

**A COMPENDIUM OF NUTRITIONAL STATUS
STUDIES AND DIETARY EVALUATION
STUDIES CONDUCTED IN THE
UNITED STATES, 1957-1967**

by

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A Compendium of Nutritional Status Studies and Dietary Evaluation Studies Conducted in the United States, 1957-1967

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"Nutritional status U.S.A." (1) published in 1959 summarized the results of regional nutrition studies carried out in the United States from 1947 through 1958 and reported in 178 publications. The studies were sponsored by State Agricultural Experiment Stations, the United States Department of Agriculture (USDA), and several state departments of public health. Children from the ages of 5 through 12, adolescents from 13 to 20, and adults from 20 to past 80 years were examined. About 4000 in each of these three age groups were studied in 39 of the 48 states. Usually 7-day records of food eaten were obtained, also physical examinations and biochemical analyses of blood and urine samples. Sometimes dental examinations and X-rays of bones and teeth were made.

The nutritional status of the people of the USA on the whole was reported in that bulletin to be good by standards for Recommended Dietary Allowances of nutrients set up by the National Research Council in 1958 (2). Good average intakes of any population groups, however, will conceal poor nutrient intakes by some individuals. The nutrients most often found to be lower than the recommended amounts in the diets of children and adults in all regions were vitamin A, ascorbic acid, calcium, and iron. The first three nutrients were the same ones reported to be low in the 1955 USDA Household Food Consumption Survey (3). Both reports indicated that there was a lower intake of protein foods, milk, fruits, and vegetables by Southern families as compared with the other three regions. Rural low income families had diets containing the lowest nutritive value.

The blood analyses, in general, correlated well with the information from the dietary observations reported in the 1959 bulletin (1). Although clinical signs of

nutritional deficiencies occurred more frequently in the groups with low blood levels of vitamin A and ascorbic acid than in those with satisfactory blood levels, these signs did not always correlate with records of dietary intake. The hemoglobin content of the blood of nearly all the people examined was fair to excellent, and the concentrations of vitamin A and ascorbic acid in the blood serum were generally fair to good. More adolescent girls were overweight than underweight, and more adolescent boys were underweight than overweight, in nearly every group studied. The Spanish-American and Arizona Indian children had lower average heights and weights than other Western children except that the Indian girls tended to be overweight. A high percentage of older people were overweight.

Recently, it has been pointed out in newspapers and other popular communication media that there is a considerable amount of malnutrition in the United States, particularly in certain areas of the population. In 1968 a report entitled "Hunger, U.S.A." was published by the Citizens' Board of Inquiry into Hunger and Malnutrition in the United States (4). The largely subjective report concluded that an emergency situation exists in many parts of the United States in terms of hunger and malnutrition.

A report of the preliminary findings of the nationwide survey of food consumption of 7500 households made by the USDA in the spring of 1965 (5) was also released in 1968. Homemakers were asked to recall food consumed by the family for the 7 days preceding the interview. Amounts of food used in the households were sufficient, on the average, to provide the Recom-

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mended Dietary Allowances set by the Food and Nutrition Board of the National Academy of Sciences — National Research Council for calories and seven nutrients (2). Only one-half the households had diets that were classified as "good": that is, diets that provided the recommended allowances for calories and seven nutrients. About one-fifth the households had diets that were considered "poor," in that they supplied less than two-thirds of the recommended allowances for one or more nutrients. In comparison, in the 1955 Household Food Consumption Survey (3), 60% of the households had "good" diets; 15% had "poor" diets. In both surveys, the nutrients most often in short supply were calcium, vitamin A, and ascorbic acid. In the 1965 survey the proportions of households with diets containing less than the recommended allowances for one or more nutrients were comparable in the Northeast, North Central, South, and West. The number of urban and rural households having diets containing below the recommended allowances for one or more nutrients was approximately the same. At each successively higher level of income, a greater percentage of households had good diets, but high income alone was no assurance of a good diet.

Because of the great concern aroused by some of the recent reports and the need to update our knowledge, the present survey of the literature covering nutritional status and dietary evaluation studies carried out between 1957 and 1967 was undertaken. The objectives were to determine where studies have been conducted recently, to what extent there is evidence as to the prevalence of malnutrition in this country, and where the major gaps in our information are. Studies reported in the 1959 bulletin (1) are omitted.

During the past decade alone, approximately 50 published nutritional status studies involving approximately 30,000 people in the United States, the Virgin Islands, and Puerto Rico included some sort of clinical or biochemical evaluation. The numbers studied in the different age groups were: 4625 infants and preschool children; 2958 children; 8114 adolescents; 5948 pregnant women; 1476 adults; 1587 older people; 5301 individuals in families;

35 families; and children in eight Indian boarding schools.

Approximately 60 published studies involving over 30,000 people have included some type of dietary study. The numbers studied in the different age groups were: 8756 infants and preschool children; 2871 children; 4568 adolescents; 1240 pregnant women; 3685 adults; 1379 older people; 5721 families; and children in eight Indian boarding schools.

These studies are reviewed and the findings summarized in the following sections and in figures 1 through 3 and tables 1 through 5.

*Summary of studies involving
biochemical or clinical
evaluations, 1957-1967*

Height and weight

Height and weight in relation to age and sex have long been used as criteria of the state of nutrition. Height and weight standards frequently used for children are the Harvard growth charts (6, 9) and the Iowa growth charts (7). These charts can be found in Nelson's *Textbook of Pediatrics* (8) and they reflect the growth of Caucasian children of predominantly middle-class origin. The Harvard growth charts contain height-weight data collected by Reed and Stuart (6, 9) from 134 children from birth to 18 years of age beginning in 1930. The Iowa growth chart data were collected by Stuart and Meredith (7) between 1930 and 1945 and are based on 3771 measurements of Iowa children from 5 through 18 years of age. The Baldwin-Wood tables (10) were published in 1923 and were compiled from records of 74,000 boys and 55,000 girls from 5 to 19 years of age from 12 schools in the Northwestern and North Central States. Wetzel (11) used height-weight-age data to construct a grid to represent the physical status of growing children. Falkner standards (12) represent a collection of data on children from birth to 18 years of age compiled from many different sources.

The Seltzer and Mayer tables (13), for obesity standards in Caucasian Americans from 5 to 50 years of age, give minimum triceps skin-fold thickness by which to measure obesity. Behnke (14) has out-

lined a quantitative classification of body build for males and females, age 14 to 93 years, which is based on 11 circumferences and 8 diameters.

Tables from the Medico-Actuarial Mortality Investigation published in 1912 (15) contain data from 221,819 men and 136,000 women taken around 1900. Davenport's charts (16) are actually the tables from that investigation. In 1942, the Metropolitan Life Insurance Company (17) published a proposed range of "ideal" weights for women, age 25 and over, according to body build. The Society of Actuaries tables (18) were prepared from the Build and Blood Pressure Study in 1959. Average heights and weights were computed from a sample of 290,000 men and 70,000 women. The Metropolitan Life Insurance Company tables of 1959 (19) were derived primarily from the data of that study. The tables of Halpern et al. (20) are those prepared by the Metropolitan Life Insurance Company. Weights in table 80 of the USDA report (21) on adult heights and weights are those of the American College Health Association. Master et al. (22) present height-weight tables from the age groups 65 to 94 years. Data were obtained on 2925 men and 2694 women.

Puerto Rican standards (23) are based on height and weight measurements of 1800 private school children in San Juan. Canadian height and weight standards used for comparison in the Interdepartmental Committee on Nutrition for National Defense (ICNND) study of Alaska are based on data from 22,000 Canadians from 2 to over 65 years of age (24).

Height and weight data of subjects studied in the past decade are arranged by age group in table 1.

Infants and children. Height and weight measurements were made on over 2000 children from Caucasian, Negro, and other ethnic groups from low income families in South Carolina (2), Maryland (26), Alabama,¹ Vermont (28), Florida (30), Mississippi (31), Massachusetts (32), New York (33), and Puerto Rico (34-39); on Arapahoe and Shoshone Indians on the Wind River Reservation in Wyoming (29); on children of Eskimos and Athabascan Indians of Alaska (40); on children of the

Blackfeet (41) and Fort Belknap (42) Indian Reservations in Montana; and on children of professional and semiprofessional parentage in Southwestern Ohio (43).

Normal heights and weights were reported for the children in Alabama,² Vermont (28), New York (33), and Ohio (43). Body weights of 18 out of 36 infants studied in South Carolina (25) were below the 25th Harvard percentile (6, 9). Children in Maryland (26), Florida (30), and in six communities in Puerto Rico (34-39) had average body weights and heights below the standards published by Stuart (8). Twenty-five to 59% of the children, 9 to 13 years of age in the Roxbury section of Boston, Massachusetts (32), were in the 25th percentile and under for both height and weight (6). Heights of 19% of the children from two counties in Mississippi (31) were below and 13% were above the range between the 5th and 95th percentile for their age when compared with Falkner's physical growth standards (12); weights of 4% were below the 5th percentile and 18% were above the 95th percentile. In two studies it was reported that the Negro children were taller than the Caucasian children (26).³

The Arapahoe Indian children were similar in height and weight to Caucasians, but the Shoshone children were shorter and lighter (29). Northern Eskimo and Athabascan Indian children (40) were similar in heights and weights to Canadians (24), but Southern Eskimos were shorter. Heights and weights of Blackfeet (41) and Fort Belknap (42) Indian children were comparable to those of Caucasian children according to the Iowa growth charts (8) until age 4; after that they were above the averages on the Iowa charts.

Adolescents. Dreizen et al. (44) reported that although undernutrition retarded skeletal growth and maturation, postponed menarche, and extended the length of the growth period, there was no significant distinction in adult stature between a group of 30 undernourished girls and a group of 30 well-nourished girls

¹ Cloud, H. H. 1967 Heights, weights, triceps skinfold measurements, hematocrits, and dietary intake of 4-year-old children in day care centers and at home in Birmingham, Jefferson County, Alabama. Thesis, Department of Nutrition, Graduate School of the University of Alabama, University, Ala.

² See footnote 1.

³ See footnote 1.

studied in Alabama from early childhood to early adulthood. Plough et al. (35) and Fernandez et al. (36-39) indicated that though heights of Puerto Rican children were below those of American standards (8), there was a tendency to "catch up" during adolescence.

Girls, 12 to 14 years of age, in Indian boarding schools in the Dakotas (45) were of stockier build than non-Indian girls of like age. In a study of children in three junior high schools in Syracuse and Onondaga County, New York, a greater proportion of the children in one predominantly Negro school were classified as moderately short (46). Hodges and Krehl (47) reported heights and weights for Iowa teenagers which were substantially higher than those in the University of Iowa height and weight tables prepared in the 1940's (7).

Obesity, as determined by the triceps skin-fold method (13), was observed in 15 to 20% of the adolescents studied in Massachusetts (48, 49) and Vermont (52). Approximately 15% of those studied in California (53) were judged obese when the "body envelope" method was applied (14). Of 1500 adolescents in Pennsylvania (49) 6% of the males and 8% of the females were moderately overweight; 5% of the males and 10% of the females were markedly overweight. Most of the subjects

Masas had satisfactory body weights in general. Adult Southern Eskimos were shorter and lighter than the Canadian population (40). Adult Northern Eskimos were shorter and heavier than Canadians. Adult Athabaskan Indians were close to Canadians in height, but weighed less. Gross overweight was most prevalent in Northern Eskimo women, in women in Athabaskan Indian villages, and in young Southern Eskimo women. Heights of adults on the Blackfeet and Fort Belknap Indian Reservations (41, 42) in Montana were similar to U.S. standards (18).

A total of 1344 adults over 50 years of age was studied in New York (56), Ohio (57), Virginia (58), Massachusetts (59), California (60), and Nebraska (61). Among the segments of the older population studied, overweight was noted in from 20 to 68% and underweight in from only 10 to 20%. In only one study, in Nebraska (61), was the percentage of underweight (47%) higher than the percentage of overweight (6%).

Protein nutrition

The guide for interpreting dietary, clinical, and biochemical data published by the Interdepartmental Committee on Nutrition for National Defense (62) suggests the following standards for blood proteins:

	<i>Deficient</i>	<i>Low</i>	<i>Acceptable</i>	<i>High</i>
Total plasma protein, g/100 ml	< 6.0	6.0 -6.4	6.5 -6.9	≥ 7.0
Serum albumin, g/100 ml	< 2.80	2.80-3.51	3.52-4.24	≥ 4.25

in these studies were Caucasians from the middle or upper-middle income class.

Adults. The same percentage (16%) of young adult female students in a school for dental hygienists in Boston were overweight as were underweight (54). College women of Asian ancestry were leaner than Caucasian women.⁴ The mean heights of male and female Oklahoma and Florida Seminole Indians were significantly less than those of their white counterparts; mean weights, when corrected for height, were significantly greater than those of the Caucasian subjects (55). Adults in the Puerto Rican communities of Manzanilla (35), Mavilla (36), Naranjo (37), Duey Alto (38), and Masas (39) had mean body weights below the average for the United States, although adults in Duey Alto and

A normal serum globulin of 2.3 to 3.5, albumin of 3.9 to 4.5 (electrophoretic analysis), and total protein of 6.5 to 7.5 g/100 ml for infants are listed in Nelson's *Textbook of Pediatrics* (8). Serum albumin was 1.80 g/100 ml in those with severe protein deficiency (kwashiorkor), 3.15 g/100 ml in those with marginal protein deficiency, and 3.84 g/100 ml in repleted kwashiorkor patients as classified by Schendel et al. (63).

The method of estimating protein nutrition by the ratio of urea nitrogen to creatinine in urine has been used successfully for nutrition surveys of pregnant women in Central America (64). The av-

⁴ Clark, J. K., and S. Margen 1967 Body fat, diet, and physical activity of Oriental college women. Fiftieth Annual Meeting of the American Dietetic Association, Chicago (abstract).

erage ratios of urea nitrogen to creatinine for pregnant women in Chimaltenango and Guatemala were 5.91 and 6.59, respectively.

Serum amino acid ratios of 2.0 or more have been associated with signs and symptoms of protein-calorie malnutrition. The amino acid ratio in the serum is determined by a paper chromatographic tech-

Anemia

The most common methods used for assessing the presence of nutritional anemia in a population are by the determination of hemoglobin level and red blood cell volume.

