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To the Graduate Council:

I am submitting herewith a thesis written by Sara Edmundson Cummings entitled "Dietary Findings and Bone Densities of PreschoolChildren in Selected Day Care Centers in Knoxville, Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

Roy E. Beauchene, Major Professor

We have read this thesis and recommend its acceptance:

Mary Jo Hitchcock, Frances A. Schofield, Rossie L. Mason

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

August 3, 1970

To the Graduate Council:

I am submitting herewith a thesis written by Sara Edmundson Cummings entitled "Dietary Findings and Bone Densities of Preschool Children in Selected Day Care Centers in Knoxville, Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

Roy E. Beauchene
Major Professor

We have read this thesis and recommend its acceptance:

Mary Jo Whitehorse

Frances A. Schofield

Rossie L. Mason

Accepted for the Council:

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Vice Chancellor for
Graduate Studies and Research

DIETARY FINDINGS AND BONE DENSITIES OF PRESCHOOL CHILDREN IN SELECTED DAY CARE CENTERS IN KNOXVILLE, TENNESSEE

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

Sara Edmundson Cummings

August 1970

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ABSTRACT

The purposes of this study were to determine the contribution the food eaten at day care centers made to the Recommended Dietary Allowances of preschool children; to evaluate their nutritional status using seven-day records of food intake and measurements of height, weight, and bone density; and to study the correlation between selected nutrients and bone density.

Children from four day care centers in Knoxville, Tennessee, were participants in this study. Permission for participation was obtained by the signed consent of the parents. Complete dietary information (school lunch records and seven-day home records) and physical measurements (height, weight, and bone density) were obtained for 49 children. The research team kept records of food intake for the children at the centers, and the parents recorded intakes at home. Nutrient intakes for energy, protein, calcium, phosphorus, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid were obtained by computer calculation. Height, weight, and bone density were measured at the centers. Bone density was measured by the direct scan technique and final values were determined by computer.

The means of the nutrients supplied by the centers exceeded 33% of the RDA for all nutrients except iron. Three of the centers supplied well over 100% of the RDA for vitamin A, thiamin, riboflavin, niacin, and ascorbic acid. These values were deceivingly high because in three centers the children were receiving vitamin supplements. However, all

of the centers supplied over 33% of the RDA for vitamin A, thiamin, riboflavin, niacin, and ascorbic acid without vitamin supplements.

Mean daily nutrient intakes were determined by combining the nutrient intakes at the center and at home. The mean nutrient intakes for the boys and for the girls met or exceeded the RDA, except for the iron intake of girls. The percentages of individual children having high (all nutrients meeting the RDA); adequate (one or more nutrients less than the RDA but not less than 67%); and inadequate (one or more nutrients below 67% of the RDA) levels of nutrient intakes with supplementation were 25%, 53%, and 22%, respectively. The corresponding percentages without supplementation were 21%, 57%, and 22%. More girls tended to fall in the inadequate category than boys, and more boys were in the high category than girls. Ten of the 11 children classified as having inadequate intakes had inadequate intakes of iron. Three of the 11 inadequate diets were inadequate in calcium. One boy consumed as many as six nutrients at inadequate levels. Fifty-nine percent of the children were receiving vitamin supplements at home. All of the children normally received vitamin supplements at the centers. The supplement provided at the centers provided 100% or more of the RDA for vitamins for children.

Bone density values ranged from 0.55 to 1.16 gram equivalents of alloy per cubic centimeter of bone with a mean of 0.77. No significant sex differences were found for the growth parameters and nutrient intakes of black children, but white boys had significantly higher bone densities and intakes of protein and phosphorus than white girls. White boys were significantly older and had greater intakes of calcium than

black boys, but black boys had significantly higher bone densities than white boys. Black girls were found to have significantly greater bone densities and intakes of protein and vitamin A than white girls although white girls were significantly older. Black girls had a mean intake of vitamin A from food that was nearly twice that of white girls.

Correlations between bone density and selected factors were determined for each race according to sex. No significant correlations were evidenced for black boys or white girls when bone density was correlated to height, weight, or selected nutrient intakes. Bone density was significantly correlated to vitamin A intake in black girls and to height in white boys. When the bone densities of all children were correlated to selected factors, a significant correlation was found only between bone density and vitamin A intake. The correlations which were not significant were between bone density and age, height, weight, and between bone density and the total daily intakes of protein, calcium, phosphorus, and ascorbic acid.

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INTRODUCTION

One facet for assessing the nutritional status of an individual is the evaluation of dietary intake. Several studies have examined the nutrient intakes of preschool children, but few studies have evaluated the diet of preschool children and studied its relationship to bone density. In recent years interest in bone density measurements have increased due to the loss of bone mass by the astronauts during space flights.

The purposes of this study are to determine the contribution the food eaten at day care centers makes to the Recommended Dietary Allowances of preschool children; to evaluate their nutritional status using seven-day records of food intake and measurements of height, weight, and bone density; and to study the correlation between selected nutrients and bone density.

CHAPTER II

REVIEW OF LITERATURE

Methods of Dietary Investigation

Different methods of dietary investigation have been used to evaluate dietary intakes. Dietary histories, dietary records for various lengths of time, calculations of nutrients using food tables, and chemical analyses are methods that have been used. The accuracy and reliability of the dietary history has been questioned by Huenemann and Turner (1). When these investigators compared the nutrient intakes calculated from the dietary history and from the dietary record, the two methods differed by as much as 20 %.

Young et al. (2) found the largest source of error in keeping dietary records to be in the estimation of food portions. They concluded that such errors could be significant if one were interested in the nutrient intake of an individual rather than that of a group. At least two-thirds of the participants in their study were able to estimate their nutrient intakes within 20 % of the measured intakes. Using the same subjects, Young and coworkers (3) reported that the intakes were overestimated by the dietary history as compared to the seven-day dietary records. Adelson (4) also compared recall and record methods using business and professional men. With the help of their wives, the man were able to recall adequately the previous seven-day dietary intake.

Much concern has been demonstrated about how many and which days to use in a dietary study. Many authorities feel that a period of seven consecutive days or a large number of one-day records is necessary for accuracy, but Chalmers et al. (5) stated that a one-day record would be adequate to characterize the dietary intake of a group. A direct answer was not available concerning which day or days to use in a dietary study, but Chalmers reported that the records should be kept on consecutive days for an individual. In this study college students were reported to have a distinct decrease in food intake on weekends.

A one-day diet form that can be used by school children in a nutritional survey has been described by Anderson and Sanstead (6). The participant was given instructions on how to use the form, and he recorded his intake one day prior to a clinic appointment. The investigators felt this method was superior to the usual diet history. These authors pointed out that a one-day record or a seven-day record is not necessarily typical of the dietary intake of an individual, but it may serve as a basis for nutritional advice.

Iowa and Kansas school children were studied by Eppright and coworkers (7) using three-day and seven-day dietary records. The day-to-day intake for girls proved to be more variable than for boys. Vitamin A and ascorbic acid were found to be more variable than the other nutrients for both sexes. A combination of any three days of the week seemed to be representative of the week-day intake. However, on the weekends less milk but more meat was consumed. Nutrient intakes were larger when estimated or measured rather than weighed.

Three and seven-day dietary records were used by Trulson (8) to investigate the use of milk, protein, and vitamin A in two groups of Chicago school children. By either method, intakes of protein and milk were similar, with the lowest mean protein intake on Friday. The day-to-day intake of vitamin A was inconsistent. Lengthening the recording period from three to seven days reduced the standard deviation 10% for protein, 15% for milk, and 17% for vitamin A.

Whiting and Leverton (9) compiled the data from the literature for 300 cases in which actual analyses of food were compared with values from food tables. Calculations from food tables were found to be 10% above the analyzed values for calories in 32% of the cases; for protein in 16% of the cases; and for fat in 49% of the cases. The large discrepancy for fat could be attributed to the fact that prior to 1950 most food tables listed meat in the "as purchased" form. The authors concluded that weighing of food would be impractical for large groups, but could be useful in combination with laboratory analysis or food table calculations to check the reliability of other methods.

When studying two adults, Chappell (10) stated that there was little advantage in keeping a dietary record longer than one week, and that a more accurate estimation could be obtained if several one-week observations were made during the period. He found that three one-week dietary records were needed per year to estimate the mean consumption of the least variable nutrient with a standard error of no more than ± 5%.

There is general agreement among investigators that the most accurate method of determining nutrient intake is weighing and analyzing the food consumed, but this method is often prohibited because of necessary economies in time, money, facilities, and personnel. Hunscher (11) pointed out that it may be satisfactory to estimate nutrient intake by serving size and by the use of food composition tables, but even greater accuracy can be obtained if all food is measured or weighed and food tables are used for nutrient calculations. No matter which method is chosen, the dietary data does not determine the nutritional status of an individual. Dietary assessment is a necessary part of determining nutritional status, and the more accurate the method of evaluating the dietary intake, the more accurate the evaluation of nutritional status.

Studies with Children

Nutritional status studies with preschool children have included those studies which evaluate the dietary intake, physical measurements, biochemical findings, or a combination of one or more of these parameters. Comparisons of dietary intakes of preschool children from high and low income families have been made by several investigators.

