in terms of the occurrence of particular food groups in a specified number of instances in the daily dietary. The standard was a modified version of the "seven basic groups" then in use as a criteria for judging food habits. The six groups used consisted of: milk (including cocoa) as a beverage, three servings; vitamin C rich fruits (oranges and orange juice, grapefruit and grapefruit juice, raw tomatoes and tomato juice, with an alternative of raw cabbage), one serving; other fruits (prunes, apple sauce, fruit in sandwiches, fruit salad, fruit and sauce in dessert), one serving; leafy green and yellow vegetables (raw and cooked carrots, squash, greens, broccoli, corn, celery, lettuce), one serving; other vegetables (vegetables in sandwiches, peas, beets, cooked tomatoes, cooked and raw turnips, rutabagas, string beans, cooked cabbage, cauliflower, parsnips, radishes, onions, mixed vegetables, vegetable salad), one serving; protein rich foods (meat, fish, chicken, eggs, cheese, dry beans, peanut butter, nuts), two servings.

The committee determined that because of the universal appearance of potatoes, bread and butter in more than adequate amounts on the portion of questionnaires which was evaluated on a pilot basis, it would not be meaningful to tabulate these items separately in the final

evaluation. If an item of food was checked it was assumed that the serving represented an "average or ordinary amount" of that food having been consumed. The emphasis in this study then, was on qualitative (variety) information, rather than quantitative (total specific content) results. The point was made that the overall economic level of the times was uniformly high, and that there was little question of adequacy in caloric content, for example.

The results were summarized in terms of the percentage of the recommended number of servings in each of the six groups set up as standards. There was a separation of data as between rural and town school populations, and these showed some rather striking differences, with the town group having a better average in milk, vitamin C rich fruits, leafy green and yellow vegetable, and other vegetable food groups and the rural school children having a significantly better average in the other fruit group only. Both rural and town children consumed more than 100 per cent of the amounts of protein-rich foods as set up in the standard, with rural children having 116% and town children having 112% averages. It was noted that the average percentages for the leafy green and yellow vegetable group were attained primarily by the presence of carrots and corn in the dietary. This indicated a rather serious limitation within that food group, even though the per cent figure was higher than those for either milk or vitamin C rich fruit groups. According to the report the two categories in which all the South Dakota school children were considered to be

seriously deficient were milk and vitamin C rich fruit, and this occurred in the midst of relatively affluent times.

Since 1947 cooperative regional studies of nutritional status have been in progress. The subjects studied were from many different population groups; varying in age, sex, geographical area of residence, and in the case of two states in the Western region, in ethnic origin. In October 1959, a bulletin, called Nutritional Status U. S. A. (28), was published in which Dr. Agnes Faye Morgan analyzed and summarized the results of 178 separate publications regarding this research. She is presently Professor of Nutritional and Experiment Station Biochemist Emeritus at the University of California, and had been an active participant throughout the original research program. This interesting review of the many reports shows that her insight as to total objectives, workable methods, and validity of results, is remarkable, as is her depth of perception in regard to plausible conclusions and feasible recommendations. The very fact that such extensive investigation was made possible is in itself a recognition of the importance of nutritional status to the nation as a whole. Dr. Morgan has defined nutritional status as meaning the "State of health of the individual or group as conditioned by choice and amount of foods, or more accurately, nutrients, eaten," and nutrients as being the "Chemical constituents of foods required by the body for normal growth and function . . . proteins, carbohydrates, fats, vitamins, and minerals that make up the diet and that are needed for our continued well-being."

The standard used in all the studies for judging the adequacy of the diets was the Recommended Daily Allowances as set up and most recently revised in 1958 by the Food and Nutrition Board of National Academy of Sciences-National Research Council. This standard is usually referred to as NRC allowances. (26)

Dr. Morgan reports that taken as a whole the nutritional status of the citizens of this country "was found to be good." But as indicated earlier in this study the information concerning adolescent girls does not fit this description, in fact, "The diets of the teen-age girls presented the least favorable picture of all those examined." Their diets as a group showed adequate to high amounts of vitamin A, riboflavin, and niacin, but were "borderline low" in calories and protein, and "seriously low" in calcium, iron, thiamine and ascorbic acid. In Dr. Morgan's summary of the dietary studies, an intake for any population group which shows two-thirds or less of the recommended allowance for a given nutrient represents the borderline of inadequate choice of foods.

In the studies carried out within the Western and Northeastern regions among 13 to 16 year old girls, "About 20 to 40 per cent had diets relatively low in protein, vitamin A, riboflavin, and niacin", and more than 50 per cent of those studied in New Mexico, Colorado, and Montana had diets relatively low in calcium and ascorbic acid.

In the six states where comparisons could be drawn from data obtained separately on girls under 13 years of age, and those 13 and

above it was shown that the younger girls had the better nutrient intake, though the average was still 10 per cent less than two-thirds of the NRC allowances for calcium, vitamin A, and vitamin C.

In addition to determining the foods eaten, usually by means of some type of 7-day record, other relevant information was obtained in these investigations. Physical examinations and biochemical analyses of blood and urine samples, and sometimes dental examinations and x-rays of bones and teeth were included for at least a sampling of the total number of subjects in a given study.

Dr. Morgan discussed the blood analyses and physical signs found among subjects as they might be related to records of foods eaten. She pointed out that symptoms and blood levels "reflect long-range dietary habits, while the 7-day diet records can tell only the present and perhaps temporary conditions of food intake." Quite consistently, "The physical signs . . . of roughness of skin, inflammation and thickening of mucous membranes around the eyes, swollen and reddened gums, occurred more frequently" where low blood levels of vitamin A and vitamin C were also found. The causal relationship between food intake records and blood constituents was not always as clearly shown. However, in combining all the results obtained she explains that, "The hemoglobin content of the blood" ranged from fair to excellent and the "concentrations of vitamins A and C in the blood were generally fair to good."

There was more overweight than underweight reported for

adolescent girls in practically every regional group, with the exception of the Spanish American girls in the Western study. Both Spanish American and Arizona Indian girls had lower average heights than other children in the Western group, but the Arizona Indian girls "had much the greatest average body weight of any of the Western group." And this poor height and weight record was reflected to some extent in the findings on the adequacy of the diet and the blood composition.

Another correlation established within the Western region was that of protein intake and average heights of 14 to 16 year olds. In New Mexico adolescents from the Anglo-American and the Spanish American cultures were studied simultaneously, and a great diversity was noted between them in diet habits, body measurements, and blood composition. However, the relation of protein intake to average height was clearly demonstrated for both boys and girls in each group. The mean heights for boys were: Spanish American, 64.3 inches; Anglo-American 68.7 inches. The mean protein intakes of the boys were: 77 gms. and 101 gms. per day respectively. For the girls the mean heights were: Spanish American, 61.4 inches; Anglo-American, 64.0; and the mean protein intakes in the same order were 68 and 73 gms. per day.

In the comparisons cited earlier as to percentages of the various population groups having less than two-thirds of the NRC allowances, the 1953 figures were used, but later comparisons were based on the 1958 revision. Although ten nutrients including vitamin D are listed in the NRC allowances, vitamin D was not included in any

of the diet calculations. The author says, "The requirement for vitamin D is conditional and apparently applicable only under certain circumstances and during certain physiological periods." Of the recommendations as a whole she makes this comment, "The National Research Council recommendations provide a generous allowance which is expected to cover even the most unusual needs." Dr. Morgan also points out that they are considerably more generous than so-called "minimal requirements as set up by the Food and Drug Administration in our country, and any similar standards of the British Medical Association or of the Canadian Council of Nutrition.

Of the nine nutrients discussed, calories are considered first, and in this respect there seemed to be good agreement between all the healthy subjects and the corresponding recommendations up to 12 years of age, when both boys and girls began to fall below the recommended calories until the 20 year mark was reached.

In the case of protein, the mean intakes of both boys and girls were above the recommended amount up until age 12 and 13 years of age for the girls, when it fell considerably short until they reached 20 years. This decrease in protein intake was not evident for boys. Dr. Morgan felt that the deficit recorded for "teenage girls is particularly unfortunate." The results indicated that the average daily intake of calcium for girls beyond the age of 11 began to drop and this decline became more marked in adult years. With iron a similar situation existed, there was a wide gap between mean intakes

of the girls of 12 and up to 30 years, as compared with the recommendations. In the case of both calcium and iron the boys and girls were well above the NRC allowance.

