AN ASSESSMENT OF THE NUTRITIONAL STATUS OF FOUR-TO-SIX-YEAR-OLD CHILDREN IN DAY CARE CENTERS

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BY

PATRICIA C. BROWN, B.S.

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Texas Woman's University

Denton, Texas

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We hereby recommend that the thesis prepared under our supervision by Patricia C. Brown entitled AN ASSESSMENT OF THE NUTRITIONAL STATUS OF FOUR-TO-SIX-YEAR-OLD CHILDREN IN DAY CARE CENTERS

be accepted as fulfilling this part of the requirements for the Degree of MASTER OF SCIENCE.

Committee:

Betty B. Alford
Chairman

Margaret L. Bogle

Irene Shepherd

Accepted:

Mary Evelyn Huey
Dean of The Graduate School

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CHAPTER I

INTRODUCTION

The changing role of women and today's rising cost of living have intensified the need for quality child care services. The number of working mothers has increased more than seven fold since 1940 and has more than doubled since 1950 (27). A 1967 United States Department of Labor study states that there are approximately 4.1 million working mothers with children under six years of age requiring child care services (27). While nutrition is one of the most prevalent factors influencing the growth, health, and well-being of the preschool child, little is known about nutrient intakes and the nutrient requirements of preschool children in group care. Therefore, it seems essential to look at the nutritional status of the preschool child in day care centers.

The overall purpose of this study is to provide descriptive data on the nutritional status of four-to-six-year-old children in child care centers and to determine the percentage of the 1974 Recommended Dietary Allowances (RDA) of the National Research Council being consumed by these children at the centers.

Specific purposes of this study are:

1) To determine the adequacy of the total daily nutrient intakes of four-to-six-year-old children.

2) To assess the individual nutritional status of each preschool child by means of clinical examinations, laboratory analyses of physiological fluids (for the following: serum protein, serum albumin; vitamins A and C, B vitamins; iron--hemoglobin, hematocrit, and serum iron), and selected anthropometric measurements.

3) To provide information from the above data for the development of nutrition education programs in this area (day care centers, parents, and preschool children).

CHAPTER II

REVIEW OF LITERATURE

During the 1950s and 1960s a number of surveys were conducted in developing countries which indicated that preschool children were especially vulnerable to malnutrition and had high mortality rates up to 50 per cent the first five years of life. As a result of these studies and the fact that there was little known of the nutritional status of young children in the United States, Owen et al. (15, 17) and other investigators including the Ten-State Nutrition Survey (TSNS) (24) thought it essential to examine the nutritional status of vulnerable preschool children as well as segments of the population believed to be less likely to experience malnutrition.

Three basic methods were employed by the investigators cited in this paper to determine the nutritional status of groups of children: dietary studies, clinical studies, and laboratory investigations. Each of these methods can be used individually; however, an assessment employing all three methods provides the most comprehensive and reliable estimate of nutritional status.

Food patterns and practices developed in the early years are believed to affect food attitudes and nutritional status throughout life. Dietary studies, essential to any nutrition survey, are used to determine the sources and amounts of nutrients consumed and to obtain evidence of dietary inadequacies or excesses. Basic information which can be obtained from dietary studies is valuable in planning proper changes in nutritional practices. Depending on the objectives of the study, detailed dietary histories or daily diet records (not over one or two weeks) are the methods most often used to collect dietary information. On the other hand, some investigators believe that 24-hour recalls are very valuable especially if they are repeated to reveal daily variations (2).

Owen et al. used a three-consecutive-day diet record in a pilot study (17) and a two-day diet record in his Preschool Nutrition Survey (PNS) (15). McGanity et al. (10) recorded the frequency with which participants were served various foods. Kerry et al. (9) obtained dietary data from three-consecutive-day diet records, whereas Driskell et al. (3) used a 24-hour recall method.

Evidence of nutritional risks were for the most part present among children of lower socioeconomic status in the majority of the studies reviewed. In comparing the intakes of calories and individual nutrients with the Recommended Dietary Allowances of the National Research

Council, the mean daily intake of iron, calories, calcium, vitamin A, and ascorbic acid failed to meet the RDA's.

The PNS (15) concluded that a major nutritional problem of preschool children is insufficient food. The results of the PNS (15) and the TSNS (24) with the exception of ascorbic acid indicate that nutritional quality of the diet correlates poorly with socioeconomic status. Protein intakes were found to be adequate with little difference between age, race, and socioeconomic status (15). Parents do not scrimp in providing protein foods of some kind in their children's diets.

Low income groups received diets higher in iron and thiamin than higher income groups in Lincoln, Nebraska (9). Mean iron and thiamin intakes were significantly higher in the lower income groups. In fact, when comparing the three-day dietaries with the RDA's, the children in the lower socioeconomic group consumed a larger percentage of the RDA's than did the higher socioeconomic group.

The PNS (15) found that cereal grains were the major contributors of iron and calories and contributed less energy as socioeconomic level increased. Kerry et al. (9) also reported that 33 to 42 per cent of iron intakes of preschool children came from the bread and cereal group.

Dietary information revealed that 85 per cent of the higher socioeconomic groups in the PNS (15) were taking vitamin and mineral supplements. Supplements contributed large amounts of vitamins to total intakes. However, in comparing children receiving vitamin supplements with those not receiving supplements in the PNS (15) and Kerrey's study (9), the difference in excretions of water-soluble vitamins was greater than the difference in intakes.

Clinical studies evaluate the physical signs of malnutrition which can be valuable in detecting nutritional deficiencies. In most instances when clinical signs of malnutrition are observed, the deficiency is severe. The clinical exam is a reflection of long-term nutritional status. The most common physical signs indicative of malnutrition are in the areas of the skin, eyes, lips, mouth, tongue, hair, teeth, and skeletal development. Additional observations can be made of the cardiovascular, gastrointestinal, and nervous systems.

Christakis (2) recommends that the following anthropometric measurements be made in the clinical evaluation with preschoolers in assessing nutritional status: weight, standing height, head, chest, and arm circumference, and triceps skinfold. An x-ray of the hand and wrist enables an evaluation of skeletal maturation and the detection of early signs of rickets or scurvy.

The PNS (15) revealed that few children had signs suggestive of specific nutritional deficiency disorders. A physical exam for forty-nine signs of possible nutritional deficiencies performed in a Texas Survey (10) on one thousand preschool children revealed that 2 per cent of the children had abnormal hair color and texture due to possible protein-calorie malnutrition; 2 per cent had enlarged wrists due to possible lack of vitamin D; less than a dozen children showed the end results of rickets; and one was a pellagrin.

Watson and Lowrey (28) state that in any group of measurements body weight is probably the best index of nutrition and growth because it sums up all of the increments in size. However, Jackson and Murthy state that length is a superior criterion, but relative weight for height is better than either value alone (4). Results from the PNS (15) indicate that measurements of height or of weight alone would be as useful as measurements of both. The size of a child reflects many factors including genetic background, nutrition, and serious or prolonged illnesses and accidents.

The Texas Survey (10) gave an indication of from six to nine months of growth retardation in height and weight. The heights and weights followed the lower curve of the Iowa Growth Chart (16^{th} percentile). The fifth percentiles in the PNS (15) and TSNS (24) were also substantially lower than the Stuart-Meredith percentiles (14). The Iowa and Boston growth curves are widely used as reference standards but values in the Iowa Growth Chart came from children of higher socioeconomic families who had had professional nutritional guidance and are assumed to be optimum measurements (4). In the PNS (15) black children were heavier and taller than white children in every age and sex group (except females 4 1/2 to 5 1/2 years). However, white children had greater skinfold thicknesses. Median skinfold thickness measurements in the Texas Survey (10) were about 20 per cent thinner than published American norms.

