THE NUTRITIONAL STATUS OF EARLY ELEMENTARY SCHOOL AGE "HEAD START" CHILDREN, IN GREENVILLE, TEXAS

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN NUTRITION IN THE GRADUATE DIVISION OF THE TEXAS WOMAN'S UNIVERSITY

COLLEGE OF HOUSEHOLD ARTS AND SCIENCES

BY

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DENTON, TEXAS

MAY, 1970

A C K N O W L E D G M E N T S

The author wishes to express her sincere appreciation and gratitude to those who have assisted her throughout her master's program:

To Dr. Pauline Beery Mack, Director of the Texas Woman's University Research Institute, for her assistance in planning the author's course of study; for her interest and assistance in this particular study; for her advice and help in the preparation of this thesis; and for her evaluation of skeletal maturation for the children of the study and for her supervision of the work in bone mass;

To Dr. Betty Alford for her guidance and understanding thoughtfulness throughout the author's study; for her close supervision in the performance of the research work upon which this thesis is based and for her invaluable advice in the preparation of this Report;

To Dr. Jessie W. Bateman, Dean of the College of Household arts and Sciences, for her encouragement and interest during the author's graduate program;

To Dr. Ralph Pyke, Dr. Kathryn Montgomery and Mr. Walter Gilchrist for their assistance during the biochemical tests and the laboratory analyses performed for this study;

To Mr. William Stover and Mr. Larrell Rike for their assistance in the skeletal density studies performed in connection with this study;

To Jessie Ashby for coding and preparing data in the Texas Woman's University Statistical Laboratory;

To Lenoir O'Rear, Reba Fry and Martin Cudd for their assistance in various aspects of this study, and for the many personal kindnesses which they extended to the author;

To the Members of the Texas Legislature for providing special funds for the conduct of nutrition work of this type at the Texas Woman's University, and especially to Governor Preston Smith and Lieutenant Governor Ben Barnes of the State of Texas for their special interest in the welfare of the children of this State through the allocation of state funds for nutritional status studies of "Head Start" and other children of Texas;

To the administrators and teachers of the Greenville Independent School District and to the parents and children involved in this study;

To Klarise Harn and Eloise Jackson for typing this thesis;

To the eight Greenville women who assisted with the transportation of the children to Denton for the biochemical-medical tests; and

To the members of the author's immediate family whose constant encouragement and cooperation made this study possible.

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I N T R O D U C T I O N

This study was initiated as a part of the federal and state "Head Start" program, for the purpose of finding the initial nutrition status of preschool and early elementary school children in Greenville, Texas. The purpose of this investigation has been to determine the nutritional status of 26 preschool or early elementary school age children in low and middle-low income families who have been enrolled in the 1969 Summer Head Start Program in Greenville, Texas, and who have continued in the study, for four months, with the following objectives carried out.

OBJECTIVES

The objectives of the investigation were the following:

1. To obtain a personal history of each family interviewed and to compare the educational level of the children's parents;

2. To determine the dietary intake of these "Head Start" children by means of a diet history, a food intake record, and a food frequency chart;

3. To establish the nutritional status of these same children through examinations and tests

made in the Nelda Childers Stark Laboratory for Human Nutrition Research at the Texas Woman's University Research Institute;

The examinations and tests made on the children included:

(a) Medical examinations;

(b) Biochemical blood and urine tests;

(c) Skeletal maturation evaluations;

(d) Bone density measurements from radiographs;

(e) Measurements of height, weight and growth accomplishment;

4. To present the results of the data on the various tests to the parents of the children and to attempt to teach them, through individual instruction in one or two half-hour periods, on methods of attempting to improve the nutritional status of the children; and

5. To present the findings of this study to the teachers and the administrators in the Greenville Independent School District in order that they might be aware of inadaquacies in the diets of this group of children, so that they would cooperate in developing methods of improvement in the school health

education curriculum, the school lunch and milk programs, and, if possible, to initiate the school breakfast program.

REVIEW OF LITERATURE

The interest in the dietary intake and the nutritional status of children in the United States has increased considerably during the past decade. It was after hearings were held by the United States Senate Subcommittee on Employment, Manpower, and Poverty concerning hunger in America that the National Nutrition Survey was initiated in 1967. The results of the National Nutrition Survey have clearly identified the incidence, magnitude and location of malnutrition and related health problems within lower income population groups in the United States. The Nutrition Program in connection with the National Nutrition Survey is most interested in describing the population groups which have nutritional problems and to identify these groups, not on the basis of the state, but on the basis of the type of environment, income, and other factors which should facilitate remedial programs or better utilization of existing programs, according to Shaefer (1).

In a study conducted by Creamer (2) in 1958, involving 13,084 high school age subjects in five geographic regions of Texas, a significant relationship was found between the level of the mother's education to growth accomplishment of the youth; whereas the father's education had a lesser role in the growth accomplishment of the youth. An earlier study conducted by Melton (3) also indicates the direct correlation between education level of the parents and growth accomplishment of the children.

More recent studies have verified the fact that nutrition knowledge of the mother varies directly with the education level of the mother and that the food likes and dislikes of the father and older siblings have a significant influence upon the food preferences of the preschool child. An example is the study of Gassette (4). It also has been found that the food preferences of the husband have the greatest influence upon meal planning by the housewife and re-emphasizes the husband-father need for nutrition education, according to Owen et al.(5).

Portions of the southern states have become classic examples of rural poverty areas. In the study by Owen et al. (5), it was reported that preschool children of poor families are smaller than average and appear to be more "at risk" biochemically than were youngsters of more affluent families. The results also verified the 1965 survey reported by the United States Department of Agriculture concerning food consumption in this country, namely, that energy intakes and the intake of calcium, ascorbic acid, and riboflavin tend to be the greatest limiting factors in the American diet. Growth achievement and biochemical findings lend support to these dietary data.

An article published in The American Journal of Public Health by Cornelly (6) cites the major health problems of the Negro. They are: (a) The widening gap between Negro and Caucasian mortality and morbidity; (b) Mental retardation due to prematurity complications of pregnancy, low socio-economic status, as well as lower occupational levels, lower educational attainment and broken homes; and (c) Health concerns of the unskilled worker. The health problems of the Negro are consequently the health problems of the poor as a population group.

In a study conducted in Lincoln, Nebraska, similar to the Mississippi study by Owen et al. (5), the mean daily nutritional intake of two socio-economic groups was compared with the Recommended Dietary Allowances of the National Research Council, Food and Nutrition Board (7). For both groups of children, one of a higher socio-economic class and one group receiving some welfare, iron calcium, ascorbic acid and calories were among the least well supplied nutrients. Mean heights, weights, body circumferences, skin-fold thicknesses and muscularity measurements for the two groups were measured. All measurements, except skin-fold thickness, tended to be greater for the higher income group than the lower group, according to Kerry, et al. (8).

The food habits of American children of Mexican descent were studied by Natow (9) and were compared with their growth and skeletal status. This study of 509 children ranging in age from less than one year to 19 years, living in Waco, Dallas and Fort Worth, Texas gives us important information concerning the nutritional status of the poor living in urban areas of Texas. The results of this study indicate that the food intake of this group was extremely poor, with the younger children coming closer to meeting the requirements than the older children. The exception to this was in nutrients provided by milk which was consumed to a greater extent by the younger children.

Another study of interest concerning low socio-economic urban Texas population groups was conducted by Melton (3) in Fort Worth, Texas with a group of 56 children from three to eight years of age. Melton found that the home diets of these children were extremely poor, with protein the only nutrient reaching or exceeding the Recommended Daily Requirements. Only 7.1 per cent of the children in the study were free of anemia of one type or another. Calcium and ascorbic acid intakes were low for all of the children. Only 38 per cent of these children had achieved a skeletal age comparable to their chronological age.

In all the studies reported, the general dental status of all population groups was poor. The classification "poor" denotes a high prevalence of decayed and missing teeth, as well as abnormal changes in gum tissue. These results concur with those found in the National Nutrition Survey in which 85 to 90 per cent of the individuals studied were found to be in dire need of dental care. As a basic health problem, which could be related to poor dietary habits, it is evident that the dental aspects of the diet must receive higher priority than has been given in the past, according to Shaefer (1).

When we speak of malnutrition, we not only are referring to under-nutrition, but also to over-nutrition in the form of excessive calories resulting in obesity. This is an area of malnutrition which deserves a well planned program of nutrition education. In the study by Christakos et al.(10) with New York City children, 11.4 per cent of the subjects were obese and 11 per cent of the obese children had systolic blood pressure levels of 140 mm. and over. The total number of subjects in this study was 642 children between the ages of 10 and 13 years. There is already considerable epidemiological evidence that overnutrition may enhance risk of coronary heart disease, hypertension and diabetes. The obese child often becomes the obese adolescent and later the obese adult. Obese children and adolescents are subject to family tensions and ridicule and are more likely to have personal adjustment problems, according to Creamer (2).

One of the causes for early obesity may stem from the lack of education of the mother. Eppwright found in her study that the frequency of the mother's concern about a child eating too little far exceeded that of the child eating too much (11).

The studies conducted in the past indicate the need for a much better understanding than now is prevalent of the eating behavior of preschool children, the problems that may arise from a lack of understanding of the physiological changes undergone by children as they pass through the toddler into early preschool and elementary school years, according to Eppwright (11). It is hoped that as more information is collected, local agencies will be better prepared to determine methods and programs which will identify families requiring nutrition education programs to insure proper nutritional health for all.

PLAN OF PROCEDURE

The participants in this study were students in the Summer "Head Start" Preschool Program in Greenville, Texas during the summer of 1969. The children all were six and seven years of age at the time when the initial biochemical tests were performed in November, 1969, and March, 1970. Nineteen children were in the standard first grade classes, while 10 children were in special education classes.

The author used two survey forms to secure background information and food consumption patterns on the children and the parents. Copies of these two forms, Survey Form A and Survey Form B, appear in the Appendix of this Report.

Survey Form A called for personal information concerning the parents' occupations, education, and approximate amount of money spent on food and beverages weekly. This form also listed some questions concerning the food likes and dislikes of the child. The mother or guardian of the child answered the questions on this form.

Survey Form B was a food frequency chart and was used as a cross-check on the food habits of the child and the family. The various food groups are listed and the number of times the food was served per week, per day, or only "sometimes" was recorded. The mother or guardian answered this questionnaire in all cases.

The author initiated this study in July, 1969. The school administration of the Greenville Independent School District authorized the author to get in touch with the "Head Start" School Nurse for the purpose of locating students with possible nutritional deficiencies, as well as other students from extremely low economic status with diverse problems who might benefit through participation in this study. Letters of explanation of the study and an invitation to participate were sent to 50 families. A total of 29 families cooperated in the study.

To determine the dietary intake of the subjects, each parent kept a dietary record of all foods eaten for three days, on a prepared form. (See Appendix, page 83.) This record included all food eaten at breakfast, lunch, dinner and between meals. The quantity of food eaten by each subject was converted into grams and calculated to show the amount of each nutrient present in a three day diet. This was accomplished through the list of food values in Bowes and Church (12) and the use of punched IBM cards. The cards were tabulated on the IBM 1620 computer by the Texas Woman's University Nutrition Research Statisticians in the Data Processing Center.