The ICNND (62) has issued the following guide for use of these two parameters in nutritional status evaluation:

	<i>Deficient</i>	<i>Low</i>	<i>Acceptable</i>	<i>High</i>
Hemoglobin, g/100 ml				
Men	< 12.0	12.0-13.9	14.0-14.9	≧ 15.0
Women	< 10.0	10.0-10.9	11.0-14.4	≧ 14.5
Children, 3 to 12 yr	< 10.0	10.0-10.9	11.0-12.4	≧ 12.5
Hematocrit (PCV), %				
Men	< 36	36 -41	42 -44	≧ 45
Women	< 30	30 -37	38 -42	≧ 43
Children, 3 to 12 yr	< 30	30.0-33.9	34.0-36.9	≧ 37.0

nique which identifies the essential amino acids leucine, isoleucine, valine, and methionine in the denominator, and the nonessential amino acids glycine, serine, glutamine, and taurine in the numerator (65). It has been observed that under conditions of protein deficiency, the essential serum amino acids are reduced in concentration; the nonessential ones remain almost unaffected.

In the few studies which have involved any biochemical analysis of protein nutritional status, there was an indication that protein malnutrition is not extensive in the United States, but does exist in some of the population with lower income levels. The results of such studies are tabulated according to age in table 2.

A high percentage of protein malnutrition in infants was reported in one study in South Carolina (25). One case of kwashiorkor was reported in Florida (30) and four cases in Louisiana (66). Only a small percentage of adolescents studied had biochemical indications of low protein nutrition (33, 47). That protein nutrition may be of concern during pregnancy was pointed out by Taylor and Swartwout (67). In Puerto Ricans (35-39) serum levels of protein were usually adequate except in infants and children. Low serum albumin levels were noted in subjects in Manzanilla (35) and Masas (39). Serum protein levels were high in Alaskans (40) and were normal in the Blackfeet (41) and Fort Belknap (42) Indians.

Variation in hemoglobin levels with age is most marked under 3 years of age. Graphs showing variation of hemoglobin levels throughout life are presented on page 240 of the ICNND manual (62). Hemoglobin concentrations in pregnant women normally show variations which change with the different phases of pregnancy. These levels are given on page 236 of the ICNND manual (62).

Other hematologic data frequently obtained in a nutritional status survey include red blood cell count, mean corpuscular erythrocyte volume, mean corpuscular hemoglobin concentration, and mean corpuscular hemoglobin content.

Values for these parameters in men and women as compiled by Altman and Dittmer (69) from various references are given in the following table:

	<i>Men</i>	<i>Women</i>
Erythrocyte count, million/mm ³ blood	4.6- 6.2	4.2- 5.4
Hematocrit (PCV), %	47	42
Mean corpuscular volume, μ ³	87	87
Hemoglobin, g/100 ml	14.0-18.0	11.5-16.0
Mean corpuscular hemoglobin concentration, g hemoglobin/100 ml erythrocytes	33.5	33.5
Mean corpuscular hemoglobin, pg	29	29

Ranges of values for the above parameters which were taken from various studies and tabulated for age from birth to 14 years are also included in the above reference (69).

Plasma iron concentration, total iron-binding capacity, estimation of hemosiderin in bone marrow, and absorption of labeled iron have been used in evaluating iron status, but some of these methods are not practical for use in a survey-type study.

Beutler et al. (70) have reported normal plasma iron levels ranging from 70 to 175 $\mu\text{g}/100\text{ ml}$ and total unsaturated iron-binding capacity of 100 to 300 $\mu\text{g}/100\text{ ml}$. In iron deficiency, values of less than 50 μg iron/100 ml and over 450 $\mu\text{g}/100\text{ ml}$ iron-binding capacity are found.

Rath and Finch (71) found estimation of hemosiderin in bone marrow to be a good index of body reserves of iron, whereas hemoglobin is not.

Bothwell et al. (72) reported that the average absorption by normal subjects of a tagged test meal containing 16 mg iron was 5.3%, and variation was from 0.5 to 16.6%.

In the past decade, iron nutritional status has been studied by the determination of hemoglobin concentration, or hematocrit, or both, in about 4500 infants and preschool children, 1500 children, 2500 adolescents, 1000 adults, 400 older people, over 5000 pregnant women, and 3000 individuals in families. Details of studies of iron nutritional status are given in table 3.

Anemia in infants and preschool children is usually defined as the condition existing when the concentration of hemoglobin is less than 10 g/100 ml blood. In studies of infants admitted to hospitals in Chicago (75), St. Louis (76), and Columbus, Ohio (77) the incidence of anemia was 44, 30, and 25%, respectively. Infants studied from Child Welfare Stations in Chicago (81), children from 2 months to 5.5 years of age in Child Health Centers in Washington, D. C. (79), children from 6 months to 3 years of age in Child Health Conference sites in Allegheny County, Pennsylvania,⁵ and preschool children in Child Health Stations in New York City (80) had an incidence of anemia of 76, 29, 16 and 19%, respectively, when

status was assessed according to the above method.

In the Indian village of Acomita, New Mexico (78), 50% of the children studied under 2 years of age, 15% of those 4 years of age, and 10% of those 5 years of age showed hypochromic indices. A mean corpuscular hemoglobin concentration below 32% was defined as hypochromic. Twenty percent of the Negro children and 5% of the Caucasian children 4 years of age, in an early school admissions project in Baltimore, Maryland, had hematocrits of 33% or below, requiring diagnostic steps for the child (26). Four-year-old children in day care centers in Birmingham, Alabama were compared with children staying at home; 23% of both groups had hematocrits lower than 33.9%.⁶

The incidence of anemia varied with the ages of the children studied, being highest in those under 2 years of age. The incidence was higher in Negro children than in Caucasian children in three studies (26, 77),⁷ but there was little difference in the rate of occurrence in Caucasians, Puerto Ricans, and Negroes in one New York City study (80). Anemia was noted in the children of Negro migrant workers (30). Anemia did not appear to be much of a problem in children over 3 years of age and in adolescents (29, 32, 33, 45, 47, 49, 50, 82), except in Negro females (46).

Iron stores were scant or absent in two-thirds of 114 college women studied in Texas (83) as evaluated by amount of marrow stainable iron, and were borderline or fair in 8 of 12 university women in Washington (84), as determined by increased absorption of administered iron. Hemoglobin levels of subjects in both studies were normal. Only one borderline case of anemia was indicated by hemoglobin levels of 40 college women of Asian ancestry.⁸ Hemoglobin concentrations were comparable in Caucasian men and women in Oklahoma and in Seminole Indian men and women in Oklahoma and Florida (55).

Approximately 20% of the pregnant women studied had less than 10 g hemo-

⁵ Danneker, D. 1966 Study of hemoglobin levels of children attending Child Health Conferences, Allegheny Health Department, Pittsburgh, Penna., unpublished report.

⁶ See footnote 1.

⁷ See footnote 5.

⁸ See footnote 4.

globin/100 ml (85, 86). Serum folate values were also low in anemia of pregnancy (85, 87).

Moderate anemia of the hypochromic type was common in women and children in five areas of Puerto Rico (35-39). In Alaskans (40), mean hemoglobin levels and hematocrits were within the normal range. The average hemoglobin and hematocrit levels in all age groups for both sexes in the Blackfeet (41) and Fort Belknap (42) Indians were adequate.

Hematocrits were low for 43% of one group of elderly people (56) and for 5% of the men and 13% of the women in another group of elderly people (88) studied in New York.

Vitamin nutritional status

Clinical methods of identifying vitamin deficiencies are discussed in the ICNND Manual (62). The gingivitis of scurvy can be recognized by swollen, red, and bleeding gums, although other components of gingivitis cannot be directly related to a single specific deficiency state. Marginal gingivitis may or may not be related to ascorbic acid nutrition. Xerophthalmia and keratomalacia of the eye are evidences of severe avitaminosis A and occur most commonly in infants and young children. The presence of Bitot's spots is not a specific sign of avitaminosis A, but the spots sometimes do occur in quite young children in association with a deficiency of the vitamin. Follicular hyperkeratosis may be related to a deficiency of vitamin A also. Neurologic signs and bilateral edema of the lower extremities with or without detectable edema elsewhere may be due to a deficiency of thiamine. A deficiency of thiamine also leads to loss of vibratory sense and of ankle and knee jerk and to motor weakness. Bilateral circumcorneal infection and nasolabial seborrhea may reflect a deficiency of riboflavin. Cheilosis or angular lesions, or both, and a red, painful tongue with denudation of the epithelium, with or without fissures, may result from a lack of riboflavin. Nasal seborrhea, a red and painful tongue with denudation of the epithelium, and with pellagrous dermatitis indicate a niacin deficiency. Hyperpigmentation of hands and face may reflect niacin lack.

Biochemical and clinical evidences of vitamin deficiencies in the United States are relatively rare. The incidence of scurvy and rickets in the U. S., in the period 1956 to 1960, was reported to be 1 in 3300 and 1 in 2791, respectively, in infants and children admitted to hospitals with approved residency programs in pediatrics (89). Browning and Northcutt (30) reported some evidence of scurvy and rickets among children of Negro migrant families in Florida, but included no definitive information.

It is very difficult to identify clinical symptoms and to relate them with any certainty to a vitamin deficiency. It is desirable to attempt to correlate clinical signs of deficiency with biochemical and dietary data. In a study of 642 New York City school children (90), about 5% showed clinical signs which may have been caused by vitamin deficiencies. The serum vitamin levels of these children, however, did not differ from those of children without symptoms of deficiency.

Clinical signs of hypovitaminosis were reported for 38% of 120 hospital patients in New Jersey (68); however, there was no correlation between the presence or degree of hypovitaminemia and clinical signs of vitamin deficiency. Of 332 children studied in Boston (32), it was reported that 62% had acute gingivitis, 52% had dry, scaling skin, 25% had follicular keratosis, 25% had tongue involvement, 13% had eye signs and 15% had bow legs. No attempt was made to correlate these findings with vitamin levels in blood and urine. Ten percent of the Navajo students at Intermountain Indian School, Brigham City, Utah reportedly had gingivitis (93). White cell-platelet ascorbic acid values were significantly lower for students with gingivitis than for the control group. Seventy-two percent of the children in Dona Elena, Puerto Rico were reported to have gingivitis, 63% had angular lesions or scars of the lips, and 13% had nasal seborrhea. These signs were even more prevalent in the adults. No biochemical assays, however, were made in an attempt to determine if these findings were the results of dietary deficiencies. In Mavilla (36) and Masas (39), Puerto Rico, there was considerable presence of follicular hyperkera-

tosis and skin xerosis among subjects. Thirty-nine percent of the subjects in Mavilla (36) had low serum vitamin A and 16% had low serum carotene levels, but there was not a high incidence of low vitamin A and carotene levels in plasma of subjects in Masas (39). No clinical signs of malnutrition were noted in Alaskans (40), except for Bitot's spots observed in the primitive village of Newktok. Inhabitants of Montana Blackfeet (41) and Fort Belknap (42) Indian Reservations showed no clinical evidences of nutritional deficiency.

The ICNND has constructed a suggested guide to interpretation of blood and urinary vitamin content (62). The suggested guide for adults is given below:

	<i>Deficient</i>	<i>Low</i>	<i>Acceptable</i>	<i>High</i>
Plasma ascorbic acid, mg/100 ml	< 0.10	0.10- 0.19	0.20- 0.39	≥ 0.40
Plasma vitamin A, μg/100 ml	< 10	10-19	20-49	≥ 50
Plasma carotene, μg/100 ml	*	20-39	40-99	≥ 100
Red cell riboflavin, μg/100 ml red blood cells	< 10.0	10.0 -14.9	15.0 -19.9	≥ 20.0
Urinary thiamine, μg/g creatinine	< 27	27-65	66-129	≥ 130
Urinary riboflavin, μg/g creatinine	< 27	27-79	80-269	≥ 270
Urinary N ¹ -methyl-nicotinamide, mg/g creatinine	< 0.5	0.5 - 1.59	1.6 - 4.29	≥ 4.3

* Persons consuming adequate intakes of preformed vitamin A may have little or no carotene in the serum or plasma, but most populations derive the major fraction of their vitamin A activity from vegetables.

Pearson (91) has proposed the following guide for interpretation of urinary thiamine data:

Results of nutritional status studies involving vitamin status evaluation are listed in table 4.

	<i>Deficient</i>	<i>Low</i>	<i>Acceptable</i>	<i>High</i>
Thiamine in creatinine, μg/g				
Adult males	< 38	38-115	116-195	≥ 195
Adult females	< 33	33- 96	97-165	≥ 165

The urinary interpretative guides for thiamine and riboflavin excretion in adults cannot be applied to children, because children excrete lower levels of creatinine. A series of predicted excretions has been calculated for children at different ages

Ascorbic acid. Low serum ascorbic acid concentrations indicate that the intake of this vitamin has been poor. In scurvy, the serum ascorbic acid level is usually 0.1 mg/100 ml or less (62). There has been no clear evidence of malnutrition due to

lack of ascorbic acid in subjects with serum levels of ascorbic acid above 0.2 mg/100 ml.

Mean ascorbic acid levels in serum were in the acceptable or high ranges in Alaskans (40); Montana Indians (41, 42); teenagers in Burlington, Vermont (82); Syracuse, New York (46), and Iowa (47); college women in Berkeley, California⁹; older people in Syracuse, New York (56, 88, 94); and in inhabitants of four communities in Puerto Rico (35, 36, 38, 39). A high mean, however, often masks a low level in some segments of the population. Thirteen percent of Alaskans (40) in northern villages and 30% in southern villages had low or deficient levels of ascorbic acid in serum. Of the Montana Indians (41, 42), only two individuals had levels in the low or deficient range. About 1% of the teenagers studied in Vermont (82) and 3% in Iowa (47) had levels of ascorbic acid in the low or deficient range. Approximately 8% of the older people studied in Syracuse (56, 88) had low or deficient levels. Except in a few cases, subjects in four communities in Puerto Rico (35, 36, 38, 39) had adequate or high levels of ascorbic acid. In one Puerto Rican community (37) plasma ascorbic acid levels were unusually low in all age groups; percentages of low levels ranged from 58 for 10- to 14-year-olds to 84 for 2- to 5-year-olds.

