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ABSTRACT

This report details two screening programs aimed at determining childhood nutritional problems within a given community. Discussed in section I is a simplified screening approach which involves gathering information about the frequency of specific food stuffs and food nutrients in the community; obtaining family demographic and dietary information by interview; and determining stature, weight, and head size of each child. In section II a more detailed method is treated, which requires the gathering of specific demographic information about the community, a market analysis of local food stuffs, biographic data on the child, a dietary questionnaire for the family, and a physical examination specifically designed to detect nutritional deficiencies. Sample questionnaires and tables are included. (JB)

Screening Children for Nutritional Status:

suggestions for child health programs

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Maternal and Child Health Service
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preface

Under the sponsorship of the Maternal and Child Health Service, a group of experts met in Washington, D.C., on February 5, 1970, for the purpose of assembling suggestions that could be used in health programs for screening groups of children with respect to nutritional status. Collaborating in this effort were representatives of the Department of Health, Education, and Welfare and the Department of Agriculture.

Suggested Guidelines for Evaluation of Nutritional Status of Preschool Children, issued in 1966 by the Children's Bureau (of which MCHS was then a part), served as a focal point for discussion. It was generally agreed that the booklet should be revised and that it should: (1) Include consideration of nutritional status of all children less than 10 years of age; (2) focus on screening of groups of children rather than on assessment of nutritional status of individuals; and (3) clearly indicate what simple methods for assessment of nutritional status might be utilized in situations where facilities and personnel are limited. This revised booklet is based on these objectives and the other suggestions offered at the February 1970 meeting. Dr. Samuel J. Fomon, medical consultant in nutrition to MCHS, carried major responsibility for this publication.

MATERNAL AND CHILD HEALTH SERVICE MEETING TO DEVELOP SUGGESTIONS FOR SCREENING GROUPS OF CHILDREN FOR NUTRITIONAL STATUS

February 5, 1970

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Introduction

In planning community health programs for children it is particularly important to identify the nature and extent of common health problems, including nutritional problems. Knowledge of the frequency and severity of nutritional problems in a community will permit reasonable allocation of resources for solving the more important nutritional problems and will provide a basis for program evaluation. Without such knowledge, significant nutritional disorders may be ignored or an unwarranted investment of funds and effort may be made in combatting an imagined or trivial problem. For this reason, it seems desirable that *some* screening of groups of individuals for nutritional disorders be carried out in every health care delivery system.

Even a minimal screening program will require knowledge of the community and of food intakes and physical findings of the children. Some laboratory analyses will be necessary. Such a minimal screening program is described in Section I.

Section II includes a somewhat more sophisticated (and also more expensive and time-consuming) approach to evaluation of nutritional status. In addition, several reference tables are included as well as forms that may be utilized in recording relevant data.

Many of the suggestions in Section II are useful in evaluating nutritional status of individual children while Section I is focused primarily on nutritional screening of groups of children.

Section I

SIMPLIFIED APPROACH TO SCREENING GROUPS OF CHILDREN FOR NUTRITIONAL PROBLEMS

Information about the Community

Planning a nutritional screening program suitable for a specific community will be greatly aided by knowledge of the demographic characteristics of the community and certain information about the food and water supply. Suggestions about specific items of importance in this regard are given in section II (pp. 6–8). Feeding practices and choices of foods frequently differ remarkably from one ethnic group to another and therefore the racial and ethnic composition of the community should be known. In addition the economic and educational status of the community is likely to be correlated with the frequency of nutritional disorders.

Information about the presence of specific nutrients in various foods and about local customs concerning foods and feeding will be readily available in most communities. Such information will frequently provide clues regarding nutritional problems likely to be met in that locality and may suggest approaches to prevention. In this respect, it is important to determine the availability and uses of various foods fortified with vitamins or minerals. Most States now have laws requiring enrichment of commercially prepared breads and rolls with iron, riboflavin, thiamin, and niacin. Enrichment of these foods with calcium and vitamin D is optional. Information about laws relating to flours and grains in individual States is readily available from the American Institute of Baking, 400 East Ontario Street, Chicago, Ill. 60611. In communities where rice or grits is a dietary staple, it is important to determine whether products fortified with iron and vitamins are available.

Although most fluid whole milk sold by dairies is fortified with vitamin D, fluid whole milk not fortified with vitamin D is available in rural areas and in many cities, often at a slightly reduced price. Whether or not such milk is readily available within a community should be determined and an estimate made of the extent of its use.

Most fluid low-fat milks are fortified with vitamins A and D. On the other hand, powdered skim milk may not be so fortified. The availability and extent of use of fortified and unfortified milks in a community should be ascertained and should be considered in designing a nutritional screening program suitable for that community.

Particularly in areas in which goiter is found in children, knowledge of the availability and usage of iodized salt is valuable. Information on this topic can ordinarily be obtained from retail grocers.

The major source or sources of drinking water (e.g., community water supply, individual wells) should be determined. Information about fluoride content of water from these sources is usually available from State or local health authorities. Fluoride supplements might be widely recommended in a community in which fluoridated drinking water was unavailable but would be recommended only on an individual basis in a community where both fluoridated and unfluoridated water supplies were available.

Information about the Family and the Child

The frequency of nutritional deficiency disorders is highly correlated with the economic status of the family and with the educational level of the parents, especially the mother. Suggestions regarding useful items of information about the family are included in Section II (pp. 8–10).

Information relating to a child's past medical history and current state of health will generally be available in the child's health records and will not need to be obtained separately in relation to screening for nutritional status. Among the various items that may be useful to record (Section II, pp. 10–11) are birth weight, past history of serious or chronic illness and presence of any current illness. In analyzing data on heights and weights of children, it will frequently be desirable to compare with normal standards the values pertaining to those children who were full size at birth and do not have a history of chronic disease.

Food Intake

Information about food intake is mandatory in screening for nutritional status. If knowledge of food intake of the group to be screened is lacking, it will be desirable to accumulate data on food intake before laboratory aspects of screening are undertaken. This sequential approach would seem particularly desirable when laboratory facilities are limited.

No single method of collection of dietary intake information will be satisfactory for all purposes. Intake of food on a single day may not be typical of usual or long-term intake and cannot be expected on an individual basis to be correlated with physical or biochemical findings. Nevertheless, for the purpose of screening *groups* of children of similar age, sex, income level, etc., information about 1 day's intake can be of great value in alerting health workers to the *possibility* of a particular nutritional problem in some groups of children in the community. Appropriate further action can then be initiated. For example, if a substantial percentage of 1- to 2-year-old children in the community were found by 24-hour recall to have extremely low intakes of ascorbic acid, it would seem important to introduce biochemical screening with respect to ascorbic acid nutritional status of that age group. Obviously, nutrition counseling in the community might also be altered.

The 24-hour recall (Form A, page 12) has the great advantage of simplicity. It can be completed in 15 or 20 minutes by personnel with relatively little technical nutrition training. A method for machine analysis of the data has been reported.[1] Shortcuts aimed at obtaining dietary information in less than 15 minutes usually provide data of little value. It is better to spend 20 minutes obtaining relatively reliable information from one-fourth of the children than to spend 5 minutes with every child obtaining information of questionable value.

Suggestions for interviewers (page 14) and a form for obtaining additional information on dietary patterns and food practices (Form B, pp. 15–17) are also included in Section II.

Physical Examination

Although physical examinations are essential in nutritional screening of groups of children, these examinations will ordinarily be performed routinely in programs for delivering health care, and therefore the need for this information in nutritional screening will not constitute an added burden. Special attention should be paid to such general features as pallor, apathy, and irritability. The skin should be examined for petechiae, ecchymoses, or dermatitis, and the skeletal system for cranial bossing, enlarged joints, or costochondral beading. The lower extremities should be examined for edema; the condition of gingiva and teeth should be noted and visible thyroid enlargement recorded. The presence of heart murmurs or of enlargement of liver or spleen may suggest presence of a chronic disease responsible for growth retardation. When it is feasible to provide the degree of training

necessary for detection of signs of nutritional deficiencies in the hair, eyes, tongue, skin, nails, etc., it is suggested that a detailed form be used for recording the information (pp. 18–19). However, such training is usually difficult to accomplish and physical findings will be of value primarily in identifying diseases that may interfere with growth and general health. While such disorders (for example, congenital heart disease, chronic liver disease) may lead to unsatisfactory nutritional status, they must be distinguished from nutritional deficiencies resulting primarily from failure to *provide* an individual with food of adequate quantity and nutritional quality.