Two unpublished theses from Kansas State University written by Ling (12) and Bilderback (13) contain data which are a part of the North Central Cooperative Project. Ling compared a group of children receiving Aid For Dependent Children (AFDC) with children from the Kansas State University Nursery School. The AFDC children had a greater percentage of adequate diets than children at the nursery school. This

was surprising since the nursery school mothers had higher test scores of nutrition knowledge and had more favorable attitudes toward nutrition than the AFDC mothers. The boys were found to have slightly better diets than the girls, with iron being the least adequately supplied nutrient for both sexes. Similar results were found by Bilderback (13) in other Kansas preschool children. In this study, niacin was the only nutrient which met the RDA for all children. The children that had the least adequate diets tended to be distributed in the lower half of the Jackson-Kelly charts for height and weight. Crispin and coworkers (14) compared the dietary intakes and physical measurements of Nebraska preschool children from low and high socioeconomic groups. Physical measurements were found to be significantly related to nutrient intakes in the higher socioeconomic group. All physical measurements, except skin-fold thickness, tended to be greater for the higher than for the lower socioeconomic group.

Owen and Kram (15) also observed the relationship of socioeconomic level to dietary intake in 558 preschool children in Mississippi. The higher income children received higher caloric intakes and more calories from animal protein than the lower income group. The low income children had low iron intakes. No differences for thiamin, riboflavin, and vitamin A intakes were found between the two groups. Intakes of calories, calcium, ascorbic acid, and riboflavin tended to be inadequate for all children.

A study in Iowa by Hootman et al. (16) showed no relationship between diet and income for children 3 to 17 years of age. Diets were

classified as all nutrients meeting the RDA, as one or more nutrients less than 100% of the RDA but not less than 67%, or as one or more nutrients below 67% of the RDA. The children between 3 and 9 years consumed diets which provided all nutrients, except ascorbic acid, at a level of 67% or more of the RDA.

Iron has been consistently implicated as a problem nutrient in low income groups. Hutcheson (17) studied the problem of iron deficiency anemia in 15,681 Tennessee, preschool, poor children in 1967. Ten percent of the children were found to be anemic, and 93% of these children responded to iron and vitamin supplements in conjunction with an improved diet. The Negro children had the highest incidence of anemia. Gutelius (18) has also examined the problem of iron deficiency anemia of Negro preschool children in Washington, D.C. Hemoglobin concentrations below 10.0g/100ml of blood were found in 28% of the 460 children. Iron deficiency anemia was most prevelant in the Negro child of one year of age.

In a study conducted at the University of Minnesota by Dierks and Morse (19), preschool children of college students were found to have low intakes of iron and ascorbic acid. Vegetables were the most unpopular food with these children, with meats, fruits, and sweets being preferred foods.

Various factors affecting the dietary intakes of affluent preschool children have been examined by Fox and coworkers (20,21,22). They analyzed the family environment, nutrition knowledge and attitudes of the mothers, and frequency of eating of 3,444 preschool children who participated in

the North Central Cooperative Project. Children that had the lowest nutrient intakes tended to be those of mothers that had a less favorable attitude toward meal planning, food preparation, and nutrition. Children that received vitamin supplements tended to be children of mothers that had more favorable attitudes toward nutrition. As the formal education of the mothers increased and as more money was spent for food, the dietary intakes of calcium, thiamin, riboflavin, and ascorbic acid increased. When children had low caloric intakes, they tended to eat less frequently than those with the higher intakes; the result was an unfavorable reduction in intakes of certain nutrients.

The dietary patterns of preschool children and the relationships of these patterns to family income, employment of the mother, and food purchased have been studied by Metheny et al. (23,24). Complete dietary information was obtained for 87 children in day care centers or nursery schools in Columbus, Ohio. Children from annual income levels above $7,250 had less adequate diets than those children from families with income levels of $5,501 to $7,250. Protein, ascorbic acid, riboflavin, and niacin were the nutrients which more often met the RDA. A greater percentage of the children of employed mothers had better diets than children of unemployed mothers. Only 35% of the children ate breakfast with the entire family, but 80% ate dinner with the entire family. During the week the children ate lunch at school. The children were found to be unfamiliar with the foods that were disliked by their parents.

Macy and Hunscher (25) found that there was a divergence in the growth process of the same child at different times and of different children of the same age. Caloric intake was found to be associated with nitrogen retention and gain in body weight. A reduction of ten calories per kg of body weight could result in unfavorable health in well-nourished children. Caloric intakes of 50 to 100% above basal metabolic needs, depending on activity, were necessary for growing children. The appetites of these children could not be relied upon to assure a proper caloric intake for satisfactory weight gains.

Dietary intakes of Negro and white preschool children have been compared by different investigators. Youmans and coworkers (26) determined the dietary intake of 67 Negro and white preschool children in Nashville, Tennessee. The total intakes of protein, carbohydrate, and fat were lower in Negro than in white children, which resulted in a lower mean caloric intake (1,008) for the Negroes than for the whites (1,547). The mean weights for white and Negro children were 40 and 42 pounds, respectively.

In a study of 842 Negro and white preschool children, Stine et al. (27) found that Negro boys tended to be the tallest, heaviest, leanest, and most anemic. White girls tended to be the shortest, the fattest, and to have the best scores on the Columbia Mental Maturity Test. As a group, the white children had significantly higher red blood cell volumes, skinfold measurements, and mental ability scores than Negro children. The investigators pointed out that measuring only one physical characteristic is not a sufficient index of general health.

Physical measurements and dietary intakes of 70 Negro and white Alabama preschool children in day care centers and at home were evaluated by Cloud (28). The children at home and at the day care centers were of similar height, but the children at home weighed more than those at the day care centers. Again Negro children were found to be taller than white children, but had lower skinfold measurements. Twenty-three percent of the entire group had hematocrit levels below the ICNND low level of 33.9. Dietary intakes of the day care center children were consistently higher than the children at home. The mean intake of all nutrients exceeded two-thirds of the RDA, and the intakes for protein, thiamin, riboflavin, and vitamin A surpassed the RDA in both groups.

A few studies have endeavored to survey different national and racial groups and to determine the effects of economic and social conditions on nutritional status of preschoolers. Morgan (29) summarized the results of a number of nutritional status studies in 1959. The average nutrient intake of boys and girls up to age 12 was estimated to be adequate except for calcium.

Hardy and coworkers (30) have also examined children from different racial and national groups in Chicago. Dietary inadequacies were found to be common among the relief children (receiving private or public financial assistance), and were least frequent among those of the higher socioeconomic groups. Nutritional deficiency signs occurred often among Negro children. The adequacy of the diets was determined on the basis of the number of weekly servings of the protective foods--milk; fruits and vegetables; and meat, fish, poultry, and eggs. Only 28% of

the 7,363 children met their standards for protective foods. The children between 5 and 14 years of age consumed the more adequate diets. An improvement in the diet was noticed when relief families were given an increased amount of money in the form of food stamps. When the food budgets of Negro and white families were the same, their diet patterns were similar.

A longitudinal growth study is the most satisfactory method of studying the dietary patterns of children. Beal (31,32,33,34,35,36) has conducted such a survey with a group of healthy children living at home. The children were representative of the middle class population of Denver, Colorado. Caloric intakes recorded by the mothers were higher than the nutritionist's dietary history until the child reached 7 1/2 years. Intakes were determined for calories, carbohydrate, protein, fat, calcium, phosphorus, iron, thiamin, riboflavin, and niacin. At various times there were lags in appetite, indifferences to food, and an outright refusal of some foods. After three years of age, the child ate most nutrients in adequate amounts, except for iron and niacin. A sex difference was also noted. Boys consumed more calories than girls, and had a greater caloric intake per unit of height and weight than girls. The author indicated that height and weight alone could be used as criteria for caloric needs for growth, but information concerning energy expenditure and basal metabolism are helpful in ascertaining caloric requirements.

Newman (37) has pointed out that recommendations for the amount of nutrients necessary for growth of an individual child cannot be

made with any degree of certainty. The growth rate of an individual child varies, and it is difficult to ascertain when it is normal. The body size and the growth rate are important considerations when making dietary recommendations for a child. It should be realized that heights for both sexes in each group tend to be the same until age ten, but weight gain of boys tends to be greater than girls, except during the teens. Most of all, height and weight tables should be interpreted as averages for a group of children and not as values for an individual child.

Bone Density Measurements

With the advent of man in space and the accompanying loss of bone mass during flight, much more interest and effort has been directed toward the evaluation of bone density (38). Mack and La-Chance (39) have attempted to simulate this flight condition using young men in bed rest studies. The investigators found that increasing the level of calcium in the diet tended to reduce bone mineral losses. It was pointed out by these investigators that variables such as time in flight, stress, and dietary factors other than calcium, may influence bone mineral losses.

Since there are many different approaches to the measurement of bone density, it is difficult to compare results that have been obtained. The methodology has been reviewed by Wang (40). The direct scan method, as described by Mason and Ruthven (41), was found to have the greatest reproducibility (± 6% for humans) when Wang compared this method to other methods.

In 1969 Tucker (42) conducted a dietary and bone density study with preschool children in Head Start centers and private preschools in Knox County, Tennessee. No significant correlations were found between bone density and age or intakes of calcium and ascorbic acid. This investigator also reported that bone density values were not affected by sex or socioeconomic level. However, bone density and weight were significantly correlated for boys, and bone density and height approached significance for girls.

Bone density and dietary findings have also been reported for preschool and elementary school children by Mack and coworkers (43). Favorable changes in skeletal growth were found in the children when orange juice was incorporated into the school lunch program. Schraer (44) evaluated the bone density of the os calcis and phalanx 5-2 of children and young adults roentgenographically. The mean bone density for both bones increased significantly with age. Sex differences were not noted in the 7 to 9 year group for either bone, but males in the older groups were found to have greater densities for the os calcis than for the phalanx 5-2, while the reverse was true for females.

