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Methods of Assessing the Physical Fitness of Children

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UNITED STATES DEPARTMENT OF LABOR

CHILDREN'S BUREAU

UNITED STATES DEPARTMENT OF LABOR
FRANCES PERKINS, Secretary
CHILDREN'S BUREAU · KATHARINE F. LENROOT, Chief

Methods of Assessing the Physical Fitness of Children

A study of certain methods based on anthropometric, clinical, and socioeconomic observations made of 713 7-year-old white boys and girls in New Haven, Conn., over a period of 19 or 20 months during 1934–36

By
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and
SUSAN P. SOUTHER, M. D.

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Letter of Transmittal

UNITED STATES DEPARTMENT OF LABOR,
CHILDREN'S BUREAU,
Washington, August 15, 1940.

MADAM: There is transmitted herewith Methods of Assessing the Physical Fitness of Children, a study based on observations made in New Haven, Conn.

The problem of finding an efficient, economical, and simple method of assessing physical fitness has occupied the attention of workers in the field of child health and growth for many years. Recently a number of methods have been recommended, especially those based on anthropometric measurements of the child. Some of these procedures have been in more or less widespread use but few attempts have been made to evaluate the different methods as applied to the same group of children and to compare the relative effectiveness of these methods in identifying boys and girls who are physically unfit.

Several years ago it was decided to make such an evaluation of several methods of assessment, including (1) indices of body build and (2) clinical judgment of general nutritional status.

The study began in 1934. It was a cooperative undertaking of Yale University through the Institute of Human Relations and the department of pediatrics of the School of Medicine and of the Children's Bureau of the United States Department of Labor, in cooperation with the Department of Health and the Board of Education, New Haven, Conn.

The study was proposed by Frank K. Shuttleworth, Ph. D., of the Institute of Human Relations, who participated in outlining the original schedules and who made preliminary statistical analyses of the data. It was carried out under the direction of the following members of the respective staffs: Mark A. May, Ph. D., Director of the Institute; Grover F. Powers, M. D., Professor of Pediatrics, the Yale University School of Medicine; and Martha M. Eliot, M. D., Assistant Chief of the Children's Bureau.

The general supervision of the field work and the physical examinations were carried out and a preliminary report of the clinical aspects of the study was prepared by Susan P. Souther, M. D., now of the Connecticut State Department of Health and formerly on the staff of the Children's Bureau; the anthropometric measurements were taken by Mary E. Parker, R. N. Assistance in some of the clinical and anthropometric aspects of the study was given by Ethel C. Dunham, M. D., and Clara E. Hayes, M. D., of the Children's Bureau, and

Sander E. Lachman, M. D., then on the staff of the Institute of Human Relations, Yale University.

After the observations were collected, the analysis was directed and the final report prepared by Rachel M. Jenss, Sc. D., statistician in charge of studies of child health and growth, Division of Statistical Research, Children's Bureau.

The study has been confined to the problem of evaluating several methods of assessing physical fitness which have been in more or less widespread use in this country during recent years. It has not attempted to ascertain why certain methods fail nor has it undertaken the problem of developing new methods of assessment.

It is hoped that the report will resolve some of the difficulties and confusion which have existed concerning the more generally accepted methods of assessment of physical fitness, and that later a more constructive approach can be made to the problem of assessing the physical fitness of school children.

Acknowledgment is made to Robert J. Myers, Ph.D., Director of the Division of Statistical Research, and to the following members of the section on child growth and development, Division of Statistical Research, for assistance given in the analysis and preparation of the report: Marie G. Fullam, Mollie Orshansky, Helen R. Robinson, and Lois F. Smith.

Respectfully submitted.

KATHARINE F. LENROOT, *Chief.*

HON. FRANCES PERKINS,
Secretary of Labor.

METHODS OF ASSESSING THE PHYSICAL FITNESS OF CHILDREN

Introduction

The importance of safeguarding the child's health and physical fitness, not only for his own sake but also for the welfare of society, is axiomatic. It follows directly that if his health is to be protected, the child must be observed at regular intervals in order to ascertain his physical condition and to determine whether he needs medical attention or nutritional advice and assistance. How is such an assessment to be made? Various methods are available. Some of them are elaborate, others are more simple; some are based on clinical examination, others depend on exacting laboratory techniques or are derived from anthropometric measurements of the child. It is important to know the relative value of these procedures. Which of the various methods of assessment in use in this country at the present time may be both easy and inexpensive to apply, and productive of results?

This question forms the basis for a study of the physical fitness of 7-year-old white boys and girls [1] living in New Haven, Conn., from September 1934 through May 1936.[2] The investigation was undertaken by the Children's Bureau of the United States Department of Labor, the Institute of Human Relations of Yale University, and the Department of Pediatrics of the Yale University School of Medicine, in cooperation with the Board of Education and the Department of Health of New Haven.

Before describing the materials and methods of this study, it may be well to define the term "physical fitness" and to outline each of the methods of assessment. Physical fitness is a comprehensive term which is broader than either health or nutrition. It includes the child's general nutritional status and the presence or absence of organic defects, both considered in relation to his general physical condition evaluated in terms of his own previous growth and development. Unfortunately, it is rather elusive of definition and difficult

[1] Age is defined in completed years on the last birthday.

[2] The children were examined for the first time when they were 6 years old, but the report is based on the observations made when the boys and girls were 7 years of age, amplified and interpreted in relation to the earlier findings.

to determine because of the fact that it evaluates the child's present condition as a *functional* state which is partly the result of previous growth and which, in turn, will affect his future health and well-being.

The child's physical fitness is related to a large number of factors, both endogenous and exogenous. Perhaps most intimately associated with his physical well-being are the child's present health and nutrition as well as his psychological state, each judged in relation to his heredity, his general disease history, and his previous growth and development. But equally and sometimes even more important is the child's socioeconomic background, because it is safe to assume that if the family's income is below a certain level, the child runs the risk of being physically unfit as a result of unsatisfactory living conditions [3] and of a suboptimal intake of the proper dietary constituents. Although it is difficult, if not impossible, to point out all the factors [4] which may play a role in affecting the child's physical fitness, it may be said in summary that the child's well-being is dependent not only on his present condition but also on his previous history (familial, antenatal, and postnatal). Together they determine his ability to compensate for or overcome his present defects and handicaps, and his future incapacities as well.

It is obviously impossible at present to appraise correctly a child's physical fitness. Not all the factors that affect a child's well-being nor their interrelationships are known; no satisfactory methods of measuring some of these factors are available; and many procedures which are satisfactory for judging specific aspects of a child's condition are too elaborate for widespread application, or the cost involved prohibits their inclusion in a school health program or a community survey.

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[3] The term "unsatisfactory living conditions" is used to include such factors as overcrowding; short hours of sleep or lack of conditions for sound, restful sleep; poor ventilation; and lack of sunlight.

[4] Home hygiene, as well as discipline and control both at home and in the school, must also be considered.

Methods of Assessing Physical Fitness

Several methods of assessing physical fitness are in use at the present time. They include the clinical examination, specific biochemical tests for particular nutritional deficiencies, tests of functional well-being, dietary and socioeconomic surveys, and anthropometric measures of body build.

The Clinical Examination

The child's "apparent" physical condition can be assessed by a physician. This examination will obviously reveal such conditions as thinness, faulty posture, flabbiness of muscles, and certain marked nutritional or organic defects, but at best it gives only an approximate evaluation. There is an increasing realization of the difficulties of assessing a child's condition by this method alone.[1]

In an article on the incidence and assessment of malnutrition Harris discusses four sources of error.[2] They are summarized as follows:

1. Inadequate clinical methods are used. Examinations are usually carried out under circumstances which require the inspection of large numbers of children in a relatively short time. Consequently laboratory techniques or the more refined methods necessary for detecting the presence of early or slight malnutrition are usually omitted.

2. Debased standards are used. It is commonly known that such figures as those for the average weights and heights of school children of a given age and sex have undergone a steady and marked rise during recent years. Furthermore, the average weights and heights of groups of children who have been fed on approved dietaries have increased beyond the weights and heights of comparable groups of children who were given neither appropriate nor supplemental diets. It is obvious, therefore, that standards which rely on past averages instead of on more recent and comparable data are dependent on the use of a debased norm, and hence, always tend to be underestimates.

3. No standards are known for assessing malnutrition; consequently no satisfactory way of measuring it exists.

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[1] See Appendix II: (*51*) Jones, (*60*) Lucas et al., (*120*) Wilkins. For a more extended discussion, see (*119*) Wilkins. The italicized numbers in parentheses refer to the numbered list of references to be found in Appendix II, pp. 115-121.

[2] See Appendix II: (*44*) Harris, pp. 225-226.

4. The effects of malnutrition are delayed. Of the failure of a superficial clinical examination to reveal abnormal conditions which may have a delayed effect, Harris says:

> It is obvious that the grosser results of malnutrition can generally be detected readily enough by the clinical observer * * * . It is rather the *earlier* effects, the influence of *partial* deficiencies, which may pass unobserved if reliance be placed on cursory clinical examination—and yet these "milder," less readily detected, types of deprivation may none the less have a profound influence, delayed it may be, on the health and well-being of the subject.[3]

Biochemical Tests for Specific Nutritional Deficiencies

Biochemical tests can be made for particular deficiencies including the vitamins, the inorganic elements such as iron, calcium, phosphate, and other important dietary constituents. Many of these tests are complicated and expensive; others, particularly those for the vitamins, lack specificity or sensitivity; all of them have limited value in assessing physical fitness because they measure only particular nutritional deficiencies.

Functional Tests

Under the general heading of functional tests may be included, among others, tests of lumbar pull (on a dynamometer), vital capacity, and basal metabolism.[4] Many of these techniques are still in a developmental stage and require further study and application before satisfactory norms are available. But even when such standards have been developed, giving the tests will require special training or equipment and will, therefore, be beyond the reach of the average public-health officer or school official. Furthermore, they give only a partial answer to the question "Is the child physically fit?"

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[3] See Appendix II: (*44*) Harris, p. 225.

[4] (*87*) Pryor and Smith give a brief review of the history of strength tests, including the use of the ergograph and Kellogg's universal dynamometer, and Sargent's chinning and dipping tests to judge endurance. Galton's tests of reaction time to auditory and visual signals are also mentioned.

For illustration of the use of tests of vital capacity and tests with the spring dynamometer, see Appendix II: (*19*) Cheesman, (*118*) Warrington [England], reference to Magee in (*44*) Harris, p. 227, (*69*) Milligan, and (*128*) Woolham and Sparrow. See (*118*) Warrington [England] for application of the Romberg test for determining a child's power of equilibration and coordination and (*127*) Woolham and Honeyburne, for pulse and respiratory tests.

For attempts to use standard athletic performances such as the 60-meter race, ball throwing, and jumping as indications of physical fitness, see (*129*) Wroczynski, p. 673.

Standards based on combinations of various tests of physical performance have also been derived. For example, a physical-fitness index has been developed by (*92*) Rogers. See also (*128*) Woolham and Sparrow for a physiological formula developed by Flack and Woolham.

Dietary Inquiry

A detailed inquiry may be made into the dietary habits and environment of the child in order to estimate his nutritional status.[5] Wilkins, pointing out the fundamental importance of this aspect of the problem, writes:

> Workers in animal nutrition know only too well that a diet must be tested, not only through the whole life of the individual, but through at least three or four generations before it can be passed as fully adequate. Yet it is customary to pass children, the most valuable animals of all, as normal in their nutrition, and, presumably, therefore to pronounce their diets fully adequate in each and every constituent, without any inquiry into the details of their diets, and without even testing the efficiency of a single bodily function. [6]

Making detailed dietary inquiries is, however, difficult. They are also expensive and time-consuming, for they require the services of well-trained observers and the whole-hearted cooperation of the child and his family.

Socioeconomic Inquiry

An estimate of the net family income per capita gives a fairly reliable basis for estimating whether a satisfactory diet is purchasable, because, as Wilkins has pointed out, "Enough work has been done on family budgets and minimum costs of living to enable us to make a rough estimate of the nutritional possibilities of any family." [7]

On the other hand, although it is inevitable that if the money available for food is inadequate the child's diet is unsatisfactory and his health suffers, it should be pointed out, as is stated in an editorial which appeared in the Journal of the American Medical Association, that "malnutrition is no longer considered to be exclusively an outcome of poverty or bad environment." [8]

Anthropometric Measures of Body Build

Because of the difficulties involved in the application and the appraisal of the techniques that have been discussed, attempts were begun to derive indices of body build, based on the interrelations of

[5] See Appendix II: (*11*) Boudreau and Kruse, (*44*) Harris, (*89*) Roberts, and (*121*) Wilkins.