In x-rays of the hand and wrist the PNS (15) revealed a positive direct relation between socioeconomic status and skeletal maturation in white children. Black children at any age exhibited greater bone equivalent ages than did white children.

Biochemical measurements represent the most objective and precise assessment of the nutritional status of an individual. Laboratory tests can provide information as to the present and long-range nutritional status. Measurement of circulating levels of nutrients in the blood and urine and functional tests are generally used in laboratory surveys. Results from laboratory tests in the TSNS (24) revealed considerable evidence of clinical and subclinical nutritional deficiencies. "Composite surveys reported at the White House Conference on Food, Nutrition and Health revealed similar findings" (2).

Since all nutrients cannot or should not be assessed, laboratory methods are generally used to determine deficiencies in serum protein; the blood-forming nutrients: iron, folacin, vitamin B_6, and vitamin B_{12}; water-soluble vitamins: thiamine, riboflavin, niacin, and vitamin C; vitamin A; certain minerals including iron and iodine; and levels of blood lipids (2).

Serum albumin levels are considered a more reliable index of protein nutritional status than total protein levels (23). On the other hand, some authors state that plasma albumin levels become abnormal only after severe protein deprivation (22). Very few of the PNS (15) children had serum albumins below 3 gm/ml; whereas, 3 per cent of the TSNS (24) black and Spanish American children in the southeastern United States had albumins below this level. There was a tendency for black children on the whole in the PNS (15) to have slightly lower concentrations of albumin than white children.

Investigators have consistently found iron intakes of preschool children to be lower than the RDA's. A deficit of iron usually results in anemia, and the most common method of detecting anemia is a measurement of the hemoglobin level and the hematocrit. However, anemia may be caused by numerous nutritional or non-nutritional factors other than iron. Serum iron levels are better indicators of iron nutrition than hemoglobin and hematocrit (2, 22). Since there is a diurnal variation of serum iron concentration in the blood, specimens should be obtained in the morning.

Kerrey et al. (9) found that preschool children from lower and higher socioeconomic levels had similar hemoglobin and hematocrit values. Hemoglobin and hematocrit values of preschoolers in Nebraska, Iowa, Kansas, and Georgia (3) were mostly within normal ranges, while hemoglobin levels in Louisiana and Texas in the TSNS (24) and in Memphis (30) were below normal. An evident relationship existed between hemoglobin and socioeconomic status in the PNS (15) and the TSNS (24).

Cholesterol levels have important implications in regard to nutritional status, as well as to coronary heart disease and diabetes, and should be included in nutrition surveys. Among nonfasting children in the PNS (15), 90 per cent of the cholesterol values were between 120 and 200 mg/ml with a mean value of 161 (S.D. 35) mg/ml.

Plasma vitamin C and vitamin A vlaues in the PNS (15) and the TSNS (24) revealed a significant difference between blacks and whites in every age group with the white children having higher values. Increasing values were noted as socioeconomic levels increased. Geographically, in the PNS (15) plasma values were higher in the Northeast and the North Central regions than those in the South and West for both vitamin A and ascorbic acid.

Autopsies on a significant number of children in Canada and the United States showed no vitamin A reserves in their livers, the primary storage center of this vitamin (2). Since xerophthalmia is rarely observed in the United States, the significance of these low levels of vitamin A is questionable.

There was a significant difference in the vitamin A levels of children receiving supplements and those not receiving supplements (1). Daily doses of vitamin C in excess of 125 mg resulted in little increase in plasma ascorbic acid, the excess probably being excreted in the urine (15).

Urinary measurements of thiamine and riboflavin are precise, but when concentrations are expressed per gram of creatinine, the excretion of which varies during the day, the significance of the values is reduced. It has been reported by many investigators that urinary levels of these constituents vary widely (15), and supplementation has a definite influence on the levels available for excretion. The PNS (15) found a twofold difference in values of white children versus black children mainly because white children were supplemented twice as often as were black children. However, even in unsupplemented children values for white children were consistently higher than values for black children.

CHAPTER III

PROCEDURES OF INVESTIGATION

The population consisted of eighty-five preschool children in five different child care centers which included an industrial center, a private center, a community center, and two public centers partially supported by Denton County United Fund and Texas State Department of Public Welfare. The sample was divided into the following age groups: four years, 49 subjects; five years, 31 subjects; and six years, 5 subjects. The sample may be further classified as follows: 20 black children and 65 white children. All subjects appeared to be in good health.

Family socioeconomic and past medical history information regarding each subject was collected (appendix 1). Information on vitamin supplementation was also recorded. Because there were substantial socioeconomic differences, the children were divided into four groups using the Warner Index Status characteristics (ISC) (11) for occupation and education. Each of the two status characteristics was rated for each child on a 7-point scale ranging from a rating of "1," very high status value, to "7," very low status value. The ratings were then combined into a single numerical index by assigning each one a weight and gathering a weighted total of separate ratings. This sum was then converted into a prescribed rank: 1, 2, 3, or 4 with group 1 being the highest socioeconomic group and group 4 the lowest socioeconimic group.

Dietary

A dietary interviewer contacted and enlisted the cooperation of each family. Three-day dietary intake records were kept on two different occasions. Food intake data were collected away from the day care centers by the person responsible for feeding the child (in most cases the mother or mother figure) and in the centers by the interviewers. The interviewer instructed each respondent regarding the importance of recording the child's actual food intake according to time of day, place, kind of food, method of preparation, and amount eaten. Written instructions were also given to each family concerning the recording of food intake (appendix 2). Use of meal names were avoided to prevent labeling of meals as such. Rulers, measuring cups, and spoons were provided for each respondent to improve accuracy in recording actual food intake. Recipes were collected for all home-prepared foods.

The interviewers reviewed the intake records, and when there were questions concerning the recording of food items the respondents were contacted for clarification. The diet records were coded according to United States Department of Agriculture Handbook No. 8 (28) and computer analyzed using the USDA Tape.

Clinical

All children were examined by a pediatrician during the same period in which dietary intakes were recorded. The children were weighed and measured for height as well as for head, chest, arm circumference, and triceps skinfold thickness using standardized techniques (16). The Lange skinfold caliper was used in determining skinfolds. Roentgenograms were made of the left hand and wrist and were compared to standards developed by Greulich and Pyle (7). All observations were recorded on examination forms (appendix 3).

Biochemical

Efforts were made by medical technologists to obtain samples of blood and urine from every child; however, in a few cases when the child refused to cooperate, sufficient samples were not collected. Approximately 10 ml of blood were obtained from fasting children by venipuncture. The blood samples were analyzed for levels of hemoglobin, hematocrit, total protein, albumin, ascorbic acid, serum iron, total iron binding capacity (TIBC), cholesterol, and vitamin A. The cyanmethemoglobin method was employed using a spectrophotometer for the determination of hemoglobin (20). A micro-hematocrit method was employed for the hematocrit determination (13). Total protein and albumin were determined colorimetrically by the method described by Saifer and Zymous (20) with a modification of the biuret reagent outlined by Gornall (6). Plasma ascorbic acid concentration was measured photometrically by the method described by Mindlin and Butler (12) with a slight modification suggested by Bessey and King (1). Serum iron and TIBC were determined with the use of a kit developed by Harleco. A simple direct procedure by Pearson et al. (19) was employed to determine the serum cholesterol. This procedure utilizes a modified Lieberman-Burchard reaction. Plasma vitamin A content was measured by a fluorometric technique (5).

The values for the various biochemical analyses were compared to the dietary data and the clinical data. They were also compared to appropriate standards (26, 8) and to values obtained in other studies, particularly the PNS (15) to determine the nutritional status for each subject.