Varich et al. (45) studied Papago Indian children to determine the effects of an adequate or inadequate school lunch on bone density. It was found that height and weight were not influenced by the quality of the school lunch, but higher values for blood vitamin A and ascorbic acid were reported for children receiving adequate school lunches. The incidences of vitamin A and ascorbic acid deficiencies were more

prevalent in children who received an inadequate lunch. Inadequate lunches were also associated with lower bone density values for girls.

Schraer and Schraer (46) examined the effects of various levels of calcium on bone density of weanling rats. After seven days of calcium supplementation, the rats on low calcium diets were found to have a noticeable increase in bone density. Williams and coworkers (47) also reported that weanling rats on low calcium diets demonstrated significant increases in bone density when calcium was increased.

The bone densities of cadavers from an aged population were examined by Baker and Angel (48) using a specific gravity technique. No relationship was found between age and bone density, but the bone densities of Negro males were greater than that of white males.

A few dietary and bone density studies have included participants of all ages. Odland et al. (49) examined the dietary intake and bone density of the os calcis and phalanx 5-2 ends and center of all age groups in the western part of the United States. Bone density values of the os calcis plateaued for males during adolescence, but showed an increase for females. The bone density of these phalanges gradually decreased during the life span of males and increased for females until age 49 when a gradual decrease in bone density occurred. Little relationship was observed between diet and bone density.

In "Nutritional Status U.S.A." Morgan (29) reported that during the growing years, females exhibited greater bone densities of the phalanx 5-2 than males. No sex differences were observed for the phalanx 5-2 after age 60. The density of the os calcis was greater for males than females at all ages, but was little affected by age.

All age groups have been included in a dietary and bone density study in Cumberland County, Tennessee, by Mason and coworkers (50). Bone density of the phalanx 5-2 increased during the growth years in both sexes. It began to decrease at age 20 for males and rapidly decreased after age 60. The bone density of females increased until age 50 and then gradually decreased. The age-associated decreases in bone density were paralleled by similar decreases in calcium intake.

CHAPTER III

EXPERIMENTAL PROCEDURE

Subjects

Preschool children from four day care centers located in different elementary schools in Knoxville, Tennessee, were participants in this study conducted during April and May of 1970. There was a total of 68 children enrolled in the four centers, but only 56 children participated (parents agreed to keep records of child's food intake at home and to permit physical measurements to be made). Complete information was obtained for 49 of the children. Most of the children were five years of age with a few being four or six. Information pertaining to the sex, school, and race distribution of the participants is presented in Table 1. The four centers are identified as C-1, C-2, C-3, and C-4.

At the first center, letters-of-explanation were sent to the parents, but this approach was not very successful because the names and addresses were incorrect in many cases. In the other centers, letters-of-explanation and permission slips were sent home by the persons picking up the children. A sample letter-of-explanation and a permission slip are presented in the Appendix. At two of the centers, most of the parents received further information about the study when they came to get their children at the centers. The majority of the parents were contacted by telephone; a few homes were visited; and at

TABLE 1

DISTRIBUTION OF SUBJECTS WITH COMPLETE DIETARY AND PHYSICAL MEASUREMENTS

Centers	Total Enrollment	Complete Dietary and Physical Measurements[a]		
		Blacks	Whites	Total
C-1				
Boys	13	2	5	7
Girls	5	1	2	3
C-2				
Boys	5	3	0	3
Girls	8	8	0	8
C-3				
Boys	10	8	1	9
Girls	6	5	0	5
C-4				
Boys	11	0	8	8
Girls	10	0	6	6
Total Boys	39	13	14	27
Total Girls	29	14	8	22
Total	68	27	22	49

[a]Includes height, weight, and bone density.

one center a show-and-tell-time was devoted to explaining the study to the children.

Dietary Information

Abbreviated dietary histories and seven-day records of intake were used to obtain dietary information. A sample dietary history and a blank dietary record are presented in the Appendix. Dietary histories were recorded by the parents for a majority of the children, but in a few cases histories were obtained by telephone or interview with the parents. The parents recorded the dietary intakes for their child for seven days using household measurements (measuring cups and spoons, and ruler). These measurements were converted to grams according to the values obtained from Food Values of Portions Commonly Used by Bowes and Church (51).

The day care centers had several factors common to each other. Each center was located in an elementary school, and each received food from its school cafeteria which served a Type A School Lunch. Snacks were served in the morning and afternoon at all centers. Normally all four centers provided a vitamin capsule each morning that contained 5000 IU of vitamin A, 400 IU of vitamin D, 10 IU of vitamin E, 2.5 mg of thiamine, 2.5 mg of riboflavin, 20 mg of niacinamide, 0.5 mg of pyridoxine, 5 mg of calcium pantothenate, 2 μg of vitamin B_{12}, and 50 mg of ascorbic acid. However, C-4 exhausted its supply of vitamin capsules just prior to the recording week, and C-2 exhausted its supply after two days of the recording week. The other centers (C-2 and C-3) provided vitamin supplements all five school days of the recording week.

C-1 served lunch and snacks in the main classroom. Food portions served to the children were adjusted for preschool children. Second servings were allowed at lunch if the child ate all of the first servings, and the children were not allowed desserts until their plate had received the approval of the teacher. Morning snacks consisted or orange-pineapple juice, and the afternoon snack consisted of 4 oz of milk with two butter cookies. One afternoon during the "recording week" one of the children celebrated a birthday. The parents of the "birthday child" provided a white cake with butter frosting. Thus, the afternoon snack that day included cake as well as the regular serving of milk.

The children at C-2 sat in assigned seats, and the teacher served food portions according to the usual appetite of each child. After receiving permission from the teacher, the children took their plates to an adjoining kitchen and scraped any left-over food into the garbage can. They stacked their dishes and returned to the table for dessert. Eight ounces of milk were served at lunch. Any milk that was not drunk at lunch was marked with the child's name, refrigerated, and served to him at the afternoon snack. Children who had drunk their milk at lunch were given 4 oz of milk at snack time. Apple juice was served for the morning snack, and milk and a butter cookie were served for the afternoon snack. Ice cream was served every Friday afternoon. A birthday party also occurred one afternoon when the research team visited this center. The regular Friday afternoon ice cream was served, and the parents provided chocolate cake with chocolate icing.

At C-3 food was served in a dining room adjacent to the classroom. Food portions were adjusted according to the age of the children. Second servings were allowed for some food items even though the child may not have finished other foods on his plate. The morning snack usually consisted of orange juice and two saltine crackers, but popsicles and assorted raw vegetables were served two mornings of the recording week. Milk and chocolate cookies were served for the afternoon snack three days a week, and ice cream was served on Tuesday and Friday afternoons.

At C-4 food was also served in an adjoining dining room, and serving sizes were adjusted to the age of the children. Orange juice and a saltine cracker were served for morning snacks, and milk and a chocolate cookie were served for afternoon snacks four days of the week. Ice cream was served every Friday afternoon.

The author and other members of the research team recorded the food consumed by the children at the centers. Food portions were usually estimated, but occasionally, servings were weighed if any doubt existed as to their approximate size. Mothers of the children kept records of what her child ate at home for seven days. Most of the instructions for keeping the records were given to the parents by telephone. A few instructions were given to the parents at the school, or by a letter that the children took home with them. A sample one-day record, blank dietary records for seven days, a dietary history sheet, measuring cups, measuring spoons, a pencil, a self-addressed stamped envelope, and a small ruler were sent home in a packet with each child

that participated in the study. Once the records were completed, the parents returned the completed forms in the stamped envelope.

The food items of the dietaries were summarized, and assigned USDA Handbook No. 8 (52) code numbers. The food item numbers and the weight in grams were recorded on data sheets for computer calculation. The nutrient intakes were calculated using the food values in USDA Handbook No. 8. Mineral and vitamin supplements, and any food item not listed in Handbook No. 8 were added manually. Each child's dietary intake was compared to the 1968 Recommended Daily Dietary Allowances (53). Determination of niacin equivalents from tryptophan was made on the basis that 1% of all protein is tryptophan, and that 60 mg of tryptophan was equivalent to 1 mg of niacin (53).

Bone Density

Bone density measurements were performed at the centers by the method described by Mason and Ruthven (41). The bone densitometer was developed by the Department of Nutrition at The University of Tennessee. It uses x-radiation as the source of energy and utilizes a scintillation detector. A collimator decreases x-ray scatter and exposure to the participant. The absorption curve for the bone and an aluminum-alloy wedge, used as a standard, are traced directly on graph paper as the bone or wedge is passed through the x-ray beam.

The bone used was the phalanx 5-2 of the left hand. The midpoint of the bone was marked, placed on the finger stand, and traces of the anteroposterior and lateral views were made. Williams and Mason (54) have described this wedge as one that has an absorption

approximating bone mineral. Flesh and bone areas for both the antero-posterior and the lateral views were measured by planimeter. These measurements were transferred to the wedge trace, and were used in computer calculation of bone density. Bone density values are expressed in terms of x-ray equivalent grams of alloy per cubic centimeter of bone.

Height and Weight

Height and weight measurements without shoes were also made at the centers when bone density measurements were made. Since the measurements were made in the Spring of 1970, the clothing that each child wore was light in weight. Weight was measured to the nearest 1/4 pound, and height was measured to the nearest 1/8 inch.