Ten to 15% of 120 hospital patients in New Jersey had below 0.5 mg ascorbic acid/100 ml serum (68); however, 0.4 mg/100 ml is classified in the high range by the ICNND guidelines (62). Ascorbic acid content of the serum was in the low to deficient range in 8 of 36 Negro infants studied in South Carolina (25). Fourteen percent of the Negro migrant workers at King Ferry, New York¹⁰ had below adequate levels of ascorbic acid in the serum.

Vitamin A and carotene. Serum levels of vitamin A do not necessarily indicate recent intake, but reflect intake over several months' time (95). The serum concentration of carotene usually reflects recent dietary intake (62).

Low serum vitamin A and carotene levels were observed in 10% or less of the subjects surveyed in three Puerto Rican communities (35, 38, 39), of children in

Burlington, Vermont (82), college women in Berkeley, California,¹¹ older subjects in Syracuse, New York (56, 88), and Negro migrant workers in King Ferry, New York.¹²

Group means for serum vitamin A and carotene of Boston children (32) were in the lower part of the acceptable range. Thirty-nine percent of the subjects in Ma- villa, Puerto Rico (36) had low serum vitamin A levels, but only 16% had low carotene levels. Plasma vitamin A levels were low in all age groups in Naranjo, Puerto Rico (37), ranging from 16% of the adults to 50% of the preschool children. Carotene levels were low in 17% of the infants and in 16 to 32% of those over 14 years of age.

About 20% of the subjects studied in Alaska (40) had vitamin A and carotene levels in the low range. In Blackfoot Indians (41) vitamin A serum levels were low or deficient in 35% and carotene in 6%. In Fort Belknap Indians (42) only 13% had levels in the acceptable range and none in the high; serum carotene levels were acceptable or high. Fifty percent of the teenagers studied in Iowa (47) had less than acceptable levels of carotene in the serum, but only about 1% had less than acceptable levels of vitamin A. Ten to 15% of the 120 hospital patients in New Jersey (68) had low serum vitamin A levels.

Thiamine. Thiamine excretion appears to be linearly related to intake except at very low levels (62). Excretions of from 5 to 20 $\mu\text{g}/\text{day}$ have been associated with thiamine intakes of around 0.2 mg/1000 kcal. In beriberi, excretions of from zero to about 15 $\mu\text{g}/\text{day}$ have been noted (95).

Urinary thiamine levels were below acceptable levels by ICNND guidelines (62) in less than 10% of the inhabitants of four Puerto Rican communities (36-39), Alaska (40), Blackfoot and Fort Belknap Indian Reservations in Montana (41, 42), and of teenagers in Iowa (47). Twenty percent of the subjects in Manzanilla, Puerto Rico (35) had low or deficient levels of urinary thiamine. The percentage of low urinary

⁹ See footnote 4.

¹⁰ Thiele, V. F., M. Brin and M. V. Dibble 1968 Nutritional status evaluation of Negro migrant workers in King Ferry, New York. Federation Proc., 27: 679 (abstract).

¹¹ See footnote 4.

¹² See footnote 10.

thiamine levels was 41 (56), 18 (88), and 50 (94) in three studies with older people, and 36 in Negro migrant workers.¹³

Seven percent of the boys and 12% of the girls studied in Burlington, Vermont (82), 25% of the boys and 50% of the girls studied in three New York schools (46), and 20% of the school children in a depressed urban district of Boston (32) had below acceptable levels of thiamine in the urine when compared with Pearson's guide (91). Twenty-five percent of 120 hospital patients in New Jersey (68) had what were considered low levels of blood thiamine.

The thiamine pyrophosphate effect on transketolase activity was measured in some of the above studies. Ten percent of the boys and 25% of the girls studied in Vermont (82), less than 10% of the children in the three New York schools (46), 11 and 7% of older people in two New York studies (56, 88), and 4 out of 10 old men (94) exhibited transketolase responses to thiamine pyrophosphate indicative of low or deficient thiamine levels as measured by the hexose determination.

Riboflavin. Excretions of riboflavin in the range of 50 µg/day have been associated with clinical symptoms of deficiency (62). With intakes of about 1.1 mg daily or less, excretion is 10% of the intake. With intakes higher than 1.1 mg, excretion rises rapidly.

None of the values for riboflavin excretion by Alaskans (40) were in the low or deficient range by ICNND guidelines (62). Approximately 15 to 50% of the inhabitants of five Puerto Rican communities (35-39) had low or deficient levels of riboflavin in the urine. Low or deficient levels of riboflavin excretion were reported for 26% of all females and 7% of all males studied on the Blackfeet Reservation (41) and for 16% of all females and 17% of all males on the Fort Belknap (42) Indian Reservation in Montana. Less than 17% of the older people studied in Syracuse, New York (56, 88, 94) had urinary riboflavin levels in the low or deficient range. Thirty-three percent of the Negro migrant workers studied in King Ferry, New York¹⁴ excreted less than acceptable levels of riboflavin.

When values for riboflavin excreted by teenagers in Iowa (47), and boys and girls in Vermont (82) and Boston (32) were compared with Pearson's guide for children (91), it was observed that less than 10% had low or deficient levels. Twenty-seven percent of the girls and 16% of the boys from three schools in New York (46) had low or deficient levels when compared with Pearson's guide.

Ten to 15% of the 120 hospital patients in New Jersey had what were considered low riboflavin levels in blood (68). Mean red blood cell riboflavin levels of Indians in Montana (41, 42) were in the acceptable range; however, 30 and 18% of the Blackfeet and Fort Belknap Indians, respectively, had less than acceptable levels.

Nicotinic acid (niacin). There are a number of end products of niacin metabolism excreted in the urine, and the fact that tryptophan may be converted to niacin complicates the interpretation of results. The niacin metabolite most commonly measured at present is *N*¹-methylnicotinamide. Since this is a metabolite rather than the vitamin itself, the relationship of its excretion to dietary intake is complex. Excretions of 0.5 mg *N*¹-methylnicotinamide/g creatinine were found in subjects with daily intakes of about 5 mg niacin and 200 mg tryptophan when subjects began to show clinical evidence of pellagra (62).

Levels of *N*¹-methylnicotinamide excreted by the Boston children (32) were all acceptable or high. The percentages of subjects having below acceptable levels in Puerto Rican communities were: 5% for Manzanilla (35), 15% for Mavilla (36), 34 to 71% for Naranjo (37), 15% for Duey Alto (38), and 15 to 20% for Masas (39). Levels of excretion were acceptable or high for Blackfeet (41) and Fort Belknap Indians (42) and high for Alaskans (40). Twenty-five percent of 120 hospital patients in New Jersey (68) had low circulating levels of niacin in the blood. Urinary levels were low in 5 of 10 elderly men, but were not in the deficiency range (94).

Other vitamins. There are no reliable tests at present, which are suitable for

¹³ See footnote 10.

¹⁴ See footnote 10.

large scale surveys, for diagnosing deficiencies of other vitamins, although pantothenic acid (68, 90), folic acid (46, 68, 90), biotin (68, 90), vitamin B₁₂ (68, 90), vitamin B₆ (47, 68, 90), and vitamin E (68, 90) analyses were made in some of the studies.

Summary of dietary evaluation studies, 1957-1967

The Recommended Dietary Allowances published by the Food and Nutrition Board of the National Academy of Sciences—National Research Council are generally used as guidelines for nutrient intakes of healthy persons in the United States. These guidelines are revised periodically as more information on requirements becomes available. The revisions used as guidelines in the studies cited here are the 1953, 1958, 1963, and 1968 versions (2). Because of these periodic revisions, a diet considered inadequate by one standard may appear adequate by another, depending on the revision used. Therefore, it is important to know whether the dietary intake is being compared with the latest revision or with an earlier one.

Studies with infants and preschool children indicate that low nutrient intakes are most likely to be of iron¹⁵ (96-99), ascorbic acid^{16,17} (98, 99), vitamin A¹⁸ (104), calcium,^{19,20} and niacin²¹ (104). Preadolescents tended to have diets low in calcium (28, 43, 100, 102), ascorbic acid (28, 100, 102, 103), and vitamin A (28, 102, 103). Adolescents had low intakes of calcium (43, 44, 53, 102, 104-107), iron (44, 47, 53, 104, 106), ascorbic acid (44, 47, 53, 102, 104-106, 108), and vitamin A (44, 53, 102, 104, 105). College-age people had low intakes of calcium²² (54), iron²³ (54, 109), and ascorbic acid (109). Athletes in a Texas university had more than the recommended allowances of calories and nine nutrients (110). Adult Pima Indians (114) had low intakes of calcium, vitamin A, and riboflavin; only 16% of the protein was from animal sources.

In a study of New York City school children, 73% of the diets were judged to be poor (33). Of 164 crippled children under 11 years old in rural North Carolina, 75% had inadequate diets (101); more Caucasian children had adequate diets than did Negroes. Thirty-three percent of a group

of children in Boston had two or more unsatisfactory lunches in 4 days, 27% had two or more unsatisfactory breakfasts, and 14% had two or more unsatisfactory evening meals (103); a higher percentage of Negroes had unsatisfactory meals than did Caucasians.

Families as a whole had lowest levels of intake for ascorbic acid²⁴ (40-42, 111, 112, 116, 117, 121, 122), vitamin A (34, 35, 37-42, 111, 112, 116, 122) and calcium²⁵ (34, 35, 37-39, 41, 42, 111-113, 116-118, 121, 122). Some had low levels of intake of riboflavin (34, 37-39, 111, 116), iron²⁶ (37, 41, 113, 116), calories (35, 37-42, 116), protein (34, 41, 42, 116), and thiamine (40, 116, 121, 122). Thirty-one percent of Caucasian families and 64% of Negro families in four cities of Mississippi (119) had less than 90% of the amounts of dairy products recommended by the USDA (120). The average diet of approximately 60% of the families studied in Mississippi in 1967 (31) supplied less than two-thirds of the National Research Council's Recommended Dietary Allowances for one or more nutrients.

There was a history of deficient diets in 39% of 120 hospital patients in New Jersey (68). During pregnancy (124-127) intakes of calories, niacin, ascorbic acid, calcium, iron, vitamin A, and protein were often low.

Among the older population, low intakes of protein, riboflavin, niacin, calcium, iron, ascorbic acid, thiamine, and vitamin A were not unusual (56, 57, 59-61, 94, 128, 129, 131, 132).

In the dietary evaluation studies, on the whole, ascorbic acid, vitamin A, calcium, and iron were the nutrients most commonly found in the diets in amounts below the Recommended Dietary Allowances (2). There is some indication that there

¹⁵ Skidmore, K. 1965 Study of Head Start preschool children's food habits, Baltimore, Md., unpublished report.

¹⁶ See footnote 1.

¹⁷ See footnote 15.

¹⁸ See footnote 15.

¹⁹ See footnote 1.

²⁰ See footnote 15.

²¹ See footnote 15.

²² See footnote 4.

²³ See footnote 4.

²⁴ Gushee, N. I., and M. E. Thornbury. 1967 Dietary intake of family members in two socioeconomic levels of living. Fiftieth Annual Meeting of the American Dietetic Association, Chicago (abstract).

²⁵ See footnote 24.

²⁶ See footnote 24.

was a low intake of some of the B vitamins. In the few studies carried out, Government food donations and food stamps (115, 116) appeared to improve the diets of participants. Participation in school lunch programs (100) was an important factor for the improvement of diets of school children. Children in day care centers and in Head Start programs^{27,28} obtained better meals because of these programs. Calcium, ascorbic acid, and iron, the lacking nutrients, were added by the school meals. Table 5 summarizes dietary evaluation studies.

LIMITATIONS OF INTERPRETATION

It is difficult to construct a picture of nutritional status in the United States with the information available. The number of studies has been limited and those which have been done cover only a small segment of the population. Data for some populations and age groups are completely lacking. In recent years, studies on lower income groups have been prevalent, however, and this is the area where nutrition is likely to be a pressing problem.

It is usually not possible to compare the results of one study with those of another. Results are not always given in definitive terms, and even when they are, definitions of levels of sufficiency are not always the same. For example, one group of workers may use 10.0 g hemoglobin/100 ml blood as the lower level of adequacy in children, whereas another group may use 10.5 g/100 ml as the lowest desirable level. The definition of a "poor" diet as applied by the Household Food Consumption Survey group may not be used in the same sense by other groups. Some studies report percentages of subjects consuming less than 90 and 75% of the Recommended Dietary Allowances rather than less than two-thirds.

Many research workers use the standards set up by the ICNND (62) to evaluate nutrients and metabolic products of nutrients in blood and urine. Some laboratories set up their own standards based on studies of normal subjects in that laboratory. Others use the mean values obtained in the population studied as a level of comparison.

Krehl and Hodges (133) have pointed out the problems in interpretation of nutrition survey data. A statistically valid sample is not always selected, and there is often lack of adequate stratification of the population under survey. The difficulty with interpreting information on the family food supply is that it gives no definite information as to the intake of the individual within the family group.

Even individual records of dietary intake are subject to the inaccuracies of estimating amounts. Only average values for nutrient content of foods are given in the tables, and actual amounts of nutrients in foods are subject to great variation due to season, geographical location, and method of analysis. A record of a 1-week food intake will probably not be representative of the intake for the whole year.

Dietary data, however, do provide useful guides for interpreting nutrient intake within reasonable limits. The Recommended Dietary Allowances were set up to be used as goals for planning food supplies and as guides for the interpretation of food consumption records of groups of people. An individual's nutrient intake may be less than the recommended allowances and yet may be adequate to meet his needs. For another individual the same level of intake might not be sufficient. Scrimshaw (134) states that even population groups with average intakes well below the recommended allowances may contain few individuals who are actually deficient in a certain nutrient.

A dietary survey may reflect intake of a nutrient for only 1 day or 1 week of the year, whereas the biochemical evaluation frequently gives information based on a longer period of time. Clinical signs of a nutritional deficiency do not usually develop until the deficiency has been prolonged and are difficult to identify. Clinical symptoms cannot always be correlated with biochemical or dietary evaluation.

SUMMARY AND CONCLUSIONS

Regardless of the difficulties of evaluation, certain inferences with relation to

²⁷ See footnote 1.