CHAPTER IV

PRESENTATION OF FINDINGS

Assessment of nutritional status of the children was accomplished by means of dietary intake records, biochemical, and clinical measurements. The material presented in this section is based on the sample as a whole, a subdivision of the sample by socioeconomic status, and by age. Sex is considered only in the presentation of certain anthropometric data.

Dietary Findings

Since the minimal requirements for most nutrients for children are not known, values derived from other studies are used for evaluation of dietary intakes. Mean daily nutrient intakes for the group as a whole were calculated and compared to the 1974 RDA's (20), the Ten-State Nutrition Survey (TSNS) (14), and the PNS (15). These data are summarized in table 1. The group exceeded the RDA's for all nutrients except for calories, calcium, and iron. Although mean ascorbic acid intake exceeded the RDA, 11 per cent of the children had intakes below the recommended amount, while 13 per cent of the children had vitamin A intakes below the recommended amount. With the

TABLE 1

DIETARY INTAKES FOR FOUR-TO-SIX-YEAR-OLD CHILDREN

Energy and Selected Nutrients	RDA (20)	TSNS (24)	PNS (15)	Day Care Study
Energy (kcal/day)	1800	1558	1617	1581
Protein (gm/day)	30	23	61	58.3
Calcium (mg/day)	800	450	867	756
Iron (mg/day)	10	10	9.1	8.6
Vitamin A (I.U./day)	2500	2000	3949	3499
Thiamin (mg/day)	.9	.6	.9	.9
Riboflavin (mg/day)	1.1	.9	1.5	1.4
Vitamin C (mg/day)	40	40	64	84

exception of iron, the mean nutrient intakes exceeded those of the TSNS (24); whereas, in comparing the day care group with the PNS (15), there was a significant difference at the .05 level only in their intake of ascorbic acid. According to the minimal dietary intake standards established by Owen et al. (17) in a pilot study in Mississippi, 6 per cent of the children in the present study failed to meet the minimum requirement for calcium (less than 400 mg) while 39 per cent did not meet the requirement for iron (less than 8 mg).

Twenty-nine of the 85 children were taking supplements, the majority of which were multivitamin preparations with iron. Sixty-nine per cent of these children were from the higher socioeconomic ranks 1 and 2.

Mean daily intakes were determined for calories and selected nutrients by socioeconomic rank (table 2). When intakes of each rank were compared, there was a significant difference at the .05 level only for thiamin between groups 1 and 3 and groups 2 and 3. A difference may have existed between groups 4 and 3 but due to the small number of subjects in group 4 this did not appear.

Total vitamin C intakes of preschool children have been reported to parallel family income and socioeconomic status (24, 15), but due to the amount of ascorbic acid contributed by the day care centers this was not true in the present study. There was no significant difference in vitamin C intake in relation to socioeconomic status.

The percentage of the RDA's consumed at the day care centers for calories, iron, and calcium was less than the 1/2 to 2/3 per cent recommended for children in day care for 8 to 10 hours, although the recommended amounts

TABLE 2

MEAN DAILY INTAKES FOR CALORIES AND SELECTED NUTRIENTS BY SOCIOECONOMIC RANK

	Socioeconomic Rank 1*	2	3	4
Number in group	24	30	18	5
Energy (kcal)	1645	1520	1586	1684
Std. Dev.**	(326)	(282)	(326)	(574)
Protein (gm)	60	56	56	67
Std. Dev.	(12.6)	(17.3)	(14)	(20.6)
Calcium (mg)	846	747	685	625
Std. Dev.	(266)	(482)	(171)	(198)
Iron (mg)	8.5	7.9	8.8	11
Std. Dev.	(1.7)	(2.2)	(2.5)	(5)
Vitamin C (mg)	87	72	101	96
Std. Dev.	(36.9)	(32)	(43)	(41.8)
Thiamin*** (mg)	.96	.88	.9	1.3
Std. Dev.	(.22)	(.28)	(.23)	(.71)
Riboflavin (mg)	1.5	1.4	1.3	1.3
Std. Dev.	(.42)	(.67)	(.3)	(.36)

TABLE 2--Continued

	Socioeconomic Rank 1*	2	3	4
Vitamin A				
(I.U.)	4019	3123	3394	3297
Std. Dev.	(1996)	(1185)	(2074)	(1623)

*Group number 1 being the highest socioeconomic group with number 4 being the lowest.

**Standard Deviation.

***F ratio, 2.7948; probability, significant.

were served (figure 1). Lower socioeconomic groups 3 and 4 obtained a larger percentage of their RDA's from food served at the day care centers than did the higher socioeconomic groups 1 and 2. As indicated in figure 1 they also received more calories, vitamin A, vitamin C, and calcium at the centers than they did at home.

The results of this study indicated that little difference existed between children in various socioeconomic groups when considering the average nutritive quality of their diets. These results were largely affected by the nutrients provided by the day care centers.

Clinical Findings

Even though this study included many clinical parameters in the physical examination, very few signs,

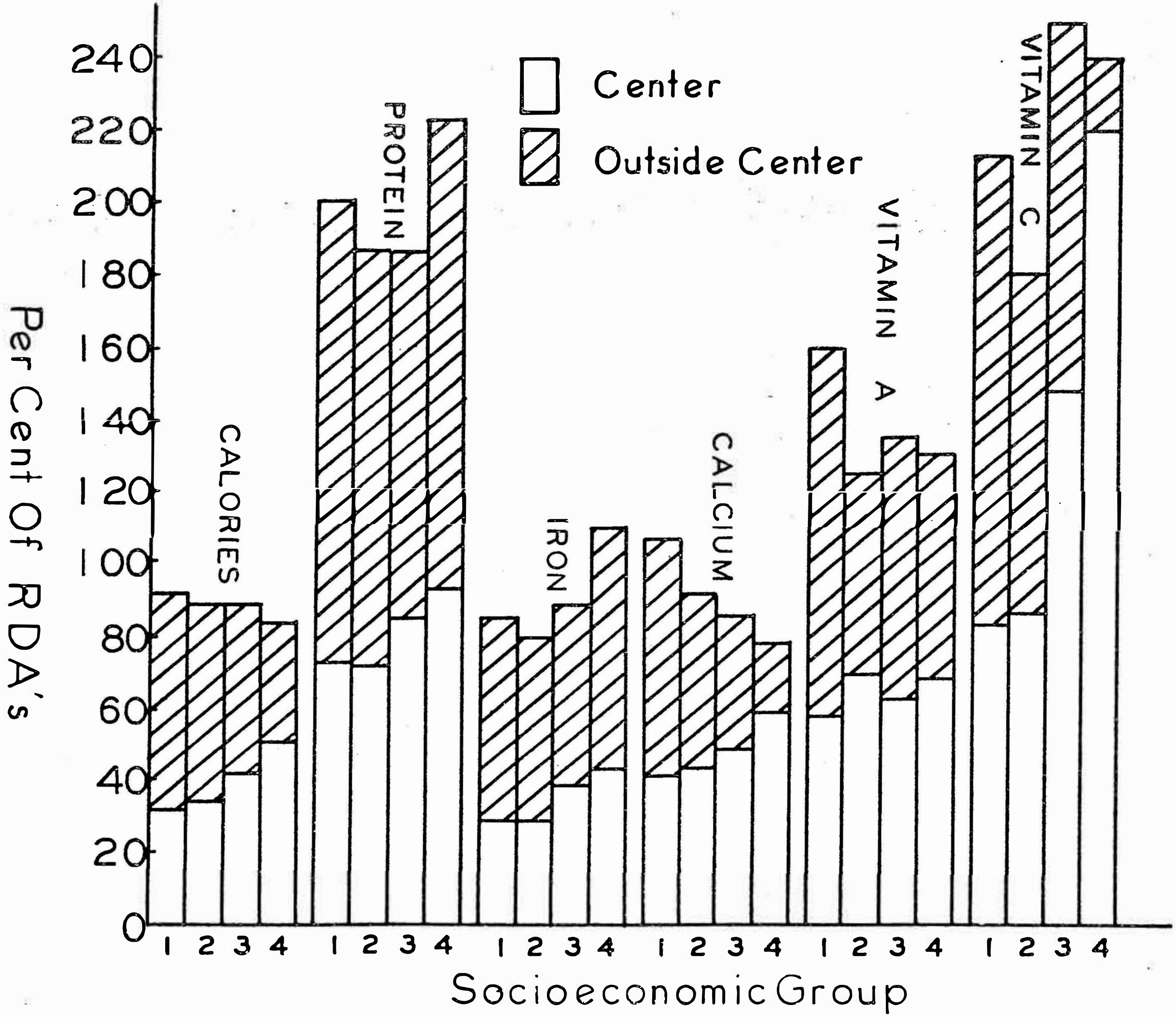

Fig. 1. Per Cent of Selected RDA'S Consumed at the Centers and Outside the Centers by Socioeconomic Rank.