For discussion of what constitutes an adequate diet, see Appendix II: (*36*) Friend, (*41*) Great Britain Ministry of Health Advisory Committee on Nutrition, (*61*) McCarrison, (*94*) Rose, (*105*) Sherman, and (*109*) Stiebeling and Clark.

[6] See Appendix II: (*121*) Wilkins, p. 145.

[7] See Appendix II: (*121*) Wilkins, p. 146. See also (*44*) Harris and reference to British Medical Association Committee on Nutrition in (*44*) Harris, and (*89*) Roberts.

[8] See Appendix II: (*47*) Indexes of Nutrition, p. 1286.

certain anthropometric measurements.[9] These indices are used to predict a measure of the child's well-being, such as his weight or arm girth in terms of his physique or body build. They assess physical fitness only insofar as it is related to abnormalities in such measures.

Four of these indices, which have received widespread application in the United States, have been applied to the children included in this study:[10]

(1) The *Baldwin-Wood Tables* published in 1923.
(2) The *ACH (arm-chest-hip) Index* developed and published by the American Child Health Association in 1934.
(3) The *Nutritional Status Indices* of Franzen published by the American Child Health Association in 1935.
(4) The *Pryor Width-Weight Tables* published in 1936.

These indices are based directly or indirectly on statistical techniques (multiple-regression procedures) which are not always employed in the development and application of other methods of assessment. For this reason it is probably advisable to describe in some detail the fundamental hypotheses on which they have been based, the possible limitations of this type of approach, and the exact methods of applying and evaluating each index, and to review critically other studies which have been made to test the effectiveness of these indices in identifying children who may be in need of medical care or nutritional advice and assistance.

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[9] This type of index is to be distinguished from simple ratios, which have been in use for a great many years, although they are not generally applied in the United States at the present time. As early as 1829, Buffon reported such an index or ratio in the form, $\frac{\text{Weight}}{\text{Height}^3}$. It was modified by Quetelet in 1836, by Rohrer in 1908, by Tuxford in 1917, and by Bardeen in 1920. Tuxford's modification was more elaborate than the others. He proposed the following formulas as a measure of the physical development of school children:

$$\text{For boys: } \frac{\text{Weight (kg.)}}{\text{Height (cm.)}} \times \frac{381 - \text{age in months}}{54}$$

$$\text{For girls: } \frac{\text{Weight (kg.)}}{\text{Height (cm.)}} \times \frac{381 - \text{age in months}}{48}$$

During the World War Pirquet developed a system for assessing nutrition which included a ratio based on weight and stem length. It is known as the "pelidisi" index and depends on the relationship

$$\sqrt[3]{\frac{\text{Weight} \times 10}{\text{Stem length}}}$$

Other measurements have also been used in deriving this type of index. For example, as early as 1886, Bernhardt used the following formula for predicting weight:

$$\text{Weight} = \frac{\text{Height} \times \text{Chest measurement}}{240}$$

and in 1901, Oppenheimer put forth a "nutritional quotient" defined by the ratio

$$\frac{\text{Maximum girth of relaxed arm} \times 100}{\text{Chest circumference at end of expiration}}$$

Other indices may be mentioned which illustrate the use of combinations of tests of physical performance. One is a physiological formula known as the Flack-Woolham product (1923). The second is an anatomical ratio called the Dreyer product (1919).

For a more complete description see Appendix II: (*82*) Paton and Findlay, pp. 51–57, on which most of the above discussion is based. See also (*27*) Dreyer, (*89*) Roberts, pp. 57–83, (*114*) Tuxford, and (*128*) Woolham and Sparrow.

[10] See Appendix II: (*6*) Baldwin and Wood, (*35*) Franzen and Palmer, (*75*) Nutritional Status Indices, and (*86*) Pryor.

Indices of Body Build as a Method of Assessment of Physical Fitness

A number of problems arise in studying these indices of body build. For example, the question is frequently asked: Can external measurements of the human body be used to assess a child's physical fitness, especially if there is an early or slight departure from health or if he is suffering from a mild form of nutritional disorder? Can they identify the child who is overweight but flabby or the one who is overdeveloped? It has been pointed out in this connection that such indices attempt only a quantitative evaluation of the child's condition and that the qualitative aspects are ignored. To be more specific: Can an index of body build differentiate between organic and dietary causes of undernutrition? Does it take inherited or constitutional factors into account? May not long-continued malnutrition have interfered with a child's growth to the extent that anthropometric measurements cannot be used to evaluate his physical fitness?

It is also well to bear in mind that recent studies of weight and weight increments have shown that certain years are "good growing years" and others are not.[1] Does this phenomenon affect the value of the indices? Can seasonal variations in the measurements from which they have been derived be ignored?

Many other questions have been asked. A discussion of their significance has been omitted, however, since this investigation is concerned with the identification of children who may be physically unfit and not with detailed technical problems in methodology. Nevertheless it may be worth while to indicate the nature of some of these questions.

For example, a great many statistical problems arise in connection with the development and application of these indices. Do the basic data comply with the hypotheses which the mathematical procedures require; i. e., are the anthropometric measures normally distributed and is their relationship linear? Are the mathematical procedures correctly applied? Is the technique equally applicable to both sexes? To children of different ages? Is the definition of age used in deriving the indices too broad? Is an index more satisfactory if it is based on longitudinal instead of cross-sectional data? In other words, if

[1] See Appendix II: (77) Palmer, p. 1153, which refers to earlier paper by same author (80).

an index for 6-year-old and also for 7-year-old children is derived from successive measurements of the same group of boys and girls, is it more reliable than if it were based on measurements of one group 6 years of age and another group 7 years of age?

In applying these indices the child's observed measure is judged in relation to the average or expected measurement of his skeletal peers. For example, the Baldwin-Wood Tables identify as skeletal peers children who are of the same sex, age, and height. These three factors are interrelated in such a way as to determine the child's expected weight, which is in reality the measurement for an average child of the same sex, age, and build (height). Now, such an average is dependent on the kind of children whose measurements have been included. If one assumes that the observations from which such an index has been developed are also representative of the group to which it is applied, the question still remains—how far does the average represent the normal, according to a dictionary definition of the latter term as applied in the medical and biological sciences—"conforming to natural order or law." [2]

It should be remembered in this connection that the average anthropometric measurements of school children of a given sex and age have shown a steady increase during the last 15 or 20 years.[3] Does this evident change in physique necessitate the construction of new indices at certain intervals? Likewise, it has been shown that in experimental trials the average weight and height of groups of children who have been fed on improved dietaries have improved beyond the weight and height of the controls or of previously comparable averages.[4] Do these findings indicate the use of debased standards?

One may also inquire: What are the standards of normal variation? How much may a child's measure deviate from the average and still be considered satisfactory? Is this deviation to be expressed in absolute or relative terms or by means of more elaborate statistical procedures?

It is essential also to know the kind of children whose measurements were used for deriving the indices. In other words, what racial, socioeconomic, and geographic groups do these boys and girls represent, and are they healthy children? In this connection it is interesting to note that the White House Conference of 1930 pointed out that most of the available standards do not represent desirable combinations of heritage, history, and home influence, and that further

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[2] See Appendix II: (*38*) Gould, p. 961.

[3] See Appendix II: (*13*) Brewer, p. 91, (*36*) Friend, pp. 27–28, 73, (*40*) Great Britain Board of Education, p. 25, (*48*) Jacob, and (*116*) Wallsend [England] Education Committee, p. 11. See also references to Rowland and Stockwell contained in (*39*) Great Britain Board of Education, p. 23, and see (*129*) Wroczynski, pp. 595–596, 678, for references to Fessard, Laufer and Laugier, Koch, and Wolff.

[4] See Appendix II: (*44*) Harris, p. 226. He refers to studies by Corry Mann, Leighton and Clark, Orr, and Scharff and Sinnadorai. See also (*59*) Loewenthal, (*90*) Roberts et al., and (*105*) Simpson and Wood.

biometric work will be necessary to furnish norms for promoting useful application of measurement.[5]

Finally, in evaluating an index it is important to consider the children whom it fails to identify as well as those whom it selects as likely to be physically unfit, for although an index may identify some children who are in need of medical attention or nutritional advice and assistance, it may fail to select an even larger number of such children than it identifies. On the other hand, it may select not only all the children who are physically unfit but also a large number of healthy boys and girls. In other words, it is important to know just how efficient such an index is.

The preceding discussion of the limitations of this type of approach, based on the prediction of one measure of the child's fitness in terms of its relation to his physique or body build, has not attempted to review critically the questions which have been raised, because this study is not concerned with the more technical aspects of evaluating these indices as a method of assessing physical fitness.[6]

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[5] See Appendix II: (*119*) White House Conference on Child Health and Protection, p. 323.

[6] It is suggested that the reader who is interested in the more technical aspects of evaluation consult such papers as those of (*9*) Bigwood, pp. 172–173, (*34*) Franzen, (*49*) Jenkins, (*50*) Jones, (*65*) Marshall, (*78*) Palmer, (*95*) and (*96*) Rosenow, and (*117*) Warner, listed in Appendix II.

The Four Indices of Body Build Included in the Study

Before giving a detailed description of the four indices included in this study, it may be well to reemphasize the fact that they evaluate physical fitness only insofar as it is related to abnormalities of certain measures of the child; for example, his weight or arm girth judged in relation to his body build.

Description of Each Index of Body Build

THE BALDWIN-WOOD TABLES

The index of body build based on the Baldwin-Wood Tables estimates a boy's or girl's weight in terms of his or her height (to the nearest inch) used as a criterion of body build at a given age (taken at the nearest birthday). Tables have been derived for ages 5 through 19 for boys and 5 through 18 for girls from which it is possible to determine what the child should weigh for his sex, age, and height (used as a criterion of body build). Then the difference between his observed and his expected weight is expressed as a percentage of the expected weight. Baldwin [1] has allowed a deviation of less than 6 percent from the average or expected weight for any height, age (under 10 years),[2] and sex for individual variations. A larger deviation (6 or more percent) indicates that a child is likely to be in need of medical attention.[3]

Measurements of an Italian child, A. R., who was included in the study, may be used to illustrate the computation of this index. (See sample schedule of physical measurements.)

It may be seen from this sample schedule that the Italian boy, A. R., weighed 46 pounds and was 44 inches tall when he was 7 years of age (7 years, 1 month, 6 days). According to the Baldwin-Wood Tables the average 7-year-old boy who is as tall as A. R. weighs 44 pounds. In other words, A. R. was 4.5 percent overweight $\left(\frac{46-44}{44}\right)$ in terms of the Baldwin-Wood standard.

[1] See Appendix II: (*5*) Baldwin, p. 4.

[2] If the child is 10 or more years of age, Baldwin has allowed less than 8 percent variation. The majority of workers, however, have allowed under 7 or less than 10 percent for children of all ages. See, for example, in Appendix II: (*22*) Clark, Sydenstricker, and Collins, (*28*) Dublin and Gebhart, and (*30*) Emerson and Manny.

[3] According to Baldwin, "children who are 15 percent overweight for their height and age may also be in need of medical attention" (see Appendix II: (*5*) Baldwin, p. 4); but this aspect of the problem of physical fitness has not been considered in the present report.

PHYSICAL MEASUREMENTS

CHILDREN'S BUREAU, U. S. DEPARTMENT OF LABOR
INSTITUTE OF HUMAN RELATIONS AND PEDIATRIC DEPARTMENT OF YALE UNIVERSITY

Name A.R. Race Italian Examination Number 277

Address — Main Street Boy / Girl Born: Year 28 Month 9 day 4

Date	10/9/34	4/8/35	10/10/35			
School	Harbor	Harbor	Harbor			
Grade	I	I	II			
Age	6/1/5	6/7/4	7/1/6			
Weight (lb.)	41¾	43¼	46			
Height (in.)	42¼	42¾	44			
Arm girth (cm.)						
Flexed	17.5	18.2	18.4			
Relaxed	16.3	16.5	16.6			
Total	33.8	34.7	35.0			
Subcutaneous tissue [4]						
I	11	11	10½			
II	10½	11	10½			
Total	21½	22	21			
Chest breadth (cm.)						
Inspiration	18.1	18.1	18.5			
Expiration	17.2	17.5	17.9			
Total	35.3	35.6	36.4			
Chest depth (cm.)						
Inspiration	13.6	13.7	14.5			
Expiration	12.6	13.0	13.7			
Total	26.2	26.7	28.2			
Hips (cm.)						
Trochanter	19.9	19.9	20.4			
Crest	19.4	19.6	20.2			
Date	9/25/34	1/23/35	5/27/35	9/18/35	1/23/36	5/27/36
Weight	40¾	43½	43½	44	47½	48

[4] The 2 measurements for subcutaneous tissue were made according to the technique described in Appendix II: (75) Nutritional Status Indices, pp. S 10, using a special subcutaneous-tissue caliper which has arbitrary units.