²⁸ See footnote 15.

the nutritional status of the population do emerge from the results of studies cited in this paper. There are indications that nutritional deficiencies do occur in certain age groups and in certain areas of the country. A large number of the studies cited here were done on low income groups; therefore, implications do not apply to the total population of an area.

Figures 1 and 2 indicate areas of the United States in which studies using biochemical or clinical analyses have been conducted. In many studies, hemoglobin or hematocrit levels, or both, were the only parameters measured. Figure 1 gives the location of studies which involved determinations of these levels. There was a high percentage of anemia in preschool children and pregnant women studied, regardless of geographical location. There was a higher percentage of anemia in Negro children than in Caucasians, even when all subjects were from the lower socioeconomic level. In figure 2, studies involving vitamin nutrition status are indicated. If more than 10% of the subjects were

deficient, or more than 20% had low blood or urinary levels of a nutrient, as judged by ICNND standards or by standards set up in the laboratory conducting the study, it was considered an indication that dietary intake was low in the group studied. The only thorough studies have been done on Blackfeet and Fort Belknap Indians in Montana, inhabitants of villages in Puerto Rico and Alaska, adolescents in Iowa and Syracuse, New York, preadolescents in New York City and Boston, older people in Syracuse, Negro migrant workers in King Ferry, New York, and hospital patients in Jersey City, New Jersey. The Montana Indians had low blood or urine levels of one or two vitamins. There were high percentages of Puerto Ricans with low intakes of one or two vitamins. Adolescents appeared to be fairly well nourished. Some Alaskan subjects had low serum vitamin A and ascorbic acid levels. Older people in Syracuse, hospital patients in Jersey City, and Negro migrant workers in King Ferry had low blood or urinary levels of two vitamins.

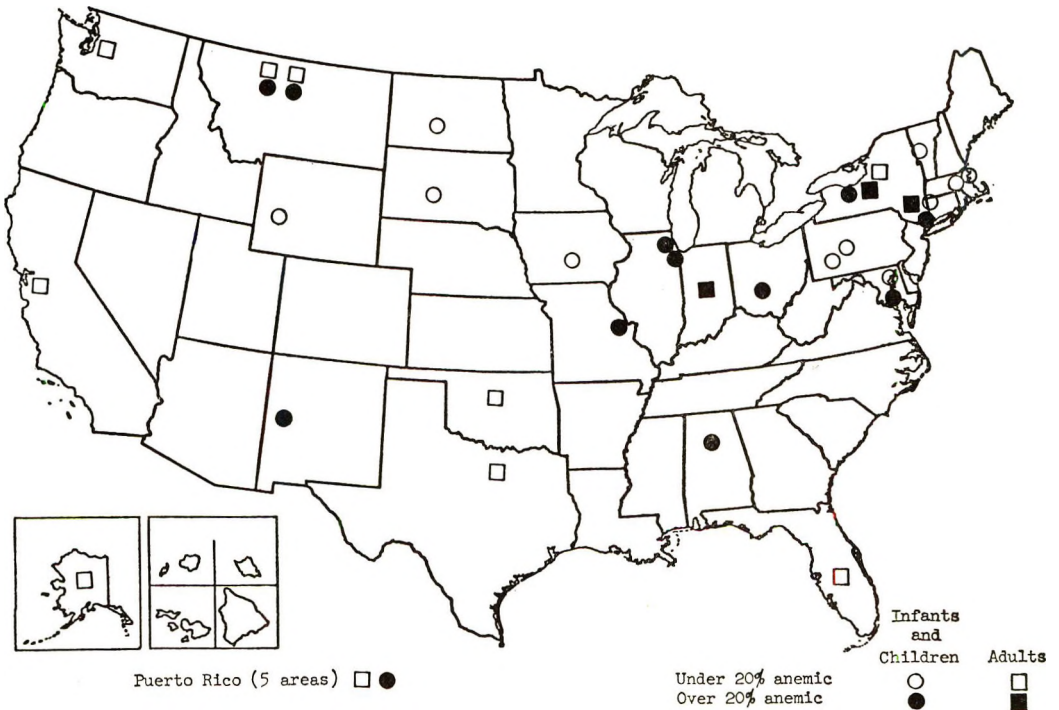


Fig. 1 Incidence of anemia in subjects studied.

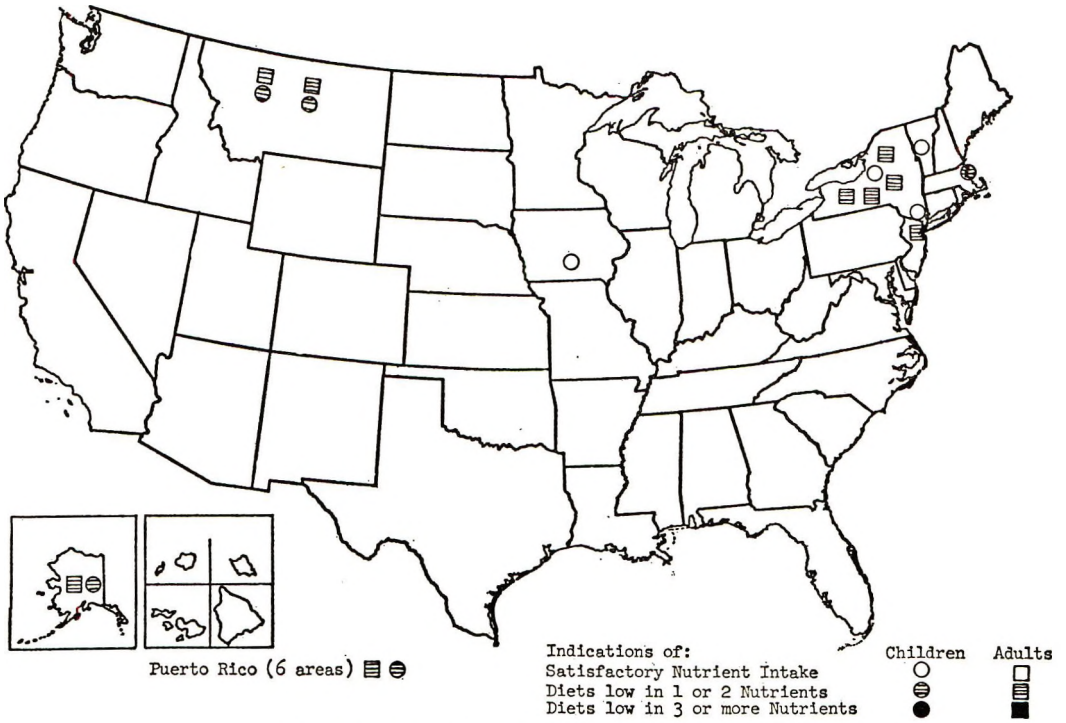


Fig. 2 Vitamin nutritional status of subjects studied.

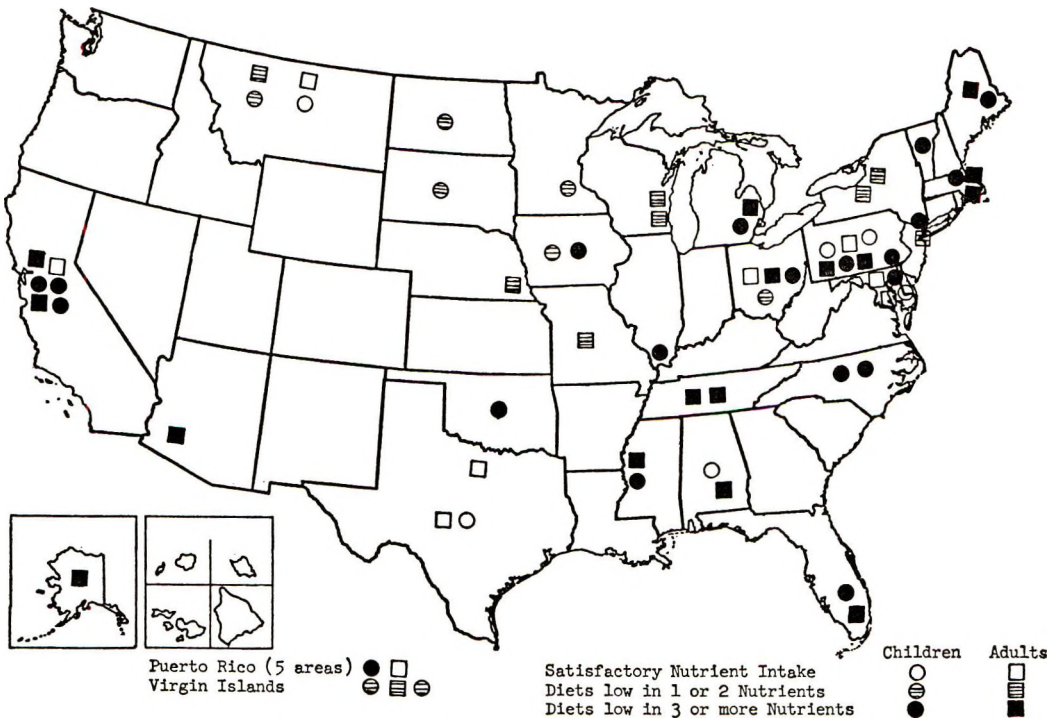


Fig. 3 Dietary evaluation of subjects studied.

Figure 3 shows locations of dietary studies reviewed in this paper. Results of the 1965 Household Food Consumption Survey indicated that 50% of the families in the United States had diets supplying all the recommended allowances of calories and seven nutrients, and 20% of the families had diets providing less than two-thirds of the recommended allowances for one or more nutrients. Because it would seem undesirable for any population group to have a higher percentage receiving less of the recommended allowances than those reported in the nationwide Household Food Consumption Survey, the following arbitrary guidelines have been employed to designate indications of low nutrient intake which may be critical. In figure 3 the subjects in the dietary evaluation studies reviewed here are designated as having diets low in a nutrient if 1) more than 50% of the subjects had less than the recommended allowances, 2) more than 30% had less than three-fourths, 3) more than 20% had less than two-thirds, 4) more than 10% had less than one-half, or 5) the average nutrient intake was below the recommended allowance. On this basis, studies in which subjects had low intakes of none, one or two, or three or more nutrients are located on the map. In the majority of the studies there was a low intake of three or more nutrients.

The quality of nutrition observed in both nutritional status and dietary evaluation studies was generally related to economic status and level of education. The foods most needed to improve diets were milk, citrus fruits, and green and yellow vegetables.

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TABLE 1
Height and weight data arranged according to age group

Subjects	Location	Nutritional status	Reference
36 Negro infants, 4 to 10 months of age, low income families	South Carolina, Greenville Well-Baby Clinic	Body weights for 7 premature and 11 other infants were below the 25th Harvard percentile (6, 9).	Jones and Schendel (25)
842 children, 4 yr of age, culturally deprived homes, Caucasian and Negro	Maryland, Baltimore, early school admissions project in 4 city schools	Median values for height and weight were below those of the standard population as published by Stuart (8). Negroes were taller than Caucasians.	Stine et al. (26)
40 Caucasian and Negro children from day care centers and 30 Caucasian and Negro children cared for at home, 4 yr of age, low income families	Alabama, Birmingham	With the exception of 12 children all of the subjects were within the 3rd to 97th percentile for height on the Stuart-Meredith height and weight charts (7). Five were outside this percentile range for weight. Negroes were taller than Caucasians.	Cloud ¹
134 children, 6 to 12 yr of age, low income families	Vermont, University of Vermont Family Care Unit	Heights were normal on the Reed and Stuart height grid (9). A larger percentage of the children were overweight than were underweight.	Wakefield and Merrow (28)
214 children from under 1 to 12 yr of age, Shoshone and Arapahoe Indians	Wyoming, Wind River Indian Reservation	Arapahoe children were comparable in height and weight to Caucasians when compared with charts from Colorado State Health Department.	Perkins and Church (29)
388 children of Negro migrant workers	Florida, Palm Beach County	A high percentage of heights and weights of children were in lower percentile of Stuart grid (6, 9).	Browning and Northcutt (30)
510 low income families, 401 males and 378 females from 2 to 12 yr of age	Mississippi, Washington and Sunflower Counties	Children were short for their age and heavy for their age and height when compared with Falkner's physical growth standard for Caucasian North American children (12).	ARS, USDA (31)
332 children, 9 to 13 yr of age, from a depressed community, predominantly Negro	Massachusetts, Roxbury Section of Boston	Using the Stuart and Reed (Boston) standards (6), they found that 59% of the Caucasian boys, 42% of the Negro boys, 57% of the Caucasian girls, and 30% of the Negro girls were in the 25th percentile and under for height. Fifty-five percent of the Caucasian boys, 40% of the Negro boys, 35% of the Caucasian girls, and 25% of the Negro girls were under the 25th percentile in weight. Only 8% were obese by Seltzer and Maye: criteria (13).	Myers et al. (32)
642 children, 10 to 13 yr of age; 64% Puerto Rican, 14% Chinese; 10% Negro, 8% Caucasian; 4% other; 19% were receiving welfare assistance	New York, New York City	Eight percent were considered below normal in anthropometric status; 7% were above normal. Normal was considered between the 10th to the 90th percentile on the Stuart chart (8).	Christakis et al. (33)