The nutritional status of the subjects was determined through the administration of a battery of medical-nutrition observations and tests on November 7, 8 and 9, 1969. The children were tested in groups of nine or 10 each day. These tests were administered at The Nelda Childers Stark Laboratory for Human Nutrition Research, Research Institute, the Texas Woman's University, Denton, Texas.

The results from the initial dietary records and medical-nutrition observations and test, which the team of research workers conducted, were discussed with the parents of the subjects. A summary was given to the parents during individual home visits. (See Appendix, page 84 .) At this time the author offered suggestions for improvement of the subject's diet. Methods of food preparation were discussed with the parents, with specific attention given to the preparation of Government Commodity Foods. In some cases, the author prepared foods using Commodities and presented them to the families with specific instructions concerning the preparation of the food.

Four months after the first medical-nutrition tests were conducted, a second series of tests was administered to the same group of children. Three of the original 29 children were ill at the time of the second series of test, bringing the number to 26 children. A three day dietary record was kept by the subjects preceeding the second testing.

The methods included a two day dietary record kept by the mother or guardian and a 24-hour recall dietary recorded by the investigator.

MEDICAL-NUTRITION OBSERVATIONS AND TESTS

MEDICAL EXAMINATION

The physician cooperating with this study examined each student for any evidences of physical status that would be related to nutritional well-being.

The medical examination of each subject included gross observations concerning: general appearance, condition of the skin (face, neck and back), tongue (chronic and acute lesions), gums (chronic and acute lesions), teeth, skeletal abnormalities, eyes, nose, lungs, heart, gait, reflexes, appearance or absence of fatigue, nervous habits, alertness and vivaciousness.

The following methods were used to tabulate the findings of the medical-nutritional observations and tests which were administered by the laboratory technicians from The Nelda Childers Stark Laboratory for Human Nutrition Research. The tests and examinations were conducted on three consecutive days with groups of nine or 10 children each day.

WEIGHT STATUS

The Pryor Norms (13) were used to establish the weight status of each subject. The standards take into account the skeletal structure of the body, as well as the sex, age, and height. Standing height was used. Measurement of the lateral chest on expiration was used to determine whether the individual was of large, medium, or small frame.

The suggested proper weight of an individual of the same age, sex, height and body build was compared to the subject's weight. The deviation from the suggested weight was calculated in terms of per cent. The following nine classifications were employed in these calculations.

	Classes	Conformity to Pryor Norms
	1	Correct weight ±10.9%
Underweight Classes	2a	-11.0 to -15.9
	3a	-16.0 to -20.9
	4a	-21.0 to -25.9
	5a	-26.0 to -99.9
Overweight Classes	2b	+11.0 to +15.9
	3b	+16.0 to +20.9
	4b	+21.0 to +25.9
	5b	+26.0 to +99.9

GROWTH STATUS

Height and weight of the children were recorded among the other body measurements, and from these the physique channel and the growth accomplishment in terms of developmental level gains were calculated by means of the Grids as devised by Wetzel (14)(15).

DEVELOPMENTAL LEVEL ACCOMPLISHMENT

Certain progress should be made in height and weight every month as a child advances in chronological age. This advancement is measured after infancy, which is set at a chronological age of 30 months. The average accomplishment per month of age shows the extent to which this developmental gain has occurred. The Wetzel Grid classification of this accomplishment, as given below, was used for this study.

Classes	Developmental Level Accomplishment
Class 1	1.00 and above
Class 2a	0.99 to 0.90
Class 2b	0.89 to 0.85
Class 3	0.84 to 0.75
Class 4	0.74 to 0.60
Class 5	0.59 and below
Adults	

PHYSIQUE CHANNEL

The Wetzel Grid is used to determine the physique channel of the individual according to the body type. The following classifications were used:

Physique Channel	Description
A_4	Obese
A_3, A_2	Stocky
A_1, M, B_1.	Slender
B_4	Very Slender

AGE SCHEDULE OF DEVELOPMENT

The classes used for age schedule of development were based on the change in developmental level between tests each month.

Classes	Age Schedule of Development
Class 1	2%, in highest 2% of the population
Class 2	15%, as good as the upper 15% of the population
Class 3	67%, Median of the population
Class 4	82%, same as 82% of the population
Class 5	98%, no better than 98% of the population

SKELETAL STATUS

SKELETAL MATURATION

X-ray films were made of each child for judging skeletal maturity and for measuring bone density. Following are the portions of the skeleton x-rayed for this purpose: hand (postero-anterior position); foot (lateral and antero-posterior positions).

The skeletal maturity of each of the participants in the study was assessed in terms of skeletal age at each test period. The postero-anterior x-ray of the hand was utilized for this purpose. The hand x-ray was compared with norms established by Todd (16) and enlarged upon by Greulich and Pyle (17).

In assigning a skeletal age to a child by means of the hand x-ray, the standard order of assessing the parts of the hand in this laboratory is as follows: (a) metacarpals; (b) proximal phalanges; (c) middle phalanges; (d) terminal phalanges; (e) radius; (f) ulna; and (g) wrist carpals. Such factors are considered as the shafts, the bases, the distal ends, and the epiphyses of the carpals and metacarpals; the shafts and epiphyses of the radius and ulna; and the individual wrist carpals. The determinator showing the greatest degree of maturation advancement and that showing the least advancement are noted; and an over-all skeletal age is assigned. The assigned skeletal age is compared with the chronological age of the child in order to assign a skeletal maturation classification.

The norms set up by Todd and by Greulich and Pyle are for Caucasians of middle socio-economic background. The subjects involved in this study were predominantly of the Negroid race and of low socio-economic background, but the Todd standards were used since the same norms were employed initially and finally for the same subjects.

BONE DENSITY

The skeletal density test is an accurate method of determining the quantity of mineral in the bones of an individual from x-rays. The technique, devised by Mack and associates (18-21) is used in this measurement. The Bone Density Assembly enployed at Texas Woman's University consists of the following basic units:

1. A modified Knorr-Albers scanning unit.
2. A Speedomax Model G transmitting recorder which produces the raw, uncalibrated film density curve of the calibration wedge, and contains within the same panel a series of potentiometers used for the purpose of calibrating the wedge density curve.
3. A Speedomax Model G recorder for displaying the calibrated wedge curve.
4. An Instron Integrator geared to the output of the second recorder.

The addition of a small digital computer into the analog system has provided further automation to the Bone Densitometer Assembly developed in stages by Texas Woman's University staff members and currently in use at this institution.

The light transmission data from the film, in the form of a voltage functional with per cent light transmission, are measured with the modified Knorr-Albers microphotometer. The film is held in a motor-driven assembly which traverses a light beam. The light beam which passes through the film has a width of 10 microns along the scan path and a height of 1.25 mm. normal to scan path. Nine different scan speeds are available. Adjustable limit-switches restrict the scan path to a predetermined range.

The output of the scanning unit is connected through the amplifier to a small digital computer. An analog-to-digital converter formats the data for direct processing by the computer, and the computer samples the data at specific intervals of time. Programming and operating control are effected through a teletypewriter unit which includes a paper-type input/output feature.

The computer program includes several operational features that permit flexibility in the use of the system. The present system provides an automatic means for calibrating the film in terms of the light transmission of the entire aluminum alloy wedge throughout its slope, the roentgenogram of which is taken simultaneously with the roentgen image of the bone of interest. Manual operations required of the operator have been reduced to those involving the scan of the film. The digital technic offers a more rapid procedure for analyzing the films, and it also reduces the technical error that can be introduced by the operator.

Quantitation of bone mass changes in growing human subjects is more difficult than that in adults because of changes in the size of the bone. The os calcis was the anatomic site utilized in this study. The reasons for the selection of this bone were the following:

(a) The os calcis is a large bone with a minimum of over- and underlying soft tissue, which has several advantages including the reduction of x-ray scattering;

(b) The os calcis has two distinct anatomical landmarks which can be located without difficulty, and which serve to mark the extremes of tracing paths which are valuable in a longitudinal study involving one group of children evaluated at intervals of time;

(c) The foot is subjected to a great deal of mechanical stress with normal activity, and therefore it is likely to show differences in bone mass in persons who differ markedly in their level of activity or in one person undergoing different levels of activity at different times; and

(d) This bone contains a large amount of cancellous or trabecular tissue. It was known by those who work in this field that interchange of ions between bone and extracellular fluid occurs more readily in newly formed trabecular bone than in older compact bone.

The "conventional" os calcis tracing path represents a section of bone from a posterior to an anterior landmark 10 microns wide, the width of the scanning beam. In making scans of the conventional tracing path in successive films of one subject, pricks are made with a steel needle at the extremities of this path, but outside of the film. Sequential films are super-imposed carefully over the original film of a series. The same super-imposition of wedge film over wedge film also is made in order to insure that the same path of the calibration wedge is traced from one time to another.

OBSERVATIONS AND TESTS FOR BODY FUNCTIONS

HEART

The physician examined the heart of each child by the use of a stethoscope. The data on the functioning of the heart were classified as follows:

Subjects exhibiting no dysfunction

Subjects exhibiting some dysfunction

REFLEXES

The medical examiner, by means of a rubber hammer, tested the reflex action in two areas, the patellar and the achilles. Presence of reflexes is normal in both of these areas. The functioning of the reflexes as observed in the all-over medical examination were classified according to:

Normal reflexes

Sluggish reflexes

Hyperactive reflexes

BODY CHEMISTRY

LEUCOCYTE COUNT

The leucocyte count was determined per milliliter of blood. This value has little nutritional significance except as it deviates from the normal, denoting infection or some pathological situation. The normal leucocyte (white cell) count varies from 6,000 to 10,000.

HEMOGLOBIN

The method used for hemoglobin determination was that outlined in The American Journal of Medical Sciences, (22)(23). This method is labeled the Cyanmethemoglobin Method. The classification used to report hemoglobin ranges found in the study were:

Classes	Range of Hemoglobin Values (gm. per 100 ml. blood)
Class 1	13.00 and above
Class 2	12.99 to 11.50
Class 3	11.49 to 10.00
Class 4	8.49 and below

ERYTHROCYTE COUNT

The method described by Hawk (24) was used to measure the number of red blood cells per cubic millimeter of blood. The improved Neubauer ruling was used in this test. The arbitrary classifications for the Red Cell Count were:

Classes	Ranges of Red Cell Count Values (millions per 100 cu. mm.)
Class 1	4.76 and above
Class 2	4.75 to 4.51
Class 3	4.50 to 4.26
Class 4	4.25 to 4.01
Class 5	4.00 and below

HEMATOCRIT

The hematocrit value, which is a number which indicates the percentage of whole blood made up of erythocytes, was measured by the method of Natelson (25). The hematocrit values were classified in the following ranges.