if any, suggested specific nutritional deficiencies. Four of the children appeared to be "anemic" but biochemical data ruled out iron deficiency anemia in any of the children.

The 10^{th}, 50^{th}, and 90^{th} height and weight percentiles were compared to those of the PNS (15) and to the Stuart-Meredith percentiles (figure 2 and figure 3). The weight percentile for girls (figure 3) is skewed upward because it is based on a very small number of subjects. When compared individually to the Stuart-Meredith percentiles, 19 per cent of the subjects fell below the 10^{th} percentile for height and 16 per cent fell below the 10^{th} percentile for weight. Mean height and weight of the subjects in this study fell between the 50^{th} and 75^{th} percentiles of the values in the PNS (15).

Figure 3 demonstrates that the males in the Day Care Study were a little heavier than those in the Stuart-Meredith and the PNS (15) groups. Mean triceps skinfold thickness for the males in this group was 10.7 mm (mean age 59 months), while the females had a mean skinfold thickness of 12.3 mm at a mean age of 56.4 months. The fact that the children in this group are heavier than those in other studies may be an area of concern because of the association of excessive weight with increased

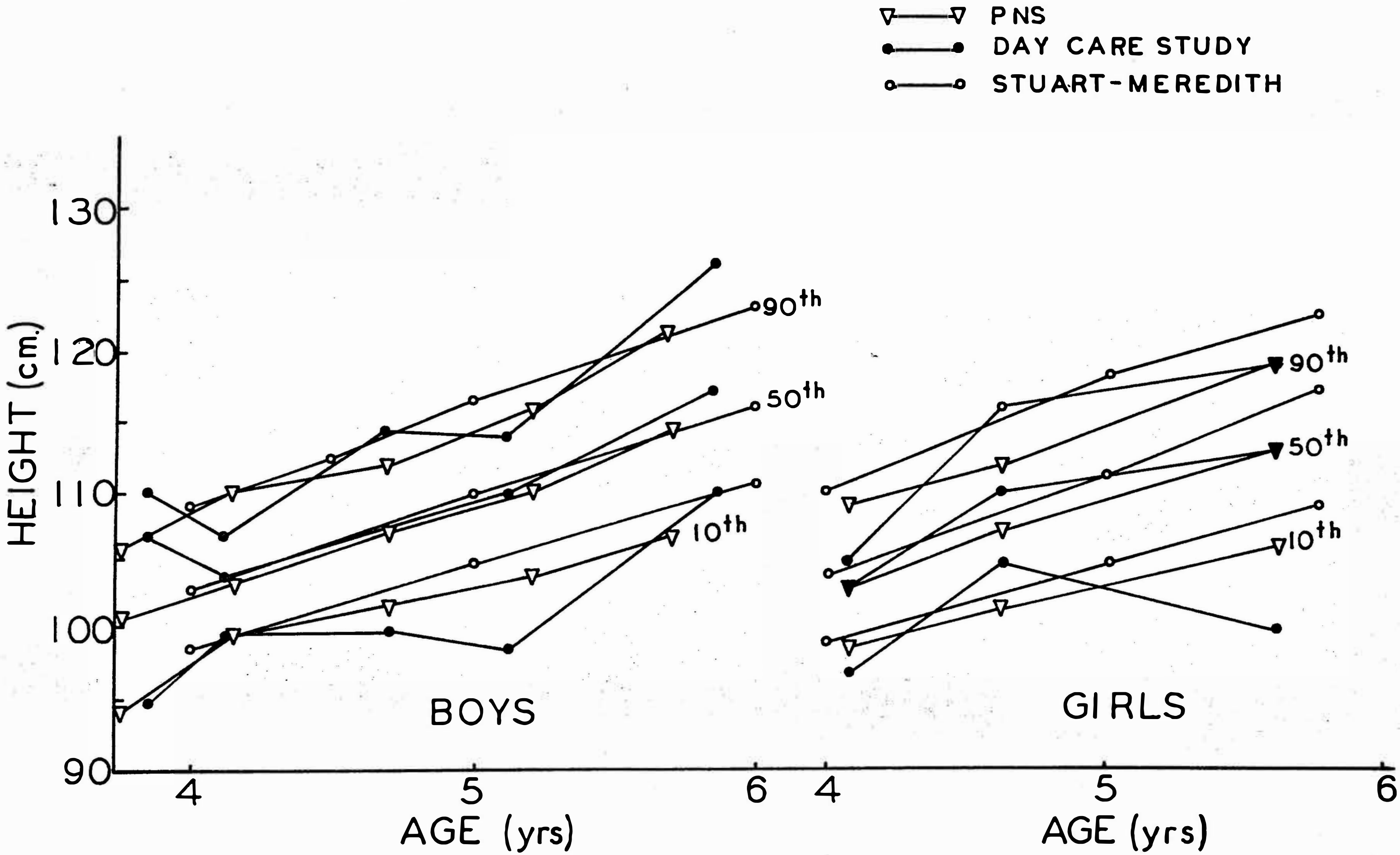

Fig. 2. Height Percentiles of Boys and Girls.