When the figures for vitamin A were analyzed for all subjects, both male and female, an excess above the allowance was shown. In the ages between 12 and 30 the girls showed a deficit in thiamine, and after 14 years, in riboflavin. When niacin was calculated on the basis of its tryptophan equivalent (60 mg. of tryptophan yielding 1 mg. of niacin), the mean intakes at all ages and for both sexes were found to be sufficient. The mean values for daily ascorbic acid intakes of children were shown to be excellent until almost 12 years of age when they dropped steadily until the age of 20 years.

Dr. Morgan has questioned the validity of the total deficit figures for such large population groups as were included in these regional studies, when they are based on the "perhaps artificial profile" of the recommended allowances. First of all the subjects were considered to be "healthy" individuals. With calories it is possible that the recommended allowance is too great. The same may also be true of calcium and iron, and there is much investigation continuing in regard to these nutrients. If calories are reduced, lower thiamine intakes could be both explained and justified. If the universal pattern of American diet were the criteria, the allowances are presently too low for vitamin A.

She points out, however, that there is not such question but

that the ascorbic acid deficits are real ones, since it is an easily destroyed nutrient and one greatly affected by all methods of food preparation. In many otherwise adequate diets good ascorbic acid food sources are omitted. The tables of food composition now in use have been found to overrate amounts of ascorbic acid in cooked foods as eaten, when checked against figures for identical analyzed diets.

In the summarization of mean nutrient intake information the author includes the following paragraph which is most pertinent to the present study of 12 to 14 year old Indian girls:

It is interesting to speculate on the reasons for the universally evident decrease in intake of some or most of the nutrients by girls after age 12. A greatly increased rate of growth normally occurs in boys and girls just preceding the onset of puberty, and this is followed by a rather rapid slowing down, particularly in girls. In boys the accelerated growth phase begins a year or two later than in girls and continues for several years longer. At least the deceleration following the adolescent spurt of growth is less marked. It is understandable, therefore, that food intake of healthy girls should be increased at ages 11 to 13 and decreased thereafter. The continued low intakes beyond age 13, however, particularly in calcium and iron, may be unfavorable and in part at least ascribable to poor food habits acquired during the decelerated growth period after puberty.

As for general recommendations for the improvement of diets in this country, Dr. Morgan says that an increase in the use of fruits and vegetables is a major one. These items should be in the fresh state to be most valuable, and for adolescent girls in particular she would specify the use of broccoli, green beans and peas, cauliflower, raw cabbage, carrots, tomatoes, turnip greens and all other greens, apricots, peaches, strawberries, citrus fruits and yellow melons as

most desirable diet items.

Blood composition as related to the diet was a part of most of the regional studies, since it "is known to reflect the nutriture of the body." In some cases the purpose was to compare values with the known dietary intake of corresponding nutrients, and in others it was to detect differences from current norms. The blood values measured in these studies were for the most part, hemoglobin, serum ascorbic acid, vitamin A and carotene.

In the instances of serum ascorbic acid, vitamin A, and carotene there was good correlation between blood values and their related dietary constituents, and in five states of the Northeast region where children included were from 13 to 20, there was a significant correlation between the hemoglobin and the dietary iron and dietary protein. In New York children from 4 to 20 were studied and there was a slow rise in hemoglobin levels for both boys and girls up to the age of 12 when the levels for boys continued to rise but these for girls declined slowly. Above 13 years of age the hemoglobin levels for girls in Maine, Rhode Island, and West Virginia either declined or remained steady, in contrast to that of the boys. Using less than 11.0 and 13.0 gram-per cent hemoglobin as indicative of anemia, the girls in particular, could have been close to that classification in Maine and Rhode Island.

Most of the subjects in the Western region were older children than in the Northeast. Included were only 70 under 12 years of age.

The total group of 2,255 in Utah, New Mexico, Montana, Arizona, Colorado, Idaho, Oregon and Washington, showed a similar pattern with respect to hemoglobin levels to that found in New York. The hemoglobin levels for boys rose after age 12 and reached a maximum of 15.2 gram-per cent at 18 years, whereas the hemoglobin levels for girls showed no rise after age 14 and attained a maximum of only 13.8 gram-per cent. Dr. Morgan explained that higher levels throughout the Western region could be attributed to the much higher altitudes at which these people lived since, "Hemoglobin concentration is regularly increased in acclimated person living at mountainous altitudes." In Montana a positive correlation was found between iron intake and hemoglobin, and in New Mexico correlation was shown with hemoglobin and protein intake of the adolescents.

In Iowa where 6 to 18 year old children were studied, the curves for hemoglobin levels were similar to those in the New York and Western studies. Only three to five per cent might have been considered as bordering on anemia, but the same maintenance or drop in hemoglobin levels was present among the girls after age 12. In this state rural and town children were studied separately, and those from towns showed generally higher levels than the rural children. The author pointed out that there was a positive correlation of protein intakes with hemoglobin levels for all of these children. This correlation was also found with the boys in niacin, iron, and riboflavin intakes, but because of the irregularity of both the hemoglobin levels and the iron

intakes of the girls the correlation for them was not established.

A cooperative study of this kind when brought together as Dr. Morgan has in this bulletin, is bound to yield much in regard to methodology for future studies and some portions of these investigations were for that express purpose. A few of the author's conclusions have already been incorporated in the previous review, but there are others from these studies which seem applicable to the present study of dietaries and nutritional status of adolescent Indian girls of the Dakotas.

In regard to food records, school children in the North Central region "were found to consume more protein, perhaps as meat, and less calcium, probably in milk, over the weekends than during the school days." When food records were compared as to reliability and number of days, it was decided that a one-day recall could be used to determine the characteristics of the food use of groups, but a fair estimate of individual intake was more assured with a 14-day record. Two seasons were included in the study of North Central regional school children, and in two of the states no significant difference in intakes was found in the spring and fall, though Ohio and Kansas children showed relatively high intakes of ascorbic acid in the spring, and of protein in the fall.

Dr. Morgan indicated that evaluation of diets for adequacy by checking against food classes such as are grouped together in the "Basic seven or four" was not considered valid. However, "food patterns" of

adolescents using food groupings were studied in Washington, Idaho, Utah, Oregon and Montana of the Western region, in Iowa, and in Maine, New York, and West Virginia of the Northeastern region. Based on average servings per day calculations for nutrients were made by means of standard tables of composition for raw and cooked foods, using a list which varied somewhat in classification and number of food groups. According to Hard and Esselbaugh (13), these studies also provided answers to such questions as: "What kinds of foods did the adolescent boys and girls eat? What were their food likes and dislikes? Did they snack between meals? Did they go without meals?" The authors felt that the answers to the above questions help to explain "the physical signs of poor eating habits," and recommended that the results be used in education for selection of nutritious food.

Dr. Morgen (28) concluded that in general investigators found the written record or the recall equally acceptable for a one-day study. Trained nutritionists obtained diet histories with equal accuracy, and arrived at similar results when nutrients were calculated.

The Indian tribes in the United States have been grouped in rather recent years according to their cultural characteristics and locations (16). The present study includes adolescents from both the Woodmen of the Eastern Forests and the Hunters of the Plains groups, since some of the students enrolled in Indian boarding schools of the Dakotas come from each side of the Missouri River. There are a few from the Chippewa, Winnebago, Potawatomi, and Sac and Fox tribes who are in the

first category. And among the Hunters of the Plains there are some scattered members or admixtures of the Omaha, Ponca, Cheyenne, Crow, Assinibone, Mandan, Hidatsa or Gros Ventre, and Arikara tribes, but the greatest majority represent the several branches of the Sioux or Dakota tribe.

Though the definition of Indian varies somewhat as between the Census bureau and the Indian bureau methods of determination within a given jurisdiction, some general conclusions can be drawn by using Census bureau figures for general population and Indian bureau figures for Indian populations in the various states. In 1950 South Dakota ranked fifth among all states in total numbers of Indian people, and third in largest proportion of Indians within the state's population, with North Dakota as seventh. According to Johansen (18), the population of South Dakota, exclusive of Indians was 652,740 in 1950. The Indian bureau figures for the same year (16) were roughly 29,000, showing the number of Indians to be 4.2 per cent of the population for the state. North Dakota also had an Indian population of more than 1.0 per cent of the total population.