Classes	Ranges of Hematocrit Values
Class 1	40.0% and above
Class 2	39.0% to 37.0%
Class 3	36.0% to 34.0%
Class 4	33.0% to 31.0%
Class 5	30.0% and below

CORPUSCULAR CONSTANTS

From the above values of hemoglobin, erythrocyte count, and hematocrit, three corpuscular constants were determined as outlined by Gradwohl (26). The mean corpuscular volume (MCV) shows whether or not the cell volume is small or large in proportion to the number of red cells, and is calculated from the formula:

$$\frac{\text{Volume of packed red cells (cc. per 1000 cc.)}}{\text{Red cell count (millions per cu. mm.)}}$$

The mean corpuscular hemoglobin (MCH) tells whether or not the hemoglobin is low or high for the number of red cells, and is calculated from the formula:

$$\frac{\text{Hemoglobin (gm. per 1000 cc.)}}{\text{Red cell count (millions per cu. mm.)}}$$

The average mean corpuscular hemoglobin concentrations (MCHC) indicated whether or not the hemoglobin concentration is low or high in comparison with the size of the cells, and is calculated from the formula:

$$\frac{\text{Hemoglobin (gm. per 100 cc. x 100)}}{\text{Volume of packed red cells (cc. per 100)}}$$

The data for all three corpuscular constants were classfied as normal, above normal, or below normal.

Mean Corpuscular Volume (MCV) normal limits ranged from 82 to 92 cubic microns.

Mean Corpuscular Hemoglobin (MCH) normal limits were from 27 to 31 micromicrograms.

Mean Corpuscular Hemoglobin Concentration (MCHC) had normal limits from 32 to 36 per cent.

BLOOD PLASMA VITAMIN A

The vitamin A content of the blood plasma was determined photometrically by the method of Kimble (27). The classifications of vitamin A values were used as follows:

Classes	Range of Vitamin A Values (mcg. per 100 ml. plasma)
Class 1	35.5 mcg. and above
Class 2	35.4 to 29.51 mcg.
Class 3	29.5 to 23.51 mcg.
Class 4	23.5 to 17.51 mcg.
Class 5	17.5 mcg. and below

BLOOD PLASMA CAROTENE

The carotene content of the blood plasma was determined photometrically by the method of Kimble (27). To determine the classes of blood plasma carotene, the following ranges were used.

Classes	Ranges of Carotene Values (mg. per 100 ml. plasma)
Class 1	0.20 mg. and above
Class 2	0.19 to 0.15 mg.
Class 3	0.14 to 0.10 mg.
Class 4	0.09 to 0.05 mg.
Class 5	0.05 mg. and below

BLOOD PLASMA ASCORBIC ACID

The concentration of the blood plasma ascorbic acid was measured photometrically by the method of Mindlin and Butler, (28) with a slight modification as suggested by Bessey and King (29).

The values of blood plasma ascorbic acid were grouped into the following seven classes with 1a, 1b and 1c considered as subdivisions of a single group:

Classes	Range of Ascorbic Acid Values (mg. per 100 ml. plasma)
Class 1a	2.00 mg. and above
Class 1b	1.99 to 1.50 mg.
Class 1c	1.49 to 1.10 mg.

Class 2	1.09 to 0.90 mg.
Class 3	0.89 to 0.70 mg.
Class 4	0.69 to 0.50 mg.
Class 5	0.49 mg. and below

BLOOD SERUM TOTAL PROTEIN

The total protein, albumin and albumin plus alpha globulin, were determined by the method of Wolfson et al. (30), as modified by Saifer and Zymoris (31), except that the biuret reagent used for color development was that proposed by Gornall et al.(32).

In these analyses, albumin plus alpha globulin (A) was determined by salt fractionation with 22.1 per cent sodium sulfate. Globulin (g) was obtained by subtracting albumin plus alpha globulin (a) from total protein. Therefore, globulin (g) represents globulin minus alpha globulin.

Albumin (a) was determined by salt fractionation with 26.9 per cent sodium sulfite. Globulin (g) was obtained by subtracting albumin (a) from total protein. The findings for total protein were classified as follows:

Classes	Gm. per 100 ml. serum
Class 1	7.00 gm. and above
Class 2	6.00 to 6.99 gm.
Class 3	5.00 to 5.99 gm.
Class 4	4.00 to 4.99 gm.
Class 5	3.99 gm. and below

These five classifications were used to report the serum albumin ranges found in this study.

Classes	Gm. per 100 ml. serum
Class 1	4.50 gm. and above
Class 2	4.00 to 4.49 gm.
Class 3	3.00 to 3.99 gm.
Class 4	2.00 to 2.99 gm.
Class 5	Below 2.0 gm.

The following classes were used to report serum globulin concentration:

Classes	Gm. per 100 ml. serum
Class 1	3.00 to 2.01 gm.
Class 2	2.00 to 1.50 gm.
Class 3	1.49 and below

BLOOD SERUM CALCIUM

The method of Ferro and Hamm (33) was used to determine the calcium content of the blood. The following ranges were used to designate the classes.

Classes	Ranges of Blood Serum Calcium Concentration
Above Normal Limits . . .	11.0 mg. and above
Within Normal Limits . .	10.0 to 10.9 mg.
Below Normal Limits . . .	9.99 mg. and below

BLOOD PLASMA PHOSPHORUS

Phosphorus in the blood plasma was determined according to the method of Dryer et al.(34). The following ranges were used to classify the phosphorus concentration.

Classes	Ranges of Blood Plasma Phosphorus
Above Normal Limits . .	4.00 mg. and above
Within Normal Limits .	3.00 to 3.99 mg.
Below Normal Limits . .	2.99 mg. and below

CHOLESTEROL

The cholesterol content of the blood was determined for each subject. The method employed was one developed and modified by Zak (35). The cholesterol was classified according to the following categories:

Classes	Ranges
Above Normal Limits . . .	300 and above
Within Normal Limits . .	200 to 299
Below Normal Limits . . .	199 and below

DETERMINATION OF THIAMINE

The urinary output of thiamine is closely related to the state of nutrition of the body. Healthy human beings on an adequate diet excrete between 50 to 150 mg. of thiamine per day. Lower values are found during vitamin B_1 deficiency, pregnancy, and a variety of diseases. The thiochrome procedure was used in this study for the determination of thiamine in the urine. This is a method modified by Mickelson et al.(36). The following classifications were used to designate the thiamine content of the urine:

Classes	Mcg. per 1 hr. fasting sample
Class 1	7.50 mcg. and above
Class 2	7.49 to 6.00 mcg.
Class 3	5.99 to 4.50 mcg.
Class 4	4.49 to 2.50 mcg.
Class 5	2.49 mcg. and above

DETERMINATION OF RIBOFLAVIN

Riboflavin is excreted predominantly in the feces and to a smaller extent in urine. During a vitamin B_2 deficiency, no riboflavin is excreted in the urine, while an increase in the vitamin's intake in human beings increases the urinary output. Normal human beings on a balanced diet excrete about 500-800 mcg. of this vitamin per day. The method used for the determination of riboflavin in urine is similar to a method developed by Ferrebee (37). The following classifications were used in this study:

Classes	Mcg. per 1 hr. fasting sample
Class 1	45.5 mcg. and above
Class 2	45.4 to 30.0 mcg.

Class 3 . . . . 29.9 to 15.0 mcg.

Class 4 . . . . 14.9 to 10.1 mcg.

Class 5 . . . . 10.0 mcg. and below

DETERMINATION OF N-METHYLNICOTINAMIDE ACID (F_2 SUBSTANCE)

A normal adult on an adequate diet excretes from three to 17 mg. (an average of seven mg.) of N-Methylnicotinamide in the urine during a 24 hour period. N-Methylnicotinamide is a metabolic end product of N-Methylnicotinic acid and nicotinamide. If a determination of N-Methylnicotinamide in urine results in low values, it can be assumed that the body does not have a sufficient supply of nicotinic acid. This determination, according to Huff (38), of the amount of N-Methylnicotinamide present, can be taken as a measure of the amount of nicotinic acid in the body. The classification used to report the F_2 Substance ranges in the study were:

Classes	Mcg. per 1 hr. fasting sample
Class 1	700 mcg. and above
Class 2	699 to 500 mcg.
Class 3	499 to 300 mcg.
Class 4	299 to 100 mcg.
Class 5	99 mcg. and below

PRESENTATION OF DATA

Information concerning the home backgrounds of the students in this study was secured through the completion of Survey Form A, as discussed in the Plan of Procedure for this study. The data obtained are given in Table I, Parts A and B in the Appendix.

The educational status of the parents of the children involved in this study is shown in Table I, Part A. The percentages were based upon 26 subjects. The mothers of the subjects received a higher level of education than did the fathers. These data may be misleading, however, because a large percentage of the educational levels of the fathers was not provided. In many cases the father was deceased or the parents were separated or divorced and the mother did not know the education level of the father. This demonstrated a disinterest in educational attainment by many of the mothers involved in this study.

Table I, Part B, gives a summary of the occupational status of the chief income earner in each family. The large percentage in the skilled worker class with the small percentage having any technical training implies that most of these skilled workers received their training on the job. Those on relief were mothers, either widowed or separated from their husbands, receiving no income other than welfare.

ENERGY AND MAJOR NUTRIENTS IN THE DIETS

Each subject participating in this study presented a record of all foods eaten for three days before the medical-nutrition tests. The first dietary records were obtained before school commenced in September, 1969. The records were recorded by the mothers as instructed by the author. The food was prepared in the homes. The second dietary records were kept in late February, and they included lunches prepared and served at school. The individual dietary records were calculated for content of energy and of the major nutrients for the 23 students. This was accomplished on the IBM 1620 computer at the Texas Woman's University Data Processing Center, which are based on the most modern available data on nutrient content of the foods. The tables summarizing the dietary data are found in the Appendix.

The 1968 revision of the Recommended Dietary Allowances of the National Research Council, Food and Nutrition Board (7) was used in the evaluation of the diets. Vitamin A was evaluated according to the recommendations of Munsell (39) as well as in accordance with those of the National Research Council.

The intake levels of most of the nutrients were divided into the following five classes, depending upon their conformity to recommendations.

Class 1. This indicates that the recommended allowances for a particular nutrient were being met or exceeded.

Class 2. This indicates that between 99.9 and 75.0 per cent of the recommendations for that particular nutrient are being met.

Class 3. This indicates that between 74.9 and 50.0 per cent of the recommended allowances are being met.

Class 4. This indicates that only 49.9 to 25.0 per cent of the recommendations are being met.

Class 5. This indicates that the diets provide less than 25.0 per cent of the recommendations for that particular nutrient.

Table II gives the comparisons of the average energy and nutrient content of the subjects' diets before the initial and the final tests, as well as the average recommended allowances for subjects of the age of the participants. All of the subjects were in age six to eight classification.