It seems necessary to emphasize that any physical finding suggesting nutritional abnormality should be looked upon as a clue rather than as a diagnosis and should be pursued further: Costochondral beading should not be interpreted as evidence of rickets without roentgenographic confirmation. Thyroid enlargement should not be interpreted as evidence of iodine deficiency without appropriate laboratory confirmation.

Stature and weight

Stature and weight are among the most important indices of nutritional status and *should be accurately determined.*

Stature should be recorded as length (recumbent) for children less than 2 years of age and for those whose height (standing) cannot be adequately determined. Measurement of length to the nearest 0.5 cm. (or ¼ inch) may be made as described by Falkner.[2] Stature of children 2 years of age and older should be recorded as height when this is possible. Measurement of height should be made to the nearest 0.5 cm. (or ¼ inch) without shoes using a right-angle triangular block of wood against a vertical wall.[2]

Scales for measurement of weight should be checked frequently with standards. Weight should be recorded to the nearest 0.2 kg. or 0.5 lb. (0.1 kg. or 0.25 lb. for infants) with the child wearing light clothing or robe but no shoes. Measurements of stature and weight should be evaluated in relation to data presented in Section II (pp. 17, 20–22).

Head circumference

When intake of calories or protein has been inadequate during at least several months of the first year of life, head circumference may be diminished. For this reason, it is desirable to measure head circumference of all children less than 2 years of age. A steel or plastic measuring tape or a cloth tape with metal inserts should be applied firmly over the glabella and supraorbital ridges anteriorly and that part of the occiput posteriorly that gives the maximal circumference. Measurement should be made to the nearest 0.5 cm. or ¼ inch and evaluated in relation to the data of Nellhaus[3] presented in Section II (pp. 23–24).

Laboratory and Roentgenographic Studies

Laboratory studies are of great assistance in screening children for nutritional disorders. Seldom will it be feasible to perform the full range of determinations listed in section II (pp. 25–26). In most instances it will be desirable to select a few laboratory studies to be carried out routinely and to do other studies only with children suspected of specific disorders on clinical grounds.

Selection of studies to be performed routinely

As a minimum, it is suggested that hemoglobin concentration or hematocrit be determined. The feasibility of performing other laboratory studies on a routine basis will depend in part on the level of laboratory competency available locally or the ease with which arrangements can be made for laboratory studies to be performed at a more distant site.

Certain laboratory determinations are likely to be of greatest value in one community while other determinations may be more valuable in another community. Within the same community, priorities may vary

from year to year or even within a period of several months. In general, specific analyses will be selected on the basis of clues provided by knowledge of the community, information about food intake or by physical findings.

For example, in a cloudy city where unfortified milk is widely available, screening for rickets might receive highest priority. For at least several months, preferably including the late winter, alkaline phosphatase activity might be determined in sera of all children less than 3 years of age; roentgenograms of the wrist might be made of all children with elevated alkaline phosphatase activity or with the slightest clinical suggestion of rickets. When several hundred children had been screened in this manner, it would ordinarily be possible to draw a conclusion about whether or not intensive preventive measures needed to be instituted. If rickets did not appear to be a problem of major importance in the community, routine screening would probably be discontinued.

If food intake data or physical findings suggested the possibilities of ascorbic acid deficiency and protein deficiency, high priority among laboratory studies would be given (at least for several months), to determining concentrations of ascorbic acid and albumin in sera.

As indicated in the examples just given, the laboratory can be used most effectively if analyses to be performed routinely are selected on the basis of information obtained by other screening efforts.

Laboratory confirmation of diagnosis based on clinical findings

Laboratory studies are also important in confining or excluding the existence of nutritional disorders suspected on clinical grounds. For example, a clinical diagnosis of rickets should be confirmed by determining alkaline phosphatase activity and concentration of inorganic phosphorus in serum and by a roentgenogram of the wrist. Similarly, a clinical impression of protein malnutrition (based, for example, on edema of the lower extremities) should be confirmed by determining the concentration of albumin in serum.

Section II

MORE DETAILED APPROACHES, DATA FORMS, AND TABULAR MATERIAL FOR INTERPRETING NUTRITIONAL DATA

Much of the material presented in Section II consists of: (1) Forms for recording data of interest in relation to nutritional status; (2) tabular material necessary for interpreting nutritional information; (3) more sophisticated approaches to nutritional status screening than those described in Section I; and (4) approaches that may in some instances be more applicable to assessing nutritional status of individual children than of groups of children.

Immediately following are forms for collecting information about the interviewer and respondent, the community, and the family.

Information about the Interviewer and Respondent

Date_____

Questions Regarding Interviewer

Interviewer's Title

- ☐ Aide or clerk
- ☐ Nurse
- ☐ Nutritionist
- ☐ Other, specify _____

Interviewer's Race

- ☐ White
  - ☐ *Mexican-American*
  - ☐ *Puerto Rican*

  } *Check if applicable*
- ☐ Black
- ☐ Other
  - ☐ *American Indian*
  - ☐ *Hawaiian*
  - ☐ *Asian*

  } *Check if applicable*

Does the interviewer speak Spanish?

- ☐ Yes
- ☐ No

Relation of Respondent to Registrant *(Ask respondent, "Are you the child's mother (father)?")*

- ☐ Mother
- ☐ Foster mother
- ☐ Grandmother
- ☐ Registrant
- ☐ Father
- ☐ Older brother or sister
- ☐ Other (specify) _____

Information about the Community

Date _____

I. Demographic Characteristics

1. Population size

2. Racial composition (percent)
   - White
     - *list if applicable:*
       - *Mexican-American*
       - *Puerto Rican*
   - Black
   - Other
     - *list if applicable:*
       - *American Indian*
       - *Hawaiian*
       - *Asian*

3. Level of annual income	Median	Range
White		
list if applicable:		
Mexican-American		
Puerto Rican		
Black		
Other		
list if applicable:		
American Indian		
Hawaiian		
Asian		

4. % of unemployment
   - White
     - *list if applicable:*
       - *Mexican-American*
       - *Puerto Rican*
   - Black
   - Other
     - *list if applicable:*
       - *American Indian*
       - *Hawaiian*
       - *Asian*

5. Median level of education (years of schooling)

   a. Total

      Male
      Female

   b. By race

      White

      list if applicable:

      Mexican-American
      Puerto Rican

      Black

      Other

      list if applicable:

      American Indian
      Hawaiian
      Asian

II. Food Supply

	Percent of commercial market	Price differential (enr. vs. unenr.)	Source of information
Milk, fluid whole, fortified with vitamin D			
Milk, nonfat dry, fortified with vitamins A&D			
Milk, evaporated, fortified with vitamin D			
Bread, enriched with B vitamins and iron			
Bread, enriched with B vitamins, iron, calcium and vitamin D			
Rice, enriched with B vitamins and iron			
Grits, enriched with B vitamins and iron			
Macaroni, noodle products; enriched with B vitamins and iron			
Bakery products, sweet rolls, doughnuts, enriched with B vitamins, iron			
Fruit drinks, enriched with vitamin C			
Salt, iodized			

III. Water Supply

Community water supplies are used by _____ percent of population

Contain _____ ppm of fluoride

☐ Naturally fluoridated

☐ Artificially fluoridated

Source of information_____

_____

Contain _____ ppm of iron

Source of information_____

_____

Well water utilized by _____ percent of population

Contains _____ ppm of fluoride

Source of information_____

_____

Contains _____ ppm of iron

Source of information_____

Information about the Family

Family Name_____

Date_____

☐ Father or ☐ Father surrogate

Mother ☐ or Mother surrogate ☐

_____ Age (years) _____

☐ WHITE ☐

Check if applicable

☐ *Mexican-American* ☐

☐ *Puerto Rican* ☐

☐ BLACK ☐

☐ OTHER ☐

Check if applicable

☐ *American Indian* ☐

☐ *Hawaiian* ☐

☐ *Asian* ☐

☐ Usually lives with family ☐

☐ Speaks English ☐

Speaks other language (specify)

_____ _____

Education

Highest grade completed

☐ 0 ☐

☐ 1–3 ☐

☐ 4–6 ☐

☐ 7–8 ☐

☐ 9–11 ☐

☐ High School graduate ☐

☐ Attended College ☐

☐ College graduate ☐

☐ Don't know ☐

Before taxes, which group (below) do you think your family income fell into last year?