Within the Aberdeen administrative area, which includes the Dakotas, the reporting of quantum of Indian blood among reservation residents indicates that approximately half of those Indians residing on reservations are fullblood. Other categories are: 1/2 but not full, 1/4 but not half, and less than 1/4.

Any assessment of health status of a population group necessitates

a comparison of birth rates and death rates as well as a look at morbidity data, according to the writers of Health Services for American Indians (16). In many instances and in most reservation areas there has been an underregistration of vital statistics in the past which precludes definite analysis, but the general conclusion is that the net rate of increase among the Indian population is presently greater than for the general population of the United States. Of the two vital statistics, "It is assumed that the death reporting is more complete, but it is felt that those in infancy may not have been reported, possibly as either deaths or births."

It is known that in the United States the degree of Indian mortality in relation to that of all races, varies at different ages. For instance, at ages one to four years it is five times higher than for all races. The ratios among adults 25 - 34 years of age are three times higher than for the general population. These are statistics which coincide with death rate information for the general public about 20 years ago. Life expectancy for Indians in 1950 was at the level of the white population in 1930, and the high infant mortality among Indians accounts to a considerable degree for this discrepancy. In listing the major causes of death there are variations, too, between Indian and non-Indian groups. Influenza and pneumonia, tuberculosis and certain diseases of early infancy caused one-fourth of the Indian deaths in the 1951-53 period, whereas they are shown to have caused only one-tenth of the deaths for all races in 1952. Infant death rate for Indians remains

rather constantly two and one-half times as high as for all races in this country. In this report it was pointed out that this great difference in infant death rates, "Is due primarily to diseases and conditions which are related to environmental sanitation, housing, nutrition and personal hygiene."

Maternal mortality rates were higher for Indian women for selected causes than for the total population, with that from hemorrhage being four and one-half times as high. During the 1949-53 period 23 Indian women died for every 10,000 live births while only 7.5 maternal deaths for the same number of live births occurred in the general population. Complications of pregnancy reported for the total obstetrical caseload of 6,340 deliveries in Indian hospitals during 1955 was shown to be 8 per cent. There were in addition 442 abortions, and 1,110 patients hospitalized for complications of pregnancy occurring at other than the time of delivery.

In discussing nutrition as a separate topic in the present preventive health program for all Indians, anemia, overweight, and too rapid weight gain among prenatal patients, and anemia and poor musculature among babies are mentioned as specific conditions which medical personnel have attempted to alleviate by various means and with varying degrees of success. For instance, prescribed diets were not always consistent with the "resources or cultural preferences of the patients," and dried baby milk formulas or canned preparations often advised were expensive. In spite of the rather routine recommendation for formula

feeding it was noted that the babies were many times breast-fed for from 1 1/2 to 2 years without supplementation of any kind. Multi-vitamin preparations were judged to be immediately useful in many cases, but only stop-gap means as contrasted to a long-range solution to the problem.

Again speaking for all reservation areas this report states (16) that, "Diets in some areas appear to be deficient in protein," except that where game and native wild-growing foods are abundant, diets may possibly be more nutritionally adequate. Where gardens are grown by reservation families they are apt to produce a limited variety of vegetables. An important food source is that of surplus commodities. With these, the major problem is that of acceptance and use.

A portion of this evaluation described representative reservation areas. The results of a survey conducted in a section covering a population group which is included in the present study indicates the following in regard to nutrition as part of health status, "Little information is available on the . . . diet. A large proportion of the residents are welfare cases, and surplus commodities represent a major portion of the total diet. In 1955 commodities were distributed to 1,167 persons on the reservation." The Indian population for the vicinity was estimated to be around 1,900.

In the 1946 book, Warriors Without Weapons (23), quoted earlier in regard to health status of Pine Ridge school children, MacGregor reviews the modern historical background of the Plains Indians. He gives

full credence to the extermination of the buffalo as a major disorganizing factor in the breakdown of their culture, since at one time it was the central point of their subsistence and was basic to their total economy. But he also maintains that at the very beginning of the 1900's the tribes had attained a degree of success with the production of beef cattle as a substitute economy. And he points out that cattle and land sales, brought about for varying and somewhat debatable reasons by 1920, were more far-reaching in their effects than the disappearance of the buffalo herds. He attributes the "failing will to live" of the Indians, as well as "lack of sufficient food and increasing sickness" to these relatively recent developments. He explains that an appearance of starvation among them in the middle 1920's was followed by a general apathy, and that most of the Sioux of North and South Dakota showed signs of undernutrition about this time. This was to be expected when their century-old food staple of meat was disappearing. Recognition that these developments have had a multi-faceted effect in regard to the background of adolescents in the present study is brought out in the following analysis of MacGregor's.

Even during the time between the disappearance of the buffalo and the building of large cattle herds, the Sioux had been supported by government rations. The years after 1916, when beef was no longer included in their rations, were their first experience in living without meat for a long period of time. The loss of the beef and the cattle was an ecological change which has continued for nearly thirty years. This change might, and probably did, cause modifications in the physiology of the Sioux. Health conditions and observations of diet among them substantiate the assumption that much of their present behavior may be attributable to physiological causes.

More recent sociological and socio-economic studies of the Sioux groups, in which the majority of subjects in the present study are represented, describe current conditions which can hardly be considered as highly conducive to the ultimate in nutrition. In his study, The Dakota Indian Family (24), Dr. Malan stresses the "providing of a subsistence level of living" as the major problem of the reservation. He questions whether the smattering of income from land leases, stock raising, wage labor, and salaried employment can qualify even fifty per cent of the reservation residents for the classification of "self-supporting." He describes the relief load as heavy, with large increases during the winter months, and explains that surplus commodities are distributed to families in "dire need." He points out that in instances of so-called self-sufficient families, it is difficult to explain "how they survive on the quantity of food they purchase." In two communities under study, it was felt that only about one-third of the families could possibly have had "adequate financial resources to meet their obligations for food and other necessities at the general store located in the area."

In a somewhat similar study of another reservation located in central South Dakota (25) Malan and Powers discuss economic resources of the general environment. The indication is that they are limited, with livestock raising as the main enterprise. They list Chinese pheasants and fish as abundant supplemental food sources, and mention deer as available occasionally in the wooded areas.

The studies of the Sioux Indians described in this review of

literature, and particularly the recent ones by Malan, Powers, and others afford valuable background information for the present study.

CHAPTER III

METHOD OF STUDY

This study was made possible through the opportunity of the investigator to participate in a nutrition survey of 7 to 14 year old children in eight Indian boarding schools in the Dakotas. The dietary survey, conducted by South Dakota State College nutrition research workers, was a portion of a larger study sponsored by the National Institutes of Health and the Division of Indian Health of the United States Public Health Service, with the cooperation of the Bureau of Indian Affairs and the private schools whose students were included in the study.

Specific aims of the nutrition survey related to the present study were: to obtain information on the dietary intakes of the children 7 to 14 years of age at certain periods during the school year; to estimate the nutrients of the diets by means of calculation from standard tables of food composition; to obtain information on growth and development of the children studied through periodic measures of height and weight; and to assist with the securing of representative samples of certain body fluids for biochemical tests.

In the present study only information regarding adolescent girls attending the eight boarding schools will be reported. Four of these schools are private and four are operated by the Bureau of Indian Affairs. Criteria for enrollment in the schools varies somewhat, but in general

it may be assumed that the quantum of Indian blood is 1/4 or more. The tribe most widely represented is the Sioux or Dakota. For the most part the 12 to 14 year old girls were in grades five through nine.

Six of the schools could be termed "on-reservation boarding schools" since they are located directly on reservations or closely adjacent to one or more reservation areas. Two of the Bureau schools fall in the "off-reservation" category, and are situated in or near quite sizable urban centers.