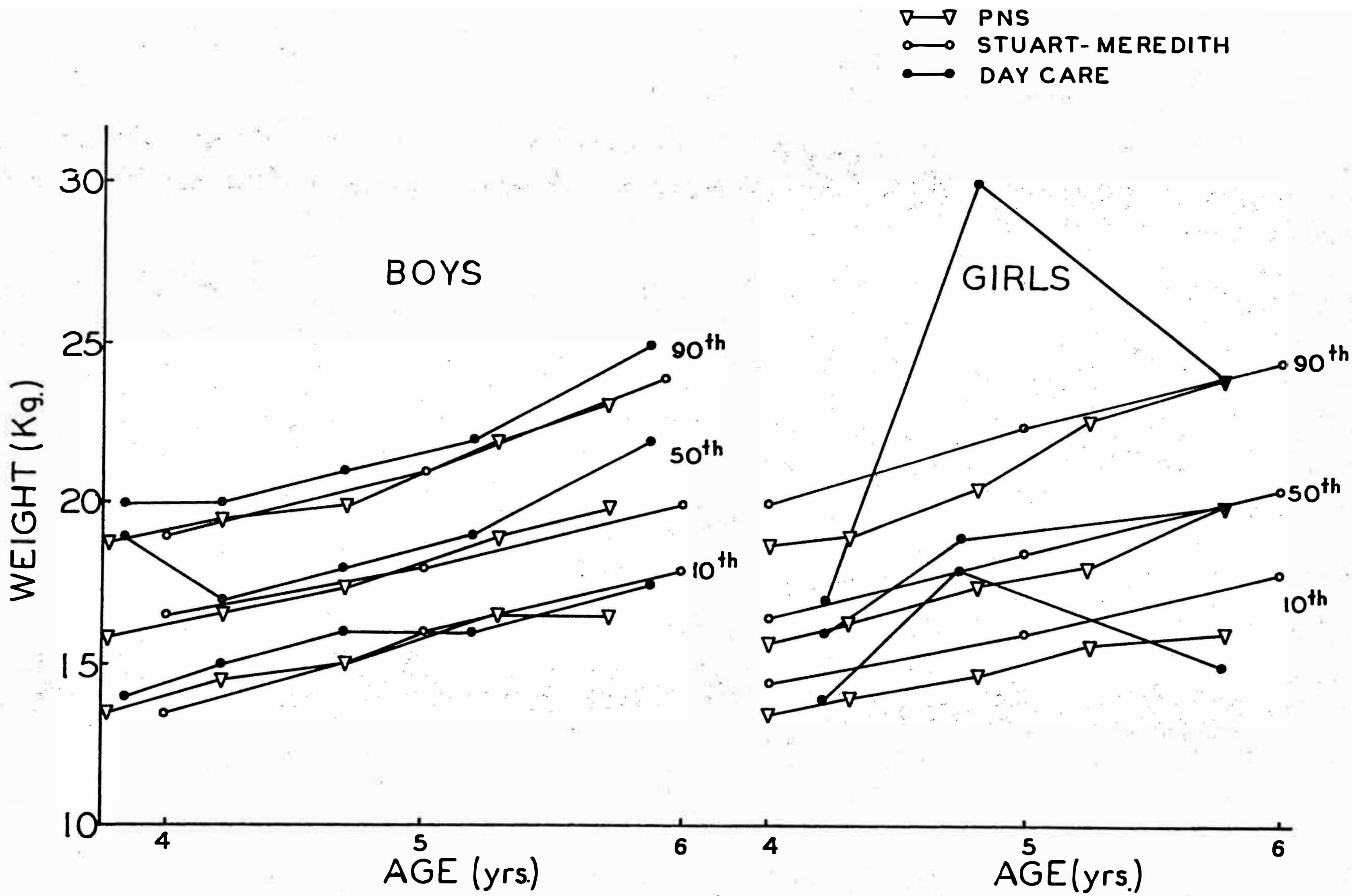

Fig. 3. Weight Percentiles of Boys and Girls.

rates of cardiovascular disease and other chronic illnesses.

According to data in the TSNS (24) mean growth of individuals in the lower income levels appeared to be less adequate than that of higher income levels. The results of the findings in this study are given in table 3. Numbers of children were too small to allow separation by race and sex at age intervals. The trend was toward similar growth achievement for the different socioeconomic groups.

TABLE 3

GROWTH ACHIEVEMENT OF SOCIOECONOMIC GROUPS

	Socioeconomic Rank			
	1	2	3	4
Number in Group	24	31	20	5
Mean Age (months)	59.67	57.09	56.5	53.6
Mean Number of Ossification Centers	24.25	25.19	24.85	26
Mean Height (cm)	110.10	103.59	106.6	105.67
Mean Weight (kg)	19.54	17.67	19.02	17.5

Biochemical Findings

Mean hemoglobin, hematocrit, serum ascorbic acid, serum total protein, serum albumin, serum iron, transferrin saturation, and cholesterol values obtained in this study were compared with the data reported in the PNS (15) and standards (2) established for this age group (table 4). Using a rough approximation of the standard error of the mean, a significant difference was determined between each of the biochemical values in this study and those obtained in the PNS (15) except for hemoglobin. Only one child had hemoglobin concentrations below the acceptable level of 11 gm per 100 ml; two children had transferrin saturation values below the acceptable level of 20 percent; and 11 per cent of the children had albumin values below 3 gm per 100 ml. All of the children either met or exceeded the remaining biochemical variables analyzed in this study.

When the mean biochemical values for the different socioeconomic groups were statistically compared using a one-way analysis of variance, there was a significant difference at the .05 level only in the serum albumin values between groups 1 and 3 and groups 2 and 3. Figure 4 demonstrates the differences of selected biochemical variables in the four socioeconomic groups. The data reported

TABLE 4

BIOCHEMICAL VALUES FOR FOUR-TO-SIX-YEAR-OLD CHILDREN

	Acceptable Levels (2)	PNS (15)	Day Care Study
Hematocrit (packed cell volume in per cent)	34	36.6	40.17
Hemoglobin (gm/100 ml)	11	12.6	12.6
Serum Iron (mcg/100 ml)	40	80	96
Transferrin Saturation (per cent)	20	23.25	36.25
Serum Ascorbic Acid (gm/100 ml)	.2	1.1	1.4
Serum Protein (gm/100 ml)	5.5	6.81	7.04
Serum Albumin (gm/100 ml)	3	3.96	4.62
Serum Cholesterol (mg/100 ml)	<230	162	180

here agree with those of Kerrey et al. (9) who found similar hemoglobin and hematocrit values in groups of preschool children regardless of socioeconomic status. The PNS (15) found a greater percentage of higher albumin levels in the higher socioeconomic groups, whereas in this study the