Less than $1,000	$7,000 to $7,999
$1,000 to $1,999	$8,000 to $8,999
$2,000 to $2,999	$9,000 to $9,999
$3,000 to $3,999	$10,000 to $14,999
$4,000 to $4,999	$15,000 to $19,999
$5,000 to $5,999	$20,000 and over
$6,000 to $6,999	

Be sure to include income from all sources such as:

Wages and salaries	Pensions
Social Security	Support from others
Welfare payments	Income after expenses from business and farming
Insurance payments	
Veterans benefits	

Total number of persons supported by this income _____.

Number of children less than 9 years of age supported by this income _____.

Is family (or any family member)

- ☐ Receiving donated foods
- ☐ Participating in Food Stamp Program
- ☐ Participating in Supplemental Food Program
- ☐ Receiving free ☐ or reduced cost ☐ lunch, and/or breakfast in school, day care or Head Start program

Who prepares the meals? _____

Who is responsible for feeding the child? _____

Does the home have a working stove? ☐ Yes ☐ No

Oven? ☐ Yes ☐ No

Does the home have a refrigerator? ☐ Yes ☐ No

Home Location?

☐ Urban ☐ Suburban ☐ Rural nonfarm ☐ Farm ☐ Other

Does the family do any of the following to obtain part of its food supply?

☐ Have a vegetable garden ☐ Keep a cow
☐ Raise chickens ☐ Fish

Information about the Child

As mentioned in Section I certain data concerning aspects of general health of children are essential in evaluating nutritional status of groups of children. Other data, while not essential, may be highly useful. For example, the immunization status of children in a community is likely to reflect the level of health care generally and may therefore be correlated with the level of nutritional supervision.

General information about the individual child is often important in assessing his nutritional status. Motor development will ordinarily be retarded in the case of severe or prolonged illness ("serious illnesses") while the age at which the child began to walk ("walked alone at ____ months") represents a developmental landmark that will be recalled by most parents of preschool children. This landmark is useful in assessing progress during infancy.

Retarded growth, the most common manifestation of gross nutritional deficiency, may reflect serious illness of non-nutritional origin. Proper interpretation is therefore impossible unless a record is made of each serious or prolonged illness. This knowledge of past or current illnesses may also aid in interpreting other manifestations suggesting nutritional deficiency.

Information about the Child

Date of Evaluation_____

Name_____

Address_____

Birth date_____

Sex: ☐ Male ☐ Female

Birth weight_____

Birth order_____

Multiple birth ☐ Yes ☐ No

Feeding during first year

	Duration (months)				
	0	1	1–3	3–6	6–12
Breast					
Iron-fortified formula					
Other formula					
Other milk—specify					

Dietary supplements	Duration (months)					
	1	1–6	6–12	12–24	Now	Brand name if known
Vitamins						
Vitamins with iron						
Vitamins with fluoride						
Vitamins with fluoride and iron						

Regularity of administration (specify)_____

Immunizations

- ☐ DPT primary series
- ☐ DPT, DT, or tetanus booster
- ☐ Smallpox vaccine
- ☐ Oral polio vaccine
- ☐ Measles vaccine
- ☐ German measles (rubella) vaccine
- ☐ Mumps vaccine

Walked alone at _____ months

Serious illnesses:

Hospitalizations (give age, time hospitalized, and nature of illness):

☐ Ill now? If ill, indicate nature of illness:

Food Intake

The need for data on food intake has been emphasized in Section I. Suitable information will usually be obtained most easily by 24-hour recall (Form A). The data can be conveniently tabulated for coding and summarized using a method [1] designed for this purpose.

If time permits and there is need for additional information on dietary patterns and food practices, the Dietary Questionnaire (Form B) may be employed to indicate the frequency with which various foods are eaten. It supplements and verifies the 24-hour recall qualitatively. The two forms (A and B) may be used together to describe dietary patterns of groups of children.

Form B may be used to describe the frequency of consumption of foods by groups

of children classified by age, weight, or other characteristics. For example, it may be used to show how frequently meat is consumed at different economic levels, or how frequently high-carbohydrate foods are consumed by obese children. It cannot be used for calculation of nutrient intake, since amounts of foods consumed are not included.

It is recommended that Forms A and B be used by trained interviewers with supervision from a nutritionist especially trained in obtaining dietary recall information. A well-qualified nutritionist should be called upon to advise on selection of the method for collecting dietary intake information in specific situations and for selection of methods for analyzing and processing the data collected.

When information on the nutrient intake of individual children is desired, a more detailed and accurate method of obtaining data on both frequency and amounts of foods consumed must be used. This method is not included in these guidelines because it requires an interviewer with special training and experience in the use of the method as well as considerable background in nutrition and allied sciences. Therefore, the reader interested in details of a more complex nutrition history is referred to a report by Beal.[4]

Food Intake

Form A—24-Hour Recall

Name_____

Date & Time of Interview_____

Length of Interview_____

Date of Recall_____

Day of the week of Recall

1–M 2–T 3–W 4–Th 5–F 6–Sat 7–Sun

"I would like you to tell me about everything your child ate and drank from the time he got up in the morning until the time he went to bed at night and what he ate during the night. Be sure to mention everything he ate or drank at home, at school, and away from home. Include snacks and drinks of all kinds and everything else he put in his mouth and swallowed. I also need to know where he ate the food, but now let us begin."

What time did he get up yesterday?_____

Was it the usual time?_____

What was the first time he ate or had anything to drink yesterday morning? (list on the form that follows)

Where did he eat? (list on the form that follows)

Now tell me what he had to eat and how much?

(*Occasionally the interviewer will need to ask:*)

When did he eat again? or, is there anything else?

Did he have anything to eat or drink during the night?

Was intake unusual in any way? Yes _____ No _____

(If answer is yes) Why? _____

In what way? _____

_____

What time did he go to bed last night? _____

Does he take vitamin and/or mineral supplements?

Yes _____ No _____

(If answer is yes) How many per day? _____

Per week? _____

What kind? (Insert brand name if known)

Multivitamins _____

Ascorbic Acid _____

Vitamins A and D _____

Iron _____

Other _____

Suggested Form for Recording Food Intake

TIME	WHERE EATEN*	FOOD	TYPE AND/OR PREPARATION	AMOUNT	FOOD CODE	AMOUNT CODE**

*Code
H—Home
R—Restaurant, drug store or lunch counter
CL—Carried lunch from home
CC—Child care center
OH—Other home (of a friend, babysitter, or relative)
S—School
FD—Food dispenser

**Do not write in these spaces

Suggestions for Interviewers:

Information will usually be obtained from [illegible] responsible for feeding the child. Older children may be able to give more reliable information regarding their own intakes than will the responsible adult. The interviewer should judge this in each individual case.

How questions are asked is important. Avoid questions that suggest the correct answers—e.g., Did you have a dark-green or deep-yellow vegetable today? Avoid expressing approval or disapproval of the foods reported. If you feel there are omissions, ask additional questions: What did he drink with his lunch? What did he have on his toast?