During the spring of 1959 it was considered advisable to conduct a pilot study in two of the eight boarding schools which were to be included in the dietary survey to begin in the fall of 1959. A school was visited by each of the field workers for a period of approximately five days. Relevant information previously obtained was discussed and summarized for each of the schools. This included: total number of children in the schools and deviations to be expected on week-ends or special days; absences due to illness; numbers of individuals taking meals in addition to the students; types and variations in food service; operating conditions in the bakeries; general schedules for food preparation; extent of student participation in food preparation and service; foods normally being served to the students; and amounts and kinds of USDA commodities received.

It was then determined that one of the main objectives of the pilot study was to select a method which would be suitable for obtaining dietary information in all schools during the regular survey period.

At the time it was anticipated that only children from 8 to 14 years of age would be studied, but this was expanded to include 7 year olds before the fall dietary study began.

As a means of recording dietary information in the pilot study a form was prepared on which to make note of the following: the menu; the number of both boys and girls in each age group at meals; the food items served and the total quantity consumed; the estimated original serving, amounts of seconds, and average serving of all food items eaten by each age-sex group. Space was also allowed for details of recipes and method of preparation for all mixed dishes. Amounts allocated to the separate age groups, identified by school personnel according to dining room seating, were noted. In one of the schools of the pilot study and in two of the schools of the regular study day students were present for the noon meal, therefore the record form also provided for recording enrollment of these students. Investigators observed the large groups as they were eating and noted practices as to food acceptance and number of seconds when available. After the meal left-over food was weighed and amounts recorded. The difference between left-overs and amounts prepared provided a measure of the total quantity consumed by all the children. Some servings of foods were measured and some were weighed to arrive at fairly uniform sizes of servings for the various sex-age groups. Both of the schools in the pilot study were employing modified cafeteria type food service with the beverage, bread, butter and occasionally other specified food items being placed at the

tables, or in some cases, on individual trays prior to the arrival of the children in the dining room.

After compiling the data, recipes and individual food items for each meal were evaluated for 10 nutrients using USDA Handbook 8 (45) and the tables of food composition prepared by Bovey and Church (4). The nutrients calculated were calories, protein, fat, carbohydrate, calcium, iron, vitamin A, ascorbic acid, thiamine, and riboflavin. The values thus obtained for each sex-age group for the different meals and snack periods were then averaged for each school. These meal averages were combined to obtain daily average nutrient intakes. Approximately 119 girls age 12 to 14 years were observed in the two schools during the pilot period.

After the results of the pilot study were summarized it was felt that more meaningful dietary information might be obtained if observations were carried out through a consecutive 7-day period, and if individuals from the various groups could be interviewed at meal time. It was thought that the method used in the pilot study for obtaining data on food preparation, amounts of food prepared and quantities left over, was suitable and these same procedures were followed in the dietary survey.

The dietary survey included all 7 to 14 year old children in the eight boarding schools. Both boys and girls were placed separately into three age groups for the observations as follows: 7 and 8 year old; 9 to 11 year olds; and 12 to 14 year olds. Observations were made

for 7-day periods in the late fall and again in the early spring. For a 7-day period, five different children from the six sex-age groups were selected for observation each day. At the end of an observation in a given school there were 35 daily records and a weekly total of 210. In some instances, depending upon enrollment at the various age levels and other factors, some duplication of individuals occurred.

The children selected for observation were supplied the evening before or on the morning of the day of observation with small brightly colored ribbons which they were asked to wear. These served as a means of identification and also as reminders that they had been asked to tell the nutritionist immediately after a meal what they had eaten. They were also to report at the interviews as to snacks eaten during the day or the evening before. This direct account was used along with the weighed estimated servings obtained before meals to arrive at individual amounts of food items consumed. A mean of these food consumption records for all five children in each of the six groups was then computed for use in evaluation. The data were evaluated similarly to that of the pilot study for 10 nutrients. These 10 included phosphorus and niacin but excluded fat and carbohydrate.

The fall 1959 observations in the eight schools included approximately 270 girls in the 12 to 14 year old groups and about 120 girls 9 to 11 years old. The present study reports dietary data from five of the schools in the fall observations. It includes 172 girls from the older group and 175 of the younger girls.

Copies of the forms devised for recording all types of data from the dietary observations appear on pages 84, 85, and 86 of the appendix.

In the eight Indian boarding schools included in the larger study periodic height and weight measures were begun in the spring of 1959. These were continued at approximately four month intervals. In some instances field workers for the nutrition survey participated with other team members from the National Institutes of Health in taking the measurements. The procedures for measuring and recording heights and weights were established by the NIH group and the standardized portable equipment which they supplied was used throughout the study. Heights were measured to the nearest 1/4 inch and weights to the nearest 1/2 pound. Measurements were taken with subjects in light clothing and without shoes.

For the present study physical measurements were obtained on 257 of the 12 to 14 year old girls in the spring of 1959, on 335 in the fall of 1959, and 347 in the winter of 1960. There is a certain amount of shift in school population over a period of nine months which accounts for the variations in numbers. In the case of 150 of these girls in six of the schools data were available on three successive measures.

With the cooperation of personnel at four of the schools it was possible to schedule meetings with groups of 12 to 14 year old girls for the purpose of interviewing them about onset of menstruation. The subjects were then asked individually during the visits to the schools

in the spring of 1960 as to when they began to menstruate. At two schools not visited for dietary observation at that time, dormitory advisers obligingly made the inquiries and mailed the information to the investigator. In the present study data on age at menarche as recalled by the subjects are included for 259 adolescent girls from six of the schools.

Measurement of hemoglobin levels was carried out by the National Institutes of Health team on the basis of an approximate 10 per cent sampling of the total group of children included in the larger study. Drabkin's method (6), which utilizes standard solutions that are considered both stable and accurate for this purpose was employed. It is recommended for clinical hemoglobinometry by the U. S. armed services medical group.

In the present study the hemoglobin values for 12 to 14 year old girls obtained in the fall of 1959 and spring of 1960 were made available to the investigator. Four schools were represented in this sampling. Of the 73 girls on whom hemoglobin values were obtained in the fall of 1959, 60 were present for the second determination. The data on hemoglobin levels will be reported in regard to age and schools represented and by age at menarche.

CHAPTER IV

DIETARY FINDINGS AND DISCUSSION

In the present study the mean nutrient intakes of the 12 to 14 and 9 to 11 year old girls closely approached or exceeded the NRC allowances for 13 to 15 and 10 to 12 year old girls for most nutrients and in most schools. As can be seen in Table I, both age groups at every school exceeded the allowances for thiamine and riboflavin. The allowances for calories were very closely approached by both age groups at all schools with the possible exception of School No. 3. Intakes of protein equalled or exceeded the allowances except for 12 to 14 year olds at Schools No. 3 and 8 and both age groups of girls at School No. 7. Calcium intakes exceeded the allowances for that nutrient at three of the five schools. At two schools the mean intake of iron exceeded the allowances for both age groups. At only one school, in the case of 12 to 14 year old girls, the iron for the day was less than two-thirds of the recommendation. In this same school the mean for vitamin A for the 12 to 14 year olds was also less than two-thirds of the recommendation for the age group. In School No. 2 the intake of vitamin A exceeded the allowance in the 9 to 11 year group and both ages at School No. 8 were well above the amount recommended. With these exceptions the intakes of vitamin A were near the two-thirds level.