THE ACH (ARM-CHEST-HIP) INDEX

The ACH Index was developed by the American Child Health Association in 1934 and is "a screening technique constructed to meet the demand for a practical method of selecting, from a large group, those children who need a medical examination because they have extremely small amounts of musculature and subcutaneous tissue." [5] More specifically, "when the case is selected he is certain to have an arm-girth deficiency and very likely to be deficient in subcutaneous tissue and weight as well." [6]

[5] See Appendix II: (75) Nutritional Status Indices, p. 1.
[6] See Appendix II: (35) Franzen and Palmer, p. 11.

Basic tables have been prepared for children of each sex aged from 7 through 12 years (age at last birthday) who have hip widths ranging from below 20.0 cm. to 29.0 cm. and above. These tables give the minimum difference between arm girth and chest depth [7] (AG — CD) for a given hip width (at the trochanters). If the difference between a child's arm girth and his chest depth is exactly equal to or less than the value given in the table, the boy or girl is identified as in need of further examination. On the other hand, if the difference is greater than this minimum, the child is not selected.

The original ACH Index was set to select "about 10 percent of a group (in a broad, general sampling). About 60 percent of this selection are extreme-defect cases and over 80 percent are either extreme defects or those that border on extreme defects. It does miss some extreme-defect cases and these omissions are deliberately sacrificed in the interest of speed and simplicity of measurement." [8] The scale has also been set to select 14, 20, or 25 percent of a group of boys or girls. [9] The 25-percent selection contains nearly all (about 90 percent) of the extreme-defect cases that can be identified if the more elaborate Nutritional Status Indices (described on pp. 13–16) had been applied to the entire group of children in the first place, but it also includes an appreciable number of children who do not have extreme defects. In other words, it is probably advisable to apply the more refined method, namely, the Nutritional Status Indices, to the preliminary ACH 25-percent selection.

Though the index screens out the children with "extremely small amounts of soft tissue * * * it does not make individual distinctions between the children. Neither does it discriminate, for a given child, between a deficiency in musculature as opposed to a deficiency in subcutaneous tissue. * * * The ACH Index was intentionally so restricted in order that the practical time limits for measurement in a school or other group situation would not be exceeded." [10]

According to Franzen and Palmer: "The use that is to be made of the index depends upon the objectives sought. If we wish to be sure to identify all extreme-defect cases, then the screen method [25-percent selection] with the additional measures is indicated. If, on the other hand, this is not feasible and we are content merely with knowing that the cases are for the most part severe defects and do warrant review by a physician, then the simpler * * * method [10-percent selection] answers the purpose." The index used in this way "is intended both as an aid to the physician and as a mass

[7] Both these values represent the sum of two measurements. Chest depth, that is, the measurements for expiration and inspiration, and arm girth, that is, the measurements of the upper arm, flexed and relaxed.

[8] See Appendix II — (6) Franzen and Palmer, p. 3.

[9] See Appendix II — (5) Nutritional Status Indices, p. 66.

[10] See Appendix II — (5) Nutritional Status Indices, p. 2.

selective measure for comparing groups."[11] If desired, the index may also be set to identify 14 percent or 20 percent of the children.

The calculation of the ACH Index can also be illustrated for the Italian boy, A. R. The sample schedule of physical measurements (see p. 11) shows that at 7 years of age he had an arm-girth measurement of 35.0 cm. (sum of 18.4 cm. flexed and 16.6 cm. relaxed) and a chest-depth measurement of 28.2 cm. (sum of 14.5 cm. inspiration and 13.7 cm. expiration). The difference between his arm girth and his chest depth is 6.8 cm. The width of his hips at the trochanters was 20.4 cm. The tables show that for a boy of 7 years with a hip width between 20.0 cm. and 20.4 cm. the minimum difference between the arm-girth and chest-depth measurements is 0.0 cm., if 10 percent of the group of boys are to be identified;[12] 0.5 cm., if 14 percent;[13] 1.0 cm., if 20 percent;[13] and 1.5 cm., if 25 percent[13] of the boys are to be selected for either further measurement or direct reference to a physician. As the difference between A. R.'s arm girth and chest depth (6.8 cm.) is larger than any of these minimum differences, it follows that he does not fall in the lowest 10, 14, 20, or 25 percent of the boys in respect to a deficiency in arm girth and probably a deficiency in subcutaneous tissue and weight as well.[14]

THE NUTRITIONAL STATUS INDICES

Tables for the Nutritional Status Indices were developed by Franzen and his coworkers in the American Child Health Association in 1935. They may be used to evaluate a child's condition from 7 through 12 years of age (age at last birthday) in terms of his weight, muscle size (as indicated by the girth of the upper arm), and the amount of subcutaneous tissue (measured over the biceps). Each of these three measures is compared with the weight, arm girth, or subcutaneous tissue which the average child of the same sex and age is expected to have for his skeletal build, judged in terms of his height, the width and depth of his chest, and his bitrochanteric width.

These comparisons make it possible to determine the child's standing in weight, arm girth, and subcutaneous tissue in relation to other children of comparable skeletal build. Thus it is possible to calculate the number in 1,000 children of the same sex, age, and skeletal build who have smaller indices of weight, of arm girth, and of subcutaneous tissue than the child examined.

[11] See Appendix II: (35) Franzen and Palmer, p. 7.
[12] See Appendix II: (35) Franzen and Palmer, p. 12.
[13] See Appendix II: (75) Nutritional Status Indices, p. 66.
[14] See Appendix II: (35) Franzen and Palmer, p. 11.

This procedure was devised not only to reveal differences in the nutritional status of children [15] but also to discriminate between a deficiency in musculature and a deficiency in weight or subcutaneous tissue, "a distinction that is important if differential diagnosis of nutritional status is to be made." [16] The indices "are not intended to supplant the physician in the diagnosing of malnutrition. Rather, they furnish the physician with more adequate evidence for his diagnosis than he has had in the past. Using these indices, in conjunction with other clinical signs, the physician can diagnose the condition and prescribe what shall be done." [17]

The score card for Nutritional Status Indices shows the steps necessary for the calculation of the three Nutritional Status Indices. The computations for the weight index may be found on page 16. The procedures for evaluating the other two—namely, the child's arm girth and subcutaneous tissue—are not described because they involve similar calculations.

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[15] Defective nutrition is defined by Franzen and his coworkers as "a low amount of arm girth, subcutaneous tissue and weight, each for skeletal build. Our definition is specific, but it represents a condition which includes many other subjective signs." See Appendix II: (*83*) Physical Defects; the pathway to correction, p. 63.

In 1935 Mitchell, who was also associated with this group, added: "These measurements compared with a random 1,000 children of the same skeletal build are not in themselves an evaluation of nutritional status, but they do give reliable, objective, and valid distinctions in weight, musculature, and adiposity which are significant in such an appraisal. They are indices of physical signs which should be properly evaluated in a composite of signs and symptoms. Of course, deviations from an average should not be interpreted directly as desirable and undesirable signs, but the average provides a convenient reference point which gives definiteness to the measurements. The use of accurate distinctions in these three physical signs releases the clinician from the difficulties of individual judgment and gives him greater freedom to apply all the subtleties of the art of medicine in judging function, growth, and development and all the intricate factors involved in the nutritional process." See Appendix II: (*71*) Mitchell, p. 319.

[16] See Appendix II: (*75*) Nutritional Status Indices, p. 2.

[17] See Appendix II: Ibid., p. 5.

SCORE CARD FOR NUTRITIONAL STATUS INDICES [1]

Name	A.R.	Sex M	Age 7	
School	Harbor	Room	Grade II	Date 10/10/35

MEASUREMENTS

Arm Girth	Flexed	a 18.4	c 35.0
	Relaxed	b 16.6	
Subcutaneous Tissue over the Biceps		d 10.5	f 21.0
		e 10.5	
Weight			g 46.0
Height			h 44.0
Chest Breadth	Expiration	i 17.9	k 36.4
	Inspiration	j 18.5	
Chest Depth	Expiration	l 13.7	n 28.2
	Inspiration	m 14.5	
Width of Hips			o 20.4

COMPUTATION OF INDICES

	Arm Girth		Sub. Tissue		Weight	
	+ Value	− Value	+ Value	− Value	+ Value	− Value
Measure	99.1		62.2		118.4	
Height	11.5		10.0			8.2
Ch. Breadth		11.3		1.8		12.4
Chest Depth		14.3		4.8		11.7
Hip Width		16.2		18.3		22.4
Adjustments for age		0		1.8		1.5
Sums	+110.6	−41.8	+72.2	−26.7	+118.4	−56.2
Indices	68.8		45.5		62.2	
No. in 1,000 with smaller indices	964		309		885	

[1] This form is presented in (75) Nutritional Status Indices, p. 15 (see Appendix II).

The detailed steps in the determination of this weight index for the Italian boy, A. R., are presented at this point. The exact wording used in the instructions given in the monograph, Nutritional Status Indices, has been followed as closely as possible.

a. Look up A. R.'s weight under Weight Reading in Table C for 7- to 9-year-old boys (see p. 24 of the monograph, Nutritional Status Indices) [18] and record the corresponding table value on the line opposite "Measure" on the score card (score card for Nutritional Status Indices) in the plus (+) column under "Weight." The table value for A. R.'s weight of 46.0 lb. is 118.4.

b. Look up his height under Height Reading in Table D, p. 25. Opposite the reading are three values. Select the one for weight and record this value in the line opposite "Height" in the section under the proper heading on the score card. Since the value is negative it is to be entered in the minus (−) column. A. R.'s height was 44.0 in., which has the following table value for weight: −8.2.

c. Look up his chest-breadth measurement in Table E, p. 26. Record on the score card the table value given for weight and enter this value opposite "Chest Breadth" under the proper index heading in the column with the appropriate sign. A. R.'s chest breadth of 36.4 cm. has a table value for weight of −12.4. Since this is a negative value, enter it in the negative column.

d. Similarly, obtain the values for his chest depth, Table F, p. 27, and for hip width, Table G, p. 28. The table values for A. R. are written on his score card (score card for Nutritional Status Indices).

e. Look up his age in Table H. Since A. R. is a 7-year-old boy, 7 but not 8, the table value for his age to be used for his weight-index calculation is −1.5. Enter this value on the line opposite "Adjustments for Age" under the proper index heading in the column with the appropriate sign.

f. Add the figures in the plus column for the weight index and record the total in the plus column on the line opposite "Sums." Likewise, add the figures in the minus column and record the total in the minus column on the line opposite "Sums." These two sums for A. R.'s weight index are +118.4 and −56.2.

g. Subtract the sum of the values in the negative column (56.2) from the sum of the values in the positive column (118.4) and record the difference (62.2) in the line opposite "Indices." This score, 62.2, is A. R.'s nutritional index for weight and is strictly comparable with his indices for arm girth and subcutaneous tissue. By referring this score or index to Table X of the monograph, Nutritional Status Indices, p. 65, A. R.'s standing in weight relative to others like him in skeletal build may be obtained. Using Table X, look up 62.2, A. R.'s weight score. The table value opposite this is 885, the number in 1,000 children of the same sex, age, and skeletal build who have smaller weight indices (scores) than A. R. In other words, among a general sampling of 1,000 boys of the same age and skeletal build, 885 in 1,000 weigh less than A. R.[19]

In order to facilitate comparisons with the other indices included in this study, Table X of the monograph, Nutritional Status Indices, has been modified to show the number of children in 100, instead of in 1,000, having less than a given score in one of the Nutritional Status Indices. When this revised form of Table X is used 88 (88.5) boys in 100 of the same age and skeletal build weigh less than A. R.

[18] See Appendix II: Ibid., p. 24.