Community population	Puerto Rico, Dona Elena, an isolated mountain community	Heights and weights of children were low for age when plotted on charts showing zones of growth in height and weight by age (8).	Roberts (34)
315 from a community population of 390	Puerto Rico, Manzanilla, a small isolated community	Body heights and weights of children were below the American averages (8). Adults showed a great variation in weight; mean adult weights were on the thin side (15).	Plough et al. (35)
306 from a community population of 321	Puerto Rico, Mavilla, Vego Alto, a rural community	Height and weight data were considerably below averages for the U.S. (8) and Puerto Rico (23) for both children and adults (21).	Fernandez et al. (36)
542 subjects	Puerto Rico, Naranjo, Moca, a rural community	Body weights and heights were below the averages for the U.S. (8) and Puerto Rico (23) for children and adults (21).	Fernandez et al. (37)
461 persons examined, representing 81% of the total population	Puerto Rico, rural area of Duey Alto, San German	Body weights and heights of children were below the averages for the U.S. (8) and Puerto Rico (23). Adults, in general, had satisfactory weights, although adult height and weight means were also below the U.S. averages (21).	Fernandez et al. (38)
307 persons, or 97% of the population	Puerto Rico, rural area of Masas, Gurabo	Body weight and height averages of children were below those for the U.S. (8) and Puerto Rico (23). Adults, in general, had satisfactory weights (21).	Fernandez et al. (39)
Aleuts, Eskimos, and Indians; 805 village inhabitants	Alaska	Growth in both height and weight of the Northern Eskimos closely followed that of the Canadian population (24). Height of the Southern Eskimos was below that of Canadians; weight growth was faster until 8 to 10 yr, then lagged below. The height curve of the Athabaskan Indians fell close to that of the Canadians, and the weight curve did also, until age 10, when it lagged.	ICNND (40)
1390 children and adults	Montana, Blackfeet Indian Reservation	Through the first 4 yr of life, heights and weights coincided with the 33rd and 50th percentile lines of the Iowa growth charts. From 5 yr on, heights and weights were above Iowa means for both sexes. Heights of adults were similar to standards (18). Considerable numbers of persons over 25 yr of age had a percent "standard weight" of 120 or greater (15). There also were significant numbers whose percent "standard weight" was 90% or less.	ICNND and DIH (41, 42)
700 children and adults	Fort Belknap Indian Reservation		
200 children, 1 month to 18 yr of age, children of professional and semiprofessional parentage	Ohio, southwestern area	Children were comparable to or exceeded the RDA "reference" children (2) in height and weight. After age 12 the boys were generally heavier.	Garn et al. (43)

TABLE 1 (Continued)
Height and weight data arranged according to age group

Subjects	Location	Nutritional status	Reference
Longitudinal study of 30 undernourished and 30 well-nourished girls, from early childhood to early adulthood	Alabama, Birmingham	Although undernutrition retarded growth and maturation, there was no significant difference in adult stature between the two groups.	Dreizen et al. (44)
Sioux children in eight Indian boarding schools, 12 to 14-yr-old girls	Dakotas	Height was short by Stuart and Meredith standards (7) and weight average when compared with data in Baldwin and Wood tables (10).	Wenberg et al. (45)
122 Negro, 282 Caucasian children, 12 to 15 yr, one school predominantly Negro, two others predominantly Caucasian	New York, Syracuse and Onondaga County	Children in predominantly Negro school were moderately short and percent average weight as a group was lowest.	Dibble et al. (46)
2045 teenagers studied, data on 252	Iowa, statewide	Heights and weights were substantially higher than those in the University of Iowa height and weight tables (7).	Hodges and Krehl (47)
446 female adolescents, senior high school, middle and upper-middle class	Massachusetts, suburban community	Fifteen percent were obese by triceps skin-fold method of Seltzer and Mayer (13).	Dwyer et al. (48)
Outpatients of Children's Medical Center; 163 males, 195 females, 11 to 19 yr old	Massachusetts, Boston	Fifteen percent of the males and 18% of the females were obese by standard clinical evaluation. Height/weight relationship was in or above the A ₄ channel of the Wetzel grid (11).	Wenzel et al. (49)
1273 males, 1398 females, 14 to 17 yr of age, middle class families, Caucasian	Pennsylvania, Dormont	Eleven percent of the males and 18% of the females were overweight; 2% of the males and 5% of the females were underweight (51). Almost all markedly overweight children were outside channel A ₄ on the Wetzel grid (11).	Rogers and Reese (50)
296 males, 261 females, 14 to 19 yr of age, Caucasian	Vermont, Burlington	Twenty percent were obese by triceps skin-fold criteria of Seltzer and Mayer (13).	Merrow (52)
950 teenagers, 4-yr longitudinal study; 30% Negro, 10% Oriental, remainder Caucasian	California, Berkeley Public High School	Fourteen percent of the males and 16% of the females were classified as obese by the "body envelope" method (14). There was more obesity in Negroes, particularly in girls. There was more obesity in girls from low income groups.	Huenemann et al. (53)

144 female students in school for dental hygienists, 18 to 25 yr of age	Massachusetts, Boston	The same percentage (16%) were overweight as were underweight by Davenport's standard (16).	Fry (54)
40 college women of Asian ancestry	California, San Francisco and Berkeley	Women of Asian ancestry were leaner than Caucasian women.	Clarke and Margen ²
302 Seminole Indians in Oklahoma, 422 Caucasians in Oklahoma, 211 Seminole Indians in Florida; ages 14 to 65 and over	Oklahoma, Seminole County	Indians were shorter and heavier than Caucasians.	Mayberry and Lindeman (55)
214 men and women living in public housing, ages 50 to over 90 yr, average age, 71.3 yr	New York, Syracuse	Sixty-seven percent of the women and 46% of the men were more than 10% overweight; 9% of the women and 19% of the men were more than 10% underweight (21).	Dibble et al. (56)
200 men and women over 65 yr of age	Ohio, Columbus, Ohio State University Nutrition Clinic	Sixty-eight percent were more than 10% overweight; 8% were more than 10% underweight when compared with ideal weight.	Skillman et al. (57)
681 people over 65 yr of age; 207 women, 474 men, less than 10% Negroes. Subjects either attended an outpatient clinic or were residents in a domiciliary institution for the elderly	Virginia, Charlottesville, University of Virginia	Eleven percent of the men and 3% of the women were overweight by 20% or more when compared with the average for ages 55 to 59 yr given in the Metropolitan Life Insurance Company tables (19).	Hollifield and Parson (58)
104 men and women, 51 to 97 yr of age; most were middle class and retired	Massachusetts, Boston, Age Center of New England	Forty percent were more than 10% overweight; 8% were more than 10% underweight; over 25% were more than 20% overweight when compared with "desirable" weight for height (19, 22).	Davidson et al. (59)
54 men and 58 women over 50 yr of age; average age approximately 75 yr	California, San Mateo County	Thirty-one percent of the men and women were overweight; 11% of the men and 17% of the women were underweight according to standards of Metropolitan Life Insurance Company (17).	Steinkamp et al. (60)
32 women, 65 to 85 yr, active, living in their own homes	Nebraska, Lincoln	Forty-seven percent were underweight, 6% overweight, according to Davenport's standards (16).	Fry et al. (61)

¹ Cloud, H. H. 1967 Heights, weights, triceps skin-fold measurements, hematocrits, and dietary intake of 4-year-old children in day care centers and at home in Birmingham, Jefferson County, Alabama. Thesis, Department of Nutrition, Graduate School of the University of Alabama, University, Ala.

² Clarke, J. K., and S. Margen 1967 Body fat, diet, and physical activity of Oriental college women. Fiftieth Annual Meeting of the American Dietetic Association, Chicago (abstract).

TABLE 2
Protein nutrition data arranged according to age group

Subjects	Location	Nutritional status	Reference
36 Negro infants, 4 to 10 months of age, low income families	South Carolina, Greenville Well-Baby Clinic	Twenty-six percent had serum globulin levels below 1.7 g/100 ml, 29% had albumin concentrations below 3.52 g/100 ml, and 61% had total serum protein levels below 6.0 g/100 ml.	Jones and Schendel (25)
388 children of Negro migrant workers	Florida, Palm Beach County	One case of kwashiorkor and some evidence of marasmus were reported.	Browning and Northcutt (30)
642 children, 10 to 13 yr of age; Negro, Puerto Rican, Chinese, Caucasian and other	New York, New York City	Seven percent had an amino acid ratio of 2.0 or more, suggestive of protein malnutrition.	Christakis et al. (33)
669 teenagers, grades 9 through 12	Iowa, statewide	Total protein was below 6.0 g/100 ml blood for approximately 8%.	Hodges and Krehl (47)
Pregnant women; 57 indigent patients, 11 wives of medical students and staff, 10 private patients	Georgia, Atlanta	The indigent patients had a urea nitrogen-to-creatinine ratio of 3.02, wives of staff and students of 4.04, and private patients of 6.11.	Taylor and Swartwout (67)
390 people from 70 families	Puerto Rico, Manzanilla	Levels of total serum protein were usually elevated; only 12.2% had below 6.5 g/100 ml. Albumin levels were 4.0 g/100 ml or over for 18.7% and below 3.0 g/100 ml for 19.5% of the population. Low values were noted in children under 10 yr.	Plough et al. (35)

296 subjects	Puerto Rico, Mavilla	In only a few of the population were serum protein levels below 6.0 g/100 ml; only 1 subject had below 3.0 g albumin/100 ml serum.	Fernandez et al. (36)
526 subjects	Puerto Rico, Naranjo	Total plasma protein was adequate except in infants and children; a small percentage had values below 6.0 g/100 ml. Albumin levels were above 3.0 g/100 ml in children.	Fernandez et al. (37)
461 subjects	Puerto Rico, Duey Alto	Total plasma proteins were low, particularly among children and adult men. Approximately 10 to 15% of the values were below 6.0 g/100 ml. There were few albumin levels below 3.0 g/100 ml.	Fernandez et al. (38)
307 subjects	Puerto Rico, Masas	There was a considerable number of low total plasma protein levels, particularly among infants and pre-school children. Low albumin levels, less than 3.0 g/100 ml, were found in a small number of children and adults.	Fernandez et al. (39)
826 males, 145 females, and 209 children	Alaska	Serum protein means tended to be above 7.0 g/100 ml.	ICNND (40)
148 children and adults	Montana, Blackfoot Indian Reservation	Values for total plasma protein was above 7.0 g/100 ml, and for serum albumin above 3.0 g/100 ml.	ICNND, DIH (41)
128 children and adults	Montana, Fort Belknap Indian Reservation	Total plasma protein and serum albumin levels were in normal range.	ICNND, DIH (42)

TABLE 3
Incidence of anemia arranged according to age group

Subjects	Location	Nutritional status	Reference
425 infants, 6 months to 2 yr of age	Illinois, Chicago Children's Memorial Hospital	Forty-four percent had hemoglobin levels < 10.5 g/100 ml.	Schulman (75)
Infants from low socioeconomic level, mostly Negro	Illinois, Chicago Welfare Stations, 8th Health District	Hemoglobin was below 10 g/100 ml in 76%. Hematocrits and serum iron levels were low.	Andelman and Sared (81)
Control group of 572 infants admitted consecutively to hospital	Missouri, St. Louis, Washington University Hospital	177 had hemoglobin levels below 10 g/100 ml.	Holowach and Thurston (76)
797 infants, 6 to 24 months of age, Caucasian and Negro	Ohio, Columbus Children's Hospital	Twenty-five percent had hemoglobin levels indicative of iron deficiency (< 9.9 g/100 ml). Twenty-seven percent of those 6 to 18 months of age, and 17% of those 19 to 24 months of age were anemic.	Shaw and Robertson (77)
145 Indian children under 6 yr of age, primitive living conditions	New Mexico, Acoma	There was a high incidence of iron-deficiency anemia. During year 2 of life about 50% of children tested were hypochromic; by ages 4 and 5, 15 and 10% showed hypochromic indices. Hypochromic was defined as a mean corpuscular hemoglobin concentration below 32%.	Corbett (78)
460 Negro preschool children, 2 months to 5.5 yr of age	Washington, D.C., Children's Hospital	Twenty-nine percent had hemoglobin levels of < 10 g/100 ml; 63% of children 12 to 17 months of age had levels below 10 g/100 ml.	Gutelius (79)
190 Caucasian and 578 Negro children, 4 yr of age, low income families	Maryland, Baltimore, early school admissions project	Twenty percent of Negro and 5% of Caucasian children had red blood cell volumes of 33% or less.	Stine et al. (26)
542 children, 6 months to 3 yr of age	Pennsylvania, Allegheny County	Nineteen percent of Negro children and 7% of Caucasian children had hemoglobin levels of 10 g/100 ml or less.	Danneker ¹

40 Caucasian and Negro children from seven day care centers; 30 Caucasian and Negro children cared for at home, 4 yr of age	Alabama, Birmingham	Twenty-three percent in each group had hematocrits lower than 33.9%; only 1 was below 30%.	Cloud ²
286 preschool children, low income families; 75% Puerto Rican, 15% Negro, 10% Caucasian	New York, New York City Child Health Stations	Nineteen percent had hemoglobin levels below 10 g/100 ml, mostly those under 2 yr old. Percent was approximately the same in all 3 race groups.	Haughton (80)
388 children of Negro migrant workers	Florida, Palm Beach County	Some children showed evidence of nutritional anemia.	Browning and Northcutt (30)
214 children, from under 1 to 12 yr of age, Shoshone and Arapahoe Indians	Wyoming, Wind River Indian Reservation	Of 199, only 7 had < 10 g/100 ml hemoglobin. For 195, the mean hematocrit was 39%.	Perkins and Church (29)
332 children, 9 to 13 yr of age, from a depressed community, predominantly Negro	Massachusetts, Roxbury section of Boston	Twenty-two percent of the children had hemoglobin values under 14 g/100 ml and significantly more of these were Negro than Caucasian children. Thirteen percent of the children had low hematocrit values by ICNND criteria. None had hemoglobin levels below 12 g/100 ml or hematocrits below 36%.	Myers et al. (32)
642 children, 10 to 13 yr old; Negro, Puerto Rican, Oriental, Caucasian and other	New York, New York City	Three percent of the group had hemoglobin levels < 10 g/100 ml. Five percent of the boys and 8% of the girls had hematocrit levels < 39%. Negro and Chinese children had low hematocrit levels.	Christakis et al. (33)
133 girls, 12- to 14-yr-old	Dakotas, Indian Boarding Schools	Mean hemoglobin level was 11.64 g/100 ml, which was considered only fair.	Wenberg et al. (45)
401 children, 12 to 15 yr of age, approximately one-quarter from low income families	Vermont, Burlington	Only 1 boy and 3 girls had hemoglobin values < 12 g/100 ml. One boy and 2 girls had hematocrits < 36%.	Morse et al. (82)
122 Negro, 282 Caucasian children, 12 to 15 yr of age	New York, Syracuse and Onondaga County	A large number, particularly Negro girls, had hematocrits below acceptable levels.	Dibble et al. (46)
672 teenagers in grades 9 through 12	Iowa, statewide	Hemoglobin values were below 12 g/100 ml for 24 subjects; hematocrits below 37% for 20.	Hodges and Krehl (47)