Each of the major nutrients, fat, carbohydrate, protein, ascorbic acid, vitamin A, thiamine, niacin, riboflavin, calcium, phosphorus and iron are summarized in parts A through F of Table

TOTAL ENERGY INTAKE (CALORIES)

The classifications for energy intake have been changed in this study because of the general opinion that it is just as serious a form of malnutrition to be above normal limits in regard to caloric intake as it is to be below the normal limits. Therefore, the following classifications have been adopted:

Above normal limits . . . . 2300 calories and over

Within normal limits . . . 1800 to 2300 calories

Below normal limits . . . . 1799 calories and below

The recommended number of calories for children ages six to eight years is 2000 calories daily. With the normal limits set at 1800 to 2300 calories daily, Table II, Part A indicates that 4.3 per cent of the subjects were within this normal range at the time of the initial test, with 13.0 per cent within normal range at the final test. This was a very favorable trend regarding caloric intake. The data show that 91.4 per cent of the children were below the normal limits for caloric intake in the first test and 4.3 above normal limits, as noted.

One child, a six year old female, appeared to be above the normal range in the second test as well as in the first test. Her dietary record, however, did not indicate this. Perhaps not all her food intake was recorded or her activities below normal. The children who appeared very small and under-nourished in the initial test, appeared to be larger and better nourished in the final test. The data indicates, that for some of the children, this was true. The mean daily caloric intake increased from 1269 calories to 1502 calories during the study.

FAT INTAKE

The average daily intakes of fat, carbohydrate, and protein are shown on Table II, Part B. The recommendations concerning fat by the Food and Nutrition Board, National Research Council are limited to the statement that fat is to be included in the diet, with no specific percentage of the total calories as fat recommended. In this study, the mean fat intake increased from 55.3 per cent in the first test to 70.5 per cent in the final test, representing 39.0 per cent and 42.0 per cent of total calories as fat. This appears to be slightly high, particularly in the second test. The Food and Nutrition Board, in their report concerning the 1968 Recommended Dietary Allowances (7), does state that data indicate that the proportion of total fat in the diet from animal sources is decreasing while that from vegetable sources is increasing in the United States. Many studies indicate that the percentage of fat calories in the United States diet is too high and that the trend toward a lower fat intake containing more linoleic acid is desirable.

CARBOHYDRATE INTAKE

The data show that the average carbohydrate intake for the subjects in this study decreased significantly in the final test. Their average caloric intake increased, however, from Test I to Test II. These data tend to indicate that the subjects substituted some protein and fat for carbohydrate in their final diet.

PROTEIN INTAKE

Part C of Table II gives the average protein intake of the subjects and the per cent in various classes of conformity to protein recommended allowances in which the subjects fell.

The summary of the data indicates a dramatic change in the percentage of subjects moving from Class 3 and Class 2 in the initial test to 100.0 per cent falling into Class 1 in the final test. The diet instructions given to the parents by the author and the increased protein intake through the school lunch contributed to this favorable increase in protein consumption. There was a highly significant difference statistically in the protein intake from animal sources between the two tests. See Table VII. The correlation between the means of protein intake from animal sources and protein intake from total sources was very highly significant in Test I and Test II. The correlation between the means of protein intake from vegetable sources and protein intake from total sources was very highly significant in Test I and Test II.

ASCORBIC ACID INTAKE

The summary of the data concerning the ascorbic acid intake of the subjects appears on Table II, Part C. The mean total daily intake of cooked and raw ascorbic acid in the diet decreased from 63.6 milligrams in the initial test to 54.6 milligrams in the final test. This result does not conform with the blood plasma analysis of ascorbic acid, in which the data shows a slight increase in blood plasma ascorbic acid in the final test. This could be explained only if ascorbic acid from cooked sources were decreased.

There was a general upward trend in class distribution of the subjects in dietary ascorbic acid intake. These results are shown by a decrease in Class 5 from 4.3 per cent in the initial test to 0.0 in the final test, and a decrease in Class 4 in the initial test from 17.4 per cent to 4.3 per cent in the final test. Class 3 had the same distribution in both tests and Classes 1 and 2 increased in the final test.

VITAMIN A INTAKE

The National Research Council recommends an average of 3,500 International Units of Vitamin A for children in the six to eight year age range. The summary for the data concerning the dietary intake of vitamin A, Table II, Part D, for the subjects of this study indicates that the mean daily intake of the animal sources of vitamin A decreased from 1,741 I.U. in the initial test to 1,409 I.U. in the final test. The vegetable sources of vitamin A precursors increased from a mean daily intake of 2,316 I.U. to 3,293 I.U. There was statistically a highly significant difference in the vitamin A intake from vegetable sources between Test I and Test II. Refer to Table VII. There was, however, a very highly significant correlation between the mean intake of vitamin A intake from animal sources and the mean intake from total vitamin A sources in both tests. The correlation of the means of vitamin A intake from vegetable sources and vitamin A from total sources was highly significant in both tests.

Following the trend of an increase in total daily intake of vitamin A, the percentage of children in Class 1 and Class 2 increased also. The percentage of children in Class 3 decreased from 17.4 in the initial test to 0.0 per cent in the final test and the percentage of children in Class 4 and Class 5 decreased from the first to the second test.

The results show a generally favorable trend in daily dietary intake of vitamin A from the first to the second tests. There is some inconsistency, however, with the results of the blood plasma vitamin A and the dietary intake of vitamin A. The blood plasma vitamin A shows a decrease from the first to the second test, although the carotene of the blood did show a slight increase. These results may be attributable to the fact that the animal sources of vitamin A decreased from the first to the second test, while the vegetable sources of vitamin A increased during this period. Evaluation of vitamin A from plant sources is complicated by the fact that not all of the precursors are biologically active as vitamin A, while those which are active may vary considerably in biological potency (40).

When the subjects were classified according to the Munsell Recommendations for vitamin A intake, the initial test shows the same percentage of children in Class 1 as there were in Class 2. Classes 2, 3 and 4 increased in the final test in percentage of children in each of these classes. Class 5 decreased from 43.5 per cent in the initial test to 4.4 per cent in the final test. The same explanation for the results of the vitamin A intake according to the National Research Council recommendations would apply to the results of the vitamin A intake according to the

Munsell recommendations.

CALCIUM INTAKE

The calcium calculations shown in Table II, Part E, reveal the fact that not one of the subjects of this study met the daily recommended allowances for calcium in the initial test. The Class 1 percentage did increase in the final test to 21.7 per cent. Class 2 showed a large increase in percentage in the final test (from 13.0 per cent to 43.5 per cent), and the percentages in Class 4 and Class 5 decreased significantly. The increase was influenced by the increased consumption of milk and dairy products during the four month interval between the tests.

PHOSPHORUS INTAKE

The phosphorus intake in the diets of the children in this study was slightly lower than the recommendations of the National Research Council in the first test and slightly above the recommendations in the final test. The percentage of children in Class 1 increased from 26.1 per cent in the initial test to 65.2 per cent, and the percentage in Class 4 decreased from 13.0 per cent to 0.0 in the final test. Classes 2 and 3 decreased in percentages from Test I to Test II.

The results of these data indicate a larger than recommended proportion of calcium to phosphorus relationship.

IRON INTAKE

The dietary iron intake for the subjects in this study is summarized in Part E, Table II. The data indicate that the mean daily iron intake had increased in the final test, although the mean did not reach the level recommended by the National Research Council. The percentage of children in Class 1 increased from 26.1 to 30.4 per cent and those in Class 2 from 34.8 to 47.8 per cent. The percentages in Classes 3 and 4 had decreased significantly by the final test.

These results indicate a larger intake of iron rich foods. The hemoglobin level was reduced from the first to the second test, however, and this may indicate a larger percentage of iron required for growth during this period.

THIAMINE

The average recommended allowance of thiamine for all of the subjects included in this study was 1,000 micrograms. Table II, Part E, gives the per cent distribution of subjects in the classes for thiamine conformity.

The mean daily intake of thiamine of the children was 747 micrograms in the initial test. This decreased to 686 micrograms in the final test. Class 3 shows an increase in the percentage of subjects from the initial test to the final test. All other classifications either decreased or remained the same.

RIBOFLAVIN

The data concerning riboflavin intake indicate a significant increase from Test I to Test II. The recommended intake of 1,100 micrograms was not met in mean daily intake in the initial test, but was found to exceed the recommendation in the final test. The percentage of subjects in Class 1 increased significantly, from 43.5 per cent to 78.3 per cent, from the initial test to the final test.

The class distribution in percentages increased in Class 1 from 8.7 per cent in the initial test to 21.7 per cent in the final test. Class 2 likewise increased from 30.7 per cent to 47.9 per cent. Classes 3, 4 and 5 showed a decrease in percentage distribution from the initial test to the final test.

NIACIN INTAKE

The children in this study initially showed a lower intake of niacin than the recommended amount of 13.00 milligrams daily. The summary of the data on Table II, Part E, indicates that the mean daily intake of niacin for the children was 3.67 milligrams below the recommended 13.00 milligrams in the first test, and 2.26 milligrams below the recommendation in the second test. This indicates a slight increase in the two mean daily levels of intake.

WEIGHT STATUS

The results from the data concerning weight status in Table III show that the weight status of the children as a group did not change in percentage distribution in the two tests. At the time of each test, 22 children fell within the normal limits according to the Pryor Norms, and four children were above normal limits at this time. None of the subjects were below the normal limits in either test.

GROWTH PROGRESS

The 23 first grade children taking part in this study showed some growth progress between the two test periods. Table IV summarizes the results of the measurements related to growth. Part A of Table IV indicates that the percentage distribution of children in Class 2a increased from 11.5 per cent to 23.1 per cent, with decreases in Class 4 from 7.7 per cent to 0.0 per cent and in Class 5 from 7.7 per cent to 3.8 per cent. Classes 1, 2b and 3 remained the same in both tests.

Part B of Table IV summarizes the results from the Wetzel Grid measurements for the physique channel of the children. Only one child was in Class A_4, showing obesity in both tests. This child had grown in height and had increased in weight between the two testing periods. There was some improvement in those classified as stocky, which can be verified by a decrease in this classification from five children in the first test to three in the final test. The medium build classification increased from 18 children in the initial test to 19 in the final test. Only one child was of very slender build in the initial test, and this child improved to the level of a slender build in the final test.

The Age Schedule of Development, as determined by the Wetzel Grid, showed that two children fell in the best 2.0 per cent of the population with respect to growth in comparison with age in both tests. Table IV, Part C, also indicates that four children in the initial test and five children in the final test had advanced to the level of 15 per cent of the population. Fourteen children in the first test and 12 children in the final test fell in the 67 per cent, or median range of the population. Six children in the first test and seven in the final test were no better than 82 per cent of the population. Most of these results indicate a generally favorable trend in growth of the 26 children in this study.

SKELETAL STATUS

SKELETAL MATURATION

Summary A gives the results of the skeletal maturation evaluation for each subject involved in this study in the initial and the final tests. The summary also includes the change in skeletal maturation between the two tests.

Part A is the summary of the results of the skeletal maturation of the males involved in this study in Test I and Test II. In the initial test, it was shown that 11 male children were below their chronological age in skeletal maturation. Three children were above their chronological age in maturation and one child was found to have a chronological age which was the same as his skeletal age.