[19] This description of the method of computing the Nutritional Status Index for Weight is based on the illustration given on pp. 14-18 of the monograph, Nutritional Status Indices. See Appendix II: (75).

THE PRYOR WIDTH-WEIGHT TABLES

The Pryor Tables estimate the average weight of a boy or girl of a given age (at nearest birthday) and body build, judged in terms of his or her height (to the nearest inch) and bi-iliac diameter.

The calculation of this index also may be illustrated for the Italian boy, A. R.: According to the sample schedule of physical measurements (see p. 11), when A. R. was 7 years old his height was 44 in., his weight was 46 lb., and "the width of his iliac crest" was 20.2 cm.[20] As the Pryor Table for 7-year-old boys does not give the expected or average weight for a boy who is 44 in. tall and has a crest measurement of 20.2 cm., it is necessary to approximate A. R.'s expected weight. The following method is used: The table gives the average weight, 42 lb., for a boy of the same height as A. R., who has a bi-iliac diameter of 19.3 cm. (0.9 cm. less than A. R.'s). It also gives the expected weight, 46 lb., for a boy of the same height who has a diameter of 21.5 cm. In other words, an increase of 2.2 cm. (21.5 cm. —19.3 cm.) in the width of the iliac crest—to use one of Pryor's terms—corresponds to an increase of 4 lb. in the average weight of a boy of this age and height. A. R.'s crest measurement is 0.9 cm. larger than the smaller of these two diameters given in the table and corresponds approximately to a weight increase of 1.6 lb., which is added to the average weight, 42 lb., of a boy with a bi-iliac diameter of 19.3 cm., giving an expected weight of 43.6 lb. for a child who was weighed with his clothing removed. As the boys and girls included in this study were weighed wearing their clothing, an allowance of 2 lb. for the weight of the clothing must be made for children who are more than 40 in. tall.[21] Therefore, a 7-year-old boy with the same height and crest measurements as A. R. weighs, on the average, 45.6 lb. (43.6 lb.+2 lb.), compared to A. R., who weighed 46 lb. In other words, according to this index, A. R. was 0.4 lb. overweight (46–45.6). As the Pryor Tables do not define the amount of variation in weight which is within normal limits nor the child's relative standing in weight, a procedure has been developed which is comparable to Table X [22] in the monograph, Nutritional Status Indices.[23] It gives the number in 100 children of the same sex, age, and body build who weigh less than any individual child. When this method of scoring is used, 54 boys in 100 of the same sex and build weigh less than A. R.

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[20] Pryor uses the following terms interchangeably: Width of iliac crest, bi-iliac diameter, width of pelvic crest, bicristal diameter, and width of crest of ilium.

[21] See Appendix II: (86) Pryor, p. 11.

[22] See Appendix II: (75) Nutritional Status Indices, p. 65.

[23] The exact method of deriving and using this method of scoring is described in detail in Appendix I, pp. 97-98. It was approved by Pryor in a personal communication dated Feb. 3, 1948.

Limitations of the Four Indices of Body Build

In outlining the limitations of measuring the child's fitness in terms of his body build, certain questions which refer either directly or indirectly to the four indices included in this study have been omitted intentionally from the discussion. For example, Wilkins in an article entitled "The Assessment of Nutrition in School Children," which appeared in The Medical Officer in 1937, points out a "subtle error" in the standard based on the relation of weight to height; namely, that "the well-nourished child, while both taller and heavier than the poorly nourished, is at the same time lighter in relation to its height than the less well-nourished. In other words, the less well-nourished child is often heavier in relation to its height than is the better-nourished child. This disturbance of the natural relation of weight to height is, of course, the result of faulty nutrition affecting growth over a considerable period." [24]

Various workers have also raised questions concerning some of the measurements used for the Nutritional Status Indices. For example: Is the amount of subcutaneous tissue which can be picked up associated with the size of the finger tips? Can one pick up *two* layers of the skin of a very fat child, with the calipers set at 30 to standardize the size of the bite? [25] Are the fat and muscle of the upper arm representative of the subcutaneous tissue and musculature of the entire body?

Many other questions arise which one would like to study. For example: To what extent is an index prognostic as well as diagnostic? What happens to an index during an acute illness? Is an index related to a child's gain in weight or to some other measure of his growth and development?

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[24] See Appendix II: (*121*) Wilkins, p. 146.

[25] The measurements "are taken with the special subcutaneous-tissue caliper. The examiner stands to the right of the child and measures the bare right upper arm.

"Ask the child to extend the bared right arm at right angles to the side of the body, and then to flex the arm and 'make a muscle.' Mark with a pencil the highest point on the biceps muscle. Then have the child relax and lower his arm. (This highest point on the biceps muscle is the same level at which the girth of the upper arm is measured and, in actual practice, is marked at the same time the arm-girth measurements are taken.) Through this 'biceps point' draw a short line across the arm. This line furnishes a reference point for taking the measurements.

"The size of the 'bite,' or the amount of tissue that is grasped, has considerable influence on the accuracy of this measurement. In order to standardize the amount of tissue grasped, the size of the 'bite' is determined by the caliper itself. Take the caliper in the right hand and open it to a reading of 30. Then, using the 'biceps point' as a center, straddle the blades of the caliper, equally on each side of the 'biceps point,' with the lower edges of the blades touching on the horizontal line which has been drawn on the arm. With the left hand above the caliper, place the index finger and the thumb of the left hand in contact with the outer surface of the caliper blades, remove the caliper, and pinch up the amount of tissue indicated, thus freeing the tissue from the underlying musculature. Place the blades of the caliper as closely below the index finger and thumb as possible, release the blades, and measure the thickness of the subcutaneous tissue. Record the caliper reading.

"The second measurement is taken in exactly the same way as the first, except that to locate the position of the index finger and the thumb the caliper blades are placed with the upper edges, rather than the lower edges, touching on the line. The sum of the two readings is the Subcutaneous-Tissue measurement." See Appendix II: (*75*) Nutritional Status Indices, pp. 8-10.

The importance of all these problems is fully recognized, but, on the other hand, they are necessarily subordinate to the question with which this study is concerned; namely, do any or all of these indices satisfactorily measure physical fitness? Warner (1935)[26] has summarized the criteria which such an index should possess in this manner: Any satisfactory index of nutritional status (1) must correlate to a high degree with a clinically acceptable definition of nutrition; (2) must be objectively determinable; and, finally (3) must be relatively simple and applicable to the ordinary school health program, and of such a character that it might be used by persons with only a moderate amount of training and technical skill.[27]

The indices included in this study were, of course, designed to select the child (of a given sex and age) who is physically unfit only insofar as physical fitness is related to and can be measured by certain abnormalities of physique. The Baldwin-Wood and Pryor Tables were developed to identify a boy or girl who is *underweight* for his or her body build,[28] judged in terms of height or height and bi-iliac diameter; the Nutritional Status Indices, to identify one who is *below his skeletal peers* (children of the same height, chest breadth, chest depth, and hip width) *in subcutaneous tissue, arm girth, or weight;* and the ACH Index, to identify the child who has a *small amount of soft tissue in relation to his build.* Therefore, the association between a deficiency in any one of these measures and the child's physical fitness determines the extent to which any of these indices may be expected to identify the child who is physically unfit.

Previous Studies

A considerable literature is concerned with this subject—the efficiency of each of these four indices in identifying children who are physically unfit. It may be classified conveniently under two headings: (1) Studies in which the indices have been applied to children belonging to another race, to children of a different chronological age, or to children living in widely separated geographic regions; and (2) studies in which the children are more or less comparable to the 7-year-old white boys and girls living in New Haven, Conn., observations of whom form the basis of this report.

Under the first heading are included such studies as those of Aykroyd and Rajagopal (*4*), who tested the ACH Index on a group of children in South India; Franzen (*33*) (1934), who studied the ACH Index, the Baldwin-Wood Tables, and an index of weight for height and hip width on a group of 11-year-old boys and girls; Le Riche (*55*), who

[26] See Appendix II: (*117*) Warner, p. 19.

[27] Warner defined these criteria for indices of nutrition as distinguished from indices of physical fitness.

[28] Baldwin stated that "children who are 15 percent overweight for their height and age may also be in need of medical attention" (see Appendix II: (*5*) Baldwin, p. 4). Only underweight children, however, are being considered in this report, as is indicated on p. 10.

applied the ACH Index to children living in Pretoria, South Africa; Jones (*51*), who tested several indices, including Pryor's Tables, on a group of English school boys; and Steggerda and Densen (*108*), who applied the Baldwin-Wood standard to Navaho Indian children and to children of Dutch descent.[29]

It is unnecessary to review such studies, for the success or failure of an index applied to children of another race or age or those living in different geographic regions has no direct bearing on the effectiveness of an index to identify 7-year-old white children living in New Haven, Conn., who may be in need of medical care or nutritional advice and assistance.

On the other hand, it is important to know whether other investigators have found a given index a satisfactory method of assessment when applied to children who are more comparable to those included in this study. Only a few studies come under this heading:

Clark and his associates (*22*) tested the Baldwin-Wood Index in 1924 on a group of 506 native white children,[30] aged from 6 to 18 years, inclusive (at nearest birthday), including 32 7-year-old boys and girls. All these children were without physical defects or evidences of disease and were judged to be in good or excellent nutritional condition.[31] Their findings for 7-year-old boys and girls are given in the following table:

Nutrition: Good or Excellent [1]

Percentage deviation from the Baldwin-Wood standard	Number of 7-year-old children who are a given percent above or below the Baldwin-Wood standard weight	
	Boys	Girls
16 to 20 percent underweight	1	1
11 to 15 percent underweight	1	—
6 to 10 percent underweight	3	5
1 to 5 percent underweight	4	6
0 to 5 percent overweight	1	2
6 to 10 percent overweight	2	1
11 to 15 percent overweight	1	3
16 percent or more overweight	1	—
Total	14	18

[1] This table is adapted from table IV of the report discussed which includes figures for children from 6 to 18 years of age, inclusive. Only findings for 7-year-old boys and girls have been used here. See Appendix II: (*22*) Clark, Sydenstrieker, and Collins, p. 523.

[29] See also Appendix II: (*1*) Allman, who applied the Baldwin-Wood and ACH Indices; (*3*) Aykroyd, (*5*) Aykroyd, Madhava, and Rajagopal, (*16*) Buck, (*18*) Chatterji, (*62*) McPherson, (*84*) Pinekney, reference to Clements and Leipoldt in (*99*) Scantlebury, (*122*) Wilson, Ahmad, and Mitra, (*123*) Wilson and Mitra, who used the ACH Index; (*70*) and (*72*) Mitchell, (*101*) Schlutz, who employed the Nutritional Status Indices; (*112*) and (*113*) Turner, for studies using the Baldwin-Wood Tables; (*130*) Zayaz et al., for an application of the Pryor and Baldwin-Wood Tables; and (*98*) Snyder, St. Paul, Minn., who used the Pryor Tables.

[30] Both the parents and the grandparents of these children were born in the United States. A more detailed description of the group is given in a study by the same authors entitled "Indices of Nutrition." These 506 children lived in 4 States: Florida, 130; Georgia, 159; Tennessee, 110; and Utah, 107. There is no indication as to whether they lived in rural or urban areas. See Appendix II: (*21*) Clark, Sydenstricker, and Collins, pp. 1244–1245.

[31] A 5-point scale ("excellent," "good," "fair," "poor," or "very poor") was used by the physicians for grading nutrition evaluated in terms of general appearance, activity, condition of the skin, amount of subcutaneous fat, muscle tone, alertness, and vitality. See Appendix II: (*21*) Clark, Sydenstricker, and Collins, pp. 1244–1245.