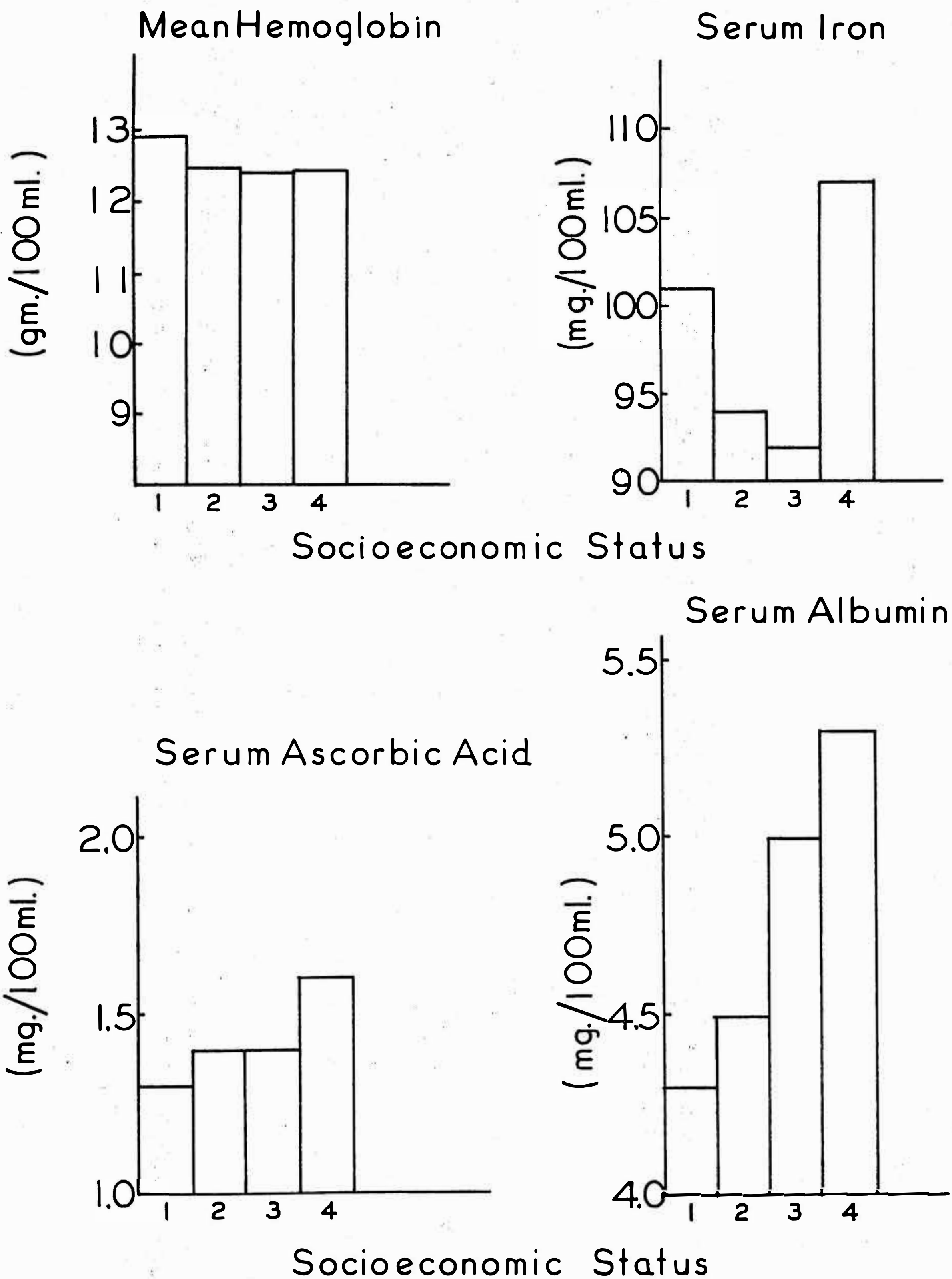

Fig. 4. Differences of Selected Biochemical Variables in the Four Socioeconomic Groups.

trend was toward a greater proportion of higher values being among lower socioeconomic groups (as indicated by figure 4).

The children in the higher socioeconomic groups who were taking vitamin supplements containing vitamin C had a mean serum ascorbic acid value of 1.4 gm/100 ml and those children in the lower socioeconomic groups who were not taking vitamin supplements also had a mean serum ascorbic acid value of 1.4 gm/100 ml. According to Owen et al. (15) a child with a daily intake of vitamin C greater than 30 mg had only one chance in twenty of having an unacceptable plasma ascorbic acid value. It is likely that the children taking vitamin supplements were excreting large quantities of water-soluble vitamins in urine because their mean daily food intakes alone contained more than 30 mg of vitamin C.

The PNS (15) reported lower mean ascorbic acid values of children in the South as compared to those in the North and indicated that socioeconomic circumstances influenced dietary intake of vitamin C and, therefore, plasma ascorbic acid values. This relationship of plasma ascorbic acid values with socioeconomic status was not detected in the children in day care. The plasma ascorbic acid values of this study are compared with those of the

PNS (15) in figure 5. None of the children had serum vitamin A levels below the recommended level.

These results are largely affected by the high percentage of nutrients provided to the lower socioeconomic groups by the day care centers.

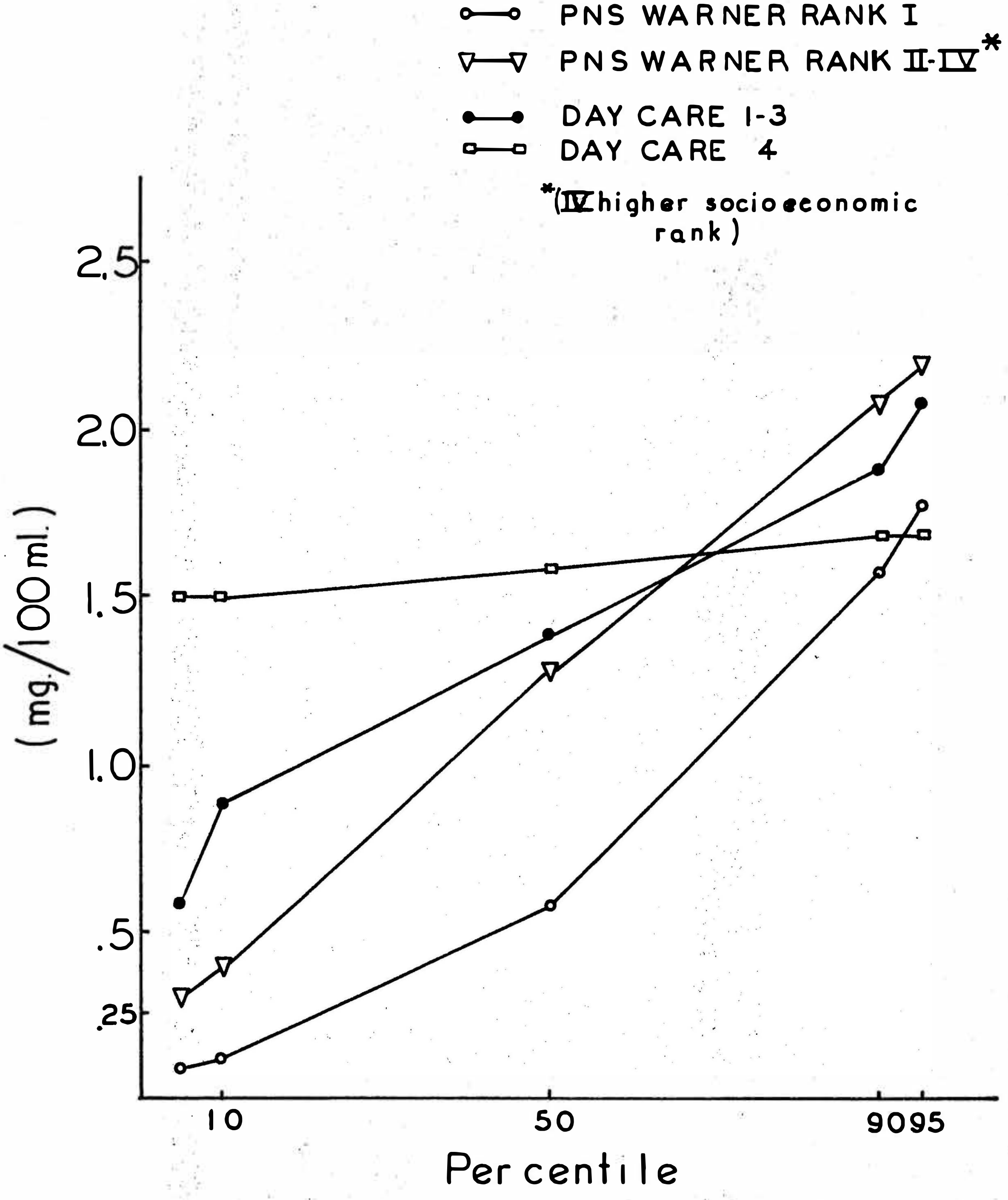

Fig. 5. Distribution of plasma ascorbic acid percentiles of four-to-six-year-old children in the PNS (15) and in the Day Care Study.

CHAPTER V

CONCLUSIONS

The findings of this study indicated that dietary intakes, physical size, and biochemical values of four-to-six-year-old preschool children were similar regardless of their socioeconomic status. This data differs from the findings of the PNS (15) and those of the TSNS (24).

The high percentage of nutrients consumed at the centers enabled every child to meet the RDA's except for calories, iron, and calcium. Since the recommended amounts of these nutrients were also available to the children, this suggests that allowances for these particular nutrients are possibly too high for this age group. Physical size and anthropometric measurements of the children in this study do not support the need for additional calories, nor do the biochemical values for serum iron and transferrin saturation suggest iron anemia. No overt signs of calcium deficiency were revealed from the roentgenograms.

The consumption of multivitamin supplements has been overemphasized through the years. The children in day care were consuming the recommended amounts of vitamins through food alone and biochemical values did not indicate any signs of vitamin deficiencies; therefore, excess amounts provided by supplements were not needed.

The lower socioeconomic groups in this study had higher nutrient intakes and biochemical values than did the children in the lower socioeconomic groups in the PNS (15) and in the TSNS (24) who, for the most part, were not attending day care centers. The nutritional care provided by the centers in this study enabled every child, especially those in the lower socioeconomic groups, to obtain a high nutritional status.