Check carefully for the following information to help complete the 24-hour recall intake form:

A. *Additions to foods already recorded, such as:*

1. Fats: Butter, margarine, honey-butter, peanut butter, mayonnaise, lard, meat drippings, cheese spreads, and others.

   Used on toast, bread, rolls, buns, cookies, crackers, sandwiches.

   Used on vegetables.

   Used on potatoes, rice, noodles. etc.

   Used on other foods.

2. Sugars: Jam, jelly, honey, syrup, sweetening, etc.

   Used on breads, sandwiches, vegetables, fruit, cereal, coffee, tea, other foods.

3. Other spreads: Catsup, mustard, etc.

4. Milk: Cream, half and half, skim milk, etc.

   Used on cereal, coffee, tea, desserts, other foods.

5. Gravies: Used on bread, biscuits, meat, potatoes, rice, noodles, other foods.

6. Salad dressings: Used on vegetables, salads, sandwiches, other foods.

7. Chocolate or other flavoring to milk, e.g., Quik, Bosco.

B. *Food Preparation*

1. Preparation of eggs, e.g., fried, scrambled, boiled, poached.

2. Preparation of meat, poultry, fish, e.g., fried, boiled, stewed, roasted, baked, broiled.

3. Preparation of mixed dishes—major ingredients used, e.g, tuna fish and noodles, macaroni and cheese.

4. Special preparation of food—strained, chopped, etc.

C. *Special additional detail about food items*

1. Kinds of milk (whole, partially skim, skim, powdered, chocolate, etc.)

2. Kinds of carbonated beverages (regular, low-calorie).

3. Kinds of fruits (canned, frozen, fresh, dried, cooked with sugar added).

4. Kinds of fruit juices, fruit drinks, or juice substitutes.

By carrying a few standardized props it will be possible to obtain more accurate recording of amounts: a teaspoon and tablespoon; several sizes of glasses and bowls (including a 4-oz. and an 8-oz. measure); something to indicate thickness of meat—a ruler or a standard form such as a model of a slice of bread.

Food Intake

Form B—Dietary Questionnaire

Name _____

Date _____

1. Does the child eat at regular times each day?_____

2. How many days a week does he eat—
   a morning meal? _____
   a lunch or mid-day meal? _____
   an evening meal? _____
   during the night* _____

3. How many days a week does he have snacks—
   in mid-morning? _____
   in mid-afternoon? _____
   in the evening? _____
   during the night* _____

4. Which meals does he usually eat with your family?
   None _____ Breakfast _____ Noon Meal _____ Evening Meal _____

5. How many times per week does he eat at school or child care center or day camp?
   Breakfast _____ Lunch _____ Between meals _____

6. Would you describe his appetite as Good? _____ Fair? _____ Poor? _____

7. At what time of day is he most hungry?
   Morning _____ Noon _____ Evening _____

8. What foods does he dislike? _____
   _____

9. Is he on a special diet now? Yes _____ No _____
   If *Yes*, why is he on a diet? (check)
   _____ for weight reduction (own prescription)
   _____ for weight reduction (doctor's prescription)
   _____ for gaining weight
   _____ for allergy, specify _____
   _____ for other reason, specify _____
   If *No*, has he been on a special diet within the past year? Yes __ No __
   If *Yes*, for what reason? _____

10. Does he eat anything which is not usually considered food ? Yes __ No __
    If *Yes*, what? _____ How often? _____

11. Can he feed himself? Yes __ No __
    If *Yes*, with his fingers? _____ with a spoon? _____

* Include formula feeding for young children

12. Can he use a cup or glass by himself? Yes __ No __

13. Does he drink from a bottle with a nipple? Yes __ No __

If *Yes*, how often? _____ At what time of day or night? _____

_____

14. How many times *per week* does he eat the following foods (at any meal or between meals)?

Circle the appropriate number:

Bacon	0	1	2	3	4	5	6	7	>7, specify _____
Tongue	0	1	2	3	4	5	6	7	>7, specify _____
Sausage	0	1	2	3	4	5	6	7	>7, specify _____
Luncheon meat	0	1	2	3	4	5	6	7	>7, specify _____
Hot dogs	0	1	2	3	4	5	6	7	>7, specify _____
Liver—chicken	0	1	2	3	4	5	6	7	>7, specify _____
Liver—other	0	1	2	3	4	5	6	7	>7, specify _____
Poultry	0	1	2	3	4	5	6	7	>7, specify _____
Salt pork	0	1	2	3	4	5	6	7	>7, specify _____
Pork or ham	0	1	2	3	4	5	6	7	>7, specify _____
Bones (neck or other)	0	1	2	3	4	5	6	7	>7, specify _____
Meat in mixtures (stew, tamales, casseroles, etc.)	0	1	2	3	4	5	6	7	>7, specify _____
Beef or veal	0	1	2	3	4	5	6	7	>7, specify _____
Other meat	0	1	2	3	4	5	6	7	>7, specify _____
Fish	0	1	2	3	4	5	6	7	>7, specify _____

15. How many times *per week* does he eat the following foods (at any meal or between meals)?

Circle the appropriate number:

Fruit juice	0	1	2	3	4	5	6	7	>7, specify _____
Fruit	0	1	2	3	4	5	6	7	>7, specify _____
Cereal-dry	0	1	2	3	4	5	6	7	>7, specify _____
Cereal-cooked or instant	0	1	2	3	4	5	6	7	>7, specify _____
Cereal-infant	0	1	2	3	4	5	6	7	>7, specify _____
Eggs	0	1	2	3	4	5	6	7	>7, specify _____
Pancakes or waffles	0	1	2	3	4	5	6	7	>7, specify _____
Cheese	0	1	2	3	4	5	6	7	>7, specify _____
Potato	0	1	2	3	4	5	6	7	>7, specify _____
Other cooked vegetables	0	1	2	3	4	5	6	7	>7, specify _____
Raw vegetables	0	1	2	3	4	5	6	7	>7, specify _____
Dried beans or peas	0	1	2	3	4	5	6	7	>7, specify _____
Macaroni, spaghetti, rice, or noodles	0	1	2	3	4	5	6	7	>7, specify _____
Ice cream, milk pudding, custard or cream soup	0	1	2	3	4	5	6	7	>7, specify _____
Peanut butter or nuts	0	1	2	3	4	5	6	7	>7, specify _____
Sweet rolls or doughnuts	0	1	2	3	4	5	6	7	>7, specify _____
Crackers or pretzels	0	1	2	3	4	5	6	7	>7, specify _____
Cookies	0	1	2	3	4	5	6	7	>7, specify _____
Pie, cake or brownies	0	1	2	3	4	5	6	7	>7, specify _____
Potato chips or corn chips	0	1	2	3	4	5	6	7	>7, specify _____
Candy	0	1	2	3	4	5	6	7	>7, specify _____
Soft drinks, popsicles or Koolaid	0	1	2	3	4	5	6	7	>7, specify _____
Instant Breakfast	0	1	2	3	4	5	6	7	>7, specify _____

16. How many servings *per day* does he eat of the following foods?
Circle the appropriate number:

Bread (including sandwich), toast, rolls, muffins (1 slice or 1 piece is 1 serving)	0	1	2	3	4	5	6	7	>7, specify _____
Milk (including on cereal or other foods) (8 ounces is 1 serving)	0	1	2	3	4	5	6	7	>7, specify _____
Sugar, jam, jelly, syrup (1 teaspoon is 1 serving)	0	1	2	3	4	5	6	7	>7, specify _____

17. What specific kinds of the following foods does he eat most often?

Fruit juices _____

Fruit _____

Vegetables _____

Cheese _____

Cooked or instant cereal _____

Dry cereal _____

Milk _____

Physical Examination

As discussed in Section I, a general physical examination is important in nutritional screening as it is in other aspects of health care. When it is feasible to provide the degree of training necessary for detection of signs of nutritional deficiencies in the hair, eyes, tongue, nails, etc., it is suggested that a form be used similar to that which was employed by National Nutrition Survey[5] (p. 18).