TABLE 3 (Continued)
Incidence of anemia arranged according to age group

Subjects	Location	Nutritional status	Reference
163 boys, 192 girls, 11 to 19 yr old	Massachusetts, Boston	The obese (25 girls and 36 boys) had low serum iron and normal hemoglobin compared with that of normal weight subjects. No values were in the deficiency range.	Wenzel et al. (49)
338 girls, 313 boys, 14 to 19 yr of age; Caucasian middle class	Pennsylvania, Dormont	Ten girls had hematocrits 40% or below; 11 boys had hematocrits 44% or below.	Rogers and Reese (50)
114 females, 19 to 25 yr of age, socioeconomically privileged	Texas, University of Texas Southwestern Medical School	Iron stores were scant or absent in two-thirds. Serum iron and transferrin saturation correlated with iron stores.	Scott and Pritchard (83)
12 female university students, 19 to 37 yr of age	Washington, University of Washington	No subjects had anemia. Four had good iron stores, 3 fair. Five subjects had borderline iron deficiency as reflected by iron stores, increased iron absorption when iron was given, and a decreased level of saturation of transferrin.	Monson et al. (84)
40 college women of Asian ancestry	California, San Francisco and Berkeley	Only 1 borderline case of anemia.	Clarke and Margen ³
302 Seminole Indians in Oklahoma, 422 Caucasians in Oklahoma, and 221 Seminole Indians in Florida	Oklahoma and Florida	Hemoglobin concentration was comparable in Caucasian and Indian women, but was slightly higher in Indian men than in Caucasian men.	Mayberry and Lindeman (55)
1052 pregnant women, unselected	New York, New York City	Forty-nine percent had hemoglobin levels between 10 and 12 g/100 ml; 23% had < 10 g/100 ml. Eighty percent of 130 cases with anemia had < 50 µg iron/100 ml serum; 65% had < 4 µg folate and 31% had < 100 pg of vitamin B ₁₂ /ml serum.	Benjamin et al. (85)
4744 pregnant women	Indiana, Indiana University Medical Center	Moderate anemia (hemoglobin 9 to 11 g/100 ml) was present in 852 women, and severe anemia (hemoglobin < 9 g/100 ml) in 89	Hunter (86)
24 patients with megaloblastic anemia of pregnancy; 50 nonanemic pregnant women	New York, New York City	Serum folate was low in 83% with anemia, 26% without. Only 2 patients with anemia could definitely be said to have low serum vitamin B ₁₂ activity.	Lawrence and Klipstein (87)

390 people from 70 families	Puerto Rico, Manzanilla	Fourteen percent of the population had hemoglobin levels of < 10 g/100 ml.	Plough et al. (35)
296 inhabitants	Puerto Rico, Mavilla	Infants, preschool children, girls 10 to 14 yr, and lactating women had the higher percentage of hemoglobin values below 10 g/100 ml.	Fernandez et al. (36)
542 subjects	Puerto Rico, Naranjo	Average hemoglobin level was greater than 10 g/100 ml for both sexes in all age groups. A moderate normochromic anemia was seen which affected mainly infants and lactating women.	Fernandez et al. (37)
456 subjects	Puerto Rico, Ducey Alto	Low hemoglobin levels were particularly prevalent among infants, small children and pregnant and lactating women.	Fernandez et al. (38)
305 subjects	Puerto Rico, Masas	The general prevalence of anemia was low and occurred mostly in male children under 2 yr of age and in pregnant females. The incidence was 14 and 13%, respectively.	Fernandez et al. (39)
826 adult males, 145 adult females, 209 children	Alaska	Mean hemoglobin levels and hematocrits were within the normal range.	ICNND (40)
148 children and adults on Blackfoot Reservation; 128 children and adults on Fort Belknap Reservation	Montana, Blackfoot and Fort Belknap Indian Reservations	Average hemoglobin and hematocrit levels in all age groups and for both sexes were adequate. A large proportion of the children in the 0 to 4-yr-old group had hemoglobin and hematocrit levels in the "deficient" range. Mean corpuscular hemoglobin concentration was in a deficient or low range in only 3 of the 0 to 4 yr olds on the Blackfoot, and in no females, and in 25% of the males on the Fort Belknap Reservation.	ICNND and DIH (41, 42)
214 men and women over 50 yr of age, living in public housing	New York, Syracuse	Hematocrits were low for 43% of the total group.	Dibble et al. (56)
225 well men and women, average age of 71 yr	New York, Syracuse	Five percent of the men and 13% of the women had low hematocrits.	Brin et al. (88)

¹ Danneker, D. 1966 Study of hemoglobin levels of children attending Child Health Conferences, Allegheny Health Department, Pittsburgh, Penna., unpublished report.
² Clout, H. H. 1967 Heights, weights, triceps skin-fold measurements, hematocrits, and dietary intake of 4-year-old children in day care centers and at home in Birmingham, Jefferson County, Alabama. Thesis, Department of Nutrition, Graduate School of the University of Alabama, University, Ala.
³ Clarke, J. K., and S. Margen 1967 Body fat, diet, and physical activity of Oriental college women. Fifteenth Annual Meeting of the American Dietetic Association, Chicago (abstract).

TABLE 4
Vitamin nutrition status data arranged according to age group

Subjects	Location	Analyses	Nutritional status	Reference
36 Negro infants, 4 to 10 months of age	South Carolina, Greenville Well Baby Clinic	Blood: ascorbic acid.	Eight infants had serum ascorbic acid levels with a mean of 0.18 mg/100 ml; 4 infants had a mean of 0.42 mg/100 ml; 24 infants had a mean of 1.39 mg/100 ml.	Jones and Schendel (25)
332 children, 9 to 13 yr of age, from a depressed community, predominantly Negro	Massachusetts, Roxbury section of Boston	Blood: vitamin A and carotene. Urine: thiamine, riboflavin. <i>N</i> -methylnicotinamide. Clinical examination.	Group averages for serum vitamin A and carotene were 26 μ g/100 ml and 57 μ g/100 ml, respectively. Twenty percent of the children had low levels of urinary thiamine. Riboflavin and <i>N</i> -methylnicotinamide levels in urine were all within normal limits. Sixty-two percent had gingivitis and 25% had follicular keratosis.	Myers et al. (32)
642 children, 10 to 13 yr of age	New York, New York City	Blood: vitamins A, E, B ₂ , B ₆ , ascorbic acid, thiamine, riboflavin, niacin, folic acid, pantothenic acid, biotin.	Puerto Ricans: average thiamine, niacin, vitamin B ₁₂ , and folate were lower than means for the total population. Chinese: vitamin A, pantothenic acid, riboflavin, and vitamin E were lower than means for the total population. Negro: 68% had below the total population mean in thiamine, biotin, and pantothenic acid. Caucasian: riboflavin was somewhat lower than that of the population mean.	Baker et al. (90)
Children and 24 adults in 100 homes	Puerto Rico, Dona Elena	Subjects examined for signs of clinical deficiency.	Conditions attributable to a riboflavin deficiency were seen in two-thirds of the subjects. Three-fourths of the subjects had gingivitis.	Roberts et al. (34)
390 people from 70 families	Puerto Rico, Manzanilla	Blood: vitamin A, and ascorbic acid. Urine: thiamine, riboflavin, <i>N</i> -methylnicotinamide. Clinical examination.	All ascorbic acid serum levels were over 0.5 mg/100 ml. Vitamin A serum levels were above 20 μ g/100 ml in adults, but were lower in children. Urinary thiamine levels were low in 1/5 the inhabitants. Urinary riboflavin levels were low in 1/2 the inhabitants. <i>N</i> -Methylnicotinamide excretion was at a satisfactory level. ICNND standards were used for comparison.	Plough et al. (35)

542 persons	Puerto Rico, Mavilla	Blood: Vitamin A, ascorbic acid. Urine: thiamine, riboflavin, N ¹ -methylnicotinamide. Clinical examination.	Serum ascorbic acid levels were satisfactory. Thirty-nine percent of the subjects had low serum vitamin A, and 16% had low serum carotene levels. There was considerable presence of follicular hyperkeratosis and skin xerosis among children. Thiamine levels in urine were normal. Urinary riboflavin levels were low in 28% of the subjects. Amounts of N ¹ -methylnicotinamide excreted were low in 15% of the subjects. ICNND standards were used for comparison.	Fernandez et al. (36)
542 persons	Puerto Rico, Naranjo	Blood: vitamin A, ascorbic acid. Urine: thiamine, riboflavin, N ¹ -methylnicotinamide. Clinical examination.	Plasma ascorbic acid values were markedly low in all age groups and were below 0.2 mg/100 ml in all male infants and in men 20 to 39 yr of age. Plasma vitamin A levels were low in all age groups. In 50% of the infants and children, vitamin A plasma values were less than 20 µg/100 ml. Carotene levels in plasma were low in infants and those over 14 yr. Urinary thiamine content was adequate in most subjects, low in 9.5%. Urinary riboflavin levels were low in all subjects except children 2 to 5 yr old. N ¹ -Methylnicotinamide excretion levels were low, particularly in girls 10 to 14 yr of age and in lactating women. ICNND standards were used.	Fernandez et al. (37)
456 subjects	Puerto Rico, Duey Alto	Blood: vitamin A, ascorbic acid. Urine: thiamine, riboflavin, N ¹ -methylnicotinamide. Clinical examination.	Plasma ascorbic acid levels were satisfactory. Vitamin A plasma levels were low in 8% of the subjects studied. Urinary thiamine levels were adequate except for 7 subjects in the low range. Urinary riboflavin levels were deficient in 25% of the subjects. Urinary N ¹ -methylnicotinamide levels were low in 15% of the subjects. ICNND standards were used.	Fernandez et al. (38)
305 subjects	Puerto Rico, Masas	Blood: vitamin A, ascorbic acid. Urine: thiamine, riboflavin, N ¹ -methylnicotinamide. Clinical examination.	Plasma ascorbic acid levels were adequate or high. There was a prevalence of follicular hyperkeratosis and xerosis of the skin, but not a high incidence of low vitamin A and carotene levels in plasma. Only 4 subjects had low excretion levels of thiamine. Riboflavin was excreted in low-to-deficient amounts by 9 to 21% of the subjects in the different age groups. Low excretion rates of N ¹ -methylnicotinamide ranging from 15 to 20% of the subjects prevailed in all age groups over 6 yr. ICNND standards were used.	Fernandez et al. (39)

TABLE 4 (Continued)
 Vitamin nutrition status data arranged according to age group

Subjects	Location	Analyses	Nutritional status	Reference
826 males, 145 females, 209 children	Alaska	Blood: vitamin A, ascorbic acid. Urine: thiamine, riboflavin, N ¹ -methylnicotinamide. Clinical examination.	Mean serum ascorbic acid content was in the acceptable range, or 0.4 mg/100 ml, except for men in southern villages, where the average was 0.32 mg/100 ml. Few subjects had vitamin A and carotene levels in the deficiency range. Bitot's spots were seen in Newtok, the most primitive village. Urinary thiamine levels were in the acceptable or high range. Urinary riboflavin levels were acceptable and high. N ¹ -Methylnicotinamide excretion levels were in the high range.	ICNND (40)
148 children and adults	Montana, Blackfeet Indian Reservation	Blood: vitamin A, ascorbic acid, red cell riboflavin. Urine: thiamine, riboflavin, N ¹ -methylnicotinamide. Clinical examination.	Mean levels of ascorbic acid in the serum were in the high range. Mean serum vitamin A levels were in the acceptable range; mean serum carotene levels were acceptable and high. A large percentage of children and adult females had vitamin A levels in the low range. Mean urinary thiamine levels were acceptable or high. Only 2 adult males and 8 adult females had excretion levels in the low or deficient range. The mean red blood cell riboflavin was 17 µg/100 ml for males and 15 µg/100 ml for females. Mean urinary riboflavin levels were in the acceptable range. Twenty-six percent of all females and 7% of all males had low or deficient urinary levels of riboflavin. N ¹ -Methylnicotinamide levels of excretion were acceptable or high in all persons.	ICNND and DIH (41)
128 children and adults	Montana, Fort Belknap Indian Reservation	Blood: vitamin A, ascorbic acid, red cell riboflavin. Urine: thiamine, riboflavin, N ¹ -methylnicotinamide. Clinical examination.	Mean serum ascorbic acid levels were in the high range. Mean serum vitamin A levels were in the low range. Only 12% of the males and 14% of the females had levels in the acceptable range. Serum carotene levels were high and acceptable in all groups. Mean urinary thiamine levels were acceptable or high. Three adult males had low or deficient levels of thiamine excretion. The overall mean of red blood cell riboflavin was 17 µg/100 ml. Urinary riboflavin levels were in the low range in 25 to 50% of the adult groups. Sixteen percent excreted low or deficient levels of riboflavin. N ¹ -Methylnicotinamide levels of excretion were acceptable or high except in 1 female.	ICNND (42)

<p>401 children, 12 to 15 yr of age</p>	<p>Vermont, Burlington</p>	<p>Blood: vitamin A, ascorbic acid, transketolase activity. Urine: thiamine, riboflavin.</p>	<p>Most of the subjects had high plasma levels of ascorbic acid; 8% of males and 3% of females had less than 0.4 mg/100 ml. Vitamin A and carotene blood levels were normal; 5% of females and 9% of males had less than 30 µg vitamin A/100 ml; 1% of males and 2% of females had less than 40 µg carotene/100 ml. Seven percent of the males and 12% of the females had less than 151 µg thiamine/g creatinine. By thiamine pyrophosphate (TPP) effect (92) on hexose 9.5% of boys and 25% of girls were low or deficient in thiamine; with the TPP effect on pentose, 98% had ample thiamine. Three percent of males and 8% of females had less than 200 µg riboflavin/g creatinine in the urine.</p>	<p>Morse et al. (82)</p>
<p>122 Negroes, 282 Caucasians, 12 to 15 yr of age, in three schools: (1) 94% Negro children; (2) 91% Caucasian; (3) 99% Caucasian</p>	<p>New York, Syracuse and Onondaga County</p>	<p>Blood: ascorbic acid, transketolase activity. Urine: thiamine, riboflavin, folic acid.</p>	<p>Mean levels of plasma ascorbic acid were acceptable, but were lowest in the Negro school. There was a high incidence of low transketolase activity in the blood of Negro students. Twenty-five percent of the boys and 50% of the girls had below acceptable thiamine levels in urine. Twenty-seven percent of the girls and 16% of the boys had low or deficient levels of urinary riboflavin. Folic acid excretion levels were similar in all 3 schools; folic acid excretion levels were lower in Negroes.</p>	<p>Dibble et al. (46)</p>
<p>672 teenagers, grades 9 through 12</p>	<p>Iowa statewide</p>	<p>Blood: vitamin A, ascorbic acid. Urine: thiamine, riboflavin, pyridoxine.</p>	<p>Of 666, approximately 30 had < 19 µg carotene/100 ml serum. Of 652, approximately 10 had < 19 µg vitamin A/100 ml. Of 392, approximately 10 had < 0.19 mg ascorbic acid/100 ml. Of 551, approximately 55 had < 99 µg thiamine/g creatinine in urine. Of 554, approximately 40 had < 199 µg riboflavin/g creatinine.</p>	<p>Hodges and Krehl (47)</p>
<p>283 subjects, 11 to 22 yr of age</p>	<p>Utah, Brigham City</p>	<p>Blood: ascorbic acid in white cells and platelets.</p>	<p>Ten percent of all students had gingivitis. Of the students with gingivitis, 186 were compared with 97 who had healthy gums. There were more ascorbic acid values in the deficient range for subjects with gingivitis.</p>	<p>Wilcox et al. (93)</p>
<p>40 college women of Asian ancestry</p>	<p>California, San Francisco and Berkeley</p>	<p>Blood: vitamin A and ascorbic acid.</p>	<p>Blood vitamin A and ascorbic acid were within the normal range.</p>	<p>Clarke and Margen¹</p>