Nine of the subjects who were below chronological age in skeletal maturation in Test I improved in Test II. Two children who were below their chronological age in skeletal maturity in Test I remained below chronological age in Test II with no change recorded between the two tests. The one child who indicated the same chronological age and skeletal age in Test I, improved in Test II. The four male children who were above chronological age in skeletal maturity in Test I improved in Test II.

Part B gives a summary of the results of the skeletal maturation of the females involved in this study in Tests I and II. In the initial test, the results indicate that four of the female subjects were below chronological age as compared with skeletal maturation. Six of the female subjects were above chronological age as compared with skeletal maturation in Test I. In the final test, the results indicate that two of the subjects who were below their chronological age as compared with their skeletal age in Test I improved in Test II, and two of the subjects who were below their standards for skeletal maturity in Test I indicated no change in Test II. Of the six female subjects who were above chronological age as compared with skeletal maturity in Test I, only one subject showed an improved change in Test II and this was the same child who was classified as 4B in Test I and 5B in Test II according to the Pryor Norms, indicating obesity.

The skeletal maturation status of all of the children involved in this study either was maintained or improved during the time involved in the study. All in all, 14 children (10 boys and four girls) were low in skeletal age in the initial test, with only seven boys and three girls with skeletal ages lower than chronological ages when the study closed.

BONE DENSITY

The summary of the individual bone density evaluations (Summary B) indicates that there were slight individual variations in the calibration wedge equivalency for the bone density of the central os calcis section between the initial test and the final test. These variations were small, however, and were not statistically significant when data for all subjects were pooled together.

SUMMARY A

SKELETAL MATURATION STATUS OF THE CHILDREN IN THE STUDY

PART A. BOYS IN THE STUDY

Case Number	Skeletal Age		Comparison with Chronological Age		Change Between Tests
	Test I	Test II	Test I	Test II	
2795	5 yrs., 3 mos.	6 yrs., 3 mos.	-2 yrs.	-1 yr., 3 mos.	+9 mos.
2797	4 yrs., 9 mos.	5 yrs., 3 mos.	-2 yrs.	-1 yr., 3 mos.	+3 mos.
2798	5 yrs., 9 mos.	6 yrs., 3 mos.	-6 yrs.	-3 mos.	+3 mos.
2799	6 yrs., 9 mos.	7 yrs., 3 mos.	+3 mos.	+6 mos.	+3 mos.
2801	6 yrs., 3 mos.	7 yrs., 3 mos.	±0	+9 mos.	+9 mos.
2802	5 yrs., 3 mos.	5 yrs., 9 mos.	-1 yr.	-1 yr.	±0
2803	6 yrs., 3 mos.	7 yrs., 3 mos.	-3 mos.	+3 mos.	+6 mos.
2808	6 yrs., 3 mos.	6 yrs., 9 mos.	-0	+3 mos.	+3 mos.
2811	5 yrs., 3 mos.	6 yrs., 3 mos.	-1 yr., 6 mos.	-1 yr., 3 mos.	+3 mos.
2812	5 yrs., 9 mos.	6 yrs., 3 mos.	-6 mos.	-6 mos.	±0
2813	6 yrs., 3 mos.	7 yrs., 3 mos.	-3 mos.	+6 mos.	+9 mos.
2814	6 yrs., 3 mos.	6 yrs., 9 mos.	-6 mos.	-3 mos.	+3 mos.
2816	6 yrs., 3 mos.	7 yrs., 3 mos.	-3 mos.	+6 mos.	+9 mos.
2817	7 yrs., 3 mos.	7 yrs., 9 mos.	+9 mos.	+1 yr.	+3 mos.
2818	7 yrs., 3 mos.	7 yrs., 9 mos.	+9 mos.	+9 mos.	±0
2820	6 yrs., 9 mos.	7 yrs., 3 mos.	+3 mos.	+6 mos.	+3 mos.

SUMMARY A, CONTINUED

SKELETAL MATURATION STATUS OF THE CHILDREN IN THE STUDY

PART B. GIRLS IN THE STUDY

Case Number	Skeletal Age		Comparison with Chronological Age		Change Between Tests
	Test I	Test II	Test I	Test II	
2794	5 yrs., 9 mos.	6 yrs., 3 mos	-1 yr., 3 mos.	-1 yr., 3 mos.	±0
2800	5 yrs., 3 mos.	5 yrs., 9 mos.	-1 yr., 3 mos.	-1 yr., 0 mos.	+3 mos.
2804	5 yrs., 9 mos.	6 yrs., 0 mos.	-1 yr.	-1 yr.	±0
2805	6 yrs., 3 mos.	6 yrs., 9 mos.	-3 mos.	0	+3 mos.
2807	7 yrs., 3 mos.	7 yrs., 9 mos.	+3 mos.	+3 mos.	±0
2809	7 yrs., 3 mos.	7 yrs., 9 mos.	+1 yr.	+1 yr.	±0
2810	7 yrs., 3 mos.	7 yrs., 9 mos.	+6 mos.	+9 mos.	+3 mos.
2819	7 yrs., 6 mos.	7 yrs., 6 mos.	+6 mos.	+6 mos.	±0
2821	7 yrs., 9 mos.	7 yrs., 9 mos.	+1 yr.	+1 yr.	±0
2822	7 yrs., 0 mos.	7 yrs., 3 mos.	+6 yrs.	+6 yrs.	±0

SUMMARY B

SUMMARY OF SKELETAL DENSITY IN TERMS OF INDIVIDUAL EVALUATIONS FOR CALIBRATION WEDGE EQUIVALENCY

Case Number	Central Os Calcis Section	
	Test I	Test II
2793	0.8575	0.8187
2794	0.8059	0.7454
2795	1.0765	1.0934
2796	0.9341	0.8937
2797	0.6737	0.5620
2798	0.8229	0.7665
2799	0.8718	0.7837
2800	0.7300	0.7490
2801	0.8863	0.7950
2802	0.8484	0.7730
2803	0.9565	1.0138
2804	0.8741	0.8301
2805	0.9664	0.9787
2807	1.3468	1.1768
2808	1.0184	0.9985
2809	0.9045	0.8668
2810	1.3011	1.2787
2811	1.1182	1.1027
2812	0.9600	0.9344
2813	0.9648	1.0014
2814	0.9519	0.9395
2816	0.9109	0.8660
2817	0.9139	0.8346
2818	1.0202	1.0801
2819	0.9240	0.9082
2820	0.9334	0.9096
2821	0.9492	0.8996

BIOCHEMICAL TESTS

Hemoglobin Concentration

For the students as a whole, the mean for hemoglobin was 12.1 grams per 100 milliliters of blood at the first test, in comparison with a slight decrease to 11.8 grams at the time when the final analysis was made. There was a marked drop in the percentage distribution of children in Class 1 during the study, with the percentage in Class 2 remaining about the same and an increased number in Class 3. This decrease in hemoglobin concentration may have been caused by increased metabolism due to growth during this period as well as a decrease in the diet of foods rich in iron.

Erythrocyte Count

Erythrocyte count is the count of red cells in the blood stream. Table V, Part A, indicates that there was come slight general improvement in the red cell count between the first and the second tests. While the percentage of subjects in Class I decreased somewhat, those in Class 5 had decreased markedly at the time of the second tests and a significantly larger number moved into the Class 3 range.

Hematocrit (Packed Cell Volume)

The average packed cell volume of the blood (hematocrit) is recorded on Table V, Part A. The hematocrit is related to the size of the red cells. Macrocytosis may indicate lack of B_{12}, folate, and possibly vitamin E; or microcytosis may indicate lack of iron and vitamin B_6. The means in these data indicate a slight increase in packed cell volume from the first to the second tests, and a marked increase in the percentage of subjects in Class 1 at the second test period. There were no subjects in Class 5 in either test and none in Class 4 in the final test.

Mean Corpuscular Volume

The data on Mean Corpuscular Volume are recorded in Table V, Part B. The normal range for this test represents the range of values for this MCV factor in which the packed cell volume is in proper proportion to the red cell count. The results from the first group of tests indicate that 50.0 per cent of the subjects were within the normal limits and 50.0 per cent were above normal limits. In the second test, the subjects within normal limits decreased to 34.6 per cent and the subjects above normal limits increased to 65.4 per cent, denoting an improvement.

Mean Corpuscular Hemoglobin

The results concerning the Mean Corpuscular Hemoglobin constant are given in Table V, Part B. When a subject falls within the normal limits for this factor, this indicates that the hemoglobin is in the proper ratio to the number of erythrocytes. The per cent of subjects falling within the normal range for this factor initially was 53.9.

This fell only slightly to 50.0 per cent at the last test.

Mean Corpuscular Hemoglobin Concentration

When a subject falls within the normal limits for the MCHC factor, the hemoglobin concentration is normal for the size of the red cells.

The subjects who initially were within the normal range showed a marked decrease from 50 per cent to 3.8 per cent between tests. The subjects in the range below normal limits increased 96.2 per cent and those in the range above normal limits decreased 50 per cent. The data for these findings are recorded in Table V, Part B.

The results of this finding are the result of the marked decrease in hemoglobin which occurred during this study.

Leucocyte Count

The leucocyte count for all of the subjects in this study fell within the normal range in both tests. There are fewer leucocytes in number than the red cells. Normally there are from 5,000 to 10,000 leucocytes per cubic millimeter. In many infections and inflammatory conditions they increase in number, while in some abnormal states they decrease.

Blood Plasma Vitamin A

Table V, Part C, contains the reports of the findings of the blood plasma analysis of the subjects. Initially all of the subjects averaged 34.4 micrograms of blood plasma vitamin A per 100 milliliters. On the final test, there was a mean of 23.1 micrograms of blood plasma vitamin A per 100 milliliters.

The mean of blood plasma vitamin A decreased from Test I to Test II by a difference which was slightly significant ($P < 0.10$). See Table VII in the Appendix.

There was a marked drop in Class 1 (from 36.0 per cent to 8.0 per cent). The percentage in Class 4 increased from 16.0 per cent to 48.0 per cent. This marked decrease in vitamin A may be explained by a decreased intake of green and yellow vegetables during the winter months, with little or no liver in the diet during this period. It appears that the majority of the mothers of the subjects depended upon the school lunch as the most important source of food intake while school was in progress, with much to be desired in the selection and preparation of the school lunch meals which were consumed.

Blood Plasma Carotene

The data concerning blood plasma carotene are found in Table V, Part C. These data show slight increases in

Classes 3 and 4. Class 1 had 0.0 per cent distribution in both tests while Class 5 decreased from 4.0 per cent to 0.0 per cent in the second test.

Blood Plasma Ascorbic Acid

The average blood plasma ascorbic acid level increased slightly from an initial 0.7 milligrams per 100 milliliters of blood to an average of 0.75 milligrams.