The fact that the lower socioeconomic groups consumed a larger percentage of their total daily nutrients in the day care centers than did the higher socioeconimic groups demands that special consideration be given to food provided in centers serving children of a lower socioeconomic status. As stated previously, the employment of all women, as well as the employment of mothers with preschool children, is expected to continue to rise. This study should provide a degree of assurance to the working mothers that their children will receive quality nutritional services in day care centers.

APPENDIX I

FAMILY INFORMATION FORM

1. Birth weight ____________________

2. Walked at ______________ months.

3. Serious illnessess (diabetes, pneumonia, heart disease, kidney disease, allergies, asthma, other).

Illness	Age at time of illness	None ________
____________________	____________________	
____________________	____________________	
____________________	____________________	

4. Hospitalizations (give age, length of stay, and nature of illness: ____
____
____

5. Is the child ill now? __________. If ill, how? ____________________

6. Is the child taking any medicine now? _______. If yes, what kind of medicine and how often is it taken? ________________________________.
____

7. Does the child take vitamin and/or minerals? __________________________
If answer is yes: How many per day? ___________ Per week ___________.
What kind? (Brand names if known) ________________________________.
Multivitamins __________________ Vitamins A and D ________________.
Vitamin C ______________________ Other ______________________________.
Iron ____________________________.

8. Does the child have any food allergies? ________ If yes, what? _______
____.

9. Is the child on a special diet now? ________________________ If yes, describe the diet ____.
If no, has the child ever been on a special diet? ___________________.
If yes, for what reason ____.

10. Does the child have a ( ) Good appetite
( ) Fair appetite
( ) Poor appetite

11. Does the child drink carbonated beverages (soft drinks), Kool Aid, or Hi C type drinks? ________________. If yes, how many times does he have them:
Soft drinks ________ in a day, ________ in a week.
Kool Aid and others ________ in a day, ________ in a week.

12. Which, if any, of the following meals does the child miss:

	Occasionally	Frequently
Morning meal	____________	____________
Noon meal	____________	____________
Evening meal	____________	____________

13. What are the reasons for the child's missing meals?

	Morning Meal	Noon Meal	Evening Meal
Lack of appetite	____________	____________	____________
Lack of time	____________	____________	____________
Other (specify)	____________	____________	____________

14. Number in household fed: Adults ____________ Children ______________.

15.

FATHER		MOTHER
______________	Height	______________
______________	Weight	______________
	Age:	
______________	Under 18	______________
______________	18-25	______________
______________	26-35	______________
______________	36-over	______________
	Highest level of education completed	
______________	0-3	______________
______________	4-6	______________
______________	7-9	______________
______________	10-11	______________
______________	High school graduate	______________
______________	Years of college	______________
______________	Other types of training	______________
______________	Occupation	______________
______________	Hours worked per week	______________

APPENDIX 2

SUBJECT'S DIETARY RECORD FOR THREE TYPICAL DAYS

Directions:

If possible, everything that the child eats or drinks should be premeasured to get the correct amount that your child does eat or drink. Be sure to list everything that the child eats or drinks away from home other than at the child center. Include snacks and drinks of all kinds and everything else that he puts into his mouth and swallows.

The following information should be helpful in recording the foods eaten:

JUICES: Tell the kind and how much in parts of a measuring cup (1/4 cup, 1/2 cup, 1 cup, etc.)

FRUITS: Tell if canned, frozen, fresh, dried, cooked with sugar added. If fruit was canned, was it canned in thick syrup or water. Tell how many pieces and size (small apple, medium apple, or large apple) or tell how much was eaten (1 small sauce dish - 1/2 measuring cup, 4 rounding tablespoons = 1/2 cup).

VEGETABLES: Tell if canned, frozen, fresh, or cooked with butter or other fat. Tell how much was eaten in rounding tablespoons or in parts of a measuring cup (1/4 cup, 1/2 cup, 1 cup). One small saucer of vegetables = 1/2 cup = 4 rounding tablespoons.

CEREAL: Is it dry or cooked? Tell how much in rounding tablespoons or in parts of a measuring cup. Small, individual boxes of dry cereal have the weight listed on the box - tell this weight. Also, list brand names on cereals.

BREAD: How many slices if bought as sliced bread. If not, tell thickness as 1 biscuit - 2 inches wide or whatever it is.

BUTTER: Tell in level teaspoons. (1 pat = 1 level teaspoon). Be sure to list the butter used on potatoes, bread, or vegetables.

EGG: Tell if it is a whole egg or yolk only. Tell if it is fried, poached, scrambled, or boiled and how many were eaten.

BACON: How many slices - tell if they are long (full length) slices or 1/2 slices.

MILK: Tell what kind - nonfat dry milk, low fat (2%), whole milk, Amount on cereal - tell in parts of measuring cup. If cream is used tell if it is light, medium, or heavy. Milk to drink tell how much in parts of a measuring cup. Cup in all cases means a measuring cup. Tell kind and how much chocolate or other flavorings added to milk (Quick, Instant Breakfast, Hershey's, etc.)

SUGAR: How much in level teaspoons.

SALT: Is extra salt added at the table to most foods _____ yes _____ no?

OTHER FOODS: Tell how much was eaten in terms of cups, tablespoons, teaspoons, or how many pieces.

MEAT, FISH, OR CHICKEN: Weight out cooked portion on scales and tell how many ounces were eaten. One small serving meat or fish = 1 ounce - 2 tablespoons, 1 average serving meat or fish = 3 ounces, 1 large serving meat or fish = 4 ounces. Tell how many pieces of chicken were eaten and tell if they were drumsticks, breasts, thighs, etc. Tell if meat, fish or chicken was fried, boiled, stewed, roasted, baked, broiled. If luncheon meats were eaten, say what kind and how many slices were eaten.

DESSERT: Tell kind and how much was eaten in parts of measuring cup. Where cookies are eaten tell kind and how many eaten.

If mixed dishes or home recipes are used tell major food items in each one (tuna fish and noodles, macaroni and cheese, etc.) List recipes on back of this page. If a sandwich was eaten tell every food item that was included in the making of the sandwich. For example: 2 slices of bread, 2 ounces of ham, lettuce, 1 slice of tomato, 1 teaspoon of salad dressing, etc.

After reading the directions carefully now record the foods that your child eats on the following pages.

Food Intake Record Form

Case No. ____________ Is this a usual day? ____________ Date ____________________

If NO, explain on the back.

Filled out by ____________________________

		Time Eaten	Where Eaten *	Food Item	Description and/ or how cooked	Amount Eaten

Be sure to include extra foods like jelly, syrup, sugar, butter on vegetables, bread, potatoes, candy, soft drinks, and all snacks.

*Use code: H-Home
R-Restaurant
FD-Food dispenser or vending machine
OH-Other ho (of a friend, babysitter, or relative).

APPENDIX 3

PEDIATRIC CLINICAL EXAMINATION	Case No.______ Date of Birth______ Sex______ Name______

A.