TABLE 4 (Continued)
Vitamin nutrition status data arranged according to age group

Subjects	Location	Analyses	Nutritional status	Reference
120 hospital patients over 25 yr of age	New Jersey, Jersey City	Blood: vitamins A, E, B ₁₂ , B ₆ , ascorbic acid, thiamine, riboflavin, niacin, folic acid, pantothenic acid, biotin. Clinical examination.	Circulating levels for one vitamin were low in 105 subjects; for 2 vitamins low in 71. Serum folate activity was low in 45% of the 105. Over 25% of the subjects had a reduction in thiamine (levels were less than 20 $\mu\text{g}/\text{ml}$ serum), niacin (levels were less than 2.5 $\mu\text{g}/\text{ml}$ serum), and vitamin B ₆ (levels were less than 20 $\mu\text{g}/\text{ml}$ serum). From 10 to 15% of the subjects had less than 0.5 mg ascorbic acid/100 ml serum. Ten to 15% had vitamin A serum levels of less than 20 $\mu\text{g}/100$ ml. Ten to 15% had less than 100 $\text{m}\mu\text{g}$ of riboflavin/ml serum.	Leevy et al. (68)
111 Negro migrant farm workers	New York, King Ferry	Blood: vitamin A, ascorbic acid and transketolase activity. Urine: thiamine, riboflavin.	Biochemical measures showed the following percentages to have below adequate levels by ICNND standards: ascorbic acid, 14; carotene, 4.7; vitamin A, 2.4; thiamine, 36.5; riboflavin, 33.3.	Thiele et al. ¹
214 subjects over 50 yr of age	New York, Syracuse	Blood: vitamin A, ascorbic acid and transketolase activity. Urine: thiamine, riboflavin.	Ascorbic acid serum levels were deficient or low in 7% by ICNND standards. Less than 5% of the subjects had vitamin A serum levels below 20 $\mu\text{g}/100$ ml, or carotene serum levels below 40 $\mu\text{g}/100$ ml. Thiamine and riboflavin levels in the urine were at suboptimal levels in 41 and 17%, respectively. Transketolase activity of the blood was satisfactory.	Dibble et al. (56)
234 subjects, average age 71 yr, subjects were in a county home, public housing, or the veterans hospital	New York, Syracuse	Blood: vitamin A, ascorbic acid and transketolase activity. Urine: thiamine, riboflavin.	Ascorbic acid serum levels were deficient in 8% by ICNND standards. Vitamin A levels in serum were acceptable and high. The average vitamin A content of serum was 54 $\mu\text{g}/100$ ml; average carotene content was 134 $\mu\text{g}/100$ ml. Seven percent of the subjects had low transketolase activity in the blood and 18% had low levels of urinary thiamine. None of the subjects had deficient levels of urinary riboflavin.	Brin et al. (88)
10 men, 62 to 92 yr of age	New York, Syracuse	Blood: ascorbic acid and transketolase activity. Urine: thiamine, riboflavin, N ¹ -methylmethionamide, and xanthurenic acid following a tryptophan test load.	Ascorbic acid content of serum was 0.51 to 2.65 mg/100 ml. Thiamine was deficient in the urine of 5; 4 were deficient in thiamine as indicated by transketolase activity. Riboflavin and xanthurenic acid in the urine were in normal amounts. Excretion of N ¹ -methylmethionamide was low in 5, but not in the deficiency range.	Brin et al. (94)

¹ Clarke, J. K., and S. Marseen 1967 Body fat, diet, and physical activity of Oriental college women. Fiftieth Annual Meeting of the American Dietetic Association, Chicago (abstract).
² Thiele, V. F., M. Brin and M. V. Dibble 1968 Nutritional status evaluation of Negro migrant workers in King Ferry, New York. Federation Proc., 27: 679 (abstract).

TABLE 5
Dietary evaluation studies

Subjects	Location	Methods and calculations	Dietary evaluation	Reference
4310 infants, 6 months of age	Nationwide	24-hr dietary recall by mothers; calories and iron	Mean iron intake was 8.9 mg/day. Iron intake was low (1.1 mg/kg per day) compared with 1.5 mg/kg per day recommended by Comm. Nutr. Amer. Acad. Pediat.	Filer and Martinez (96)
4146 infants, 6 to 8 months of age	Nationwide	24-hr dietary recall; calories and 11 nutrients	Mean iron intake was low for all except 1/4 of the infants (Comm. Nutr. Amer. Acad. Pediat. standards). Mean intakes for all other nutrients were well above recommended levels.	Filer and Martinez (97)
40 infants, 9 months to 2 yr of age	Pennsylvania, University Park	7-day dietary records; calories and seven nutrients	Except for iron and ascorbic acid, few infants received < 2/3 recommended allowances (NRC, 1958). Eleven percent received < 2/3 of the recommended allowances for iron, and 15% < 2/3 for ascorbic acid.	Guthrie (98)
40 children from day care centers; 30 cared for at home; Caucasian and Negro; 4 yr of age	Alabama, Birmingham	3-day dietary records; calories and eight nutrients	Mean nutrient intakes were higher for day care groups in every nutrient than for children at home. Food supplied in the day care centers furnished more calcium and ascorbic acid. Both groups received 2/3 or more of the recommended allowances.	Cloud ¹
Preschool children, Project Head Start, 75 children, 88% Negro, 12% Caucasian	Maryland, Baltimore	24-hr dietary recall by mothers; calories and eight nutrients; information about family food consumption	Seventy percent of the children received 2/3 and over the recommended allowances (NRC, 1963) of calories and 8 nutrients. Lowest intakes were of iron, vitamin A, ascorbic acid, and niacin. Only 15 and 35% of the children had diets meeting the recommended allowances for calcium and iron, respectively, without the school meals. School meals supplied 70 and 25%, respectively, of the recommended allowances for calcium and iron.	Skidmore ²
115 children, 23 to 63 months of age, University of Minnesota housing project	Minnesota, St. Paul	3-day dietary records kept by mothers; calories and seven nutrients	Ninety percent or over of the children, 1 to 3 yr of age, had nutrient intakes exceeding 75% of the recommended allowances (NRC, 1963) except for iron (71%), niacin (79%), and ascorbic acid (86%). Of 4 to 6-yr-old children, intakes exceeded 90% of recommended amounts except for vitamin A (89%) and niacin (69%).	Dierks and Morse (99)

TABLE 5 (Continued)
Dietary evaluation studies

Subjects	Location	Methods and calculations	Dietary evaluation	Reference
16 children under 10 and their 93 siblings	Iowa, Iowa City	24-hr dietary recall by mothers twice during the year	The nutrient intakes of the 16 children receiving lunch and milk were greater on the average than the recommended allowances. Siblings staying at home lacked calcium, iron, thiamine, and ascorbic acid in sufficient amounts.	Kugel and Parsons (100)
164 crippled children under 11 yr old; Caucasian, Negro	North Carolina, five rural counties	Dietary recall by mothers for 1 day; weekly cross-check of foods consumed	Diets of 73% were inadequate, in 15% due to feeding difficulties caused by physical handicap. Only 44% of 71 Caucasian children and 11% of 93 Negro children had obviously adequate diets (NRC, 1958).	Bryan and Anderson (101)
134 children, 6 to 12 yr of age, from low income families	Vermont, Burlington	7-day dietary records kept by mothers	Children obtained < 90% of the recommended allowances (NRC, 1963) for calcium, vitamin A, and ascorbic acid.	Wakefield and Merrow (28)
332 children, 9 to 13 yr of age, from a depressed community, predominantly Negro	Massachusetts, Roxbury section of Boston	4-day dietary records. Individual meals were classified according to specific coding instructions	Negro children scored lower in every evaluation than the Caucasian children. Low scores were found for the consumption of citrus fruits and juices, green leafy and yellow vegetables, and milk. Thirty-three percent of the children had 2 or more unsatisfactory lunches in 4 days. Twenty-seven percent had 2 or more unsatisfactory scores for breakfast, and 14% had 2 or more unsatisfactory scores for evening meals.	Myers et al. (103)
642 children, 10 to 13 yr of age	New York, New York City	24-hr dietary recall. Evaluation by six food groups; nine micronutrients	Seventy-three percent of the diets were judged to be poor, 20% adequate, and 7% excellent.	Christakis et al. (33)
642 children, 10 to 13 yr of age	New York, New York City	24-hr dietary recall. Protein	Twelve percent had below adequate intakes of protein.	Baker et al. (90)
Children in eight Indian boarding schools, 7 to 14 yr of age	Dakotas	7-day dietary records	On the average, diets of the children were within the recommended allowances (NRC, 1958) for all nutrients except ascorbic acid.	Wenberg et al. (45)
200 children, 1 month to 18 yr of age, of professional and semi-professional parentage	Ohio, southwestern area	7-day dietary records. Calorie, protein, calcium, and phosphorus content	Calorie intake and calcium intake were below the recommended allowances (NRC, 1968). Protein and phosphorus intakes exceeded the recommended allowances.	Garn et al. (43)

1200 children, grades 1 through 12; 94% Caucasian, 4% Negro, 2% Indian	Oklahoma, five counties	24-hr dietary recall; nine nutrients	Fifty percent of the diets contained < 2/3 of the recommended allowance for ascorbic acid, 40% for vitamin A, 30% for calcium, 20% for iron, and 15% for riboflavin.	Becker (102)
421 adolescents, 13 to 18 yr of age	Southern Illinois	3-day dietary records; calories and nine nutrients	Nutrients consumed in the lowest amounts were calcium, iron, vitamin A, and ascorbic acid. Sixty percent of the females and 50% of the males consumed < 2/3 of the recommended allowance for vitamin A, 50% of the females and 60% of the males for ascorbic acid, 70% of the females and 40% of males for calcium, 40% of females and 20% of males for iron.	Wharton (104)
620 youth, grades 7, 9, 10, and 12	North Carolina, Greensboro	24-hr dietary recall; coded according to six food groups	Evaluation suggests that vitamin A, ascorbic acid, and calcium tended to be low.	Edwards et al. (105)
122 teenagers, Caucasian, Negro, Oriental	California, Berkeley	7-day dietary records; calories and eight nutrients	More diets furnished < 2/3 of the recommended allowances (NRC, 1963) for calcium and iron than for other nutrients. Twenty-six percent of the males and 49% of the females had < 2/3 of the recommended allowance for calcium, 12% of males and 58% of females for iron, 31% of males and 12% of females for ascorbic acid.	Hampton et al. (106)
2045 teenagers	Iowa, statewide	Detailed dietary history for 1/2 the subjects	A sizable number had low intakes of ascorbic acid. A minority had low intakes of iron.	Hodges and Krehl (47)
30 undernourished and 30 well-nourished girls	Alabama	Longitudinal study from early childhood to early adulthood. Field observations and food preparation and intake records	The undernourished girls had diets deficient in ascorbic acid, vitamin A, calcium, iron, and animal protein. The well-nourished girls had diets which consistently exceeded the recommended allowances in all nutrients.	Dreizen (44)
68 subjects, grades 11 and 12 in two schools	Virgin Islands, St. Thomas	7-day food intake records; calories and nine nutrients	In general, mean values showed that diets provided 2/3 or more of the recommended allowances (NRC, 1963), except for calcium.	Sprauve and Dodds (107)

TABLE 5 (Continued)
Dietary evaluation studies

Subjects	Location	Methods and calculations	Dietary evaluation	Reference
950 teenagers; Caucasian 60%, Oriental 10%, Negro 30%	California, Berkeley	7-day food intake records; calories and seven nutrients	Mean intakes of girls were lower than recommended allowances (NRC, 1963) for calcium, iron, and calories. Intake of boys met the recommended allowances for seven nutrients; only calories were low. Those from the lower socioeconomic groups had lower intakes of calories, protein, and ascorbic acid. More than 1/2 the females had iron intakes, 1/2 had calcium intakes, and 1/4 had vitamin A and ascorbic acid intakes < 2/3 of the recommended allowances. One-third of the boys had intakes of ascorbic acid, 1/5 of calories, calcium, vitamin A, and 1/10 of iron and thiamine < 2/3 of the recommended allowances.	Huenemann et al. (53)
282 Navajo Indian students, 11 to 22 yr of age	Utah, Brigham City	Five 1-day individual dietary records	From 8 to 33% of the total number of subjects had < 2/3 of the recommended allowance (NRC, 1958) of ascorbic acid.	McDonald (108)
144 female students 18 to 25 yr of age	Massachusetts, Boston	7-day dietary records; calories and eight nutrients	Fifty-seven percent had calcium intakes, 41% had iron intakes, 25% had riboflavin, thiamine, and energy intakes < 2/3 of the recommended allowances.	Fry (54)
106 married students, 90 children	Pennsylvania, Pennsylvania State University	24-hr dietary recall; calories and eight nutrients	Thirty-four percent had vitamin A intakes, 40% iron intakes, 38% ascorbic acid intakes below the recommended allowances (NRC, 1963).	Piley and Dodds (109)
60 college athletes, 18 to 25 yr of age	Texas, North Texas State University	5-day dietary records; calories and 10 nutrients	The high calorie diets consumed contributed minerals and vitamins in excess of the recommended allowances (NRC, 1958).	Mays and Scoular (110)
40 college women of Asian ancestry	California, Berkeley and San Francisco	7-day dietary records; calories and five nutrients	Several subjects had intakes of protein, iron, and calcium < 2/3 of the recommended allowances (NRC, 1963).	Clarke and Margen ³