Stature and Weight

Deficiency of total caloric intake, of protein or of any other essential nutrient, may result in decreased rate of growth and, ultimately, in abnormally low stature or weight. Comparison of size of children in the population under study with size of normal children is therefore extremely valuable in screening groups of children with respect to nutritional status. However, it is extremely difficult to locate suitable data concerning size of normal children. Data most commonly employed as reference norms have been based on semilongitudinal observations of volunteers. The extent to which such observations reflect size of the general childhood population must be questioned.

Recently the Health Examination Survey has reported[6] size of children from 6 through 11 years of age. In contrast to other large-scale studies in the United States, these children had been selected by a national probability sampling technique and would be more likely to reflect size of American children generally. Table 1 is adapted from the National Health Survey findings. The following description of the data in Table 1 has been provided by Dr. Hamill.[7]

The data have been adapted from the findings of the Health Examination Survey's Cycle II concerning 7,119 children examined between 1962 and 1965. These children comprised 96 percent of the nationwide probability sample of 7,417 children representing the 24 million non-institutionalized children 6 through 11 years of age in the United States. A detailed description of the data has been published.[6]

In order that the data in Table 1 might reflect as closely as possible the anticipated growth of normal well-fed children in the United States, data from two groups of children were excluded from these tabulations of the Health Examination Survey data: Those with birth weights less than 5 pounds 9 ounces and those from families with annual incomes less than $3,000. From preliminary socioeconomic analysis of the Health Examination data and from other sources, it has been shown that the relationship of height and weight to annual family income in the United States is very roughly linear, with the biggest difference occurring at about the $3,000 level; that is, heights and weights tended to be less for children in families which had incomes below this figure than for children in families which had higher incomes.

NATIONAL NUTRITION SURVEY
PEDIATRIC CLINICAL EXAMINATION

(Children under 6 years of age)

Budget Bureau No. 68-S68029
Approval Expires June 30, 1970

A. Identification code

State (1-2) | County (3-5) | E.D. (6-7)

Household No. (8-9) | Family (10) | Line No. (11-12)

Dietary (13) | Date of Birth (14-19): Month Day Year | Sex (20)

B. Name *(First, middle, last)*

C. GENERAL EXAMINATION—Code: 0–Negative; 1–Positive; unless other positive codes are designated; 8–Not applicable

Examination		Doubtful	Col. No.	Code
1. HAIR All Neg. ☐	a. Dry staring		(21)	
	b. Dyspigmented		(22)	
	c. Easily Pluckable		(23)	
	d. Abnormal texture or loss of curl		(24)	
2. EYES All Neg. ☐	a. Circumcorneal injection, bilateral		(25)	
	b. Conjunctival injection, bilateral		(26)	
	c. Xerosis conjunctivae		(27)	
	d. Bitot's spots		(28)	
	e. Keratomalacia		(29)	
	f. Xerophthalmia		(30)	
3. LIPS All Neg. ☐	a. 1—Angular lesions 2—Angular scars 3—Both		(31)	
	b. Cheilosis		(32)	
4. TEETH All Neg. ☐	a. Visible caries 4+		(33)	
	b. 1—Debris 2—Calculus, 3—Both		(34)	
	c. Fluorosis		(35)	
5. GUMS All Neg. ☐	a. Marginal redness or swelling 1—Local 2—Diffuse		(36)	
	b. Swollen red papillae, 1—Local 2—Diffuse		(37)	
	c. Bleeding gums 1—Local 2—Diffuse		(38)	
6. TONGUE All Neg. ☐	a. Filiform papillary atrophy 1—Mild 2—Moderate 3—Severe		(39)	
	b. Fungiform papillary hypertrophy or hyperemia 1—Mild 2—Moderate 3—Severe		(40)	
	c. Geographic		(41)	
	d. Fissures		(42)	
	e. Serrations or swellings		(43)	
	f. Red edges		(44)	
	g. Scarlet Beefy (Glossitis)		(45)	
	h. Magenta		(46)	
7. FACE AND NECK All Neg. ☐	a. Nasalabial Seborrhea		(47)	
	b. Parotids visibly enlarged		(48)	
	c. Thyroid enlarged 0, 1, 2, 3		(49)	
8. FINGERS AND NAILS Neg. ☐	1—Clubbed 2—Spooned 3—Ridged 4—Combinations		(50)	
9. SKIN All Neg. ☐	a. Follicular Hyperkeratosis, Arms		(51)	
	b. Follicular Hyperkeratosis, Back		(52)	
	c. Dry or scaling (Xerosis)		(53)	
	d. Hyperpigmentation, Face and hands		(54)	
	e. Thickened Pressure Points		(55)	

C. GENERAL EXAMINATION—continued

Examination		Doubtful	Col. No.	Code
10. ABDOMEN All Neg. ☐	a. Pot belly		(56)	
	b. Hepatomegaly		(57)	
11. LOWER EXTREMITIES Neg. ☐	a. Pretibial Edema-Bilateral		(58)	
12. SKELETAL All Neg. ☐	a. Beading of ribs		(59)	
	b. Bowed legs		(60)	

Examination		Doubtful	Col. No.	Code
12. SKELETAL (Continued) All Neg. ☐	c. Epiphyseal Enlargement, wrists		(61)	
	d. Bossing of skull		(62)	
	e. Winged scapula		(63)	
13. IMPRESSIONS All Neg. ☐	1—Skinny 2—Fat 3—Neither		(64)	
	1—Apathetic 2—Irritable 3—Both		(65)	

D. Date of Examination (69–74)
Month Day Year

E. Completion code (75)
0—Completed
1—Refusal
2—Not available
3—Informant incapable
4—Other

F. Examiner's name
Code No. (76–77)

G. Card number (78–80)
0 3 1

Comments:

The data included in the table are raw "unweighted" data because of the preliminary state of the analysis; consequently the resulting frequency distributions cannot be applied to the U.S. population of children 6–11 years of age as can be done in the formal reports of findings from the National Health Survey.

The following suggestions are made for utilization of the data in Table 1 for interpreting size of children in a population being screened with respect to nutritional status. Data on the population being evaluated should be recorded and the results summarized in a manner similar to those presented in Table 1; that is, only data pertaining to children with birth weights greater than 5 pounds 8 ounces (2,500 g.) should be included and the summary figures for each sex should be tabulated for age intervals of 6 months. The number of children in the study population whose heights (or weights) fall below the 10th percentile values of Table 1 should be determined and expressed as a percentage of the total and interpreted on this basis. For example, if it were found that 17.5 percent of males in the study population had heights less than the 10th percentile values of Table 1, it would be reasonable to conclude that 7.5 percent of males in the study group were undersized (i.e., height of 10 percent of normal males are *expected* to fall below the 10th percentile values; 17.5 percent are *observed* to fall below, giving an excess of 7.5 percent). Of course, the above procedure only provides a quick, crude comparison; for a proper comparison, the sample size and variability, along with all other important epidemiologic factors, must be taken into account.

It is hoped that a study in progress at present will yield data of similar nature concerning children less than 6½ years of age. Meanwhile, it is necessary to use reference data that have not been based on a random sampling technique. For this purpose, the data of Stuart and Meredith [8] are frequently employed and are highly useful as an arbitrary reference. However, such data are of limited value for estimating the percentage of stunted children in a population being screened.

Head Circumference

As discussed on page 3 of Section I, measurement of head circumference should be made to the nearest 0.5 cm. or ¼ inch and evaluated in relation to the data of Nellhaus [3] as presented in the charts (p. 23–24).

Laboratory Studies

The basis for selecting specific laboratory determinations has already been discussed (pp. 3–4). Studies that require timed collections of blood and/or urine are unsuitable for screening purposes and are not considered here. (See Table 2, p. 25–26.)