It may be seen from this table that 5 of the 14 7-year-old boys (36 percent) and 6 of the 18 7-year-old girls (33 percent), all of whom were clinically in good or excellent condition, were 6 or more percent underweight according to the Baldwin-Wood standard. Although these results are based on only a small number of children, they naturally throw some doubt on the Baldwin-Wood method of assessment.[32]

In discussing the significance of their findings Clark and his associates point out three possible sources of error in the Baldwin-Wood Tables: (1) They may be based on an unrepresentative group of children; (2) the limits for normal variation (10 percent) in a child's actual weight compared with his expected weight may be too narrow; these limits may vary with sex or age;[33] and, finally, (3) a deviation from an average weight for sex, height, and age may be an unsatisfactory criterion of physical fitness.[34]

In 1924 Dublin and Gebhart applied the Baldwin-Wood Tables[35] to a group of 4,047 first-generation Italian children aged from 2 to 10 years, inclusive (age at nearest birthday), living in the Mulberry District of New York City. These boys and girls were the apparently well children coming under the care of the Association for Improving the Condition of the Poor. They were examined by one well-trained pediatrician and were diagnosed as either well-nourished or undernourished. The authors state:

> The doctor's diagnosis of defective nutrition was based on the picture of the whole child and not on the weight and height alone. Such items as the state of the musculature, the luster of the eyes, the color and bearing of the children, their posture, and the relative amount of subcutaneous tissue were all taken into account in assessing the child's nutrition. In addition, the physical measurements of height and weight were given careful consideration in relation to the child's age.[36]

The accompanying table shows the agreement between the Baldwin-Wood standard and the physician's judgment, for the 455 7-year-old children included in the study. In this table a 7-percent limit for underweight has been used. In other words, if the difference between the child's observed and his expected weight is less than 7 percent of his expected weight he is not identified by the Baldwin-

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[32] Although the authors recognize the fact that no satisfactory standard of physical fitness should include any large proportion of a group which, judged by careful medical examination, is found to be in ill health, they did not study this important aspect of the problem. See Appendix II: (22) Clark, Sydenstricker, and Collins, p. 519.

[33] It is interesting to note that Faber (1925) questioned the validity of Baldwin's standards (1921), as well as other generally used standards, of percentage underweight and overweight. He studied the heights and weights of about 34,000 San Francisco school children aged 5 through 14 years (age at the nearest birth day), including 3,421 7-year-old children, and concluded that underweight and overweight standards should vary with sex and age. See Appendix II: (31) Faber.

[34] See Appendix II: (22) Clark, Sydenstricker, and Collins, p. 521.

[35] The Woodbury Tables for boys and girls from birth to school age were used for the very young children. See Appendix II: (125) Woodbury.

[36] See Appendix II: (28) Dublin and Gebhart, p. 4.

Wood standard as being underweight. For example, there were 77 7-year-old boys who, according to the physician's judgment, were undernourished. The Baldwin-Wood Tables failed to identify 52 (67.5 percent) of these 77 children as underweight. In other words, using a 7-percent limit for percentage underweight, the tables selected only 32.5 percent of the boys whom the physician had diagnosed as undernourished.

A Comparison of the Selection Made by the Physician's Diagnosis of Nutrition and by the Use of the Baldwin-Wood Tables [1]

BOYS

Age [4]	WELL-NOURISHED			UNDERNOURISHED		
	Doctor's diagnosis	Weight table 7 percent limit [2]	Percent agreement	Doctor's diagnosis	Weight table 7 percent limit [3]	Percent agreement
7	137	130	94. 9	77	25	32. 5

GIRLS

Age [4]	WELL-NOURISHED			UNDERNOURISHED		
	Doctor's diagnosis	Weight table 7 percent limit [2]	Percent agreement	Doctor's diagnosis	Weight table 7 percent limit [3]	Percent agreement
7	142	134	94. 4	99	25	25. 3

[1] Adapted from table I, p. 5, in Dublin and Gebhart (*28*) (See Appendix II).
[2] A child is identified as well-nourished if he is less than 7 percent underweight or if his observed weight is more than his expected weight.
[3] A child is selected as undernourished if he is 7 percent or more underweight according to the standard.
[4] Age at nearest birthday.

In discussing these results Dublin and Gebhart conclude: "A method which misses three-fourths [37] of all of the children whom a competent physician, after a thorough examination, would call undernourished has certainly scant value even as a 'rough index for sorting out the most needy cases.'" They attribute the failure of the index in part to the fact that "these Italian children are heavier for each inch of height than the children used in the Wood-Baldwin-Woodbury Table." [38]

In Mitchell's study (1935) the Baldwin-Wood Tables and the Nutritional Status Indices were applied to only eight children, including two 7-year-old boys,[39] James and Edward, who had been referred by their teachers to a physician for special examinations.

James weighed 43 lb. and was, according to the investigator, obviously undernourished. He was so unusually low in weight, musculature, and adiposity that he appeared thin and frail and suggested poor nutrition to the casual observer. The clinical examination also showed very little flesh over the chest, well-defined winged scapulae, and soft, flabby muscles. According to the Baldwin-Wood Tables

[37] The tables failed to identify three-fourths of the children of all ages (2–10 years, inclusive); two-thirds of the 7-year-old boys and three-fourths of the 7-year-old girls.
[38] See Appendix II: (*28*) Dublin and Gebhart, p. 8.
[39] No statement is given as to how age was defined, nor an indication of the race, or the location of the homes of these children.

he should have weighed 50 lb. and was, therefore, 14 percent underweight. In terms of the Nutritional Status Indices only 2 in 100 boys with the same skeletal build weigh less than James; 6 have a smaller arm girth and 20 in 100 have less subcutaneous tissue.[40]

Edward weighed 47½ lb. The investigator described him as of about average height with average chest breadth and a shallow chest and narrow hips. Both arms and legs appeared very thin and his muscles were very soft and flabby. The child was one of nine children; the family was entirely dependent on public relief; investigation showed a diet of excess starchy foods which may have accounted for his adipose tissue. During 6 months' observation he gained only ½ lb.[41] According to the Baldwin-Wood Tables he was 10.4 percent underweight. In terms of the Nutritional Status Indices, 7 boys in 100 with the same skeletal build have a lower weight; 9, a smaller arm girth; and 50, a smaller amount of subcutaneous tissue.

To summarize: The Baldwin-Wood Tables identify both James and Edward as markedly underweight. According to the Nutritional Status Indices also, both these children were underweight; they had exceptionally small arm girths; and James had a deficiency in subcutaneous tissue as well. These findings indicate that the Nutritional Status Indices may be more useful than the Baldwin-Wood Tables because they evaluate not only the child's weight but also his musculature and subcutaneous tissue. It should be pointed out, however, that Mitchell tested the indices on only a small number of children, and there is no evidence in this study to indicate that the Nutritional Status Indices will identify other children who are poorly nourished.

It is difficult to evaluate and compare these three studies for five reasons: (1) The indices were applied to groups of children living under varying conditions; (2) clinical judgment of nutrition was made by different physicians; (3) there was no attempt to evaluate the objectivity and stability of clinical judgment nor the accuracy of the anthropometric measurements; (4) in one study (Clark et al., 1924) the indices were tested only on children who were clinically in good or excellent nutritional condition, in another (Mitchell, 1935), on children who had been referred by their teacher to the school physician for special examination, in the third (Dublin and Gebhart, 1924), on boys and girls whom the physician judged to be either well or poorly nourished; and (5) different selection points were used for testing the same index.

For example, Clark applied the Baldwin-Wood Tables to children in excellent or good nutritional condition and, using 6 percent as a limit for underweight, grouped the children by 5-percent differences

[40] See Appendix II: (71) Mitchell, pp. 316-317.

[41] See Appendix II: Ibid., pp. 318-319.

in the index. Dublin and Gebhart, on the other hand, applied both 7 and 10 percent or more underweight as criteria for selection, classified the children in only two groups, those who were identified as underweight and those who were not.

Probably a more satisfactory method of testing and comparing such indices is to apply them to a group of children belonging to the same nationality,[42] of a given sex and age, and living in one community, who have been under observation for a sufficient period to permit evaluation of their physical well-being and their socioeconomic status, and then to compare the effectiveness of each of the indices in selecting those children who, in terms of each of several carefully defined criteria, are likely to be in need of medical attention or nutritional advice and assistance.

The importance of such a study was pointed out by Jones in his monograph entitled "Physical Indices and Clinical Assessment of the Nutrition of School Children," in which he writes:

> Hundreds of physical indices of nutrition have been proposed by writers in many languages, but it is difficult to discover precisely what these indices will perform in practice. Though there is an enormous literature, there is no agreement among writers as to which index is best. General claims concerning the value of an index are met more frequently than precise details of performance, and few attempts have been made to test different indices on the same large group of children.[43]

The observations made of the children included in the present study may be used to test the indices in this way and to evaluate other methods of assessment, particularly the clinical examination. How accurate is the physician's judgment of the child's general nutritional status? Is it stable? Is his assessment of the child's nutrition in agreement with the judgment of other physicians? To repeat: This investigation of the physical fitness of New Haven children may be used to measure the relative efficiency of several methods of assessing the physical fitness of 7-year-old school children.

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[42] This term is used to distinguish broad, ethnic groups.

[43] See Appendix II; (*51*) Jones, pp. 2–3.

Material and Methods

The observations were made of 713 7-year-old white children [2] (365 boys and 348 girls) attending the kindergarten, first grade, or second grade of the public or parochial schools of New Haven, Conn., from September 1934 through May 1936. Of these 713 children 661 (92.7 percent) attended 44 of the 49 public grade schools in New Haven;[3] 52 (7.3 percent) of the boys and girls were enrolled in 4 of the 9 parochial schools.[4]

Each of these children may be briefly described as follows:

Race	White.
Sex	Male or female.
Nationality [5]	Italian, American, or other.[6]
Age (in completed years at first physical examination in 1934)	Six years (only a child who was a single legitimate birth and was born during the period from July 1 to December 31, 1928, was eligible for inclusion).
Residence	Living with his family or in a foster home.
School attendance	Attending a public or parochial school in 1928, inclusive, New Haven.
Period of observation	A minimum period of 12 consecutive months during the school years 1934–35 and 1935–36. (Most of the children were observed for either 19 or 20 months.)[7]

[1] Included in this section are descriptions of the observations made of these New Haven children. Some of these data will form the basis for additional studies of child growth and development.

[2] Age is defined as age at last birthday. As is stated on p. 1, the children included in this study were 6 years old when the first medical examination was made. Periodic weighings were made of some of these children before they were 6 years old, the age at the first weighing ranging from 5 years 8 months to 6 years 6 months. This report is based on observations made when the boys and girls were 7 years of age, amplified and interpreted in relation to the earlier findings.

Only children who were single, legitimate births, who were born during the period from July 1 to December 31, 1928, inclusive, and who were living with their families or in foster homes were included in the study.

[3] 5 of the public schools were excluded because they served highly specialized groups of children. That is, one school had a very high percentage of Negroes in attendance; the second was conducted for children living in an orphanage; the third was used as a training school for teachers and was omitted for administrative reasons; the fourth had only a small enrollment of 6-year-old children; the fifth was a special school for mental defectives.

[4] These children were included in order to have the different nationality groups in New Haven adequately represented.

[5] "Nationality" has been defined arbitrarily according to the birthplace of the grandparent. For example, a child 3 of whose grandparents were born in Italy is classified as "Italian." It was necessary to expand this definition for "American" children to include boys and girls both of whose parents and 2 of whose grandparents were born in the United States.

[6] A more detailed nationality distribution is given in Appendix I—supplementary table 1, p. 100.

[7] About 56 percent of the children were observed for 19 months and about 40 percent for 20 months.

The following observations were made of the child during this 19- or 20-month period of observation:

Physical examinations:

He was given two annual physical examinations by one pediatrician. The first examination was made when the child was 6 years old; the second, 1 year later.[8] When the first examination was made, most of the child's clothing above the waist was removed; at the second examination, written permission had been obtained from the parents to remove all the clothing above the waist.

Anthropometric measurements:

He was measured at the same time the annual physical examinations were made by one observer trained in anthropometry.[9]

Periodic weighings:

The number of weighings varied: The minimum number was five; the maximum, nine; the average, eight. The child's age at the first weighing ranged from 5 years 8 months to 6 years 6 months; at the last weighing, from 7 years 2 months to 7 years 10 months. His weight was taken at the time each of the annual physical examinations was made; 6 months after the first examination; and at 4-month intervals [10] during the school years 1934–35 and 1935–36.[11]

Information was also obtained concerning the following items:

Socioeconomic status:

An economic analyst [12] visited his home during each of the 2 school years (1934–35 and 1935–36) and obtained information from his mother (or some other responsible adult member of the family if the mother was absent) concerning the child's general disease history, his dietary habits (particularly his consumption of milk and leafy vegetables), and the economic status of the family. These visits were usually made within a period 2 to 3 weeks after the physical examinations.

Schooling:

Information concerning *school absences*—namely, the date, duration, and reason for each absence of 3 or more days' duration—was obtained from the school nurses' files.[13]

School progress was also recorded as "passed" or "failed."