At two of the schools the intake of ascorbic acid of the 9 to

TABLE I. MEAN DAILY NUTRIENT VALUES FOR 7-DAY MEANS OF 12-14 AND 9-11 YEAR OLD GIRLS AT FIVE SCHOOLS

Nutrient	School: No. 2		Mean Daily Values, 7-Day Diets		No. 3		No. 4		No. 5		No. 6		NRC Allowances Girls
	12-14	9-11	12-14	9-11	12-14	9-11	12-14	9-11	12-14	9-11	12-14	9-11	
Calories S.D.*	2447 373	2382 336	2049 376	2135 938	2457 249	2469 377	2205 201	2231 522	2407 270	2481 307	2600	2500	
Protein (gm.) S.D.	84 15	86 25	73 17	70 11	82 79	64 15	67 15	69 20	74 12	77 12	80	70	
Calcium (gm.) S.D.	1.3 0.22	1.3 0.39	1.3 0.22	1.2 0.29	1.4 0.42	1.6 0.38	0.8 0.42	0.8 0.35	0.9 0.31	1.1 0.25	1.3	1.1	
Phosphorous (gm.) S.D.	1.5 0.13	1.6 0.18	1.5 0.39	1.5 0.66	1.7 0.82	1.8 0.39	1.1 0.36	0.8 0.41	1.2 0.19	1.3 0.16	--	--	
Iron (mg.) S.D.	13.0 2.4	13.0 4.4	9.1 1.8	11.0 1.4	14.0 4.4	13.0 3.3	13.0 2.5	13.0 7.7	16.0 2.4	17.0 6.5	15.0	12.0	
Vitamin A (I.U.) S.D.	3929 1591	4528 1646	3229 506	3163 1029	3533 1153	4095 960	3336 1519	3382 2215	6677 3262	7516 3790	5006	4503	
Ascorbic Acid (mg.) S.D.	70 16	80 51	40 22	39 20	63 25	65 23	49 29	39 9	76 31	97 33	80	75	
Thiamine (mg.) S.D.	1.7 0.48	1.5 0.52	1.5 0.34	1.3 0.13	1.9 0.16	2.0 0.43	1.8 0.44	2.0 0.32	2.0 0.47	2.0 0.53	1.3	1.3	
Riboflavin (mg.) S.D.	2.4 0.18	2.6 0.46	2.1 0.52	2.2 0.39	2.0 0.39	2.8 0.57	2.2 0.56	2.4 0.56	2.1 0.49	2.4 0.79	2.0	1.8	
Niacin (mg.) S.D.	14.0 3.5	13.0 3.5	11.9 7.6	11.7 6.6	15.0 3.1	14.0 3.6	14.0 2.6	15.0 3.2	16.0 3.5	17.0 4.3	17.0	17.0	

*S.D. reflects differences as between mean intakes of five different girls in each age group for each of the seven days.

11 year old girls exceeded the allowance, but at two others neither age consumed as much as two-thirds of the recommended amounts.

For niacin the allowance was equalled by 9 to 11 year old girls at School No. 8, and all intakes were well above two-thirds of the NRC allowances with the exception of School No. 3.

The mean daily nutrient values from breakfast only are shown in Table II for the five schools. For the 12 to 14 and the 9 to 11 year olds these are compared with the values for one-fourth of the NRC allowances for 13 to 15 and 10 to 12 year olds, respectively.

In this comparison a greater divergence can be seen than was found for the total daily intakes. In addition there are fewer instances in which NRC allowances are exceeded. In one school only do both ages exceed the allowance for calories, though the 9 to 11 year olds at School No. 4 have more than one-fourth of the recommended calories. At this same school the 12 to 14 year olds have considerably less than the NRC allowance for calories. The 9 to 11 year old girls at School No. 4 were the only group whose breakfast exceeded one-fourth of the daily protein recommendation. The remaining groups at all schools approached the breakfast allowance rather closely. Girls in both age groups at Schools No. 2 and 3 were well above the allowance for calcium, as were the 9 to 11 year olds at School No. 4. The 12 to 14 year olds at School No. 4 and both age groups at Schools No. 7 and 8 fell below the allowance for calcium. The calcium intakes of the 12 to 14 year olds at each school were lowest, but both age groups

TABLE II. MEAN DAILY FURNISHMENT VALUES OF BREAKFASTS OF 12-14 AND 9-11 YEAR OLD GIRLS FOR SEVEN DAYS AT FIVE SCHOOLS

Schools Age-Gr.	Mean Breakfast Values, Seven Days										1/4 RRC Allowances Girls	
	No. 2 12-14 9-11		No. 3 12-14 9-11		No. 4 12-14 9-11		No. 5 12-14 9-11		No. 6 12-14 9-11		13-15 yr. 10-12 yr.	
Calories S.D.	653 203.8	624 202.0	653 145.0	67.9 132.8	591 120.3	728 120.3	600 104.2	637 104.9	710 158.4	747 130.3	661	667
Protein (gm.) S.D.	20 9.23	17 5.21	18 8.22	19 2.66	17 2.34	22 3.27	17 2.77	20 3.76	19 3.0	20 2.27	21	21
Calcium (gm.) S.D.	0.42 0.23	0.30 0.20	0.43 0.04	0.42 0.07	0.35 0.12	0.49 0.15	0.11 0.07	0.10 0.10	0.29 0.05	0.32 0.05	0.40	0.36
Phosphorus (gm.) S.D.	0.48 0.14	0.41 0.16	0.47 0.25	0.48 0.23	0.38 0.13	0.52 0.13	0.19 0.06	0.24 0.09	0.28 0.23	0.33 0.14	—	—
Iron (mg.) S.D.	3.6 1.73	2.7 0.89	2.1 0.74	2.3 0.48	2.4 1.32	3.0 0.84	3.0 0.70	3.1 0.43	4.5 1.29	4.7 5.39	3.0	2.5
Vitamin A (I.U.) S.D.	979 408.9	1017 295.0	864 228.5	941 96.0	517 164.6	793 165.0	372 59.6	369 109.4	1245 602.6	1356 583.3	880	893
Ascorbic Acid (mg.) S.D.	34.0 46.69	40.0 45.25	3.4 2.00	3.5 0.60	3.4 1.59	5.0 1.38	2.0 0.70	2.0 0.49	29.0 26.15	35.0 29.49	16.0	18.1
Thiamine (mg.) S.D.	0.43 0.45	0.41 0.06	0.56 0.35	0.45 0.07	0.48 0.11	0.54 0.08	0.51 0.17	0.57 0.08	0.57 0.13	0.59 0.14	0.54	0.54
Riboflavin (mg.) S.D.	0.67 0.22	0.80 0.38	0.74 0.44	0.74 0.12	0.68 0.36	0.90 0.43	0.65 0.14	0.81 0.16	0.65 0.13	0.71 0.22	0.70	0.79
Niacin (mg.) S.D.	2.5 0.79	2.4 0.69	2.6 0.57	2.5 0.73	2.5 1.30	2.8 1.22	2.0 1.13	3.0 0.76	3.7 1.97	3.9 1.27	2.8	2.9

*S.D. reflects differences as between mean intakes at breakfasts of five different girls in each age group for each of the seven days.

of girls at School No. 7 were considerably below their respective recommended calcium allowances. Iron intake either exceeded or met the allowances at all schools except School No. 3 for both age groups and at School No. 4 for 12 to 14 year olds.

At two schools the vitamin A intake was considerably higher than the NRC allowance, and the 9 to 11 year olds at one other school also exceeded it. However at two schools vitamin A intakes for both age groups appeared to be seriously low. Both age groups of girls at two schools had mean intakes of ascorbic acid which were almost twice the allowances, while the remaining three schools averaged less than one-third of the allowance. Though there was not much difference as between the two age groups in ascorbic acid consumption at breakfast, there was a tendency for the younger girls in all schools to have the higher intakes. The 12 to 14 year olds at Schools No. 7 and 4, the 9 to 11 year olds at School No. 3, and both age groups at School No. 2 were somewhat below the recommended allowance for thiamine. For the other age groups and schools the breakfast allowances were met or exceeded. Riboflavin intakes for 9 to 11 year olds at Schools No. 2, 4, and 7 and for 12 to 14 year olds at School No. 3 were above the allowances. Both age groups of girls at School No. 8 were below the allowances, as were 12 to 14 year olds at Schools No. 4 and 7. Niacin exceeded one-fourth of the daily NRC recommendations at School No. 8 for both age groups, and closely approached it for each group at the remaining schools, with the exception of 12 to 14 year old girls at School No. 7.

In the present study the girls who were observed and interviewed were in a fairly well routinized living situation. Exceptions were made in the case of families visiting students and occasional trips away from the school, or when parties were held, but by and large the students were reporting to the dining room for regular meals throughout the study. Opportunity for indiscriminate snacking varied between schools, and supplementary snacks which were served as part of the school feeding program were taken into account where that was practiced.