In most instances it will be desirable to obtain a small sample of venous blood from the antecubital or external jugular vein (the femoral vein is not recommended). However, several of the determinations listed can be performed on an amount of capillary blood readily obtained from fingertip or heel. Blood should be placed immediately into plain tubes (for serum) or into dry, heparinized tubes (for plasma).

Microhematocrit and concentration of hemoglobin should be determined with blood obtained directly from the fingertip or heel or from the heparinized tube. Heparinized blood should then be centrifuged immediately, whereas blood in plain tubes should be centrifuged as soon as it has clotted. If concentration of ascorbic acid is to be determined, it should be performed immediately or the plasma should be mixed with metaphosphoric acid and frozen (without separating the supernatant from the protein precipitate) until the determination can be performed. Other determinations should be performed within 8 hours or the serum or plasma should be frozen and maintained in the frozen state until the analyses can be performed.

Urine should be acidified with hydrochloric acid to a final pH less than 3.0. If analyses cannot be carried out within 8 hours, the samples should be stored in the frozen state.

Table 1—Data from Health Examination Survey

Height of Males from 6½ Through 10 Years of Age

Age (years)	Number of subjects	Centimeters (percentiles)					Inches (percentiles)				
		10th	25th	50th	75th	90th	10th	25th	50th	75th	90th
6½	219	112.9	115.5	119.0	121.9	124.2	44.5	45.5	46.9	48.0	48.9
7	223	115.6	119.1	122.5	126.0	128.7	45.5	46.9	48.2	49.6	50.7
7½	224	118.7	121.3	124.5	128.2	131.2	46.7	47.8	49.0	50.5	51.7
8	215	121.2	125.0	128.1	131.3	135.2	47.7	49.2	50.4	51.7	53.2
8½	211	123.8	126.9	130.2	133.3	136.3	48.7	50.0	51.3	52.5	53.7
9	213	126.0	129.5	133.0	137.1	140.5	49.6	51.0	52.4	54.0	55.3
9½	218	128.2	133.0	135.7	139.0	142.7	50.5	52.4	53.4	54.7	56.2
10	227	129.5	133.3	138.5	142.3	145.7	51.0	52.5	54.5	56.0	57.4

Weight of Males from 6½ Through 10 Years of Age

Age (years)	Number of subjects	Kilograms (percentiles)					Pounds (percentiles)				
		10th	25th	50th	75th	90th	10th	25th	50th	75th	90th
6½	219	18.1	20.4	21.8	23.6	25.6	40.0	45.0	48.0	52.0	56.5
7	223	19.7	21.5	23.1	25.6	27.7	43.5	47.5	51.0	56.5	61.0
7½	224	20.9	22.2	24.5	26.5	29.9	46.0	49.0	54.0	58.5	66.0
8	215	22.0	23.8	26.1	28.4	31.3	48.5	52.5	57.5	62.5	69.0
8½	211	23.1	25.0	27.7	29.5	34.0	51.0	55.0	61.0	65.0	75.0
9	213	24.5	26.1	28.6	32.0	36.3	54.0	57.5	63.0	70.5	80.0
9½	218	25.6	27.4	29.9	33.8	38.8	56.5	60.5	66.0	74.5	85.5
10	227	25.6	28.6	31.3	35.4	39.9	56.5	63.0	69.0	78.0	88.0

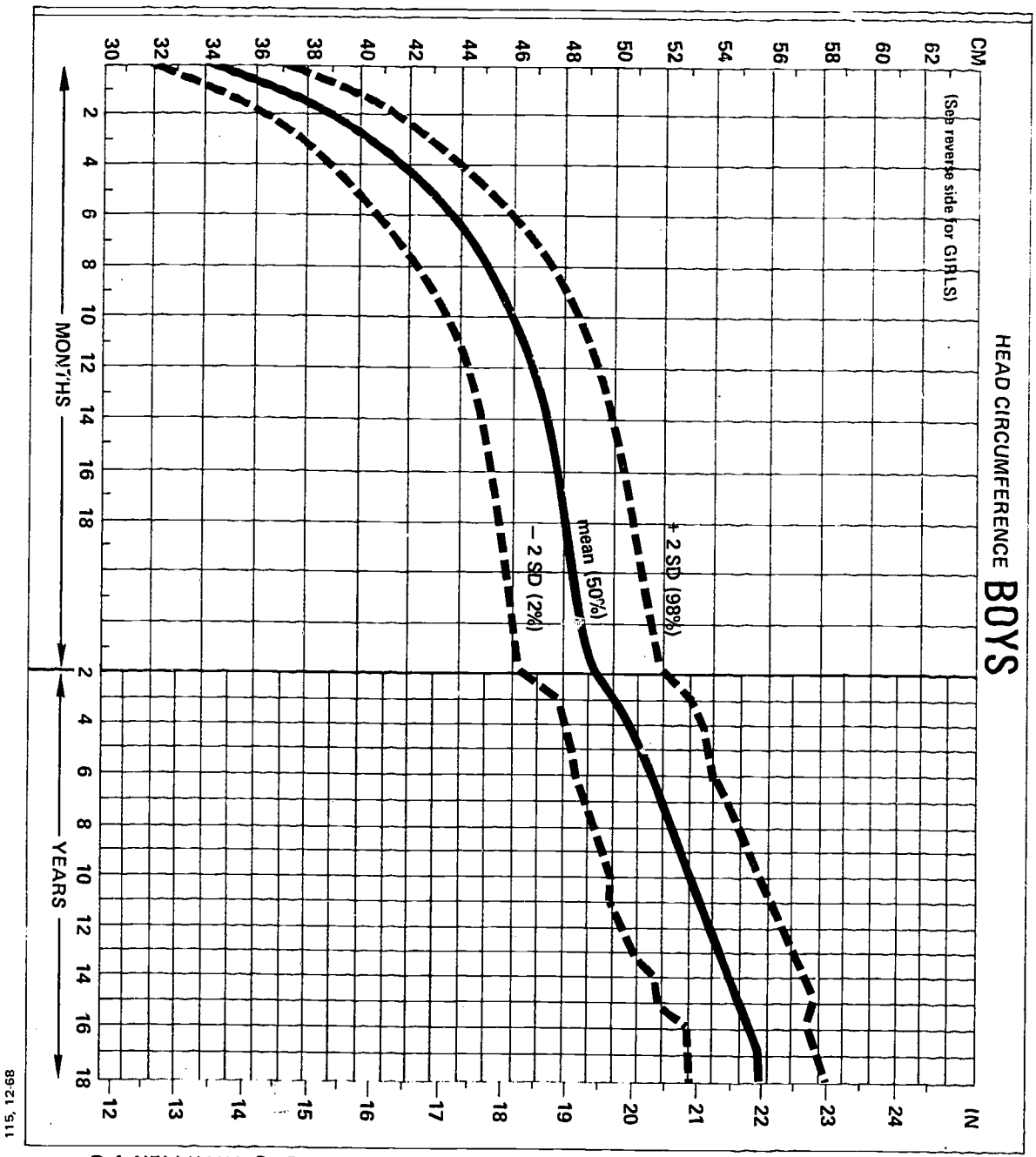
Table 1 (*continued*)

Height of Females from 6½ Through 10 Years of Age

Age (years)	Number of subjects	Centimeters (percentiles)					Inches (percentiles)				
		10th	25th	50th	75th	90th	10th	25th	50th	75th	90th
6½	184	112.3	115.1	118.2	122.1	125.0	44.2	45.3	46.5	48.1	49.2
7	215	114.0	117.5	120.9	124.7	127.6	44.9	46.3	47.6	49.1	50.2
7½	201	116.6	120.4	124.0	127.4	131.1	45.9	47.4	48.8	50.2	51.6
8	213	119.0	122.5	127.2	130.3	133.2	46.9	48.2	50.1	51.3	52.4
8½	220	122.7	125.8	130.2	134.0	137.7	48.3	49.5	51.3	52.8	54.2
9	211	125.0	128.0	132.7	136.7	140.2	49.2	50.4	52.2	53.8	55.2
9½	189	127.5	130.5	135.5	140.1	144.7	50.2	51.4	53.4	55.2	57.0
10	201	132.2	135.7	138.3	142.7	148.1	52.1	53.4	54.5	56.2	58.3