These 713 white children form a selected group. They were 6 years old at the first physical examination, they were of single, legitimate

[8] There was a minimum interval of 11 months 16 days, and a maximum of 1 year 14 days, between the 2 physical examinations.

[9] A few observations were made during the first year of the study by another trained observer who repeatedly checked her observations against those made by the anthropometrist.

[10] These weighings were made for the most part during the last weeks of September 1934; January, May, and September, 1935; and January and May 1936.

[11] The weights were secured for the most part within a 3-day interval, and were taken by the anthropometrist, the pediatrician, and the office clerk. A few weighings were also made by the economic analysts who collected the socioeconomic data.

[12] The socioeconomic data were collected from October through March or April of each year of the study. 6 economic analysts were employed during the first year, and 2 new agents collected the data during the second year of the study.

[13] In the case of absences which occurred prior to the second home visit these data were supplemented by information obtained from the mother at this visit. In appropriate instances additional inquiries were made about absences which occurred subsequently.

birth, their nationality was known, they were living in their own or foster homes, they were attending school in New Haven, and most of them were under observation for a 19- or 20-month period.

Conversely, boys and girls were excluded or discharged from the study for any of the following reasons: Multiple birth; illegitimacy; incorrect age; unknown or incorrectly stated race or nationality; residence in an orphanage or other institution; attendance at a private school (other than parochial) or nonenrollment at school;[14] omission of certain anthropometric measurements or of either of the physical examinations; interval of more than 1 year and 14 days, or less than 11 months and 16 days between the two annual physical examinations; establishment of residence in another city; death during the period of observation; or age outside limits established for testing the indices.[15] It is, of course, difficult to estimate the effect of excluding these children from the study, and no attempt has been made to do so.

A Description of the Boys and Girls Included in the Study

A description of the age and nationality groups represented, the kind of homes the children came from, and the general physical condition of the 713 boys and girls included in the study may be helpful in interpreting the results.

AGE

The ages (in completed years and months) of the children when the second annual physical examinations were made are given in table 1. None of these 713 boys and girls were less than 7 years 0 months of age. Approximately 72 percent were less than 7 years 4 months, and none of them were more than 7 years 7 months of age. In other words, there is relatively very little variation in the ages of the boys and girls included in the study.

This somewhat unusual age distribution is probably the result of the following circumstances: Only children born during the period from July 1 to December 31, 1928, inclusive, were eligible for inclusion; the annual physical examinations were made from October of one year through March of the next; and no child was retained in the study who was less than 6 years of age at the time of his first medical examination or less than 7 years old at the second examination, which was made approximately 1 year later.

[14] There were 2 reasons for nonenrollment: (1) Children were not required to attend school until they were 7 years of age; (2) they were physically incapacitated and unable to attend school.

[15] At the beginning of the study, age was defined as age at nearest birthday. Later, it was changed to age at last birthday in order to permit testing of the Nutritional Status and ACH Indices on all the children included.

TABLE 1.—*Age of the boys and girls at the time of the second physical examination*

Age[1]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	713	100.0	365	100.0	348	100.0
7 years 0 months	74	10.4	36	9.8	38	10.9
7 years 1 month	151	21.2	78	21.4	73	21.0
7 years 2 months	150	21.0	67	18.3	83	23.9
7 years 3 months	137	19.2	74	20.3	63	18.1
7 years 4 months	91	12.8	46	12.6	45	12.9
7 years 5 months	70	9.8	39	10.7	31	8.9
7 years 6 months	33	4.6	20	5.5	13	3.7
7 years 7 months	7	1.0	5	1.4	2	.6

[1] Age is given in completed years and months.

NATIONALITY

The nationalities to which the children belong are shown in table 2.[16] About 46 percent of the children were classified as "Italian" and approximately 18 percent as "American." The remaining 36 percent, representing various geographic groups, were classified as "Russians," "Polish," "Irish," and "All others." The fact that so large a number of Italian children were included in the study is of particular significance because, on the average, the Italian boys and girls were shorter and tended to weigh less than the other children.[17] Is this difference in their body build likely to affect the efficiency of the indices?

TABLE 2.—*Nationality of the boys and girls*

Nationality [1]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	713	100.0	365	100.0	348	100.0
Italian	330	46.3	166	45.5	164	47.1
American	130	18.2	65	17.8	65	18.7
Russian	66	9.3	34	9.3	32	9.2
Polish	35	4.9	19	5.2	16	4.6
Irish	34	4.8	17	4.7	17	4.9
All others	118	16.5	64	17.5	54	15.5

[1] Classification was based on the birthplace of 3 of the child's grandparents. The classification "American" includes not only children 3 of whose grandparents were born in the United States but also children whose parents and 2 of whose grandparents were born here.

HOMES

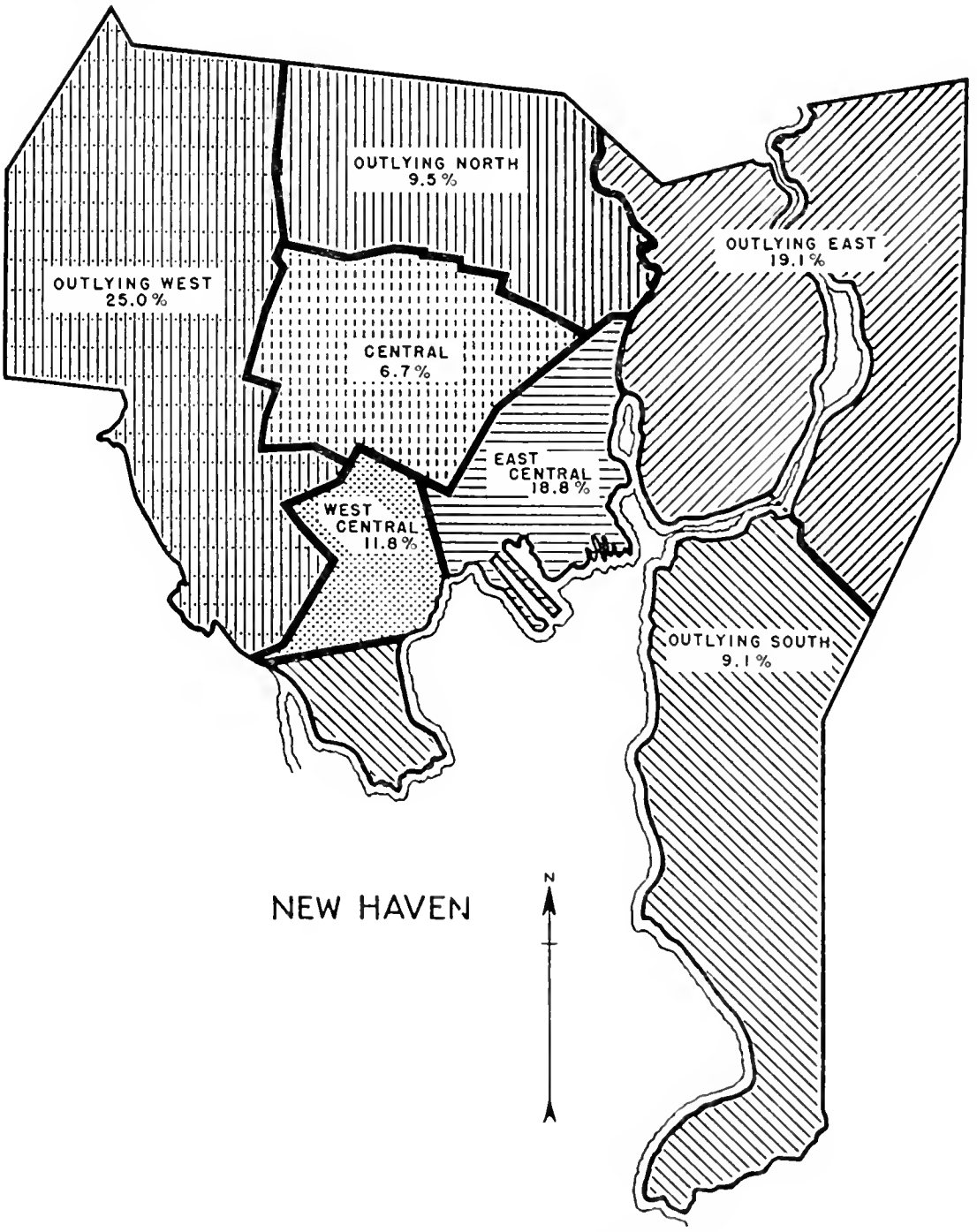
Location.

The location of these children's homes is shown on the map on p. 29.

[16] For the definition of "nationality" used in the study see page 25.

[17] See tables 11 and 12, which give the heights and weights of the boys and girls belonging in each nationality group. See also Meredith's discussion of this problem: Appendix II: (68) Meredith, p. 344.

The various sections of the city were all fairly well represented, but the majority (62.7 percent) of the boys and girls lived in the outlying regions, especially in the eastern (19.1 percent) and western (25.0 percent) parts of New Haven.



Location of the Homes of the Children

Type of dwelling.

Only about 12 percent of the boys and girls were living in one-family dwellings; all the others, approximately 88 percent, lived in flats or apartments. (Table 3.) The fact that so few of the children lived

in one-family houses can be attributed in part to the relatively small number of such dwellings which exist in New Haven.[18]

TABLE 3.- *Type of dwelling occupied by the families of the boys and girls* [1]

Type of dwelling [2]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	[3] 695	100.0	[3] 358	100.0	[3] 337	100.0
One-family dwelling	84	12.1	37	10.3	47	13.9
Flat or apartment	611	87.9	321	89.7	290	86.1

[1] Data based on observations made when the children were 6 years of age.
[2] A 1-family dwelling is a residence adapted to the use of only 1 family. It may be connected with a store or it may be one of a series of houses with adjoining walls. A flat or apartment is a 1-family unit in a building adapted to 2 or more families. These definitions are adapted from Appendix II: (*26*) Dreis, p. 9.
[3] Type of dwelling was unknown for 7 boys and 11 girls.

Presence of parents in the home.

Most of these children (90.3 percent) were residing with both their parents. Less than 10 percent (9.0 percent) lived with only one parent; and very few boys and girls (0.7 percent) resided in foster homes. (Table 4.)

TABLE 4.—*Presence of parents in the homes of the boys and girls*

Parents living in the home	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	713	100.0	365	100.0	348	100.0
Both parents	644	90.3	339	92.9	305	87.6
One parent	64	9.0	24	6.6	40	11.5
Neither parent [1]	5	.7	2	.5	3	.9

[1] Cases of children living in foster homes.

Number of persons in household.

The number of persons in the household included not only the members of the child's immediate family but also any relatives, friends, roomers, and servants living under the same roof.[19] Nearly three-fifths (58.6 percent) of the children lived in households including four, five, or six members. A few (4.7 percent) lived in homes containing as many as 11 or more persons. (Table 5.)

[18] The Southern New England Telephone Co. Market Survey of 1931 indicated that less than one-fifth of all the occupied dwellings in New Haven were 1-family residences. See Appendix II: (*26*) Dreis, pp. 9, 11.
[19] Boarders were excluded.

TABLE 5.—*Number of persons in the households in which the boys and girls lived*[1]

Number of persons in household [2]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	[3] 709	100.0	[3] 364	100.0	[3] 345	100.0
2	3	0.4	0	0.0	3	0.9
3	65	9.2	36	9.9	29	8.4
4	140	19.7	76	20.9	64	18.6
5	149	21.0	74	20.3	75	21.7
6	127	17.9	55	15.1	72	20.9
7	77	10.9	42	11.5	35	10.1
8	58	8.2	29	8.0	29	8.4
9	34	4.8	20	5.5	14	4.1
10	23	3.2	13	3.6	10	2.9
11	16	2.3	10	2.7	6	1.7
12	11	1.6	5	1.4	6	1.7
13	3	.4	3	.8	0	.0
14	3	.4	1	.3	2	.6

[1] Data based on observations made when the children were 6 years of age.
[2] Number of persons in household included the child's immediate family, relatives, roomers, friends, and servants living under the same roof.
[3] Number of persons in household was unknown for 1 boy and 3 girls.

Number of persons per room.

If crowding is defined arbitrarily as one and one-half or more persons per room,[20] it may be seen from table 6 that approximately 32 percent of the children included in this study were living in homes where overcrowding was a serious problem, although in about 43 percent of the households there were from one to less than one and one-half persons per room, and about 25 percent of the children were living in homes with less than one person per room.