Nutrient intake was delimited primarily by the menu offerings at the individual schools. This is shown quite clearly for most nutrients when the intakes of the 9 to 11 year olds at the various schools are compared. The comparison of intakes for both age groups at the breakfast meal alone pointed up the fact that those breakfasts which did not consist of the four food groups considered as constituting a standard breakfast pattern by Furdue researchers (17), also did not meet nutrient amounts of one-fourth the daily NRC allowances. In such cases mentioned in Roberts' Nutrition Work with Children, "the chances are great that he . . . (the child) . . . will not compensate for the loss at lunch." (17)

Among these adolescent girls it is quite clear also that the breakfast deficit was not made up at any time during the day for the one most glaring lack, that of ascorbic acid. The pattern for a Type A school lunch was followed at the noon meal in the schools.

Raw and cooked vegetables and fruits were offered at that time in the majority of schools, but were not sufficient to make up for the omission of fruit or fruit juice (preferably citrus) at the breakfast meals. This food group was considered first by the Purdue workers in evaluating breakfasts for adequacy (17).

Quite obviously there are factors other than menu offerings which are operative in total food consumption, since considerable variation existed as between the 12 to 14 year olds and the 9 to 11 year olds throughout. In the case of calories in all but one school and of protein, vitamin A and riboflavin in the majority of schools, the findings indicate that the 9 to 11 year olds had higher intakes than the 12 to 14 year olds. Since the intakes of the 9 to 11 year old girls reflect the availability of nutrients in the menus those of the 12 to 14 year olds must fluctuate from other causes. The investigator found that in the case of the 12 to 14 year olds interviewed, individual choice in regard to menu offerings played a large part in the final dietary findings for the group. In addition to the tapering off of adult supervision of the child's eating practices, there appears to be a tendency for the older adolescent girl to assert her independence to a degree by omitting certain foods which she has earlier identified as being "good for her." A growing concern over the possibility of gaining too much weight is sometimes evident also. As Morgan pointed out in her summary of the regional nutritional status studies (28), there may be an actual decrease in appetite with resultant

lowered total food intake following the pre-pubertal growth spurt.
This factor may well have contributed to the variations noted here.

CHAPTER V

RESULTS OF PHYSICAL AND PHYSIOLOGICAL
MEASUREMENTS AND DISCUSSION

Mean heights and weights of girls falling in the 12 to 14 age group from the eight boarding schools in the larger study are recorded in Table III. These are for three successive seasons of the year and ages are to the nearest birthday as of January, 1960. The total number of girls represented was 257 in the spring of 1959, with 335 in the fall of 1959, and 347 in the winter of 1960. These results indicate greater height and weight with increased years at all schools. They also show no drop off in growth during the summer months. The gain in height for all 12 year olds between the spring and fall measures was 3.0 inches, but between the fall and winter it was 0.3 inches. Corresponding gain for 13 year olds during the summer months was 1.4 inches and during the fall was 0.6. Fourteen year olds showed the least gain in height at both seasons. They increased in height by only 0.9 inches between spring and fall, and by 0.3 between September and January. The results in weight gain follow a similar pattern: twelve year olds gained 5.1 pounds during the summer and 3.4 during the fall; thirteen year olds gained 7.9 pounds between April and September and 2.3 during the fall; fourteen year olds increased in weight by 7.0 pounds between summer and fall and by 1.3 between fall and winter.

With this group of adolescents greater growth in both height

TABLE III. MEAN HEIGHTS AND WEIGHTS BY AGE AND SCHOOL.

School	Age Yrs.	No. of Subjects	Spring 1929		No. of Subjects	Fall 1929		No. of Subjects	Winter 1930	
			Ht. H.	Wt. Lb.		Ht. H.	Wt. Lb.		Ht. H.	Wt. Lb.
1	12	20	57.6	64.0	23	58.6	69.5	23	59.4	94.5
	13	13	58.3	93.3	13	59.1	96.3	16	60.7	100.8
	14	15	62.5	111.4	21	62.6	111.4	21	62.6	115.6
2	12	10	56.1	77.6	13	57.3	63.8	13	58.1	68.5
	13	9	59.4	96.6	11	60.8	108.5	13	61.5	107.2
	14	10	59.8	107.3	21	60.6	112.0	27	61.8	117.3
3	12	10	56.2	61.7	19	57.5	66.6	16	58.2	64.3
	13	10	57.5	67.0	14	58.0	94.3	13	59.6	98.7
	14	4	60.3	99.0	7	62.2	112.2	3	61.5	105.2
4	12	17	54.5	61.0	20	57.9	68.3	19	58.4	91.7
	13	16	59.3	92.2	17	60.7	98.0	16	60.5	102.5
	14	9	60.9	98.0	13	61.8	105.1	13	62.3	110.6
5	12	7	56.3	73.8	9	56.2	77.2	8	57.8	82.9
	13	2	59.1	67.5	3	59.4	93.0	3	60.2	94.3
	14	3	60.9	99.3	6	60.9	114.0	6	61.0	113.5
6	12	11	55.8	70.3	13	57.1	84.2	11	58.2	88.2
	13	15	59.4	93.6	17	59.9	107.4	19	60.1	102.8
	14	6	59.8	102.7	10	61.0	111.5	10	61.0	111.9
7	12	13	55.9	78.6	18	57.1	65.1	18	58.2	89.2
	13	18	57.4	90.0	23	60.0	98.0	22	60.6	101.5
	14	16	59.7	97.4	15	61.1	103.0	18	61.8	100.0
8	12	6	55.2	65.3	11	57.0	89.2	12	58.2	91.1
	13	9	58.1	92.9	12	59.2	92.6	11	60.0	98.2
	14	8	61.3	102.0	9	61.4	102.5	14	62.0	109.5
All Schools	12	94	56.2	80.4	120	57.4	65.5	120	57.7	88.9
	13	92	58.4	90.6	112	59.8	98.5	113	60.4	100.8
	14	71	60.5	108.2	97	61.4	109.2	114	61.7	118.5

and weight during the nine month period was shown among the 12 and 13 year olds than among the 14 year olds. The increases in height were more marked at the earlier age than were increases in weight.

As Hathaway points out in her Research Report No. 2 on heights and weights of children in the United States (14), "Changes in height and weight have long been used as an index of growth and a criterion of nutriture." The preparation of a growth record form which would be a convenient reference for evaluating the development of individual children or groups of children was completed by Meredith in 1949. This was based on large numbers of children who were living in the Midwest (27) and is an outgrowth of research conducted by Stuart and Meredith at the University of Iowa. Growth record charts allow for the plotting of both height and weight changes against age to establish the percentile or normative zone in which the child falls. In describing the zones which correspond to the 10th, 30th, 70th and 90th percentiles the terms "short and light, moderately short and light, moderately tall and heavy, and tall and heavy" apply, respectively, with the 50th percentile indicating "average" for both height and weight. Writers state that in most instances the child's height and weight will fall in corresponding normative zones. (22, 27)

In the present study the mean measurements of height and weight for 347 girls in the 12 to 14 year old group were compared with these norms. The results shown in Table IV indicate that as a group they may be described as between "short and moderately short" in height.

TABLE IV. MEAN HEIGHTS AND WEIGHTS AT WINTER MEASURE COMPARED WITH MEREDITH GROWTH NORMS FOR NEAREST AGE, EIGHT SCHOOLS

Age Yrs.	No. Girls	Height In.	Meredith Percentiles	Weight Lbs.	Meredith Percentiles
12	120	57.7	25th	88.9	52nd
13	113	60.4	27th	100.8	52nd
14	114	61.7	25th	110.5	53rd

Since the mean weights for each of the three age groups fall very near the 50th percentile, they would be considered "average" in weight. The investigator used the values given for the normative zones (27) and computed percentile placement of the girls in the present study to arrive at the percentile figures shown in the table.

The means for height and weight for adolescent girls in this study were compared with data for like age groups among the Navajo and Papago Indians, and with the results from a Canadian study (7, 41, 30). Measurements for these groups were obtained in the middle 1950's. Papago girls were shorter and heavier, Navajo girls were shorter and lighter, and the Canadian group was very nearly the same in both height and weight as the girls in the present study.

The literature regarding adolescents and their growth usually emphasizes the difference in timing of the rapid growth for boys and girls during the period (39, 22). The Adolescent in Your Family (39) explains that, "The twelfth year in girls and the fourteenth in boys are most often those in which the greatest gain in height is made",

and skeletal and sexual maturity are rather closely related. Longitudinal studies in this area (12, 34) show a definite relationship between stature or physique and maturation.