Statistical Analyses

The data obtained was analyzed statistically using the "t" test to evaluate the difference between means, and the correlation coefficient to evaluate the relationship between bone density and nutrient intakes and other physical parameters. These statistical procedures are described by Steel and Torrie (55).

CHAPTER IV

RESULTS AND DISCUSSION

The means of the nutrients provided daily at the centers and of the amounts actually eaten with and without vitamin supplementation are presented in Table 2 and Table 3. The same data expressed as a percent of the Recommended Daily Dietary Allowances are shown in Table 4 and Table 5. All four centers provided the Type A School Lunch which is supposed to supply 33% of the RDA. The percentages of nutrients supplied by the centers exceeded 33% of the RDA for all nutrients except iron. Almost 100% of the RDA for protein was provided at the four centers. Approximately 67% of the RDA for calcium and phosphorus was supplied at each center, reflecting the serving of milk at all of the four centers for lunch and snacks. When the nutrients eaten were examined as a percentage of the RDA, iron was the only nutrient that the children consumed in amounts less than 33% of the RDA. C-1 and C-4 were providing 27% of the RDA for iron, but the children consumed even less. Thirty-three percent of the RDA for iron was provided by C-3, and 31% and 26% of the RDA was consumed at this center by boys and girls, respectively. Calories and calcium were provided at the next lower percentages of the RDA, but exceeded 33% of the RDA. All other nutrients were consumed in amounts that exceeded 33% of the RDA at all centers. More nutrients were consumed than the amounts provided in the initial servings in a few cases

TABLE 2

MEAN DAILY INTAKES OF ENERGY, PROTEIN, AND SELECTED MINERALS AT THE CENTER COMPARED TO AMOUNTS PROVIDED

Centers	Subjects	Energy	Protein	Calcium	Phosphorus	Iron
	N	kcal	g	mg	mg	mg
1/3 RDA		533	10	267	267	3.3
C-1						
Provided		724	26	535	535	2.7
Boys' Intake	13	696	26	526	525	2.6
Girls' Intake	5	638	23	510	487	2.0
C-2						
Provided		879	33	575	596	4.3
Boys' Intake	5	740	28	461	493	3.5
Girls' Intake	8	718	29	451	504	4.1
C-3						
Provided		950	35	661	727	3.3
Boys' Intake	10	805	29	489	572	3.1
Girls' Intake	6	742	26	471	530	2.6
C-4						
Provided		820	28	523	572	2.7
Boys' Intake	11	677	23	360	430	2.5
Girls' Intake	10	632	22	346	414	2.1

TABLE 3

MEAN DAILY INTAKES OF VITAMINS AT THE CENTERS COMPARED TO THE AMOUNTS PROVIDED WITH AND WITHOUT VITAMIN SUPPLEMENTATION

		Vitamin A		Thiamin		Riboflavin		Niacin		Ascorbic Acid	
Centers	Subjects	Unsupp	Supp	Unsupp	Supp	Unsupp	Supp	Unsupp	Supp	Unsupp	Supp
	N	IU	IU	mg	mg	mg	mg	eq	eq	mg	mg
1/3 RDA		833	833	0.27	0.27	0.30	0.30	3.67	3.67	13	13
C-1											
Provided		1633	3633[a]	0.31	1.31	0.83	1.83	8.29	16.29	48	68
Boys' Intake	13	1378	3378	0.30	1.30	0.82	1.82	8.15	16.15	47	67
Girls' Intake	5	1308	3308	0.26	1.26	0.78	1.78	6.83	14.83	47	67
C-2											
Provided		2096	7096	0.41	2.91	0.93	3.43	9.17	29.17	50	100
Boys' Intake	5	1391	6391	0.32	2.82	0.74	3.24	7.75	27.75	34	84
Girls' Intake	8	1696	6696	0.37	2.87	0.75	3.25	8.32	28.32	42	92
C-3											
Provided		1855	6855	0.48	2.98	1.01	3.51	11.41	31.41	79	129
Boys' Intake	10	1592	6592	0.42	2.92	0.74	3.24	9.66	29.66	77	127
Girls' Intake	6	1474	5640	0.38	2.46	0.73	2.81	8.61	25.28	75	109
C-4											
Provided		1275	1275[b]	0.43	0.43	0.83	0.83	8.93	8.93	66	66
Boys' Intake	11	902	902	0.37	0.37	0.58	0.58	8.12	8.12	65	65
Girls' Intake	10	919	919	0.34	0.34	0.56	0.56	7.41	7.41	68	68

[a] C-1 provided vitamin supplements only two days during the recording week.

[b] C-4 did not provide any vitamin supplements during the recording week.

TABLE 4

MEAN PERCENTAGES OF RDA PROVIDED BY THE CENTERS COMPARED TO MEAN PERCENTAGES ACTUALLY EATEN FOR ENERGY, PROTEIN, AND SELECTED MINERALS

Centers	Subjects	Energy	Protein	Calcium	Phosphorus	Iron
	N	%	%	%	%	%
C-1						
Provided		45	86	67	67	27
Boys' Intake	7	44	85	66	66	26
Girls' Intake	3	40	77	64	61	20
C-2						
Provided		55	109	72	75	43
Boys' Intake	3	46	92	58	62	35
Girls' Intake	8	45	97	56	63	41
C-3						
Provided		59	118	83	91	33
Boys' Intake	9	50	96	61	72	31
Girls' Intake	5	46	87	59	66	26
C-4						
Provided		51	94	65	71	27
Boys' Intake	8	42	76	45	54	25
Girls' Intake	6	40	72	43	52	21

TABLE 5

MEAN PERCENTAGES OF RDA PROVIDED BY THE CENTERS COMPARED TO PERCENTAGES ACTUALLY EATEN WITH AND WITHOUT VITAMIN SUPPLEMENTATION

		Vitamin A		Thiamin		Riboflavin		Niacin		Ascorbic Acid	
Centers	Subjects	Unsupp	Supp	Unsupp	Supp	Unsupp	Supp	Unsupp	Supp	Unsupp	Supp
	N	%	%	%	%	%	%	%	%	%	%
C-1											
Provided		65	145	39	164	92	203	75	148	120	170
Boys' Intake	7	55	135	38	163	91	202	74	147	118	168
Girls' Intake	3	52	132	33	158	87	198	62	135	118	168
C-2											
Provided		84	284	51	364	103	381	83	265	125	250
Boys' Intake	3	56	256	40	353	82	360	70	252	85	210
Girls' Intake	8	68	268	46	359	83	361	76	258	105	230
C-3											
Provided		74	274	60	373	112	390	104	286	198	323
Boys' Intake	9	64	264	53	365	82	360	88	270	192	317
Girls' Intake	5	59	226	48	308	81	312	78	230	188	272
C-4											
Provided		51	51	53	53	92	92	81	81	166	166
Boys' Intake	8	36	36	46	46	65	65	74	74	163	163
Girls' Intake	6	36	36	42	42	62	62	69	69	171	171

because second servings were sometimes available and exchanges of food between individuals were allowed.

Since orange juice was provided during snack time at three of the centers and apple juice enriched with ascorbic acid was provided at the fourth (C-2), the ascorbic acid provided by the food at the centers exceeded 33% of the RDA. Vitamin A, thiamin, riboflavin, and niacin were also supplied in excess of 33% of the RDA by food at all of the centers. When the vitamin intakes at three of the centers included the amounts provided by the vitamin supplements, the intakes of all of the vitamins greatly exceeded 100% of the RDA. Since all of the centers provided more than 33% of the RDA for vitamins without vitamin supplementation, it appears questionable as to the need of supplying vitamin supplements at the centers.

More plate wastage (difference between food provided and eaten) occurred at C-3 and C-4 than at C-1 and C-2, and girls tended to waste more food than boys. Calculations based on the percent of calories, protein, and minerals revealed that children of C-1, C-2, C-3, and C-4 consumed approximately 95%, 85%, 79%, and 77% of the food provided, respectively. Afternoon snacks were not eaten well at C-2, C-3, and C-4. Perhaps this reflected the policy of these centers to serve the children's afternoon snacks immediately upon rising from their naps.