Height ______	Head Circumference ______
Weight ______	Chest Circumference ______
Blood Pressure ______	Triceps Skinfold ______

B. General Examination—Code: 0-Negative; 1-Positive, unless other positive codes are designated; 2-Not Applicable

Examination		Doubtful	Code
1. Hair All Neg.	a. Dry staring		
	b. Dyspigmented		
	c. Easily Pluckable		
	d. Abnormal texture or loss of curl		
2. Eyes All Neg.	a. Circumcorneal injection, bilateral		
	b. Conjunctival injection, bilateral		
	c. Xerosis conjunctivae		
	d. Bitot's spots		
	e. Keratomalacia		
	f. Xerophthalmia		
3. Lips All Neg.	a. 1-Angular lesions, 2-Angular scars, 3-both		
	b. Cheilosis		
4. Teeth All Neg.	a. Visible caries 4+		
	b. 1-Debris, 2-Calculus, 3-Both		
	c. Fluorosis		
5. Gums All Neg.	a. Marginal redness or swelling 1-Local, 2-Diffuse		
	b. Swollen red papillae, 1-Local, 2-Diffuse		
	c. Bleeding gums, 1-Local, 2-Diffuse		

B. General Examination—Continued

Examination		Doubtful	Code
6. Tongue All Neg.	a. Filiform papillary atrophy 1-Mild, 2-Moderate, 3-Severe		
	b. Fungiform papillary hypertrophy or hyperemia 1-Mild, 2-Moderate, 3-Severe		
	c. Geographic		
	d. Fissures		
	e. Serrations or swellings		
	f. Red edges		
	g. Scarlet Beefy (Glossitis)		
	h. Magenta		
7. Face and Neck All Neg.	a. Nasalabial Seborrhea		
	b. Parotids visibly enlarged		
	c. Thyroid enlarged 0, 1, 2, 3		
8. Fingers and Nails All Neg.	1-Clubbed, 2-Spooned, 3-Ridged, 4-Combinations		
9. Skin All Neg.	a. Follicular Hyperkeratosis, Arms		
	b. Follicular Hyperkeratosis, Back		
	c. Dry or scaling (Xerosis)		
	d. Hyperpigmentation, Face and hands		
	e. Thickened Pressure Points		
10. Abdomen All Neg.	a. Pot belly		
	b. Hepatomegaly		
	c. Splenomegaly		
11. Lower Extremities All Neg.	a. Pretibial Edema-Bilateral		

B. General Examination—Continued

Examination		Doubt-ful	Code
12. Skeletal All Neg.	a. Beading of ribs		
	b. Bowed legs		
	c. Epiphyseal Enlargement, wrists		
	d. Bossing of skull		
	e. Winged scapula		
13. Impres-sions All Neg.	1-Skinny, 2-Fat, 3-Neither		
	1-Apathetic, 2-Irritable, 3-Both		
14. Heart			
15. Lungs			

Comments:

Date of Examination ____________________

Examiner's name ______________________________

LIST OF REFERENCES

1. Bessey, Otto A., and C. G. King. "The Distribution of Vitamin in Plant and Animal Tissues and Its Determination." The Journal of Biological Chemistry 103 (March 1933):687-92.

2. Christakis, George. "Nutritional Assessment in Health Programs - Supplement." American Journal of Public Health 63 (November 1973):1-82.

3. Driskell, Judy A., and Claudia S. Price. "Nutritional Status of Preschoolers From Low-Income Alabama Families." Journal of American Dietetic Association 65 (September 1974):280-83.

4. Fryer, Beth A., Glenna Lampkin, Virginia M. Vivian, Ercel S. Eppright, and Hazel M. Fox. "Growth of Preschool Children in the North Central Region." Journal of American Dietetic Association 60 (January 1972): 30-37.

5. Garry. P. J., J. D. Pollack, and G. M. Owen. "Plasma Vitamin A Assay by Fluorometry and Use of a Silicic Acid Column Technique." Clinical Chemistry 16 (1970):766.

6. Gornall, Allan G., Charles J. Bardawill, and David M. Maxima. "Determination of Serum Proteins by Means of Biuret Reaction." Journal of Biological Chemistry 155 (March 1949):751-66.

7. Greulich, William W., and S. Idell Pyle. Radiographic Atlas of Skeletal Development of the Hand and Wrist. Standford: Standford University Press, 1959.

8. Interdepartmental Committee on Nutrition for National Defense. Manual for Nutrition Surveys. Washington, D.C.: United States Printing Office, 1957.

9. Kerrey, Elinor, Sharon Crispin, Hazel M. Fox, and Constance Kies. "Nutritional Status of Preschool Children: 1. Dietary and Biochemical Findings." American Journal of Clinical Nutrition 21 (November 1968):1274-1279.

10. McGanity, William J. "Nutrition Survey in Texas." Texas Medicine 65 (March 1969):40-49.

11. McGuire, Carson, and George D. White. "The Measurement of Social Status." Research Paper, University of Texas, March 1955.

12. Mindland, Rawland L., and Allan M. Butler. "The Determination of Ascorbic Acid in Plasma: A Micro and Macro Method." The Journal of Biological Chemistry 122 (August 1933):687.

13. Natelson, Samuel. Microtechniques of Clinical Chemistry for the Routine Laboratory. Springfield: Charles C. Thomas Publisher, 1957.

14. Nelson, W. E., V. C. Vaughn, and R. J. McKay. Textbook of Pediatrics, 9th Ed. Philadelphia: W. B. Saunders Co., 1969.

15. Owen, George M., Kathryn M. Kram, Phillip J. Garry, Jay E. Lowe, and A. Harold Lubin. "A Study of Nutritional Status of Preschool Children in the United States: Supplement." Pediatrics 53 (April 1974):597-646.

16. Owen, George M., Kathryn M. Kram, Phillip J. Garry, Jay E. Lowe, and A. Harold Lubin. "A Study of Nutritional Status of Preschool Children in the United States, 1968-70. Appendices to Report Appearing in Pediatrics 53: No. 4 (April, 1974)." Albuquerque: University of New Mexico School of Medicine, 1974.

17. Owen, George M., Phillip J. Garry, Kathryn M. Kram, Carl E. Nelson, and J. M. Montaluo. "Nutritional Status of Mississippi Preschool Children: A Pilot Study." American Journal of Clinical Nutrition 22 (November 1969): 1444-58.

18. Owen, George M. "Evaluation of Nutritional Status of Preschool Children." Paper, Ohio State University, 1968.

19. Pearson, S., S. Stern, and T. H. McGavack. "Total Plasma or Serum Cholesterol." Journal of Clinical Endocrinology and Metabolism 12 (1952):1245-46.

20. Recommended Dietary Allowances 8th Ed. Washington, D.C.: National Academy of Science, National Research Council Publication 1694, 1974.

21. Saifer, Abraham, and Michall C. Zymous. "Effect of Shaking on the Accuracy of Salt Fractionation Methods for Serum Albumin." Clinical Chemistry 1 (1955):180-89.

22. Sandstead, Harold H., and W. N. Pearson. "Clinical Evaluation of Nutritional Status." Modern Nutrition in Health and Disease. Philadelphia: Lea and Febiger, 1973.

23. Saulberlich, H. E., R. P. Dowdy, and J. H. Skall. CRC Laboratory Tests for the Assessment of Nutritional Status. Cleveland: CRC Press, Inc., 1974.

24. "The Cyanmethemoglobin Method." The American Journal of Medical Science 255 (1948):110-13.

25. United States Department of Health, Education, and Welfare. Screening Children for Nutritional Status: Suggestions for Child Health Programs. Rockville, Maryland: Maternal and Child Health Services, 1971.

26. United States Department of Health, Education, and Welfare. Ten-State Nutrition Survey 1968-1970. 1 - 5. Atlanta: Center for Disease Control.

27. United States Department of Labor. Working Mothers and the Need for Child Care Services. Washington, D.C.: Wage and Labor Standards Administration, Women's Bureau, 1968.

28. Watson, Ernest H., and George H. Lowrey. Growth and Development of Children, 5th Ed. Chicago: Year Book Medical Publishers, Inc., 1967.

29. Watt, B. K., and A. L. Merrill. Composition of Foods--Raw, Processed, Prepared, USDA Handbook No. 8. Washington, D.C.: United States Department of Agriculture, 1963.

30. Zec, P., T. Walters, and C. Mitchell. "Nutrition and Poverty in Preschool Children: A Nutrition Survey of Preschool Children from Impoverished Black Families." Journal of American Medical Association 213 (1970):739.