The greatest increase in percentage distribution of the subjects occurred in Class 1 in the final tests. There was a marked decrease in Class 5 (from 48.0 per cent to 36.0 per cent) and in Class 4 (from 20.0 per cent to 16.0 per cent). This, of course, tended to raise the distribution to the upper three classes. In this study, Class 1 increased from 16.0 per cent in Class 1 in the initial test to 28.0 per cent in the final test. Class 2 decreased from 12.0 per cent in the initial test to 8.0 per cent in the final test, and increased from 4.0 per cent in Class 3 initially to 12.0 per cent finally.

The availability of citrus fruits in this geographical area plus the information concerning the necessity of providing citrus fruits in the diet of the children apparently accounts for the increase of ascorbic acid in the blood plasma in the final tests.

Blood Serum Total Protein

Table V, Part D, summarizes the findings concerning the total protein, albumin and globulin levels in the blood. There was a general increase in total protein from an average of 7.43 grams per 100 milliliters in the initial test to 7.81 grams at the final test. The largest percentage of subjects (95.5 per cent) fell in Class 1 in the final test with the remainder in Class 2 (4.5 per cent). In the initial test the subjects were distributed between Class 1 (81.8 per cent), Class 2 (13.6 per cent) and Class 3 (4.6 per cent). A statistically significant increase occurred in the second test at the $P < 0.01$ level. The correlation between serum protein mean and albumin mean in the first test is very highly significant ($P < 0.001$) and also was significant in the second test ($P < 0.05$).

Blood Serum Albumin

Serum albumin values increased from an average of 4.44 grams per 100 milliliters in the initial test to 4.64 grams per 100 milliliters finally. The subjects falling in Class 1 increased from 18.2 per cent to 63.6 per cent during the study. The remainder of the children in the final test fell in Class 2 (36.4 per cent). In the initial test, the subjects were distributed in Class 3 (13.6 per cent) with no subjects falling in Class 4 or Class 5 in either test, and none in Class 3 in the final test. The increase in serum albumin values in the second test was statistically significant ($P < 0.001$).

The albumin fraction within the total protein in the serum rises when protein metabolism is optimum (41).

Blood Serum Globulin

The results of the findings concerning blood serum globulin indicate that it was this fraction of the blood serum total protein that decreased in the second test. The average of 3.54 milligrams per 100 milliliters in the initial test and 3.17 milligrams per 100 milliliters in the second test confirm this belief. In the initial test all of the subjects were in Class 1. In the second test there was a minor change, with 95.5 per cent of the subjects in Class 1 and 4.5 per cent in Class 2.

Blood Serum Calcium

Table V, Part E, summarizes the data concerning blood serum calcium. The average blood serum calcium level did not change during the study, although the number of subjects falling within normal limits increased from 70.0 per cent to 82.3 per cent. Those falling below normal limits decreased from 23.6 per cent to 17.7 per cent.

Blood Plasma Phosphorus

The average blood plasma phosphorus values increased from 4.54 milligrams per 100 milliliters in the first test to 5.57 milligrams in the second test. This change increased the percentage of subjects falling within normal limits to 16.0 per cent in the final test from 12.0 per cent in the initial test. The remainder fell above normal limits in both tests.

Cholesterol

Cholesterol values were recorded individually for each subject and the data is recorded in Table V, Part E. The results indicate that the mean value in the initial test was 164.39 milligrams per 100 milliliters of blood, and the mean value in the final test was 179.91 milligrams per 100 milliliters. These findings show that these subjects were well below normal limits in both cases.

Thiamine in the Urine

Table VI contains a summary of the findings concerning urinary analyses of thiamine, riboflavin and N--Methylnicotinamide. It was found that mean urinary output of thiamine decreased from 11.58 micrograms in the initial test to 9.97 micrograms in the final test. The percentage distribution through the classes, however, did experience some change. Class 2 distribution increased from 15.4 to 23.1 per cent and Classes 4 and 5 decreased in distribution from 3.8 to 0.0 per cent in both cases.

Riboflavin in the Urine

The daily riboflavin output average in the urine decreased very slightly from the initial to the final test. The mean daily average in Test I was 26.3 micrograms to 24.1 micrograms in Test II. The percentage distribution in Classes 1 through 5 was higher in the initial test than in the final test. This is an unfavorable result and indicates a decreased intake of riboflavin in the four month period between the two tests, although the final test represents one day only and not the entire interim period.

N-Methylnicotinamide in the Urine

The findings concerning the amount of N-Methylnicotinamide excreted in the urine indicate that there was a decreased intake of foods high in niacin from the initial test to the final test. The mean daily output in the urine decreased from 255 micrograms in Test I to 200 micrograms in Test II. The percentage distribution decreased by 3.8 per cent in each class for Classes 1, 2 and 3 and increased from 61.5 per cent in Class 4 in Test I to 80.0 per cent in Test II. Class 5 showed a 7.7 per cent decrease from Test I to Test II.

These generally decreased values of the B vitamins from the initial test to the final test may indicate a decreased intake of these vitamins or a loss of the vitamins during preparation of the food.

RESULTS OF THE CLINICAL-LABORATORY EXAMINATION AND TESTS

MEDICAL EXAMINATION

The initial physical examinations of the 26 children of this study made by the internist who serves as the Medical Consultant for the Texas Woman's University Research Institute showed no pathological situations which would interfere with a nutrition study. The purpose of the medical examination was to find whether or not any types of pathology might be present which would prevent the student from reflecting changes in clinical or laboratory tests for nutritional status, and to help in the recognition of subtle and overt signs and symptoms of malnutrition.

General Appearance of the Subjects

All of the children cooperating in this study were classified on the medical form as "good" with respect to their appearance. None of the children had the outward appearance of profound malnutrition or other physically adverse conditions.

Condition of the Eyes

The condition of the eyes generally appeared to be normal in both tests. None of the subjects wore glasses.

Condition of the Lips

In the initial test, seven of the subjects displayed some slight fissuring or angular lesions. These lesions may appear with a deficiency of niacin, riboflavin, iron, or vitamin B_6. In the final test, all subjects were classified as normal regarding the condition of the lips.

Condition of the Tongue

In the first test there were some cases in which a slight involvment of the tongue, including slight hypertrophy, slight proliferation, or slight hyperemia was recorded. In the second test, no tongue involvments were found. Nor were there any other adverse conditions of the tongue evident.

Condition of the Teeth

The general condition of the teeth of these children ranged from fair to very poor in the first test and remained the same in the final test. In the first test, only one child was rated "excellent", and one child as "good". This was related to the state of repair of the teeth, and not to an absence of caries. In the final test the number of caries per child had increased, and not one was in a good state of repair.

Condition of the Skin

In the first test, only three children were classified as "normal" with regard to the condition of the skin.

The skin of most of the children was slightly to moderately dry. Four of the children appeared to have slight follicular hyperkeratosis and slight papular roughness. These involvments of the skin may possibly be due to a deficiency of vitamin A and certain of the B-vitamins. In the second test, the condition of the skin improved in these subjects, although the skin appeared to be slightly dry in a majority of the subjects, possibly due to the fact that the time between tests included the winter months.

GENERAL PHYSICAL APPEARANCE

Appearance of the Extremities

The condition of the legs of these subjects remained nearly the same in the two tests. Only 13 of the children were classified as "normal" regarding the skeletal conformation of the lower extremities. The majority of the children displayed slight to moderate bowed legs, with the remainder displaying slight to moderate knocked knees. These minor deformities undoubtedly were related to early inadequacies of calcium and other needed nutrients in the early diets of the children.

POSTURE

The subjects of this study presented a generally fair posture consisting of a straight spine, an erect head, and straight shoulders. The abdomen in a majority of the cases was slight to intermediate in prominence, with one case classified as prominent. There were three subjects displaying slight lordosis on the final test.

PLANTAR CONTACT

Only four subjects displayed well-defined arches in either test. Twenty-one of the children showed slight to moderate evidence of flat feet, and one child had marked flat feet.

CONDITION OF SUBCUTANEOUS TISSUE AND MUSCULATURE

In the initial test, three of the subjects showed evidence of inadaquate subcutaneous tissue and very poor musculature. In the final test, all subjects appeared to have normal subcutaneous tissue, with musculature which was regarded as adequate. In the final test one child displayed evidence of excessive subcutaneous tissue. All other subjects were recorded as normal in this respect.

CONDITION OF THE HEART AND LUNGS

In both tests, two children showed evidence of a "Grade II, Apical, Systolic, High Pitched Murmur". This condition was suspected to have been congenital in both cases. There were no other irregularities concerning the heart, lungs, ears, or nose found.

CONDITION OF THE REFLEXES

One child showed a sluggish Achilles reflex in Test I, but all subjects were rated as "normal" in the final test.

STATISTICAL ANALYSIS OF BLOOD LEVELS AND NUTRIENT INTAKE BETWEEN TEST I AND TEST II

A "T" Test was calculated in order to compare the specific blood value groups between Test I and Test II. The results of these analyses appear on Table VII in the Appendix. A discussion of the results of the statistical calculations have been discussed in connection with the presentation of findings in these areas. The results which were not significant statistically appear only in the table, and did not enter into the previous discussions.

S U M M A R Y

This study was initiated in order to develop a picture of the nutritional status of preschool and early elementary school children in Greenville, Texas. Nutrition studies have demonstrated that progress could be made in the field of nutrition and health education through the public elementary schools, the volunteer groups in the community, the Public Health facilities in the community, and the Commodity Foods Program now in effect.

Purpose

The purpose of this research is to determine the nutritional status of 26 preschool or early elementary school age children in low and middle-low income families who are enrolled in the 1969 Summer "Head Start" Program in Greenville, Texas. Specific purposes will be:

(1) To determine the dietary intake of the children by means of a diet history, a food intake record, and a food frequency chart.

(2) To obtain a personal history of members of the children's families, and particularly the education level of the parents of the children.

(3) To establish the nutritional status of these children through determinations of collected data

in the Nelda Childers Stark Laboratory for Human Nutrition Research, Texas Woman's University. These tests will consist of:

(a) biochemical tests

(b) medical examination

(c) skeletal maturation status

(d) bone density

(e) height and weight-growth accomplishment

(4) To present the results of the data of the biochemical and medical tests to the parents of the children, and to teach them, through individual instruction, in several half-hour periods, how to improve the nutritional status of their children.

(5) To present the findings of this study to the teachers and the administrators in the Greenville Independent School District in order that they may be aware of inadaquacies in the diets of this group of children and may continue to develop methods of improvement in the school health education curriculum, the school lunch, and the milk programs, and, if possible, to initiate a school breakfast program.

Between the initial and the final tests, an effort was made to instruct the parents of the subjects in methods of food preparation and selection which would result in better family nutrition. The author attempted to encourage both parents and children to develop better food habits by discussing the results of the initial dietary survey and biochemical tests with them.

The socio-economic survey showed that only three of the parents had any college training. The majority of the parents completed some grades of high school. Most of the fathers were in the skilled labor or unskilled labor classifications.