The means of growth parameters and of total daily intakes of the nutrients are shown in Table 6 and Table 7. In general, the mean nutrient intakes met the RDA. In a few instances the mean intakes of calories, calcium, and iron were less than the RDA. The girls of C-4

TABLE 6

MEANS OF GROWTH PARAMETERS AND OF TOTAL DAILY INTAKES OF ENERGY, PROTEIN, AND SELECTED MINERALS ACCORDING TO CENTER

Centers	Subjects N	Age mos	Height ins	Weight lbs	Bone Density g/cc	Energy kcal	Protein g	Calcium mg	Phosphorus mg	Iron mg
RDA	--	48-72	43	42	--	1600	30	800	800	10.0
C-1										
Boys	7	70	45.0	45.2	0.74	1914	68	993	1272	9.0
Girls	3	62	42.5	41.8	0.80	1690	63	1093	1228	8.7
C-2										
Boys	3	61	43.9	45.2	0.76	1781	66	757	993	9.1
Girls	8	62	44.4	46.5	0.80	1747	66	914	1149	9.2
C-3										
Boys	9	68	45.0	46.9	0.79	1877	67	932	1201	11.2
Girls	5	66	43.0	44.2	0.86	1725	64	908	1408	9.2
C-4										
Boys	8	70	45.1	46.4	0.75	1868	68	950	1168	10.4
Girls	6	69	43.7	40.0	0.68	1548	56	774	991	7.3
All Boys	27	67	44.8	45.9	0.76	1838	64	934	1159	10.0
		±2	±0.3	±0.4	±0.01	±65	±2	±57	±50	±0.9
All Girls	22	65	43.4	43.1	0.78	1680	62	899	1113	8.6
		±2	±0.4	±1.4	±0.04	±70	±2	±63	±58	±0.4

TABLE 7

MEAN TOTAL DAILY INTAKES OF VITAMINS WITH AND WITHOUT VITAMIN SUPPLEMENTATION ACCORDING TO CENTER

Centers	Subjects	Vitamin A		Thiamin		Riboflavin		Niacin		Ascorbic Acid	
		Unsupp	Supp	Unsupp	Supp	Unsupp	Supp	Unsupp	Supp	Unsupp	Supp
	N	IU	IU	mg	mg	mg	mg	mg	mg	mg	mg
RDA		2500	2500	0.80	0.80	0.90	0.90	11.00	11.00	40	40
C-1											
Boys	7	3641	6822	1.02	2.11	1.67	3.00	20.18	31.17	72	103
Girls	3	7825	16476	0.97	2.35	1.86	3.41	20.87	33.34	92	178
C-2											
Boys	3	4024	10262	1.34	3.53	1.42	4.13	22.34	42.63	78	144
Girls	8	4587	11444	0.94	3.95	1.48	4.10	20.47	33.32	115	190
C-3											
Boys	9	6670	13447	1.27	4.01	1.80	4.80	24.40	47.73	161	225
Girls	5	6028	8885	1.10	2.53	1.73	3.16	21.74	33.17	118	146
C-4											
Boys	8	2967	5448	0.90	1.61	1.64	2.54	20.63	30.03	98	150
Girls	6	2868	7701	0.90	2.44	1.42	3.26	19.42	32.67	93	143
All Boys	27	4493	8922	1.10	2.73	1.68	3.55	21.96	37.00	106	162
		± 735	±1140	±0.08	±0.25	±0.10	±0.26	±0.80	± 2.42	± 14	± 17
All Girls	22	4880	8922	0.97	2.80	1.57	3.56	20.53	35.23	107	166
		± 750	±1333	±0.04	±0.20	±0.10	±0.25	± 0.80	± 1.81	± 8	± 13

were the only group which ate less than the RDA for calories. The boys of C-2 and the girls of C-4 consumed less than the RDA for calcium. Both sexes of C-1 and C-2, and girls of C-3 and C-4 ingested less than the RDA for iron. When all girls were combined and all boys were combined, their mean nutrient intakes exceeded the RDA for the girls' intakes of iron. The mean daily intakes of nutrients of all boys and of all girls were not significantly different regardless of whether the comparisons were made with or without vitamin supplementation.

The percentages of children taking vitamin supplements are presented in Table 8. One boy at C-3 and another at C-4 were taking vitamin supplements at home that contained iron. No children were taking iron supplements per se. The study was conducted at a critical time with respect to vitamins. All of the centers had been providing a vitamin supplement, but the supply was exhausted at C-4 prior to the recording week and at C-1 after two days of recording. C-2 and C-3 continued to receive the vitamins during the recording period. The vitamin supplement given at the centers was identical, and each capsule contained 100% or more of the RDA for children. Fifty-nine percent of the children were receiving vitamin supplements at home during the recording week. Just prior to the recording week, 100% of the children were receiving vitamin supplements at the centers.

The percentages of children classified as having high, adequate, and inadequate levels of nutrient intakes with and without vitamin supplementation are summarized in Table 9. Classification of nutrient intake levels in this study is the same as that used in previous

TABLE 8

PERCENTAGES OF CHILDREN TAKING VITAMIN SUPPLEMENTS DURING THE RECORDING WEEK

Centers	Subjects	At Home	At Center	At Home and At Center
	N	%	%	%
C-1				
Boys	7	28.6	100.0	28.6
Girls	3	66.7	100.0	66.7
C-2				
Boys	3	66.7	100.0	66.7
Girls	8	75.0	100.0	75.0
C-3				
Boys	9	66.7[a]	100.0	66.7
Girls	5	20.0	80.0	20.0
C-4				
Boys	8	62.5[a]	0.0	0.0
Girls	6	83.3	0.0	0.0
All Boys	27	55.5	70.4	37.0
All Girls	22	63.6	55.5	40.9
All Children	49	59.2	69.4	38.8

[a]One boy in the group took a vitamin supplement containing iron.

TABLE 9

PERCENTAGES OF CHILDREN HAVING HIGH, ADEQUATE, AND INADEQUATE LEVELS OF NUTRIENT INTAKE WITH AND WITHOUT VITAMIN SUPPLEMENTATION

Centers	Subjects	High[a]		Adequate[b]		Inadequate[c]	
		Unsupp	Supp	Unsupp	Supp	Unsupp	Supp
	N	%	%	%	%	%	%
C-1							
Boys	7	14	14	71	72	14	14
Girls	3	33	33	0	0	67	67
C-2							
Boys	3	33	33	33	33	33	33
Girls	8	25	25	63	63	12	12
C-3							
Boys	9	33	44	67	56	0	0
Girls	5	20	20	80	80	0	0
C-4							
Boys	8	12	25	63	50	25	25
Girls	6	0	0	33	33	67	67
All Children	49	21	25	57	53	22	22

[a]Level of all nutrients is equal to or above 100% of RDA.

[b]Level of at least one nutrient is below 100% of RDA, but none is below 67%.

[c]Level of at least one nutrient is below 67% of RDA.

studies (16,19,23). In this system diets are classified as high (all nutrients meeting or exceeding the RDA), adequate (one or more nutrients less than the RDA but not less than 67%), or inadequate (one or more nutrients below 67% of the RDA). According to this classification, 25% and 21% of all children had high intakes; 53% and 57% had adequate intakes; and 22% and 22% had inadequate diets with and without vitamin supplementation, respectively. A greater percentage of girls than boys tended to fall in the inadequate category, and there was a greater percentage of boys in the high category than girls. In general the children of C-3 had the best diets, and children of C-4 had the poorest diets.

Percentages of children having high, adequate, and inadequate intakes of individual nutrients without vitamin supplementation are presented in Tables 10 and 11. Protein, niacin, and ascorbic acid were consumed in the food at high levels by all children. When the entire group was considered, the percentages of children receiving high intakes for energy, calcium, and phosphorus were 69%, 63%, and 90%, respectively. Iron was the nutrient that was least adequately supplied in the diet with 20% of all children having inadequate intakes. The 31% of the children receiving high intakes of iron is comparable to that reported by Tucker (42). Eleven of the children in the study were classified as having inadequate diets, and ten of these had inadequate intakes of iron. Nine of these children only had one nutrient that was consumed at an inadequate level. One boy at C-4 consumed six nutrients at less than adequate levels. One girl from

TABLE 10

PERCENTAGES OF CHILDREN HAVING HIGH, ADEQUATE, AND INADEQUATE INTAKES OF ENERGY, PROTEIN, AND SELECTED MINERALS ACCORDING TO CENTER

Centers	Subjects N	Energy %	Protein %	Calcium %	Phosphorus %	Iron %
C-1						
Boys	7					
High[a]		71	100	71	100	14
Adequate[b]		29	0	29	0	72
Inadequate[c]		0	0	0	0	14
Girls	3					
High		33	100	67	100	33
Adequate		67	0	33	0	0
Inadequate		0	0	0	0	67
C-2						
Boys	3					
High		67	100	33	67	33
Adequate		33	0	67	33	33
Inadequate		0	0	0	0	33
Girls	8					
High		50	100	50	88	38
Adequate		38	0	38	12	50
Inadequate		12	0	12	0	12
C-3						
Boys	9					
High		89	100	67	100	56
Adequate		11	0	33	0	44
Inadequate		0	0	0	0	0
Girls	5					
High		80	100	80	100	20
Adequate		20	0	20	0	80
Inadequate		0	0	0	0	0

TABLE 10 (continued)

Centers	Subjects N	Energy %	Protein %	Calcium %	Phosphorus %	Iron %
C-4						
Boys	8					
High		89	100	76	88	25
Adequate		11	0	12	0	50
Inadequate		0	0	12	12	25
Girls	6					
High		50	100	50	67	17
Adequate		50	0	33	33	33
Inadequate		0	0	17	0	50
All Children	49					
High		69	100	63	90	31
Adequate		29	0	31	8	49
Inadequate		2	0	6	2	20

[a]Level of all nutrients is equal to or above 100% of RDA.

[b]Level of at least one nutrient is below 100% of RDA, but none is below 67%.

[c]Level of at least one nutrient is below 67% of RDA.