120 hospital patients over 25 yr of age; lower income level	Arizona, Pima Indian Reservation	Dietary history by recall; calories and eight nutrients	Only 16% of the protein was from animal origin. Calcium, vitamin A, and riboflavin intakes were insufficient when compared with the recommended allowances (NRC, 1953).	Hesse (114)
35 Negro migrant families	New Jersey, Jersey City	Dietary recall for 1 week and dietary history obtained	There was a history of deficient dietary intake in 39% of the patients with hypovitaminemia which best correlated with low circulating levels of vitamin A, ascorbic acid, and vitamin B ₆ .	Leevy et al. (68)
100 families receiving public assistance (446 children)	Florida, Palm Beach County	1-week food intake record	Percentages of families receiving < 1/2 of the recommended allowances (NRC, 1958): ascorbic acid, 69%; vitamin A, 42%; riboflavin and calcium, 26%. Only 6% fell below 1/2 the recommended allowances for protein and calories.	Delgado et al. (111)
Children and adults in 100 homes	Ohio, Cuyahoga County	24-hr dietary recall; content of seven nutrients	Food of 80% of the families contained < 66% of the recommended allowances (NRC) of one or more nutrients. More than 80% of the children were in families receiving < 66% of the recommended allowances. The nutrients most often in short supply were ascorbic acid, vitamin A, and calcium.	Whipple (112)
87 persons	Puerto Rico, Dona Elena	24-hr dietary recall	Diets were low in good quality protein, calcium, vitamin A, and riboflavin. Other nutrient intakes appeared adequate.	Roberts (34)
20 families	Puerto Rico, Mavilla	24-hr individual food intake weighed; nutrient content	Intakes of total energy and fat were low and calcium and vitamin A were deficient. Protein, iron, ascorbic acid, and thiamine intakes were adequate; niacin and riboflavin intakes were borderline.	Fernandez et al. (36)
15 families	Puerto Rico, Ducey Alto	24-hr individual food intake weighed; nutrient content	According to the recommended allowances of the NRC, 1963, the diet was basically deficient in calcium, calories, iron, vitamin A, and riboflavin. Ascorbic acid intake was adequate except in infants and old men. Protein, thiamine, and niacin intakes were adequate.	Fernandez et al. (37)
			According to the recommended allowances of the NRC, 1963, the diet was basically deficient in calories, calcium, vitamin A, and riboflavin. Children and women had the poorest diets. Intakes of protein, iron, and niacin were low in small children and women.	Fernandez et al. (38)

TABLE 5 (Continued)
Dietary evaluation studies

Subjects	Location	Methods and calculations	Dietary evaluation	Reference
15 families	Puerto Rico, Masas	24-hr individual food intake weighed; nutrient content	Consumption of calories, vitamin A, riboflavin, and calcium were in general low compared with the recommended allowances of the NRC, 1963. Intakes of protein, ascorbic acid, and thiamine were adequate; niacin intakes were borderline.	Fernandez et al. (39)
Eskimos and Indians; 97 men in seven villages	Alaska	7-day dietary record; calories and seven nutrients	Average intakes of vitamin A, thiamine, and ascorbic acid were below $\frac{2}{3}$ of the recommended allowances (NRC, 1953). Calorie intake was also low. The average intakes of calcium, riboflavin, and niacin were adequate, but all were low in the southern villages.	ICNND (40)
189 subjects, 9 to 65 yr of age; 94 families in fall; 83 families in spring	Montana, Blackfoot Indian Reservation	24-hr dietary recall; weekly food records	In significant segments of the study group, the levels of calorie intake, protein intake, and the dietary supply of calcium, iron, vitamin A, and ascorbic acid were borderline. Twenty-two percent of the families surveyed in the fall and 20% in the spring had $< \frac{2}{3}$ of the recommended allowances for calcium; 17% in both groups had $< \frac{2}{3}$ of the recommended allowance for ascorbic acid.	ICNND and DIH (41)
137 persons, 9 to 65 yr of age; 63 families in fall and 50 in spring	Montana, Fort Belknap Indian Reservation	24-hr dietary recall; weekly food records	In significant segments of the study group, the levels of calorie intake, protein intake and the dietary supply of calcium, iron, and vitamin A and ascorbic acid were borderline. Sixteen percent of the families studied in the fall and 14% in the spring had $< \frac{2}{3}$ of the recommended allowance for vitamin A; 9% in the fall and 12% in the spring had $< \frac{2}{3}$ of the recommended allowance for ascorbic acid.	ICNND and DIH (42)
15 urban and rural families	Virgin Islands	24-hr dietary recall; calories and eight nutrients	Average iron and calcium intakes were below the recommended allowances (NRC, 1963).	Williams and Brush (113)

1268 low income families in Detroit, 837 in Fayette County, Pennsylvania	Michigan and Pennsylvania	7-day dietary recall	Twenty-nine percent of the families in Detroit and 26% of those in Fayette County had diets that met the recommended allowances (NRC, 1958) for all nutrients in April-May 1961. In September-October, after introduction of the Pilot Food Stamp Program, these figures were increased to 48 and 39%, respectively.	ERS and ARS, USDA (115)
Two groups of families: level of living I (higher); level of living II (lower)	Maine	Dietary recall	Families in level I had more adequate diets. Children had the most adequate diets, but they often lacked sufficient ascorbic acid and iron. Ascorbic acid, calcium, and iron intakes were most often low in all age groups.	Gushee and Thornbury ⁴
60 households, 283 persons	Pennsylvania, Bellefonte	24-hr dietary recall, use of government-donated foods noted; calories and eight nutrients	Donated foods added significantly to the adequacy of the diet. However, nutritive content of the diet was below the recommended allowances (NRC, 1958) for calcium, vitamin A, ascorbic acid for 2/3 of the households; calories and riboflavin for over 1/2; protein, thiamine, and iron for 2/5.	Pontzer and Dodds (116)
63 female Negro household heads	Wisconsin, Milwaukee	7-day dietary recall	A majority of the families consumed 100% or more of the recommended allowances (NRC, 1963) for all nutrients except calcium. Ascorbic acid was also frequently below adequate levels.	Jerome (117)
151 households, three income levels, Caucasian and Negro	Washington, D. C.	7-day dietary recall	Average food supply of households provided more than the recommended allowances (NRC, 1963) for each nutrient. Calcium intake was about the same as the recommended allowance, so quite a few families must have had low intakes.	CFE, ARS, USDA (118)
1225 families; 665 urban Caucasian, 424 rural Caucasian, 136 Negro	Texas	7-day dietary recall for family. Records were analyzed for pound use per family and per person and for their nutritional contribution to families	The 3 nutrients most frequently below adequate levels were ascorbic acid, thiamine, and calcium. This was especially true for low income families with teenagers. Food consumption of Caucasian and Negro families was similar, except that Negroes did not use many dairy products.	Stubbs (121)
209 households; group A, largely Negro, low income; group B, Caucasian, higher income	California, Berkeley Health Dep.	24-hr dietary recall per family; seven nutrients	Forty-five percent of group A and 57% of group B consumed 2/3 or more of the recommended allowances (NRC, 1958) for the seven nutrients studied. In both groups the nutrients most often lacking were vitamin A, thiamine, ascorbic acid, and calcium. The protein intake was above the recommended allowance for 80%.	Shapiro (122)

TABLE 5 (Continued)
Dietary evaluation studies

Subjects	Location	Methods and calculations	Dietary evaluation	Reference
517 Caucasian, 291 Negro urban families	Mississippi, four cities	Recall of use of milk, milk products during 1 week	Thirty-one percent of Caucasian families and 64% of Negro families had < 90% of amounts of dairy products recommended by USDA (120).	Dickens (119)
510 low income families	Mississippi, Washington and Sunflower Counties	7-day dietary recall	The average diet was poor, possibly for as many as 60% of the families. The diets of families who participated in the food stamp and food donation programs were similar in many respects to those who did not participate.	ARS, USDA (31)
Employees of textile mills and garment factories	South Carolina	2-week study of food bought at mill or factory for lunch; 1334 lunches in textile mills and 1670 in garment factories	In relation to energy value, the average contents of all nutrients in the lunches were low, especially in iron, vitamin A, niacin, and ascorbic acid.	Lease et al. (123)
571 pregnant Negro women	Tennessee, Nashville Hubbard Hospital	24-hr dietary recall at intervals during pregnancy	Intakes of energy, niacin, and ascorbic acid were < 2/3 of the recommended allowances (NRC, 1958), calcium < 1/2. Diets improved as the socioeconomic and educational levels improved.	Payton et al. (124)
483 pregnant Negro women; 381 clinic, 41 private, 61 had no prenatal care	Tennessee, Nashville Hubbard Hospital	7-day dietary recall; "nutrition index" used based on recommended allowances of NRC, 1953	Only 19% had diets providing 2/3 or more of the recommended allowances (1953). Better diets were noted when the socioeconomic and educational levels were higher.	Crump et al. (125)
86 women selected from patients at the prenatal and postpartum clinics; 42 clay-eaters, 23 cornstarch-eaters, 6 eating both, and 21 controls	Alabama, Tuskegee Institute	Dietary recall of pregnant and nonpregnant women	Fifty-four percent of the diets of clay-eaters and 32% of the diets of cornstarch-eaters were classified as "poor"; that is, they furnished < 49% of the recommended allowances (NRC, 1958). Only 14% of the diets of the controls were rated "poor." Diets of the clay- and cornstarch-eaters were low in calories, calcium, iron, thiamine, and niacin.	Edwards et al. (126)

patients	Taylor County	rich foods and green and yellow vegetables.	(127)
104 subjects, 51 to 97 yr of age	Massachusetts, Boston	In 39 people, protein made up < 15% of the calories. Thirty-seven percent had less than adequate riboflavin, 57% niacin, 30% calcium, 40% iron, 7% vitamin A, 21% thiamine, and 16% ascorbic acid.	Davidson et al. (59)
283 households; average age approximately 70 yr, low income	New York, Rochester	Shortages of calcium and ascorbic acid were the most frequent. Only 70% of the households met the recommended allowances (NRC, 1963) in full for either of these 2 nutrients. About 1/4 of the households had food intakes that furnished < 2/3 of the recommended allowances for calories or 1 or more of 7 nutrients.	LeBovit (128)
10 men, 62 to 96 yr of age	New York, Syracuse	Levels of thiamine in the diet were low. No other estimates were made.	Brin et al. (94)
214 subjects over 50 yr of age, residents of public housing; fall study	New York, Syracuse	At least 50% of the subjects consumed at least 2/3 of the recommended allowances (NRC, 1963) for calories, protein, iron, vitamin A, ascorbic acid, thiamine, and riboflavin, with the exception of ascorbic acid for men.	Dibble et al. (56)
101 hospital patients, over 65 yr of age	Ohio, Columbus Alum Crest Hospital	Ascorbic acid intake was low in January, but not in June. Intakes of protein, calories, calcium, iron, vitamin A, thiamine, and riboflavin were comparable to the recommended allowances (NRC, 1958).	Skillman et al. (57)
27 males, 62 females, 60 to 95 yr of age	Missouri, Columbus	Good sources of ascorbic acid were not always included. Milk was consumed in the least adequate amounts.	Pudelkewicz et al. (129)

TABLE 5 (Continued)
Dietary evaluation studies

Subjects	Location	Methods and calculations	Dietary evaluation	Reference
32 females, 65 to 85 yr of age living in their own homes	Nebraska, Lincoln	7-day dietary records or weighed food intakes; calories and 10 nutrients	In general, diets supplied more than $\frac{2}{3}$ of the recommended allowances (NRC, 1958). Iron, calcium, and vitamin A were consumed at less than satisfactory levels by 12, 16, and 29%, respectively.	Fry et al. (61)
65 aged nursing home patients from 13 homes (356 patients)	Wisconsin, Milwaukee	Estimation of food intake for 1 week by inventory method for 13 homes; 3-day dietary records of 65 subjects	One home had lower than the recommended allowances (NRC, 1953) of calcium, 1 of vitamin A, and 6 of ascorbic acid. Of the 65 patients, 62% obtained the recommended allowances for energy, 75% for protein, 51% for calcium, 83% for vitamin A, and 40% for ascorbic acid.	Hankin and Antonmattai (131)
229 subjects over 50 yr of age	California, Berkeley	24-hr dietary records; calories and eight nutrients	Intakes of calcium, vitamin A, and ascorbic acid were most frequently below the recommended allowances (NRC, 1963). One-fourth of the males and $\frac{1}{2}$ the females had $< \frac{2}{3}$ of the recommended allowance for calcium; $\frac{1}{4}$ of the males and females had $< \frac{2}{3}$ of the recommended allowances for vitamin A and ascorbic acid.	Steinkamp et al. (60)
252 men, 20 to 99 yr of age	Maryland, Baltimore and Washington D. C.	7-day dietary record; calories and eight nutrients	Intakes of all nutrients, with the possible exception of calcium, were adequate by 1964 NRC standards for the majority of the men.	McGandy et al. (132)

¹Cloud, H. H. 1967 Heights, weights, triceps skin-fold measurements, hematocrits, and dietary intake of 4-year-old children in day care centers and at home in Birmingham, Jefferson County, Alabama. Thesis, Department of Nutrition, Graduate School of the University of Alabama, University, Ala.

²Skidmore, K. 1965 Study of Head Start preschool children's food habits, Baltimore, Md., unpublished report.

³Clarke, J. K., and S. Margen 1967 Body fat, diet, and physical activity of Oriental college women. Fiftieth Annual Meeting of the American Dietetic Association, Chicago (abstract).

⁴Gushee, N. J., and M. E. Thornbury 1967 Dietary intake of family members in two socioeconomic levels of living. Fiftieth Annual Meeting of the American Dietetic Association, Chicago (abstract).