TABLE 6.—*Number of persons per room in the households in which the boys and girls lived* [1]

Persons per room [2]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	[3] 707	100.0	[3] 363	100.0	344	100.0
Less than ½	2	0.3	0	0.0	2	0.6
½, less than 1	174	24.6	94	25.9	80	23.2
1, less than 1½	302	42.7	147	40.5	155	45.1
1½, less than 2	145	20.5	81	22.3	64	18.6
2, less than 2½	59	8.4	30	8.3	29	8.4
2½, less than 3	22	3.1	10	2.7	12	3.5
3, less than 3½	2	.3	0	.0	2	.6
3½, less than 4	1	.1	1	.3	0	.0

[1] Data based on observations made when the children were 6 years of age.
[2] The number of persons in the household included the child's immediate family, relatives, roomers, friends, and servants living under the same roof. The number of rooms excluded bathrooms and hallways.
[3] Number of persons per room was unknown for 2 boys and 4 girls.

[20] It is recognized that any arbitrary standard of crowding has limitations. In this connection Rollo H Britten, of the National Institute of Health, has pointed out that "a reasonable index should depend not only on persons per room but also on such factors as age and sex make-up of the family, size of rooms, whether the dwelling unit is in a house or apartment, geographic location, etc." See Appendix H (45) Britten.

It should be remembered, however, that the nature of the present investigation has automatically restricted the type of family under consideration. Every child in this study comes from a household consisting of at least 2 persons, a 6-year-old child and an adult. A standard of crowding applied to a group of these families is probably a more reliable index of socioeconomic status than if it is applied to a less rigorously defined group.

Number of additional persons sleeping in the child's bedroom.

Another and perhaps a more sensitive index of crowding is the number of persons occupying one bedroom. About 43 percent of the children included in this study slept in a room occupied by two or more *additional* persons, and approximately 44 percent slept in a room occupied by one other person. Only about 13 percent had their own bedrooms. (Table 7.)

TABLE 7.—*Number of additional persons sleeping in the child's bedroom* [1]

Additional persons occupying child's room	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	[2] 707	100.0	[2] 363	100.0	[2] 344	100.0
0	93	13.2	53	14.6	40	11.6
1	307	43.4	158	43.5	149	43.3
2	204	28.9	107	29.5	97	28.2
3	74	10.5	34	9.4	40	11.6
4	22	3.1	10	2.7	12	3.5
5	6	.8	1	.3	5	1.5
6	0	.0	0	.0	0	.0
7	1	.1	0	.0	1	.3

[1] Data based on observations made when the children were 6 years of age.
[2] Number of additional persons occupying same sleeping room as child was unknown for 2 boys and 4 girls.

ECONOMIC STATUS OF THEIR FAMILIES

Assistance.

With such conditions existing in the children's homes, it is reasonable to expect that a considerable number of families were in poor economic circumstances. If assistance from public or private agencies or both [21] is used as a criterion, it may be seen from table 8 that this is so. Almost 24 percent of these boys' and girls' families received assistance during the year prior to the home visit made when the child was 6 years old and again when the child was 7 years of age, compared with 70 percent that received no assistance at any time during the period of observation. A few families (4.5 percent) received assistance during the first year only and a still smaller number (1.8 percent) during only the second year of the study. In other words, nearly one-fourth of the children's families received assistance from public or private agencies or both during the years prior to both home visits; most of the remaining families received no assistance either year.

[21] This information was obtained by the economic analysts at the home visits, was cleared through the Social Service Exchange, and was checked with the records of the public and private agencies giving direct and work relief in New Haven. In addition, families reporting an income of less than $1,000 a year, those with a history of severe illness, and all other families whose income statements appeared inaccurate were cleared through the Social Service Exchange.

TABLE 8.—*Assistance from public, private, or public and private agencies given the families of the boys and girls during the year preceding each home visit*

Assistance [1]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	713	100.0	365	100.0	348	100.0
First year only	32	4.5	16	4.4	16	4.6
Second year only	13	1.8	10	2.7	3	.9
Both years	169	23.7	92	25.2	77	22.1
Neither year	499	70.0	247	67.7	252	72.4

[1] Assistance given at any time during the 12 months preceding the home visit. This assistance took the form of direct relief, work relief, or direct and work relief from any public or private agency.

Principal source of income.

What was the principal or major source of income of these boys' and girls' families during the year preceding the second home visit? Table 9 shows it to be the father's earnings in slightly more than two-thirds (68.8 percent) of the homes; the mother's earnings, in about 4 percent; assistance from public or private agencies or both, in 17 percent; and other sources, in about 10 percent.

TABLE 9.—*Principal source of income of the families of the boys and girls during the year preceding the second home visit*

Principal source of income [1]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	[2] 689	100.0	[2] 348	100.0	[2] 341	100.0
Work of father [3]	474	68.8	236	67.8	238	69.8
Work of mother [3]	26	3.8	9	2.6	17	5.0
Other sources [4]	72	10.4	36	10.3	36	10.5
Assistance [5]	117	17.0	67	19.3	50	14.7

[1] That source which contributed the major portion of the family income.
[2] The source of income was unknown for 17 boys and 7 girls.
[3] Did not include work relief.
[4] "Other sources" included income from work of children, from relatives, savings, unemployment and other types of compensation, insurance, and rent. It did not include income from work relief.
[5] "Assistance" included both work relief and direct relief from public and private agencies.

Employment of mother. [22]

In about 18 percent of the households the mother was gainfully employed, mostly outside the home. (Table 10.)

[22] In cases where the child was not living with his own mother, the information pertained to the woman in charge of the household.

TABLE 10.—*Employment status of the mothers of the boys and girls during the year preceding the second home visit* [1]

Employment status	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	713	100.0	365	100.0	348	100.0
Mother not employed	584	81.9	302	82.7	282	81.0
Mother employed	129	18.1	63	17.3	66	19.0
Inside home	12	1.7	6	1.7	6	1.7
Outside home	105	14.7	49	13.4	56	16.1
Unknown whether employed inside or outside home	12	1.7	8	2.2	4	1.2

[1] In cases where the child was not living with his own mother, the information pertained to the woman in charge of the household.

ANTHROPOMETRIC MEASUREMENTS

Height.

The heights of these children are given in table 11. As would be expected, there was considerable variation in the averages of the American and Italian boys and girls, the American child being taller on the average than the Italian. No comparison has been made between the children grouped under the heading "Other" and the American or Italian boys and girls, as the first-mentioned group of children represent so many nationalities that comparisons are not warranted.

TABLE 11.—*Heights of the boys and girls*

Height (in inches)	Boys				Girls			
	Total	Italian [1]	American [2]	Other [3]	Total	Italian [1]	American [2]	Other [3]
Total	365	166	65	134	348	164	65	119
41.0–41.9	1	1	0	0	0	0	0	0
42.0–42.9	8	6	1	1	4	3	0	1
43.0–43.9	9	7	1	1	9	7	0	2
44.0–44.9	34	25	2	7	36	28	3	5
45.0–45.9	41	25	6	10	55	36	5	14
46.0–46.9	57	29	12	16	59	26	15	18
47.0–47.9	75	39	8	28	71	27	11	33
48.0–48.9	54	20	13	21	60	28	15	17
49.0–49.9	32	7	9	16	25	5	9	11
50.0–50.9	29	5	6	18	22	4	6	12
51.0–51.9	17	2	3	12	4	0	0	4
52.0–52.9	6	0	4	2	1	0	1	0
53.0–53.9	2	0	0	2	1	0	0	1
54.0–54.9	0	0	0	0	1	0	0	1
Mean	47.5	46.5	48.1	48.3	47.1	46.4	47.8	47.8
Standard deviation	2.25	1.93	2.21	2.17	1.96	1.76	1.68	2.02

[1] 3 of the child's grandparents were born in Italy.
[2] 3 of the child's grandparents or 2 of his grandparents and both his parents were born in the United States.
[3] These children did not meet the definitions outlined in footnotes 1 and 2.

Weight.

The weights of the children are given in table 12.[23] Here, as in height, there appear to be differences between the children classified

[23] For the frequency distributions of bitrochanteric width see supplementary table II, Appendix I, p. 100.

as Italian and as American, the Italian tending to weigh less than the American boys and girls.

TABLE 12.—*Weights of the boys and girls*

Weight (in pounds)	Boys				Girls			
	Total	Italian [1]	American [2]	Other [3]	Total	Italian [1]	American [2]	Other [3]
Total	365	166	65	134	348	164	65	119
34.0–37.9	2	1	1	0	4	3	0	1
38.0–41.9	14	9	2	3	15	9	3	3
42.0–45.9	38	22	7	9	78	47	12	19
46.0–49.9	89	56	14	19	87	49	18	20
50.0–53.9	85	37	10	38	71	27	18	26
54.0–57.9	65	22	16	27	40	13	6	21
58.0–61.9	40	14	6	20	20	9	2	9
62.0–65.9	13	4	3	6	11	0	1	7
66.0–69.9	11	0	2	9	9	5	0	4
70.0–73.9	3	0	2	1	3	0	1	2
74.0–77.9	1	0	1	0	6	1	0	5
78.0–81.9	3	1	1	1	1	0	0	1
82.0–85.9	0	0	0	0	1	1	0	0
86.0–89.9	1	0	0	1	0	0	0	0
90.0–93.9	0	0	0	0	1	0	0	1
94.0–97.9	0	0	0	0	0	0	0	0
98.0–101.9	0	0	0	0	0	0	0	0
102.0–105.9	0	0	0	0	1	0	1	0
Mean	52.7	50.5	53.8	54.9	51.2	49.1	51.3	54.1
Standard deviation	7.39	6.06	8.54	7.52	8.63	7.06	9.08	9.49

[1] 3 of the child's grandparents were born in Italy.
[2] 3 of the child's grandparents or 2 of his grandparents and both his parents were born in the United States.
[3] These children did not meet the definitions outlined in footnotes 1 and 2.

Such nationality differences are important because, as has been mentioned (see p. 28), they may affect the efficiency of the indices in identifying boys and girls in need of medical attention or nutritional advice or assistance. The indices depend on estimates of body build (based on anthropometric measurements) for judging a child's physical fitness (insofar as physical fitness is related to abnormalities in certain measures such as weight or arm girth) when the expected or average measure for children of the same sex, age, and build is used as a standard. Such a standard may vary with the nationality of the children from whose measurements it was derived and may, therefore, be most efficient in judging the fitness of children of the same nationality as the boys and girls whose measurements were used in developing the index or standard.

DIETS

As information concerning the dietary habits of these children is not very satisfactory, only the data on milk consumption have been analyzed.[24] (Table 13.) Although 56.5 percent of the boys and girls

[24] The estimates of milk consumption are obviously inaccurate and in addition are based on a cup which is smaller than the standard measure.

drank an "adequate" amount (2, 3, or 4 cups per day) of milk at 7 years of age,[25] only 28.3 percent consumed an "optimum" amount (5 cups or more). On the other hand, a considerable proportion of these children (13.9 percent at the age of 7) had an inadequate amount (less than 2 cups per day) of milk in their diet, and a very small number of the boys and girls (1.3 percent at the age of 7) did not drink any milk.

TABLE 13.—*Adequacy of the amount of milk consumed daily by the boys and girls*

Adequacy of milk consumed per day	Both sexes		Boys		Girls	
	Number	Percent[1]	Number	Percent[1]	Number	Percent[1]
No milk:						
At 7 years	9	1.3	3	0.8	6	1.7
At both 6 and 7 years	*0*	*.0*	*0*	*.0*	*0*	*.0*
Inadequate:[2]						
At 7 years	99	13.9	55	15.1	44	12.7
At both 6 and 7 years	*39*	*5.4*	*25*	*6.9*	*14*	*4.1*
Adequate:[3]						
At 7 years	402	56.5	200	55.0	202	58.2
At both 6 and 7 years	*302*	*42.5*	*147*	*40.4*	*155*	*44.7*
Optimum:[4]						
At 7 years	201	28.3	106	29.1	95	27.4
At both 6 and 7 years	*50*	*7.0*	*33*	*9.1*	*17*	*4.9*

[1] The percentages in each case were based on the total number of children for whom information at both 6 and 7 years of age was available: For both sexes, 711; for boys, 364; and for girls, 347. (The amount of milk consumed daily was unknown for 1 boy and 1 girl at 7 years of age.)

[2] "Inadequate" was defined as less than 2 cups per day.

[3] "Adequate" was defined as 2 up to but not including 5 cups per day. The absolute standard of 3 cups a day has not been adopted because the estimates of milk consumption are subject to error.