TABLE 11

PERCENTAGES OF CHILDREN HAVING HIGH, ADEQUATE, AND INADEQUATE INTAKES OF VITAMINS WITHOUT SUPPLEMENTATION ACCORDING TO CENTER

Centers	Subjects	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
	N	%	%	%	%	%
C-1						
Boys	7					
High[a]		86	86	100	100	100
Adequate[b]		14	14	0	0	0
Inadequate[c]		0	0	0	0	0
Girls	3					
High		100	67	100	100	100
Adequate		0	33	0	0	0
Inadequate		0	0	0	0	0
C-2						
Boys	3					
High		67	67	100	100	100
Adequate		33	33	0	0	0
Inadequate		0	0	0	0	0
Girls	8					
High		100	75	88	100	100
Adequate		0	25	12	0	0
Inadequate		0	0	0	0	0
C-3						
Boys	9					
High		100	89	100	100	100
Adequate		0	11	0	0	0
Inadequate		0	0	0	0	0
Girls	5					
High		100	100	100	100	100
Adequate		0	0	0	0	0
Inadequate		0	0	0	0	0

TABLE 11 (continued)

Centers	Subjects	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
	N	%	%	%	%	%
C-4						
Boys	8					
High		63	76	88	100	100
Adequate		25	12	0	0	0
Inadequate		12	12	12	0	0
Girls	6					
High		50	83	83	100	100
Adequate		50	17	17	0	0
Inadequate		0	0	0	0	0
All Children	49					
High		84	82	94	100	100
Adequate		14	16	4	0	0
Inadequate		2	2	2	0	0

[a]Level of all nutrients is equal to or above 100% of RDA.

[b]Level of at least one nutrient is below 100% of RDA, but none is below 67%.

[c]Level of at least one nutrient is below 67% of RDA.

C-2 had inadequate intakes of three nutrients. Iron has been shown to be the nutrient that is more likely to be inadequate in the diet of preschoolers (12,13,17,18,19). Three of the 49 children had inadequate intakes of calcium. Other studies (12,13,23,42) have shown calcium to be the second most limiting nutrient in the diet of preschoolers. It should be remembered that an individual whose nutrient intake is at variance with the RDA is not necessarily malnourished. The Recommended Daily Dietary Allowances are intended to serve as a guide for interpreting nutrient intakes of groups of people. In order to completely assess nutritional adequacy of an individual, physical, biochemical, and clinical findings must be considered in addition to nutrient intake.

Percentages of children having high, adequate, and inadequate intakes of all nutrients without vitamin supplementation according to race and sex are presented in Tables 12 and 13. Seven percent of the black boys were classified as having inadequate intakes of calories. The percentages of black children with high intakes of iron and vitamins were greater than that of white children. Thirty-six percent of the whites had inadequate intakes of iron while the corresponding figure for blacks was 7%. None of the black children had inadequate vitamin intakes, but 5% of the white children had inadequate intakes of vitamin A, thiamin, and riboflavin. When the intakes of boys are compared to those of girls, the outstanding difference was that inadequate iron intakes occurred twice as often for girls as for boys.

A summary of the mean values and the standard errors for age, height, weight, bone density, and the intakes of protein, calcium,

TABLE 12

PERCENTAGES OF CHILDREN HAVING HIGH, ADEQUATE, AND INADEQUATE INTAKES OF ENERGY, PROTEIN, AND SELECTED MINERALS ACCORDING TO RACE AND SEX

Race and Sex	Subjects	Energy	Protein	Calcium	Phosphorus	Iron
	N	%	%	%	%	%
Blacks	27					
High[a]		63	100	55	92	37
Adequate[b]		30	0	41	8	56
Inadequate[c]		7	0	4	0	7
Whites	22					
High		73	100	73	86	23
Adequate		27	0	18	9	41
Inadequate		0	0	9	5	36
Boys	27					
High		78	100	30	92	33
Adequate		18	0	66	4	52
Inadequate		4	0	4	4	15
Girls	22					
High		54	100	59	86	27
Adequate		41	0	32	14	46
Inadequate		5	0	9	0	27

[a]Level of all nutrients is equal to or above 100% of RDA.

[b]Level of at least one nutrient is below 100% of RDA, but none is below 67%.

[c]Level of at least one nutrient is below 67% of RDA.

TABLE 13

PERCENTAGES OF CHILDREN HAVING HIGH, ADEQUATE, AND INADEQUATE INTAKES OF VITAMINS WITHOUT SUPPLEMENTATION ACCORDING TO RACE AND SEX

Race and Sex	Subjects	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
	N	%	%	%	%	%
Blacks	27					
High[a]		96	85	96	100	100
Adequate[b]		4	15	4	0	0
Inadequate[c]		0	0	0	0	0
Whites	22					
High		68	77	90	100	100
Adequate		27	18	5	0	0
Inadequate		5	5	5	0	0
Boys	27					
High		81	81	96	100	100
Adequate		15	15	0	0	0
Inadequate		4	4	4	0	0
Girls	22					
High		86	82	91	100	100
Adequate		14	18	9	0	0
Inadequate		0	0	0	0	0

[a]Level of all nutrients is equal to or above 100% of RDA.

[b]Level of at least one nutrient is below 100% of RDA, but none is below 67%.

[c]Level of at least one nutrient is below 67% of RDA.

and phosphorus are presented in Table 14 according to race and sex. No significant differences were found between black boys and girls. White boys were found to have significantly higher bone densities, and intakes of protein and phosphorus than white girls ($P < 0.05$). These findings are contrary to results obtained by Tucker (42) who found no sex differences for preschool children, but other authors (29,50) have reported that females have greater densities of the phalanx 5-2 than males during the growing years. When the races were compared, white boys were found to be significantly older and to have significantly higher calcium intakes than black boys ($P < 0.05$). However, black boys had significantly higher bone densities ($P < 0.01$) than white boys. When girls were compared, whites were found to be significantly older ($P < 0.01$) than blacks, but black girls had significantly higher bone densities ($P < 0.001$), and intakes of protein ($P < 0.02$) than white girls. White children have been reported to have better diets than black children (26,27,30), but black boys of the same age have been reported to be larger than white boys (27,28).

Mean total daily vitamin A and ascorbic acid intakes from food only, as recorded, and prior to the recording week according to race and sex are shown in Table 15. The vitamin A intakes of the blacks during the recording week from food and supplements were greater than those of whites (boys, $P < 0.001$; girls, $P < 0.05$). When vitamin A intakes from food only for girls were compared, blacks were significantly higher ($P < 0.05$). Black girls had a mean intake of vitamin A from food nearly twice that of white girls. No significant difference was obtained

TABLE 14

A SUMMARY OF MEAN GROWTH PARAMETERS AND SELECTED MEAN NUTRIENT INTAKES OF PROTEIN, CALCIUM, AND PHOSPHORUS ACCORDING TO RACE AND SEX

Race and Sex	Subjects	Age	Height	Weight	Bone Density	Intakes Protein	Intakes Calcium	Intakes Phosphorus
	N	mos	ins	lbs	g/cc	g	mg	mg
Blacks								
Boys	13	65[a]	45.1	47.4	0.80[b]	63	818	1073
		±2	±0.6	±1.6	±0.02	±3	±51	±54
Girls	14	62	43.8	44.9	0.85[c]	66[c]	944	1174
		±1	±0.5	±2.0	±0.03	±3	±80	±78
Whites								
Boys	14	71[d]	44.7	44.9	0.73[e]	65[e]	1041[d]	1239[e]
		±2	±0.5	±1.0	±0.02	±3	±93	±79
Girls	8	69[f]	43.5	41.1	0.67	55	820	1005
		±2	±0.7	±2.7	±0.02	±2	±103	±73

[a] Mean ± SE.

[b] Black boys are significantly higher than white boys ($P < 0.01$).

[c] Black girls are significantly higher than white girls ($P < 0.02$).

[d] White boys are significantly higher than black boys ($P < 0.05$).

[e] White boys are significantly higher than white girls ($P < 0.05$).

[f] White girls are significantly higher than black girls ($P < 0.01$).

TABLE 15

MEAN TOTAL DAILY VITAMIN A AND ASCORBIC ACID INTAKES FROM FOOD ONLY, AS RECORDED, AND PRIOR TO RECORDING WEEK ACCORDING TO RACE AND SEX

		Intakes					
		Vitamin A			Ascorbic Acid		
Race and Sex	Subjects	Food Only[a]	As Recorded[b]	Prior to Recording[c]	Food Only[a]	As Recorded[b]	Prior to Recording[c]
	N	IU	IU	IU	mg	mg	mg
Blacks							
Boys	13	5725[d] ±1427	11857[e] ± 1888	12162 ± 1837	131 ± 22	195 ± 26	198 ± 26
Girls	14	5962[f] ± 976	12193[f] ± 1880	12328 ± 2013	117 ± 6	183 ± 14	185 ± 15
Whites							
Boys	14	3350 ± 373	6196 ± 880	9493 ± 707	90 ±13	132 ± 19	160 ± 20
Girls	8	3007 ± 369	7614 ±1127	10838 ± 1163	88 ±17	136 ± 21	168 ± 22

[a]No vitamins from supplements included.

[b]Vitamins included from food and from supplements as provided at home and at centers during recording week.

[c]Vitamins adjusted to supplementation levels prior to those of recording week; all centers supplementing each school day.

[d]Mean ± S.E.

[e]Black boys significantly higher than white boys ($P < 0.001$).

[f]Black girls significantly higher than white girls ($P < 0.05$).

for the vitamin A intake from food for boys. Thus, the significant differences in the vitamin A intakes as recorded for boys can be explained by vitamin supplementation. At C-2 and C-3 daily vitamin supplements were provided, and the enrollment was primarily black. If identical supplementation is assumed at all centers, no significant differences for race and sex are noted (see vitamin A values prior to recording). No significant differences for race and sex were found for ascorbic acid, regardless of which of the above comparisons were made.