The dietary survey showed that, from the nutrients which provide energy, the amount of carbohydrate consumed decreased, while the intake of protein increased, during the period of the study, although protein intake was not a dietary deficiency in the initial or final test. The quality of protein, however, increased in the final test, with a greater proportion coming from animal sources. Other nutrients exhibiting some increase in intake during the study included calcium, phosphorus, iron, vitamin A, riboflavin and niacin.

The growth status of the children improved during the time between the two tests and the skeletal maturation status had improved for 73.1 per cent of the children in the final test. The bone density, on the other hand, made no statistically significant change during the study. With growth increasing as well as skeletal maturation, however, bone density actually increased by keeping up with the formation of new bone centers together with maintaining the same density for somewhat larger children.

Analysis of the blood showed distinct improvement in the hematocrit value, with improvement also evident in plasma carotene, plasma ascorbic acid, serum total protein, serum albumin, serum calcium, and plasma phosphorus.

The hemoglobin value decreased in spite of an increase in dietary iron. Other dietary components which showed an increase, however, may have made contributions to hemoglobin levels. The increase in serum albumin is indicative of a greater biological value of the protein which was ingested. The decrease in the blood value of vitamin A may be correlated to the increased blood carotene and increased nutrient intake of vitamin A. The animal sources of vitamin A decreased from Test I to Test II, resulting in a decreased total blood value vitamin A.

The urinary analyses of thiamine, riboflavin and niacin indicate a slight decrease in values from Test I to Test II. These results may have been related to a lower consumption of foods rich in some of these vitamins, or this may have been caused by an increased metabolic requirement during periods of growth.

The students were in a reasonably good physical condition, particularly in Test II. Two children had congenital heart murmurs at both tests, and most children displayed either knock-knees or bowed legs, indicative of early poor nutrition. The skin of most of the children appeared to be dry and a few children had slight fissuring or angular lesions of the lips at the time of the initial test. In the final test, the lips of all the subjects were found to be normal.

The dental status of the children in both tests was a profound example of poor earlier dietary habits to be exhibited in these subjects. This correlates with the findings of the National Nutrition Survey as reported by Schaeffer (1).

The study can be regarded as successful in that the subjects involved in the study did show a significant growth improvement and an advance in skeletal maturation, while maintaining their bone density status. Also they showed a significant increase in intake of calcium, vitamin A, and protein from animal sources. The overall level of caloric intake by the children increased while the amount of carbohydrate consumed decreased from the initial to the final test.

In view of the amount of improvement shown in these "Head Start" children within a relatively short period of time, it can be assumed that, with further training of mothers in the selection and preparation of foods, with continued training of the mothers and children in the relationship of food to health, and with an increase in the availability of essential foods particularly for the very poor, better food habits would be developed.

Training methods must be adjusted to the educational level of parents and to the age and level of education of the children.

Because heavy dependence is placed upon the school lunch by lower income families, especial training should be given to those who have charge of the planning and preparing of school meals.

RECOMMENDATIONS

Based upon the results of the study covered in this thesis, the author makes the following recommendations:

1. The nutrition education program in the Greenville Independent Schools should be developed and enlarged to encompass all grades, including kindergarten, when it is established as part of the school program. The objectives of nutrition education may be stated thus:

   a. To develop and continue good habits of eating and wholesome attitudes toward food as related to good physical status and general health.

   b. To encourage healthful habits of everyday living as related to good nutrition.

   c. To develop an increasingly intelligent understanding of the reasons for desirable health habits and to assume increasing responsibility for practicing these habits.

   d. To develop an awareness of home, school and community nutrition problems.

2. The school lunch program should play a larger part in total nutrition education of the students throughout

the school year. In addition, those responsible for the school lunch should make an especial effort toward incorporating food patterns into the menus of the school lunch which will, in part, supplement the home diet. For example, increased use of organ meats and more frequent use of various types of greens, among other changes, should be followed.

3. The development of a well-integrated community nutrition program should be encouraged, including the cooperation of School Health Officials, Public Health Officials, Home Demonstration Agents, Day-Care Center Supervisors, Pre-Natal and Well-Baby Clinic Administrators, and community volunteers in the field of nutrition and health education.

4. The need for future nutrition status research should be undertaken, concerning pre-school and early elementary aged children of low, middle, and high income socioeconomic backgrounds.

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APPENDIX

SURVEY FORM A

Name of child ______________________________ Age ______

Name of Father ____________________ Mother ____________________

Home address of child ______________________________________

Education level of Father ____________ Mother ____________________

Occupation:

Mother____________________ Hours per week ____________

Father ____________________ Hours per week ____________

Average amount of money spent on food and beverages per week __________

Who is responsible for preparation of meals for the family __________

____

Method of preparation of food: Meat ____________________

Vegetables ____________________

Types of cooking vessels used: Iron ____________________

Aluminum ____________________

Other ____________________

Food likes of child: ______________________________________

Food dislikes of child: ____________________________________

Is water supply connected to city water? ____________________

If not, where does water supply come from? ____________________

Does child receive a vitamin or mineral supplement? ______________

How often? ____________________

Content of supplement? ____________________

SURVEY FORM A, CONTINUED

Which, if any, meal does child miss:	Occasionally	Frequently
Breakfast:	________	________
Noon Meal or Lunch:	________	________
Evening Meal or Dinner:	________	________

What are the reasons for meals missed? ____________________

What foods do you think are important in the child's daily diet? ____

____

____

SURVEY FORM B

FOOD FREQUENCY CHART

How often does your child eat the following foods:

Food	Number of Times Served Per Day	Week	Sometimes
Cereals:			
Oats, cooked	____	____	____
Wheat, cooked	____	____	____
Rice, cooked	____	____	____
Oats, prepared, plain	____	____	____
Rice, prepared, plain	____	____	____
Wheat, prepared, plain	____	____	____
Oats, sugar coated	____	____	____
Wheat, sugar coated	____	____	____
Rice, sugar coated	____	____	____
Other	____	____	____
Bread:	____	____	____
Milk Products:	____	____	____
Homogenized, whole	____	____	____
Skimmed or 2%	____	____	____
Powdered	____	____	____
Evaporated	____	____	____
Cheese	____	____	____
Other	____	____	____
Eggs:	____	____	____
Meat:	____	____	____
Fats and Oils:	____	____	____
Legumes:	____	____	____
Vegetables:	____	____	____
Spinach	____	____	____
Greens	____	____	____
Carrots	____	____	____
Squash	____	____	____
Other leafy green or yellow	____	____	____
Other vegetables	____	____	____
Citrus fruits, tomatoes	____	____	____
Other fruits	____	____	____
Miscellaneous:	____	____	____
Cake, cookies	____	____	____
Candy	____	____	____
Carbonated beverages	____	____	____
Other	____	____	____

Do you give your child any special food not given to other members of your family? ____________________

Dietary Record First Day ____________

Name of Child ____________ Age ______

Usual time for: Breakfast ____________

Lunch ____________

Dinner ____________

Breakfast eaten: alone ________ with family ________

with siblings only ____________

*Include water and all other beverages with amounts.

Breakfast		Lunch		Dinner		Snack	
Food	Amount	Food	Amount	Food	Amount	Food	Amount

SUMMARY REPORT FOR THE PARENTS

TEST	WHAT DOES THE TEST TELL ME?	HOW DID MY TESTS RATE? Very Good	Good	Fair	Poor	Very Poor	WHAT FOODS DO I NEED TO IMPROVE MY NUTRITIONAL STATUS?
HEART	Condition of the heart at time of examination						
REFLEXES	Sluggish or hyperactive reflexes are related to an improperly balanced dietary						
HEMOGLOBIN	Hemoglobin is the red coloring substance in the blood. Protein and iron are chiefly related to it, but all vitamins play a part						
RATE OF DEVELOPMENT	The child with the best diet will progress in growth by one developmental level per month of age after infancy.						
DENTAL EXAMINATION	Clinical examination of the teeth show the number of missing teeth, cavities and fillings. This indicates no specific deficiency, but is related to general nutritional well-being.						

TABLE I

SUMMARY OF PARENTAL DATA OF THE EXPERIMENTAL SUBJECTS

PART A. EDUCATION OF PARENTS OF STUDENTS

Education Levels	Fathers		Mothers	
	Number	Per Cent	Number	Per Cent
B.A., B.S., or equivalent	0	0.0	0	0.0
High school graduate, some college or technical training	1	3.8	2	7.7
High school graduate, no further training	2	7.7	4	15.5
Attended high school, did not graduate	7	26.9	13	50.0
Completed Grade 8	1	3.8	1	3.8
Completed Grades 5 - 7	2	7.7	3	11.5
Completed Grades 1 - 4	2	7.7	0	0.0
Education unknown	11	42.4	3	11.5

TABLE 1, CONTINUED

SUMMARY OF PARENTAL DATA OF THE EXPERIMENTAL SUBJECTS

PART B. OCCUPATIONS OF CHIEF INCOME EARNERS IN FAMILIES OF STUDENTS

Occupational Classifications	Number	Per Cent
Business	1	3.4
Skilled	13	44.8
Semi-Skilled	1	3.4
Unskilled	11	37.9
Relief	2	6.9

None were classified in the professional, semi-professional, farmer, unemployed (not on relief), or retired groups.

TABLE II

SUMMARY OF DATA ON ENERGY AND NUTRIENT CONTENT OF DIETS

PART A. ENERGY (CALORIES)

Average Recommended Allowance	2000 Calories	
	Test I	Test II
Mean Energy Intake	1269	1502
Per Cent Subjects Above Normal Limits	4.3	0.0
Within Normal Limits	4.3	13.0
Below Normal Limits	91.4	87.0

PART B. MEAN FAT, CARBOHYDRATE AND PROTEIN INTAKE AND PER CENT OF CALORIES PROVIDED AS FAT, CARBOHYDRATE AND PROTEIN

	Test I	Test II
Mean Fat Intake	55.3	70.5
Per Cent of Calories as Fat	39.0	42.0
Mean Carbohydrate Intake	156.9	142.8
Per Cent of Calories as Carbohydrate	49.0	38.0
Mean Protein Intake	50.3	64.9
Per Cent of Calories as Protein	15.0	17.0

TABLE II, CONTINUED

SUMMARY OF DATA ON ENERGY AND NUTRIENT CONTENT OF DIETS

PART C. TOTAL PROTEIN (ANIMAL AND VEGETABLE), AND ASCORBIC ACID (RAW AND COOKED)

Average Recommended Allowances	Protein (Grams)			Ascorbic Acid (Milligrams)		
	35.0			40.0		
	Test I		Test II	Test I		Test II
Mean Daily Intake	Animal	32.2	50.3	Raw	51.0	43.2
	Vegetable	18.1	14.6	Cooked	12.6	11.4
	Total	50.3	64.9	Total	63.6	54.6
Per Cent Subjects in						
Class 1	87.0		100.0	56.6		69.6
Class 2	4.3		0.0	13.0		17.4
Class 3	8.7		0.0	8.7		8.7
Class 4	0.0		0.0	17.4		4.3
Class 5	0.0		0.0	4.3		0.0