Table V gives the information on age at first menstruation as recalled by 259 of the 12 to 14 year old girls attending six of the schools in the study. These figures indicate a relatively large number of girls in this age range, 95 out of 259, who had not reached menarche.

TABLE V. AGE AT MENARCHE AS RECALLED BY SUBJECTS IN SIX SCHOOLS

Chron. Age Yrs.	No. of Girls	Age at Menarche								Menarche Not Yet Reached	
		Before 11 yr. 6 mo.		11 yr. 6 mo.		12 yr. 7 mo.		13 yr. 7 mo.			
		No.	%	No.	%	No.	%	No.	%		
12	85	2	2.4	26	30.6	--	--	--	--	57	67.0
13	81	7	8.6	16	19.8	29	35.8	--	--	27	33.3
14	93	5	5.4	18	19.4	35	37.6	24	25.8	11	11.8
All Ages	259	16	6.2	60	23.2	64	24.7	24	9.3	95	36.6

Less than half of the twelve year olds interviewed had begun menstruating, but almost 90 per cent of the 14 year olds had reached menarche. These figures show a total of only 16 girls in the 259 as having menstruated before they were eleven and one-half years of age. The greater number of girls appear to reach menarche at about 13 years of age, as stated in the Children's Bureau publication quoted earlier. "The largest

number of girls first menstruate when 13, although a good many do so at 12." (39) The research reported by Reynolds and Wines was conducted during the 1940's and lists 12.9 years as the mean age at menarche for that group (34). In a 1936 report of 233 girls living in Northern Slovenia, Krajl-Cercek states the mean age of menarche as 13.61 years with a range of from 10.0 to 17.25 (21).

It was felt that the information in regard to onset of menstruation would be of value if considered together with other data such as the measurements of height and weight for individuals. In Tables III and IV the data on heights and weights were shown for the aggregate of girls at the given chronological ages in each of the eight schools for three seasons. Table VI compares heights and weights of 150 individuals in six of the schools with ages at menarche. This table seems to indicate that the girls reaching menarche at an earlier age were taller and heavier at a given chronological age than those who reached menarche later. At 12 and 13 years of age there is a spread of from four to six inches in height and 16 to 26 pounds in weight between those not having reached menarche and the girls who menstruated before 11 years and 6 months of age.

The percentile ranking by Meredith norms of the 150 girls on whom menstruation information was obtained is shown in Table VII. Since the number of 12, 13, and 14 year olds was approximately equal, the comparison is made using the Meredith norm for girls 13 years of age. The percentile placement in both height and weight for girls

TABLE VI. MEAN HEIGHTS AND WEIGHTS BY CHRONOLOGICAL AND MENARCHEAL AGE, SIX SCHOOLS

Age at Menarche		Chronological Age								
		12 yrs.			13 yrs.			14 yrs.		
		No.	Ht. in.	Wt. lb.	No.	Ht. in.	Wt. lb.	No.	Ht. in.	Wt. lb.
Before 11 yr. 6 mo.	Spring	1	59.5	91.0	2	62.2	116.5	2	61.2	121.0
	Fall		60.5	99.0		62.6	129.0		61.4	130.0
	Winter		60.8	98.0		63.2	132.0		61.6	126.0
	Gain		1.3	7.0		1.0	15.5		0.4	5.0
11 yr. 6 mo. 12 yr. 6 mo.	Spring	11	58.1	93.2	12	58.8	99.5	9	62.8	121.3
	Fall		59.2	98.8		60.0	102.7		63.3	124.2
	Winter		59.7	102.4		60.9	105.4		63.4	126.9
	Gain		1.6	9.2		2.1	5.9		0.6	5.6
12 yr. 7 mo. 13 yr. 6 mo.	Spring	0			18	59.7	98.9	18	61.3	103.1
	Fall					60.8	103.5		62.0	106.3
	Winter					61.2	107.4		62.2	115.8
	Gain					1.5	8.5		0.9	12.7
13 yr. 7 mo.	Spring	0			0			13	59.6	92.3
	Fall								60.5	96.2
	Winter								60.9	98.6
	Gain								1.3	6.3
Menarche not yet reached	Spring	40	55.3	74.5	20	56.5	80.8	4	59.0	83.8
	Fall		56.4	79.0		57.9	85.0		60.1	88.8
	Winter		57.4	82.3		58.7	85.1		60.2	91.2
	Gain		2.1	7.8		2.2	4.3		1.2	7.4
All ages		52			52			46		

menstruating earlier was considerably higher than that of the girls who menstruated later or had not yet menstruated.

TABLE VII. MEAN HEIGHTS AND WEIGHTS BY AGE AT MENARCHE, AND COMPARISON OF WINTER MEASURES WITH MEREDITH GROWTH NORMS, 13 YEARS

Age at Menarche	No.	Average for all ages at winter measure and Meredith growth norms for 13 year olds			
		Ht. in.	Percentile	Wt. lb.	Percentile
Before					
11 yr. 6 mo.	5	61.9	50th	119.0	83rd
11 yr. 6 mo. - 12 yr. 4 mo.	32	61.3	40th	114.9	78th
12 yr. 7 mo. - 13 yr. 6 mo.	36	61.7	45th	111.6	74th
13 yr. 7 mo. - 14 yr. 4 mo.	17	60.9	33rd	98.6	47th
Menarche Not Yet Reached	64	58.8	12th	89.2	26th

Research conducted by Iowa investigators, among 183 girls between the ages of 7 and 13, was directed toward defining characteristics of girls identified as of heavy physique. A report of their studies shows that 90 girls in their heavy and obese and medium physique groups had begun menstruating. All of these had reached menarche either before or during their twelfth year of age. These workers state, "Those girls in the heavy and obese group who had reached menarche had reached it, on the average, about four months ahead of those in the medium group."(12)

In Table VIII mean hemoglobin levels for 12 to 14 year olds in four of the schools under study are given for the fall of 1959 and spring of 1960. The mean values showed little difference for the two seasons. In some instances the trend was toward higher values in the spring than in the fall. The over all means for all ages in all schools were 11.6 and 11.7 gm./100 ml. of blood for fall and spring respectively. Hemoglobin values of 11.0 to 12.9 gm./100 ml. are considered "Fair" by some investigators (27, 42, 26), though others would judge the lower value as "Poor" (5).

TABLE VIII. MEAN HEMOGLOBIN LEVELS BY SCHOOLS AND AGE GROUPS, FOUR SCHOOLS

School	Age yrs.	Fall 1959		Spring 1960	
		No. girls	Hemoglobin gm %	No. girls	Hemoglobin gm %
5	12	7	11.7	6	12.2
	13	2	11.8	2	12.2
	14	2	10.8	2	11.7
6	12	10	11.1	7	11.6
	13	12	11.3	9	12.0
	14	2	11.6	2	10.6
7	12	3	12.3	3	12.3
	13	17	11.5	13	12.5
	14	1	11.0	1	12.6
8	12	2	12.7	1	10.7
	13	11	11.2	9	11.4
	14	4	12.2	3	10.5
All Schools	12	22	12.0	17	11.7
	13	42	11.4	33	12.0
	14	9	11.6	8	11.4
All Schools	All Ages				
		73	11.6	58	11.7
			1.086		2.105
			S.D.		S.D.
			.93		.774
			1.249		1.222
			.62		1.679

Certainly the values obtained in this study are considerably below those being reported for adolescents in somewhat similar population groups. Only seven per cent of a group of Navajo girls had values less than 12.3, with over 50 per cent having levels greater than 14.2 gm./100 ml. of blood (7). The mean value for 53 adolescent Papago girls was found to be 12.5 gm./100 ml. of blood (41). In a nutritional status study conducted in a Siamese village, hemoglobin values were obtained for 112 girls aged 7 through 14. Of this number, only 11 had values of 11.5 gm./100 ml. or below, with 75 having hemoglobin levels above 12.75 gm./100 ml. of blood (15). A report on anemia among Alaskan Eskimos lists hemoglobin levels separately for all school age children in each of the four villages under study. The means reflect levels for approximately 30 boys and girls in each village. The lowest value was 11.96 gm./100 ml., with 12.00, 12.37, and 13.21 gm./100 ml. being reported for the other three villages (36). In every case these are above the mean levels of hemoglobin found for adolescent girls in the present study.