In Table 16 bone density has been correlated with other growth parameters and selected nutrient intakes according to race and sex. No significant correlations were found between bone density and any of the other factors for either black boys or white girls. The bone densities of black girls were found to significantly correlate with vitamin A intakes during the recorded week and prior to the recorded week ($P < 0.05$). Since the intakes of vitamin A and ascorbic acid obtained during the recorded week did not reflect the previous intakes of the vitamins, the calculated intakes prior to those obtained during the recorded week (all center diets supplemented) were correlated with bone density as well as those obtained during the recorded week. Bone densities and heights of white boys were also found to be significantly correlated ($P < 0.05$). No other significant correlations were found for black girls or white boys. These findings are divergent from the significant correlation between bone density and weight obtained for boys by Tucker (42). Other authors (43,46,47,50) have indicated that significant correlations might exist between bone density

TABLE 16

CORRELATIONS OF BONE DENSITY WITH GROWTH PARAMETERS AND SELECTED NUTRIENT INTAKES

								Vitamin A		Ascorbic Acid	
Subjects	N	Age	Height	Weight	Protein	Calcium	Phosphorus	As Recorded	Prior to Recording	As Recorded	Prior to Recording
		r	r	r	r	r	r	r	r	r	r
Black Boys	13	ns[a]	ns	ns	ns	ns	ns	ns	ns	ns	ns
Black Girls	14	ns	ns	na	ns	ns	ns	0.56[b]	0.58[b]	ns	ns
White Boys	14	ns	0.54[b]	ns	ns	ns	ns	ns	ns	ns	ns
White Girls	8	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
All Children	49	ns	ns	ns	ns	ns	ns	0.34[b]	0.27[c]	ns	ns

[a]Not significant.

[b]$P < 0.05$.

[c]$P < 0.06$.

and nutrient intakes. When the bone densities of all children were correlated to selected factors, the only significant correlation was between bone density and vitamin A intake as recorded ($P < 0.05$) and prior to recording ($P < 0.06$).

In general the food at the centers provided 33% or more of the RDA, and the mean daily nutrient intakes met or exceeded the RDA. The mean values of bone density for preschoolers in this study were not significantly different than those reported by Tucker (42) and Mason (50). In general the food consumed supplied the RDA for vitamins. Thus, the author would question the necessity of the general supplementation of the diet of preschoolers with vitamins. Considering the number of children having inadequate intakes of iron, perhaps supplementation with this nutrient would be more beneficial. When the children in this study were compared to the Iowa Growth Charts (56), the mean height (44.7 ins) and the mean weight (44.9 lbs) of boys were slightly less than the standard of 45.5 ins for height and 45.5 lbs for weight. The means of the heights (43.5 ins) and weights (41.1 lbs) for girls were less than the Iowa standards for height (44.0 ins) and weight (43.0 lbs). Bone densities of black children were found to be significantly greater than those of white children, and black girls tended to have the highest bone densities. The explanation for the lack of significant correlations between bone density and nutrient intakes may be because the majority of the children in this study exceeded the RDA for almost all nutrients. However, even the child that had inadequate intakes of six nutrients and the other child that had inadequate intakes

of three, maintained normal growth as indicated by height, weight, and bone density. These findings only tend to emphasize that individual children have great variations in their nutrient requirements.

CHAPTER V

SUMMARY

An investigation of dietary and physical findings of selected preschool children was conducted in Knoxville, Tennessee. Abbreviated dietary histories and seven-day records of food intake were obtained for 49 preschool children in four day care centers. Height, weight, and bone density measurements were obtained for the children at each center. The direct scan method was used to determine the bone density of the phalanx 5-2.

The means of the nutrients supplied by the centers exceeded 33% of the RDA for all nutrients except iron. Three of the centers supplied well over 100% of the RDA for vitamin A, thiamin, riboflavin, niacin, and ascorbic acid. These values were deceivingly high because in three centers the children were receiving vitamin supplements. However, all of the centers supplied over 33% of the RDA for vitamin A, thiamin, riboflavin, niacin, and ascorbic acid without vitamin supplements.

Mean daily nutrient intakes were determined by combining the nutrient intakes at the center and at home. The mean nutrient intakes for the boys and for the girls met or exceeded the RDA, except for the iron intake of girls. The percentages of individual children having high (all nutrients meeting the RDA); adequate (one or more nutrients less than the RDA but not less than 67%); and inadequate (one or more nutrients below 67% of the RDA) levels of nutrient intakes with

supplementation were 25%, 53%, and 22%, respectively. The corresponding percentages without supplementation were 21%, 57%, and 22%. More girls tended to fall in the inadequate category than boys, and more boys were in the high category than girls. Ten of the 11 children classified as having inadequate intakes had inadequate intakes of iron. Three of the 11 inadequate diets were inadequate in calcium. One boy consumed as many as six nutrients at inadequate levels. Fifty-nine percent of the children were receiving vitamin supplements at home. All of the children normally received vitamin supplements at the centers. The supplement provided at the centers supplied 100% or more of the RDA for children.

Bone density values ranged from 0.55 to 1.16 gram equivalents of alloy per cubic centimeter of bone with a mean of 0.77. No significant sex differences were found for the growth parameters and nutrient intakes of black children, but white boys had significantly higher bone densities and intakes of protein and phosphorus than white girls. White boys were significantly older and had greater intakes of calcium than black boys, but black boys had significantly higher bone densities than white boys. Black girls were found to have significantly greater bone densities and intakes of protein and vitamin A than white girls although white girls were significantly older. Black girls had a mean intake of vitamin A from food that was nearly twice that of white girls.

Correlations between bone density and selected factors were determined for each race according to sex. No significant correlations were evidenced for black boys or white girls when bone density was

correlated to height, weight, or selected nutrient intakes. Bone density was significantly correlated to vitamin A intake in black girls and to height in white boys. When the bone densities of all children were correlated to selected factors, a significant correlation was found only between bone density and vitamin A intake. The correlations which were not significant were between bone density and age, height, weight, and between bone density and the total daily intakes of protein, calcium, phosphorus, and ascorbic acid.

REFERENCES

REFERENCES

1. Huenemann, R. L., and D. Turner 1942 Methods of dietary investigation. J. Am. Dietet. Assoc. 18:562.

2. Young, C. M., F. W. Chalmers, H. N. Church, M. M. Clayton, G. C. Murphy and R. E. Tucker 1953 Subjects estimation of food intake and calculated nutritive value of the diet. J. Am. Dietet. Assoc. 29: 1216.

3. Young, C. M., F. W. Chalmers, H. N. Church, M. M. Clayton, R. E. Tucker and W. D. Foster 1952 A comparison of dietary study methods. I. Dietary history vs. seven-day record. J. Am. Dietet. Assoc. 28: 124.

4. Adelson, S. F. 1960 Some problems in collecting dietary data from individuals. J. Am. Dietet. Assoc. 36: 453.

5. Chalmers, F. W., M. M. Clayton, L. O. Gates, R. E. Tucker, A. W. Wertz, C. M. Young and W. D. Foster 1952 The dietary record - how many and which day. J. Am. Dietet. Assoc. 28: 711.

6. Anderson, R. K., and H. R. Sanstead 1947 Nutritional appraisal and demonstration program of the United States Public Health Service. J. Am. Dietet. Assoc. 23: 101.

7. Eppright, E. S., M. B. Patton, A. L. Marlatt and M. L. Hathaway 1952 Dietary study methods. V. Some problems in collecting dietary information about groups of children. J. Am. Dietet. Assoc. 28: 43.

8. Trulson, M. F. 1955 Assessment of dietary study methods. II. Variability of eating practices and determination of sample size and duration of dietary surveys. J. Am. Dietet. Assoc. 31: 797.

9. Whiting, M. G., and R. M. Leverton 1960 Reliability of dietary appraisal: comparisons between laboratory analyses and calculation from tables of food values. Am. J. Pub. Health 50: 815.

10. Chappell, G. M. 1955 Long-term individual dietary surveys. Br. J. Nutr. 9: 323.

11. Hunscher, H. A., and I. G. Macy 1951 Dietary study methods. I. Uses and abuses of dietary study methods. J. Am. Dietet. Assoc. 27: 558.

12. Ling, L. A. 1966 Factors related to the level of dietary adequacy of preschool children from two socioeconomic groups in Riley County, Kansas. Unpublished Master's thesis. Kansas State University.

13. Bilderback, D. B. 1967 Dietary intake and anthropometric measurements of preschool children. Unpublished Master's thesis. Kansas State University.

14. Crispin, S., E. Kerrey, H. M. Fox and C. Kies 1968 Nutritional status of preschool children. II. Anthropometric measurements and interrelationships. Am. J. Clin. Nutr. 21: 1280.

15. Owen, G. M. and K. M. Kram 1969 Nutritional status of preschool children in Mississippi. J. Am. Dietet. Assoc. 54: 490.

16. Hootman, R. H., M. B. Haschki, C. Roderuck and E. S. Eppright 1967 Diet practices and physical development of Iowa children from low-income families. J. Home Econ. 59: 41.

17. Hutcheson, R. H. 1968 Iron deficiency anemia in Tennessee among rural poor children. Pub. Health Rep. 83: 939.

18. Gutelius, M. F. 1969 The problem of iron deficiency anemia in preschool Negro children. Am. J. Pub. Health 59: 290.

19. Dierks, E. C., and L. M. Morse 1965 Food habits and nutrient intakes of preschool children. J. Am. Dietet. Assoc. 47: 292.