TABLE II, CONTINUED

SUMMARY OF DATA ON ENERGY AND NUTRIENT CONTENT OF DIETS

PART D. VITAMIN A (NATIONAL RESEARCH COUNCIL RECOMMENDATIONS AND MUNSELL RECOMMENDATIONS)

Average Recommended Allowances (I. U.)	Vitamin A (NRC Recommendations)			Vitamin A (Munsell Recommendations)		
	3500			8000		
	Test I		Test II	Test I		Test II
Mean Daily Intake	Animal	1741	1409	Animal	1741	1409
	Vegetable	2316	4293	Vegetable	2316	4293
	Total	4057	5702	Total	4057	5702
Per Cent Subjects in						
Class 1		47.8	73.9		8.7	8.7
Class 2		4.4	21.7		17.4	21.7
Class 3		17.4	0.0		17.4	43.5
Class 4		26.1	4.4		13.0	21.7
Class 5		4.3	0.0		43.5	4.4

TABLE II, CONTINUED

SUMMARY OF DATA ON ENERGY AND NUTRIENT CONTENT OF DIETS

PART E. CALCIUM, PHOSPHORUS AND IRON

Average Recommended Allowances	Calcium (grams)		Phosphorus (grams)		Iron (mg)	
	0.900		0.900		10.00	
	Test I	Test II	Test I	Test II	Test I	Test II
Mean Daily Intake	0.463	0.751	0.761	1.020	8.61	9.36
Per Cent Subjects in Class 1	0.0	21.7	26.1	65.2	26.1	30.4
Class 2	13.0	43.5	34.8	26.1	34.8	47.8
Class 3	30.5	26.1	26.1	8.7	26.1	21.7
Class 4	47.8	8.7	13.0	0.0	13.0	0.0
Class 5	8.7	0.0	0.0	0.0	0.0	0.0

TABLE II, CONTINUED

SUMMARY OF DATA ON ENERGY AND NUTRIENT CONTENT OF DIETS

PART F. THIAMINE, NIACIN, AND RIBOFLAVIN

Average Recommended Allowances	Thiamine (ug)		Niacin (mg)		Riboflavin (ug)	
	1000		13.00		1100	
	Test I	Test II	Test I	Test II	Test I	Test II
Mean Daily Intake	747	686	9.33	10.74	1016	1416
Per Cent Subjects in						
Class 1	21.7	0.0	8.7	21.7	43.5	78.3
Class 2	26.1	26.1	30.4	47.9	26.1	17.4
Class 3	30.5	60.9	34.9	30.4	21.7	4.3
Class 4	21.7	13.0	21.7	0.0	8.7	0.0
Class 5	0.0	0.0	4.3	0.0	0.0	0.0

TABLE III

SUMMARY OF DATA ON CONFORMITY OF WEIGHT RECOMMENDATIONS

Ranges	Subject Number and Percentage Distribution			
	Test I		Test II	
	Number	Per Cent	Number	Per Cent
Per cent of subjects above normal limits	4	15.4	4	15.4
Per cent of subjects within normal limits	22	84.6	22	84.6
Per cent of subjects below normal limits	0	0.0	0	0.0

TABLE IV

SUMMARY OF DATA ON GROWTH PROGRESS

(WETZEL GRID)

PART A. DEVELOPMENTAL LEVEL PER MONTH OF CHRONOLOGICAL AGE AFTER INFANCY (30 MONTHS)

Classes	Subject Number and Percentage Distribution			
	Test I		Test II	
	Number	Per Cent	Number	Per Cent
Class 1 (1.00 and above)	13	50.0	13	50.0
Class 2a (0.90 to 0.99	3	11.5	6	23.1
Class 2b (0.85 to 0.89)	2	7.7	2	7.7
Class 3 (0.75 to 0.84)	4	15.4	4	15.4
Class 4 (0.60 to 0.74)	2	7.7	0	0.0
Class 5 (0.59 and below)	2	7.7	1	3.8

TABLE IV, CONTINUED

SUMMARY OF DATA ON GROWTH PROGRESS

PART B. PHYSIQUE CHANNEL

Classes	Subject Number and Percentage Distribution			
	Test I		Test II	
	Number	Per Cent	Number	Per Cent
A_4 - Obese	1	3.8	1	3.8
A_3, A_2 - Stocky	5	19.3	3	11.5
A, N, B - Medium	18	69.3	19	73.2
B_2, B_3 - Slender	1	3.8	3	11.5
B_4 - Very Slender	1	3.8	0	0.0

TABLE IV, CONTINUED

SUMMARY OF DATA ON GROWTH PROGRESS

PART C. AGE SCHEDULE OF DEVELOPMENT

Classes	Subject Number and Percentage Distribution			
	Test I		Test II	
	Number	Per Cent	Number	Per Cent
Upper 2% of the population of the same age and sex	2	7.7	2	7.7
Upper 15% of the population	4	15.4	5	19.2
Median 67% of the population	14	53.8	12	46.2
No better than 82% of the population	6	23.1	7	26.9
No better than 98% of the population	0	0.0	0	0.0
Lowest 2% of the population	0	0.0	0	0.0

TABLE V

SUMMARY OF DATA ON BLOOD ANALYSIS

PART A. HEMOGLOBIN, ERYTHROCYTE, AND HEMATOCRIT

	Hemoglobin		Erythrocyte		Hematocrit	
	Test I	Test II	Test I	Test II	Test I	Test II
Mean Values (gm. per 100 ml.)	12.1	11.8	4.0	4.1	38.0	39.3
Percentage Class Distribution in: Class 1	15.4	3.8	3.8	0.0	19.2	42.3
Class 2	69.2	69.3	15.4	3.8	65.5	50.0
Class 3	15.4	26.9	11.5	34.6	11.5	7.7
Class 4	0.0	0.0	23.1	23.1	3.8	0.0
Class 5	0.0	0.0	46.2	38.5	0.0	0.0

TABLE V, CONTINUED

SUMMARY OF DATA ON BLOOD ANALYSIS

(CORPUSCULAR CONSTANTS)

PART B. MEAN CORPUSCULAR VOLUME, MEAN CORPUSCULAR HEMOGLOBIN AND MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION

Means and Ranges	Mean Corpuscular Volume		Mean Corpuscular Hemoglobin		Mean Corpuscular Hemoglobin Concentration	
	Test I	Test II	Test I	Test II	Test I	Test II
Means	95.4	95.6	30.6	28.7	32.1	29.8
Per cent students within normal limits	50.0	34.6	53.9	50.0	50.0	3.8
Per cent students below normal limits	0.0	0.0	11.5	30.8	0.0	96.2
Per cent students above normal limits	50.0	65.4	34.6	19.2	50.0	0.0

TABLE V, CONTINUED

SUMMARY OF DATA ON BLOOD ANALYSIS

PART C. BLOOD PLASMA ANALYSIS: VITAMIN A, CAROTENE, AND ASCORBIC ACID

Averages and Ranges	Vitamin A		Carotene		Ascorbic Acid	
	Test I	Test II	Test I	Test II	Test I	Test II
Mean	34.4	23.1	.108	.113	0.7	0.75
Percentage Class Distribution in: Class 1	36.0	8.0	0.0	0.0	16.0	28.0
Class 2	4.0	8.0	24.0	16.0	12.0	8.0
Class 3	32.0	24.0	24.0	52.0	4.0	12.0
Class 4	16.0	48.0	48.0	32.0	20.0	16.0
Class 5	12.0	12.0	4.0	0.0	48.0	36.0

TABLE V, CONTINUED

SUMMARY OF DATA ON BLOOD ANALYSIS

PART D. TOTAL PROTEIN, ALBUMIN, AND GLOBULIN

Averages and Ranges	Total Protein		Albumin		Globulin	
	Test I	Test II	Test I	Test II	Test I	Test II
Mean	7.43	7.81	4.44	4.64	3.54	3.17
Percentage Class Distribution in: Class 1	81.8	95.5	18.2	63.6	100.0	95.5
Class 2	13.6	4.5	68.2	36.4	0.0	4.5
Class 3	4.6	0.0	13.6	0.0	0.0	0.0
Class 4	0.0	0.0	0.0	0.0	X	X
Class 5	0.0	0.0	0.0	0.0	X	X

TABLE V, CONTINUED

SUMMARY OF DATA ON BLOOD ANALYSIS

PART E. BLOOD SERUM CALCIUM, BLOOD PLASMA PHOSPHORUS, AND CHOLESTEROL

Averages and Ranges	Calcium		Phosphorus		Cholesterol	
	Test I	Test II	Test I	Test II	Test I	Test II
Mean	10.1	10.2	4.54	5.57	164.39	179.91
Percentage of subjects above normal limits	5.9	0.0	88.0	84.0	0.0	0.0
Percentage of subjects within normal limits	70.5	82.3	12.0	16.0	4.3	21.6
Percentage of subjects below normal limits	23.6	17.7	0.0	0.0	95.7	78.4

TABLE VI

SUMMARY OF DATA ON URINE ANALYSIS

THIAMINE, RIBOFLAVIN, AND N-METHYLNICOTINAMIDE

Averages and Ranges	Thiamine		Riboflavin		N-Methyl-nicotinamide	
	Test I	Test II	Test I	Test II	Test I	Test II
Mean	11.58	9.97	26.3	24.1	255	200
Percentage Class Distribution in: Class 1	61.5	61.5	11.5	11.5	3.8	0.0
Class 2	15.4	23.1	19.2	19.2	7.7	3.8
Class 3	15.4	15.4	50.0	38.5	11.5	7.7
Class 4	3.8	0.0	11.5	15.4	61.5	80.8
Class 5	3.8	0.0	7.6	15.4	15.5	7.7

TABLE VII

STATISTICAL ANALYSIS OF BLOOD LEVELS AND NUTRIENT INTAKE BETWEEN TEST I AND TEST II

Sample	Means	Standard Deviation	"t" Value	Probability
Blood Plasma Vitamin A				
Test I	34.4	17.7	2.8612	P<0.01
Test II	23.1	7.0		
Blood Plasma Carotene				
Test I	0.108	0.044	0.4065	N.S.
Test II	0.113	0.028		
Blood Serum Total Protein				
Test I	7.43	0.58	2.6397	P<0.01
Test II	7.81	0.44		
Blood Serum Albumin				
Test I	4.44	0.28	4.8787	P<0.001
Test II	4.64	0.28		
Protein Intake from Animal Sources				
Test I	32.2	13.9	4.5488	P<0.001
Test II	50.3	12.0		
Protein Intake from Vegetable Sources				
Test I	18.1	9.4	1.5788	N.S.
Test II	14.6	3.9		
Protein Intake from Total Sources				
Test I	50.3	17.7	2.9564	P<0.01
Test II	64.9	14.2		
Vitamin A Intake from Animal Sources				
Test I	1741	2283	0.6419	N.S.
Test II	1409	708		
Vitamin A Intake from Vegetable Sources				
Test I	2316	1783	2.6592	P<0.01
Test II	4293	3099		
Vitamin A Intake from Total Sources				
Test I	4057	2709	1.9494	P<0.10
Test II	5702	2957		