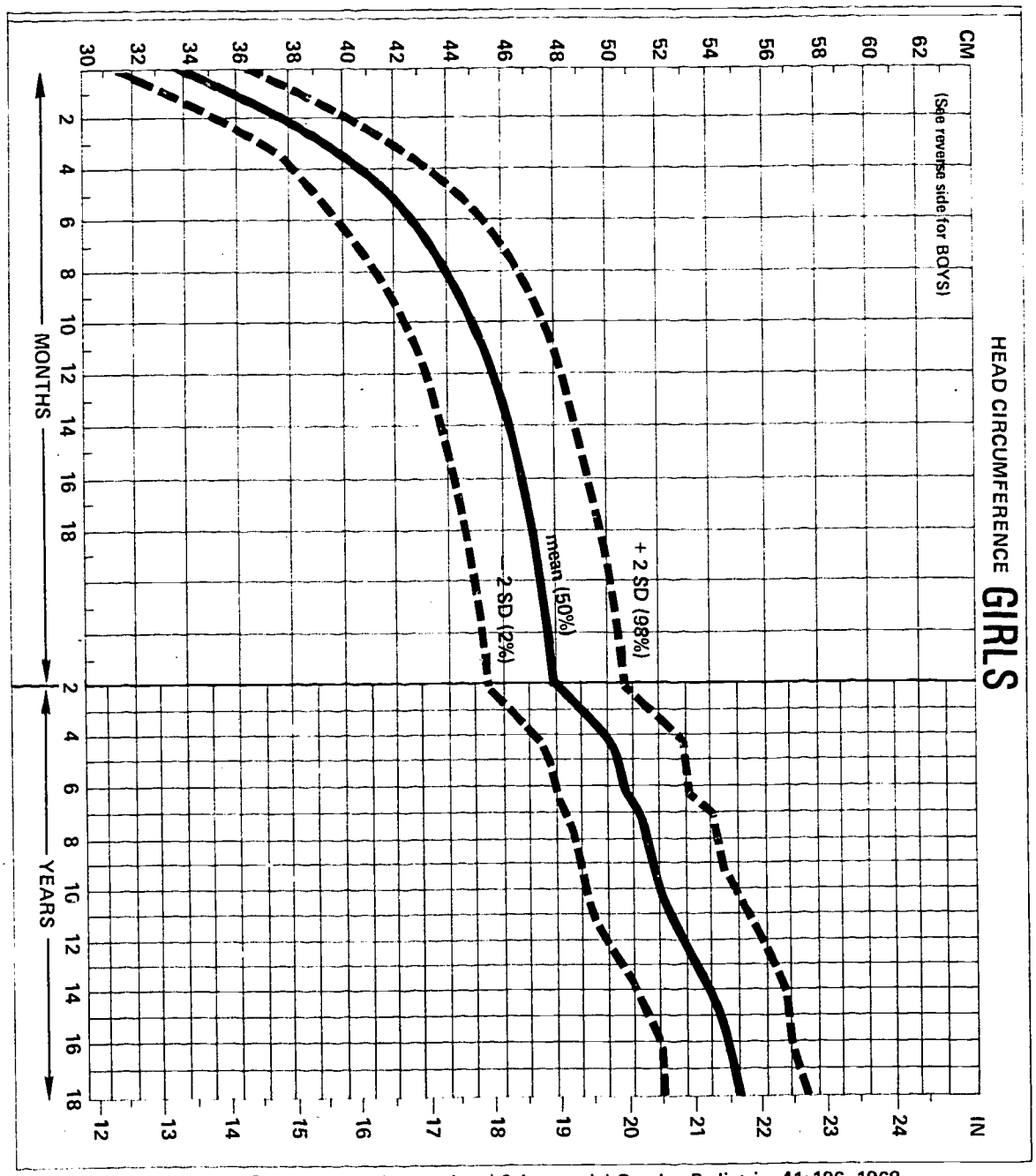
Weight of Females from 6½ Through 10 Years of Age

Age (years)	Number of subjects	Kilograms (percentiles)					Pounds (percentiles)				
		10th	25th	50th	75th	90th	10th	25th	50th	75th	90th
6½	184	18.1	19.5	21.3	23.8	26.8	40.0	43.0	47.0	52.5	59.0
7	215	18.6	20.2	22.7	25.6	29.3	41.0	44.5	50.0	56.5	64.5
7½	201	20.2	21.6	24.0	26.8	30.2	44.5	47.5	53.0	59.0	66.5
8	213	20.4	22.2	24.5	28.1	31.1	45.0	49.0	54.0	62.0	68.5
8½	220	22.2	24.3	27.2	30.2	34.9	49.0	53.5	60.0	66.5	77.0
9	211	23.1	25.4	28.6	32.0	36.1	51.0	56.0	63.0	70.5	79.5
9½	189	24.5	27.2	30.8	35.8	42.2	54.0	60.0	68.0	79.0	93.0
10	201	27.0	29.5	32.9	38.3	44.9	59.5	65.0	72.5	84.5	99.0



Ref: NELLHAUS, G., Composite International & Interracial Graphs, Pediatrics 41:106, 1968

BOYS



Ref: NELLHAUS, G., Composite International & Interracial Graphs, Pediatrics 41:106, 1968

GIRLS

Table 2

Biochemical Methods and Remarks Regarding Interpretation

Substance	Method	Quantity required	Interpretation
Hemoglobin (blood) Hematocrit (blood)	Cyanomethemoglobin [9a] Capillary tube [11a]	20 μl 40 μl	Concentration of hemoglobin (Hb) less than 10.0 gm./100 ml. and/or volume of packed RBC's less than 31 percent is assumed to indicate anemia. [10] Mean corpuscular Hb concentration less than 30 gm./100 ml. of packed RBC's indicates hypochromia and is strong presumptive evidence of iron deficiency.
Total protein (serum)	Microbiuret, manually [11b]	50 μl	
Albumin (serum)	Electrophoresis on cellulose acetate [12]	10 μl	Concentration of albumin less than 3.2 gm./100 ml. suggests poor protein nutritional status. [13, 14]
Ascorbic acid (serum)	2,4-DNP reaction, manually [15] or automated [16]	20 μl	Concentration less than 0.3 mg./100 ml. suggests that recent dietary intake has been low.
Vitamin A (plasma or serum).	Fluorometry [17, 18]	100 μl	Concentration less than 10 μg./100 ml. suggests deficiency and concentration less than 20 μg./100 ml. indicates low stores.
Alkaline phosphatase (serum).	Liberation of p-nitrophenol manually [11c] or automated [19]	100 μl	Activity greater than 150 I.U./l is suggestive of rickets.
Inorganic phosphorus (serum).	Modification of Fiske Subba Row, manually [11d] or automated [20]	50 μl	Concentrations less than 4.0 mg./100 ml. are abnormal [21, 22] and suggestive of rickets.[21] However, normal concentration does not rule out the presence of rickets.
Urea nitrogen (serum)	Urease [23] or automated [24] with diacetyl monoxime	100 μl 50 μl	Concentration less than 8 mg./100 ml. suggests low recent dietary intake of protein. However, concentrations as low as 3 mg./100 ml. are not uncommonly found in breastfed infants.[13]
Cholesterol (serum)	Manually by method of Carr and Drekter [25] or automated [26]	100 μl	Concentration greater than 200 mg./100 ml. during the first two years of life or greater than 230 mg./100 ml. indicates hypercholesterolemia.[13, 27] After the first year of life concentration less than 130 mg./100 ml. suggest steatorrhea and/or recent loss of weight.[28]