20. Fox, H. M., B. A. Fryer, G. H. Lamkin, V. M. Vivian and E. S. Eppright 1970 The north central regional study of diets of preschool children. I. Family environment. J. Home Econ. 62: 241.

21. Eppright, E. S., H. M. Fox, B. A. Fryer, G. H. Lamkin, and V. M. Vivian 1970 The north central regional study of diets of preschool children. II. Nutrition knowledge and attitudes of mothers. J. Home Econ. 62: 327.

22. Eppright, E. S., H. M. Fix, B. A. Fryer, G. H. Lamkin and V. M. Vivian 1970 The north central regional study of diets of preschool children. III. Frequency of eating. J. Home Econ. 62: 407.

23. Metheny, N. Y., F. E. Hunt, M. B. Patton and H. Heye 1962 The diets of preschool children. I. Nutritional sufficiency findings and family marketing practices. J. Home Econ. 54: 297.

24. Metheny, N. Y., F. E. Hunt, M. B. Patton and H. Heye 1962 The diets of preschool children. II. Factors in food acceptance. J. Home Econ. 54: 303.

25. Macy, I. G., and H. A. Hunscher 1951 Calories - a limiting factor in the growth of children. J. Nutr. 45: 189.

26. Youmans, J. B., E. W. Patton and R. Kern 1943 Surveys of the nutrition of populations. Am. J. Pub. Health 33: 58.

27. Stine, O. C., J. B. Saratsiotis and O. F. Furno 1967 Appraising the health of culturally deprived children. Am. J. Clin. Nutr. 20: 1084.

28. Cloud, H. H. 1967 Heights, weights, triceps skinfold measurements, hematocrits, and dietary intakes of four year old children in day care centers and at home in Birmingham, Jefferson County, Alabama. Unpublished Master's thesis. University of Alabama.

29. Morgan, A. F. ed. 1959 Nutritional Status U.S.A. California Agricultural Experiment Station Bull. 769.

30. Hardy, M. C., A. Spohn, G. Austin, S. McGiffart, E. Mohr and A. B. Peterson 1943 Nutritional and dietary inadequacies among city children from different socio-economic groups. J. Am. Dietet. Assoc. 19: 173.

31. Beal, V. A., B. S. Burke and H. C. Stuart 1945 Nutrition studies of children living at home. Am. J. Dis. Children 70: 214.

32. Beal, V. A. 1953 Nutritional intake of children. I. Calories, carbohydrate, fat, and protein. J. Nutr. 50: 223.

33. Beal, V. A. 1954 Nutritional intake of children. II. Calcium, phosphorus, and iron. J. Nutr. 53: 499.

34. Beal, V. A. 1955 Nutritional intake of children. III. Thiamine, riboflavin, and niacin. J. Nutr. 57: 183.

35. Beal, V. A. 1961 Dietary intake of individuals followed through infancy and childhood. Am. J. Pub. Health 51: 1107.

36. Beal, V. A. 1965 Nutrition in a longitudinal growth study. J. Am. Dietet. Assoc. 46: 457.

37. Newman, K. J. 1959 Nutritional needs of children after infancy. N. Y. J. Med. 59: 3252.

38. Scientific and Technical Information Division 1966 Progress in Development of Methods in Bone Densitometry, SP-64. National Aeronautics and Space Administration, Washington, D.C.

39. Mack, P. B., and P. L. LaChance 1967 Effects of recumbency and space flight on bone density. Am. J. Clin. Nutr. 20: 1194.

40. Wang, H. C. 1965 Bone density estimation for human adults. Unpublished Master's Thesis. University of Tennessee.

41. Mason, R. L., and C. Ruthven 1965 Bone density measurements in vivo: improvement of x-ray densitometry. Science 150: 221.

42. Tucker, S. M. 1969 Bone densities and dietary intakes of preschool children in Knox County, Tennessee. Unpublished Master's Thesis. University of Tennessee.

43. Mack, P. B., R. E. Beauchene, C. L. Kinard, H. B. Campbell, G. P. Vose and A. L. Kubala 1958 A Nutrition Study Involving the Feeding of Orange Juice to Preschool and Elementary School Children. Bull. 4, Texas Women's University. Denton, Texas.

44. Schraer, H. 1958 Variations in the roentogenographic density of the os calcis and phalanx with sex and age. J. Pediat. 52: 416.

45. Varich, M. G., A. R. Kemmerer and J. S. Hirsch 1954 The nutritional status of Papago Indian children. J. Nutr. 54: 121.

46. Schraer, H., and R. Schraer 1956 Quantitative measurement of bone density changes in rats fed diets of different calcium content. Federation Proc. 15: 571 (abstract).

47. Williams, D. E., B. B. McDonald, E. Morrell, F. A. Schofield and F. L. MacLeod 1957 Influence of mineral intake on bone density in humans and in rats. J. Nutr. 61: 489.

48. Baker, P. T. and J. L. Angel 1965 Old age changes in bone density: sex, and race factors in the United States. Human Biol. 37: 104.

49. Odland, L. M., K. P. Warnick and N. C. Esselbaugh 1958 Cooperative Nutritional Status Studies in the Western Region. II. Bone Density. Montana Agri. Exp. Sta. Bull. 534.

50. Mason, R. L., L. M. Odland and A. I. Alexeff 1968 Bone density and dietary findings in Cumberland County, Tennessee. Tennessee Farm and Home Science, Progress Report 68: 5.

51. Bowes, A., and C. F. Church 1966 Food Values of Portions Commonly Used, Tenth Edition, Anna de Planter Bowes, Philadelphia.

52. Watt, B. K., and A. L. Merrill 1963 Composition of Foods - Raw, Processed, Prepared. Revised. USDA Agric. Handbook No. 8.

53. Food and Nutr. Bd. 1968 Recommended Dietary Allowances, Revised 1968. Natl. Acad. Sci. Pub. 1694.

54. Williams, D. E., and R. L. Mason 1962 Bone density measurements in vivo. Science 138: 39.

55. Steel, R. G., and J. H. Torrie 1960 Principles and Procedures of Statistics. McGraw-Hill Book Company, Inc., New York.

56. Jackson, R. L., and H. G. Kelly 1945 Growth charts for use in pediatric practice. J. Pediat. 27: 215.

APPENDIX

The Department of Nutrition at The University of Tennessee is collecting bone density and dietary information of preschool children. We would like very much to have your permission to collect this information about your child.

A bone density measurement is one way of telling how strong bone is. The measurement is made by drawing a "picture" of the left little finger using a small amount of x-rays. The measurement will be made at school. It takes only a few seconds and will not hurt your child.

We would like for you to help us by keeping a record of what your child eats for one week. We will try to make it as easy for you as possible. We will show you how to do it, and we will give you measuring cups and spoons to help. We shall keep a record of the food your child eats at school. We and the day care workers feel that this will be very useful information.

If you have questions, you may call Mrs. Mason during the day. Her telephone number is 974-3491. If you wish to call at night, my telephone number is 522-7273.

We hope you will let your child participate. Please sign the enclosed permission slip and give it to your teacher at school.

Sincerely,

Sara E. Cummings
Teaching Assistant

I am ______ willing / ______ unwilling to have my child take part in the bone density research.

I understand that a bone density measurement will be made and that 7 day records are to be kept of food eaten by my child.

Signed:______________________________

Date:________________________________

UNIVERSITY OF TENNESSEE
Department of Nutrition

Expt. No.____
Date________

Name of Child:________________________________

Place of birth:______________________________

Birth Date:_____________________________Height__________Weight__________

Name of Parents:______________________________Occupation________________

Address:____Telephone:____________

Meals per day: Breakfast_____Lunch_____Dinner_____Other____________

Explanation:

Have special therapeutic diets ever been followed? Yes_______No_______

If yes, for what?____

How long ago?____

Was participant breast fed________or bottle fed________or both________ as an infant?

Has the child had any broken bones?______How many?____________________

Foods especially liked:

Foods disliked and avoided:

Supplements used: Fish liver oils______Vitamins______Minerals_______

Amounts:_____________________________Brand:_______________________

Milk and milk products used: average cups milk per day (drinking and cooking)______

Cheese used per week_____________Ice cream per week____________

Green vegetables__________________Green leafy___________________

Energy Expenditure Estimate

Time in bed at night____________Daytime sleep or rest________

Day's activities:_______________________________________

____

Energy Expenditure: Very light____Light____Moderate_____Severe______

Very Severe____

NAME____NO.________

ADDRESS____

DATE__________________________DAY OF WEEK______________

FOOD KIND STATE AMOUNT

BREAKFAST

BETWEEN MEAL

NOON MEAL

BETWEEN MEAL

EVENING MEAL

AFTER EVENING MEAL

VITA

Sara Edmundson Cummings was born in Hendersonville, North Carolina, on November 30, 1945. She attended elementary schools in Oak Ridge, Tennessee, and was graduated from Oak Ridge High School in 1963. The following September she entered The University of Tennessee, and in May, 1968, she received a Bachelor of Science degree in Home Economics from Middle Tennessee State University. In the summer of 1968, she accepted a dietetic internship appointment at Vanderbilt University Hospital, and was certified for membership in the American Dietetic Association in June, 1969.

In the fall of 1969, she accepted a graduate teaching assistantship in the Department of Nutrition at The University of Tennessee, and received the Master of Science degree with a major in Nutrition in August, 1970. She is a member of the American Dietetic Association, American Home Economics Association, and Kappa Omicron Phi.

She is married to Joe Stewart Cummings of Nashville, Tennessee.