As indicated in Roberts' Nutrition Work with Children, hemoglobin concentration is one of the most widely used biochemical measures of nutritional status, but in adults the hemoglobin levels may be lowered through blood-loss (27). With adolescent girls it might be presumed that menstruation could influence hemoglobin concentration adversely.

The data on hemoglobin were examined to ascertain whether, as might be expected, the age at menarche had influenced the mean values.

No clear relationship could be found. In the Iowa studies previously cited, Gschneidner and Roderick (12) indicated that the hemoglobin levels for the earlier maturing girls were essentially the same as for those who matured later. The mean values for the two groups were 12.59 and 12.76 gm./100 ml. of blood, respectively.

CHAPTER VI

INTERRELATIONSHIPS AMONG DIETARY FINDINGS AND PHYSICAL
AND PHYSIOLOGICAL MEASUREMENTS

The mean nutrient intakes, as calculated for the adolescent girls in the present study, could be considered satisfactory except for ascorbic acid in certain of the schools. But in assessing relationships between the diet, as shown for a mean of five different girls for each of seven days, and the physical and physiological data, it must be kept in mind that the dietary practices reported represent current conditions only, both for the boarding schools included and for the individuals under study. Assuming that the girls who were observed had been consuming a like diet throughout their school years, it would still encompass only three-quarters of each of approximately seven years, or less than half of their total life. Under these circumstances, it is questionable whether any correlation between present diets and physical and biochemical measures could be expected.

Height and weight measures are reported for five schools, age at onset of menstruation for three of them, and hemoglobin values for two. There appeared to be some relationship between the average figure for calories consumed by the girls, and the data on mean weights. Very few individuals could be considered overweight, with only a small number in the 90th percentile of the Meredith norms. Other investigators apparently found greater numbers in this classification among somewhat similar groups (28, 41).

The data in regard to age at menarche, as recalled by the girls, showed a slight trend toward earlier maturation among girls in the schools where the iron intakes, particularly of the 9 to 11 year olds, were at a relatively high level. However, when the data obtained were carefully examined with respect to protein intake and height, and iron or protein intake and hemoglobin levels, no clear cut relationships were found.

Diet histories and 7-day dietaries on an individual basis, combined with a larger sampling for hemoglobin determinations might well reveal more interrelationships.

However valuable more complete dietary data and more extensive biochemical measures might be in discovering relationships, many other factors have been shown to influence both age at menarche and concentrations of hemoglobin. A few which appear widely divergent are emotional climate, incidence of infection, and geographic location (7, 15, 21, 28, 35, 39, 44, 46). A genetic factor is sometimes suggested, but in a report on hemoglobin levels among Alaskan Eskimos this was ruled out (36).

CHAPTER VII

SUMMARY AND CONCLUSIONS

In this study on the dietaries and nutritional status of adolescent girls attending Indian boarding schools in the Dakotas, data were obtained on diets for a period of seven consecutive days, on heights and weights at three seasons, hemoglobin levels for two seasons, and age at menarche.

Standard tables of food composition (4, 45) were used to evaluate the 7-day dietaries for the 12 to 14 and 9 to 11 year old groups of girls. Calorie and nutrient values of the diets were compared with the NRC recommended allowances (9, 31, 43). The results indicated that the observed diets compared favorably with those reported by other investigators for somewhat similar groups (1, 2, 7, 11, 28, 41). In general the calorie and nutrient values of the diets closely approached or exceeded the recommended allowances with the exception of ascorbic acid at certain of the schools. The inclusion of a citrus fruit at breakfast in these schools (17) would have provided an adequate amount of ascorbic acid. A slight trend in the direction of lower nutrient intakes among the older girls of the two groups was noted.

Results of height and weight measures according to chronological age indicate that mean heights for the 12 to 14 year old girls fall within the short classification, according to Meredith norms, but mean weights were close to average. When the height and weight data were

related to menarcheal age a wider spread in percentile ranking was observed. Contrary to current opinion on the subject (8, 11, 35, 46) obesity was uncommon among the girls in the group studied.

The age at menarche, in general, is similar to that of the general population. Any difference evidenced in this characteristic is toward later rather than earlier maturation.

The mean hemoglobin values for the group as a whole were found to be in the "Fair" classification. The fact that hemoglobin levels were not higher can hardly be explained on the basis of current dietaries. These values may reflect previous dietary inadequacies or the effect of a number of other factors. However, any purely genetic influence is doubtful. Further investigation is needed in order to establish a causal relationship of any kind.

It is hoped that the present study will have contributed something of value concerning the nutrition of adolescent girls and that it may add to the information available about individuals of a particular ethnic origin.

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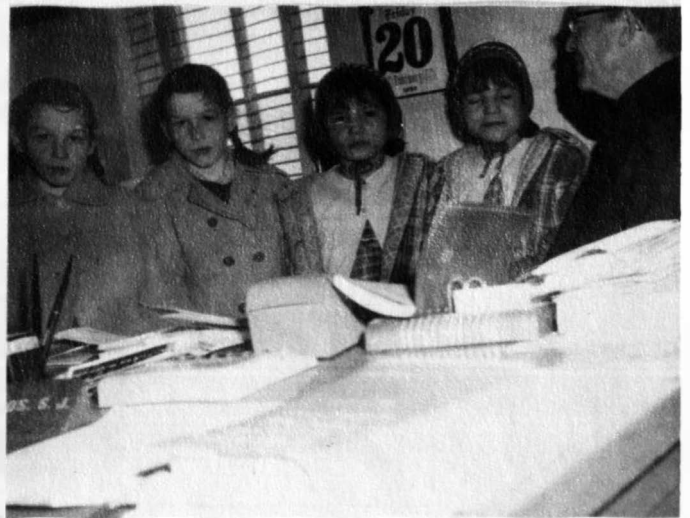
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APPENDIX



Adolescent girls in recreational activities at Holy Rosary Mission and Wahpeton Indian Schools



Some younger adolescent Indian girls at Holy Rosary Mission in Pine Ridge. Two sets of twins attending the school are shown with Father Edwards, Superior at the Mission.



Mixed groups of adolescents in class and free-time activity at Oglala Community School, Pine Ridge

Menu

.....

School

Date

Breakfast	Morning
Dinner	Noon
Luncheon	Evening
Supper	Between Meal
Snack	Morning
	Afternoon
	Evening

Boarders

Elem. Girls.....
 Elem. Boys.....
 Total.....
 H.S. Girls.....
 H.S.Boys.....
 Total.....

Day

Elem. Girls.....
 Elem. Boys.....
 Total.....
 H.S. Girls.....
 H.S.Boys.....
 Total.....

Adults

Men.....
 Women.....
 Total.....

DIETARY OBSERVATIONS

Date Meal School

Item	6 yr.		7-8 yr.		9-11 yr.		12-14 yr.	
	Girls Av. Sv.	Boys Av. Sv.	Girls Av. Sv.	Boys Av. Sv.	Girls Av. Sv.	Boys Av. Sv.	Girls Av. Sv.	Boys Av. Sv.

Form 7:l-60

Forms used to record general dietary observations.

Dietary Observations

Date	Meal				School				
Food									COMMENTS
Common Serving									
7 & 8 yr. old									
Boys									
9-11 yr. old									
Boys									
12-14 yr. old									
Boys									

Form 5:10-59

Form used to record individual interviews.

SCHOOLS INCLUDED IN THE STUDY*

Holy Rosary Mission, Pine Ridge, South Dakota

Oglala Community School, Pine Ridge, South Dakota

Pierre Indian School, Pierre, South Dakota

Rosebud Boarding School, Mission, South Dakota

St. Francis Indian School, St. Francis, South Dakota

St. Joseph's Indian School, Chamberlain, South Dakota

St. Paul's Indian School, Marty, South Dakota

Wahpeton Indian School, Wahpeton, North Dakota

*Order of above list does not relate to numbers assigned to the schools in the study.