Table 2 Continued

Biochemical Methods and Remarks Regarding Interpretation

Iron (serum) Iron-binding capacity (serum).	Atomic absorption spectroscopy [11e] Manual method of Fischer and Price [29] or automated [30]	200 μl	Concentrations of iron less than 60 μg./100 ml.,[31] iron-binding capacity greater than 360 μg./100 ml. and/or saturation of transferrin less than 16 percent [32] suggest iron deficiency even when concentration of hemoglobin is greater than 10.0 gm./100 ml.
Creatinine (urine)	Alkaline picrate manually [9b] or automated [33]	100 μl	Serves as reference for other urine determinations.
Riboflavin (urine)	Fluorometry with irradiated blank [9c]	2 ml.	Excretion less than 250 μg./g. of creatinine suggests low recent dietary intake.[14]
Thiamin (urine)	Thiochrome fluorometry [9d]	10 ml.	Excretion of less than 125 μg./g. of creatinine suggests that dietary intake has been low for weeks or months.[14]
Iodine (urine)	Modification [9e] method of Zak et al.	0.5 ml.	Excretion of less than 50 μg./g. of creatinine suggests low recent dietary intake.[34]

Roentgenographic Studies

Whenever clinical or biochemical evidence suggests rickets or scurvy, it is desirable to confirm the finding by roentgenograms of the wrist. It is not recommended that roentgenograms of the wrist be made routinely in screening unless: (1) A roentgenologist experienced in interpreting early evidences of rickets and scurvy is available; and (2) biochemical studies of plasma routinely include determinations of ascorbic acid, inorganic phosphorus and alkaline phosphatase.

References

1. U.S. Department of Agriculture: Calculating the Nutritive Value of Diets. A Manual of Instruction for the Use of Punch Cards for Machine Tabulation. Washington, D.C., U.S. Department of Agriculture Publication ARS-62-10, 1964.

2. Falkner, F.: Office measurement of physical growth. Pediat.Clin.N.Amer.8:13, 1961.

3. Nellhaus, G.: Head circumference from birth to eighteen years. Practical composite international and interracial graphs. Pediatrics 41:106, 1968.

4. Beal, V. A.: Nutritional history in longitudinal research. J.Amer.Diet.A. 51:426, 1967.

5. U.S. Public Health Service, Division of Chronic Disease Programs, Nutrition Program: National Nutrition Survey. Pediatric Clinical Examination. Form NCCD-3-3(D.C.), Rev. 3-69.

6. Hamill, P. V. V., Johnston, F. E., and Grams, W.: Height and Weight of Children. Public Health Service Publication No. 1000-Series 11, No. 104, 1970.

7. Hamill, P. V. V.: Personal communication.

8. Nelson, W. E., Vaughan, V. C., III, and McKay, R J.: Textbook of Pediatrics. Philadelphia, W. B. Saunders Co., 1969, pp. 42-47.

9. Interdepartmental Committee on Nutrition for National Defense: Manual for Nutrition Surveys, 2d ed. Washington, D.C.: U.S. Government Printing Office, 1963, (a) p. 115, (b) pp. 135-136, (c) pp. 140-142, (d) pp. 136-140, (e) pp. 155-158.

10. Fomon, S. J.: Prevention of Iron-Deficiency Anemia in Infants and Children of Preschool Age. Washington, D.C., Public Health Service Publication No. 2085, Maternal and Child Health Service, 1970.

11. O'Brien, D., Ibbott, F. A., and Rodgerson, D. O.: Laboratory Manual of Pediatric Micro Biochemical Techniques. New York, Harper and Row, 4th ed., 1968, (a) p. 187, (b) pp. 279–282, (c) pp. 248–251, (d) pp. 252–256, (e) pp. 53–54.

12. Rice, J. D., Jr.: Automatic simultaneous determination of total serum protein and serum albumin. Amer. J. Clin. Path. 45:277–282, 1966.

13. Fomon, S. J., Filer, L. J., Jr., Thomas, L. N. and Rogers, R. R.: Growth and serum chemical values of normal breastfed infants. Acta Paediat. Scand. (Suppl. 202), 1970.

14. Owen, G. M.: Personal communication.

15. Roe, J. H., and Kuether, C. A.: The determination of ascorbic acid in whole blood and urine through the 2-4-dinitrophenylhydrazine derivative of dehydroascorbic acid. J. Biol. Chem. 147:399, 1943.

16. Garry, P. J., and Owen, G. M.: Automated screening technique for vitamin C assay requiring small quantities of blood. Technicon Symp., Automation in Anal. Chem., Vol. I, New York, Mediad, Inc., 1968.

17. Garry P. J., Pollack, J. D., and Owen, G. M.: Plasma vitamin A assay by fluorometry and use of silicic acid column technique. Clin. Chem. 16:766, 1970.

18. Thompson, J. N., Erdody, P., Brien, R., and Murray, T. K.: Fluorometric determination of vitamin A in human blood and liver. Anal. Biochem. In press.

19. Morgenstern, S., Kessler, G., Auerbach, J., Flor, R. V., and Klein, B.: An automated p-Nitrophenylphosphate serum alkaline phosphatase procedure for the auto analyzer. Clin. Chem. 11:876–888 1965.

20. Kraml, M.: A semi-automated determination of phospholipids. Clin. Chim. Acta. 13:442–448, 1966.

21. Howland, J., and Kramer, B.: Calcium and phosphorus in the serum in relation to rickets. Amer. J. Dis. Child. 22:105, 1921.

22. Owen, G. M., Garry, P., and Fomon, S. J.: Concentrations of calcium and inorganic phosphorus in serum of normal infants receiving various feedings. Pediatrics 31:495, 1963.

23. Chaney, A. L., and Marbach, E. P.: Modified reagents for determination of urea or ammonia. Clin. Chem. 8:130, 1962.

24. Marsh, W. H., Fingerhut, B., and Miller, H.: Automated and manual direct methods for the determination of blood urea. Clin. Chem. 11: 624–627, 1965.

25. Carr, J. J., and Drekter, I. J.: Simplified rapid technic for the extraction and determination of serum cholesterol without saponification. Clin. Chem. 2:353, 1956.

26. Levine, J. B., and Zak, B.: Automated determination of serum total cholesterol. Clin. Chim. Acta. 10:381, 1964.

27. Frederickson, D. S., Levy, R. I., Jones, E., Bonnell, M., and Ernst, N.: Dietary Management of Hyperlipoproteinemia. A Handbook for Physicians. Washington, D.C., Public Health Service, 1970.

28. Hodges, R. G., Sperry, W. M., and Andersen, D. H.: Serum cholesterol values for infants and children. Am. J. Dis. Child. 65:858, 1943.

29. Fischer, D. S., and Price, D. C.: A simple serum iron method using the new sensitive chromogen tripyridyl-s-triazine. Clin. Chem. 10:21, 1964.

30. Garry, P. J., and Owen, G. M.: Automated micro determination (100 μl) of serum iron and total iron binding capacity. Technicon Symp., Automation in Anal. Chem., Vol. I, New York, Mediad, Inc., 1968.

31. Hillman, R. S., and Henderson, P. A.: Control of marrow production by the level of iron supply. J. Clin. Invest. 48:454, 1969.

32. Bainton, D. F., and Finch, C. A.: The diagnosis of iron deficiency anemia. Am. J. Med. 37:62, 1964.

33. Zender. R., and Falbriard, A.: Analyse Automatique de la Créatinine Dans Le Sérum Et Dans L'Urine. Valeurs "Normales" Chez L'Homme de la Créatininemie et de la Clearance. Clin. Chim. Acta. 12:183-190, 1965.

34. Follis, R. H., Jr., Vanprapa, K., and Damrongsakdi, D: Studies on iodine nutrition in Thailand. J. Nutr. 76:159, 1962.

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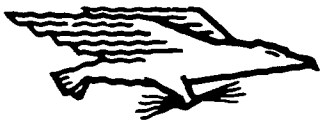

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