[4] "Optimum" was defined as 5 or more cups per day.

HEALTH

Pediatrician's assessment of general nutritional status.

As has been stated, all the children were examined both years of the study by one pediatrician, who judged their nutritional status to be "excellent," "good," "borderline," "poor," or "very poor." These estimates were based on careful physical examinations which were made according to detailed written instructions.[26]

On the basis of these examinations the percentage of children in each nutritional class was as follows:

(1) More than half the boys and girls were judged to be in a borderline condition at 7 years of age. Some of them were probably fairly well nourished; others were in a nutritional condition that bordered on poor. Nevertheless, all these children constitute a health problem,

[25] The standard of 3 cups per day as adequate and 4 cups as optimum has not been applied. (See Appendix 11. (*109*) Sherman and Hawley.) Instead, 2 up to but not including 5 cups a day (an average of 3½ cups) has been considered adequate; less than 2 cups, inadequate; and 5 cups or more, an optimum amount. This grouping has been made in order primarily to identify 2 of the 3 groups of children: (1) Those who had a definitely *unsatisfactory* amount of milk in their diets as compared with (2) those who had an *optimum* amount.

[26] A detailed evaluation of both the objectivity and the stability of the pediatrician's judgment occurs on pp. 82–87.

as they are difficult to identify and their condition may grow progressively worse if they do not receive proper care and treatment.

(2) About 34 percent of the boys and girls were judged to be in good or excellent nutritional condition (30.2 percent good and 3.4 percent excellent) at 7 years of age.

(3) Necessarily, if about 57 percent of the children were rated as in borderline and about 34 percent in good or excellent nutritional condition, only a small percentage (9.5 percent) could have been judged by the physician to be poorly or very poorly nourished at 7 years. All these children, 28 out of 365 boys and 40 out of 348 girls, were classified as poorly nourished; none of them as very poorly nourished.

It is also interesting to note (table 14) that, according to this pediatrician's judgment, about 5 percent of the children were poorly nourished during both years of the study, compared with about 9 percent at 7 years of age.

TABLE 14.—*Pediatrician's assessment of nutritional status of the boys and girls*

Nutritional status	Both sexes		Boys		Girls	
	Number	Percent [1]	Number	Percent [1]	Number	Percent [1]
Excellent:						
At 7 years	24	3.4	11	3.0	13	3.7
At both 6 and 7 years	*14*	*2.0*	*5*	*1.4*	*9*	*2.6*
Good:						
At 7 years	215	30.2	120	32.9	95	27.3
At both 6 and 7 years	*101*	*14.2*	*47*	*12.9*	*54*	*15.5*
Borderline:						
At 7 years	406	56.9	206	56.4	200	57.5
At both 6 and 7 years	*293*	*41.1*	*151*	*41.4*	*142*	*40.8*
Poor:						
At 7 years	68	9.5	28	7.7	40	11.5
At both 6 and 7 years	*39*	*5.4*	*16*	*4.4*	*23*	*6.6*
Very poor:						
At 7 years	0	.0	0	.0	0	.0
At both 6 and 7 years	*0*	*.0*	*0*	*.0*	*0*	*.0*

[1] The percentages in each case were based on the total number of children for whom information at both 6 and 7 years of age was available: For both sexes, 713; for boys, 365; and for girls, 348.

Diagnoses made at annual physical examinations.[27]

The diagnoses made at the examinations given when the children were 6 and again when they were 7 years of age are shown in table 15. At 7 years of age 53 percent of the boys and girls were found to be suffering from various ailments, mostly of the respiratory tract. Under nonrespiratory infections only one case of rheumatic heart disease was included, and under the heading "Other positive diagnoses," three congenital heart conditions. With few exceptions, the rest of the diagnoses were of minor importance. This is not surprising, for all the children were well enough to attend school and to be under observation for approximately a 2-year period.

[27] If more than 1 diagnosis was made at a given examination, that which the pediatrician considered most important clinically was recorded.

TABLE 15.—*Diagnoses made at the annual physical examinations of the boys and girls*

Diagnosis	Both sexes				Boys				Girls			
	At 6 years		At 7 years		At 6 years		At 7 years		At 6 years		At 7 years	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	713	100.0	713	100.0	365	100.0	365	100.0	348	100.0	348	100.0
No disease	265	37.2	335	47.0	119	32.6	152	41.6	146	42.0	183	52.6
Disease [1]	448	62.8	378	53.0	246	67.4	213	58.4	202	58.0	165	47.4
Infectious disease	444	62.3	374	52.5	243	66.6	211	57.8	201	57.7	163	46.8
Respiratory	273	38.3	232	32.6	163	44.7	136	37.3	110	31.6	96	27.6
Nonrespiratory	171	24.0	142	19.9	80	21.9	75	20.5	91	26.1	67	19.2
Other [2]	4	.5	4	.5	3	.8	2	.6	1	.3	2	.6

[1] If more than 1 diagnosis was made at a given examination, that which the pediatrician considered the most important clinically was recorded.
[2] "Other" included asthma and congenital heart conditions.

Two other items may be useful in indicating the general physical condition of the boys and girls included in this study: (1) School absences; and (2) the physician's judgment of the child's need for medical or dental care.

Number and duration of reportable school absences.

Only absences of 3 or more school days' duration are reportable in New Haven. The school nurse's files show the number of such absences, the total number of school days which they represent, and the reasons for the absences. Only absences due to illness have been recorded, and the material has been analyzed in terms of the association between the duration of reportable absenes cand the number of such absences. (Table 16.)

TABLE 16.—*Association between the number of reportable absences during the school year and the duration of these absences* [1]

Number of reportable absences [2]	Duration of reportable absences							Total
	0	3–4	5–9	10–14	15–19	20–29	30 or more	
0	186	0	0	0	0	0	0	186
1	0	102	107	20	5	7	8	249
2	0	0	49	54	17	22	8	150
3	0	0	1	22	20	19	7	69
4 or more	0	0	0	3	4	12	19	38
Total	186	102	157	99	46	60	42	[3] 692

[1] The data on school absences have not been presented separately for boys and girls, because analysis failed to reveal any sex difference in either the number or the duration of reportable absences.
[2] A reportable absence is an absence of 3 or more school days.
[3] Information on school absences was lacking for 8 boys and 13 girls.

During 1935–36, when the children were 7 years of age, approximately 27 percent of the boys and girls had no reportable school

absences.[28] It should be remembered, however, that these children may have been absent any number of days during the year if each absence were of less than 3 school days' duration. It is unfortunate that such boys and girls have not been differentiated from the children who had no absences, for a sickly child who is able to attend school except for absences of a day or two should be distinguished from a healthy boy or girl who never misses school. On the other hand, none of these children had any protracted illnesses during the school year, although it may well be that some of the boys and girls frequently suffered from minor ailments which undermined their health but did not materially affect their attendance at school.

Most of the other boys and girls (36.0 percent of all the children) had only one reportable absence. This absence usually lasted from 3 to 9 school days (41.0 percent, 3 or 4 days, and 43.0 percent, 5 to 9 days); there were a few boys and girls (10.0 percent) absent from 10 to 19 days, and an even smaller number (6.0 percent) absent 20 days or more.

About 22 percent of all the children were absent twice for periods of 3 school days or more. About one-third of these boys and girls were out less than 10 days; a somewhat larger proportion (36.0 percent), 10 to 14 days; and the others (31.3 percent), 15 days or longer.

Finally, a considerable number of the children (more than 15 percent of the total) were reported as having had three or more absences at 7 years. These boys and girls were usually absent for long periods. Twenty-nine percent of them were not at school for 20 to 29 days, and nearly one-fourth of these children had reportable absences totaling 30 school days or more.[29]

Medical and dental care.

When the pediatrician examined the children each year she indicated whether they needed medical care or dental care or both (table 17). Analysis of her findings shows that nearly 60 percent of the boys and girls were in need of both medical and dental care at 7 years of age, and that slightly more than 40 percent needed such care at both 6 and 7 years. In other words, nearly half the children were in need of medical and dental care during both years of the study. Even more significant, perhaps, is the fact that only about 2 percent of the boys and girls needed neither medical nor dental care at 7 years of age and that only 1 percent of the children needed neither type of care at 6 or at 7 years of age.

[28] The data on school absences have not been presented separately for boys and girls, because analysis failed to reveal any sex differences in either the number or the duration of reportable absences.

[29] A larger percentage of the children had reportable absences totaling 10 school days or more at 6 than at 7 years, but there appears to be little association between the duration of reportable absences at 6 and at 7 years except for the boys and girls who had absences totaling 15 days or more. Consequently, findings at the earlier age have been omitted from the discussion.

In interpreting these findings it should be remembered, however, that need for medical care refers to observation as well as treatment; undoubtedly many of the children needed observation only, because of a reported history of colds, perhaps; or such conditions as dull ear drums; mouth breathing; or moderately enlarged tonsils.

TABLE 17.—*Recommendation of the pediatrician on the need of the boys and girls for medical and dental care*

Type of care needed	Both sexes		Boys		Girls	
	Number	Percent [1]	Number	Percent [1]	Number	Percent [1]
Medical and dental care:						
At 7 years	422	59.2	215	58.9	207	59.5
At both 6 and 7 years	*296*	*41.5*	*150*	*41.1*	*146*	*42.0*
Medical care only:						
At 7 years	7	1.0	3	.8	4	1.1
At both 6 and 7 years	*3*	*.4*	*2*	*.5*	*1*	*.3*
Dental care only:						
At 7 years	271	38.0	143	39.2	128	36.8
At both 6 and 7 years	*123*	*17.2*	*66*	*18.1*	*57*	*16.4*
No care:						
At 7 years	13	1.8	4	1.1	9	2.6
At both 6 and 7 years	*8*	*1.1*	*1*	*.3*	*7*	*2.0*

[1] The percentages in each case were based on the total number of children for whom information at both 6 and 7 years of age was available: For both sexes, 713; for boys, 365; and for girls, 348.

SUMMARY

Most of the boys and girls were between 7 and 7½ years of age when the indices were tested. Nearly half of them were Italian, and nearly 20 percent were American children; the others represented various smaller nationality groups.

The different sections of New Haven were all fairly well represented. Most of the children lived in flats or apartments with both their parents; and there were generally four, five, or six persons living in their homes. Considerable overcrowding existed; about 32 percent of the boys and girls lived in households where there were one and one-half or more persons per room and in about 43 percent of the homes at least two people were occupying the same bedroom with the child who was included in this study. Some of these boys and girls were in extremely poor economic circumstances; about 24 percent of their families received assistance (from public, private, or both public and private sources) during the year prior to each of the home visits. Even more significant is the fact that 17 percent of the families were dependent on such assistance for the principal part of their income during the second year of the study.

There were marked differences in the body build of these boys and girls. For example, the Italian children were shorter and tended to weigh less, on the average, than the American children.

The diets, judged in terms of the number of cups of milk consumed per day, were often inadequate. At 7 years of age, only about 28 per-

cent of the boys and girls drank an optimum amount (five or more cups); about 15 percent of the children had less than two cups per day.

If the physician's judgment is used as a criterion of general nutritional status, about 34 percent of the boys and girls were in good or excellent nutritional condition at the time the indices were applied (at 7 years); almost 57 percent were in a borderline condition, and approximately 9 percent were judged to be poorly nourished.

Other evidence which gives some indication of the health of these children includes: (1) The specific clinical findings at the physical examinations; (2) absence from school; and (3) the physician's judgment of the boys' and girls' need for medical and dental care.

(1) At the time the second physical examinations were made, the physician found more than half the boys and girls suffering from various ailments, mostly respiratory-tract infections.

(2) Of the boys and girls with reportable school absences (i. e., absences of 3 school days or more) at 7 years of age, 36.0 percent were absent only once, 21.7 percent, twice, and 15.4 percent, three or more times. A large proportion (53.3 percent) of those who had been out three or more times were out of school for as much as 20 school days or longer.

(3) According to the physician's judgment, nearly 60 percent of the children were in need of both medical and dental care at 7 years, and slightly more than 40 percent at both 6 and 7 years of age. A child in need of medical attention was almost always in need of dental care, although the reverse was not generally true.

All these findings—medical, dental, and socioeconomic—indicate that without doubt there must be boys and girls included in this study who were likely to be undernourished and to be in need of medical care or nutritional advice and assistance.

The Observations Made of These Children

TECHNIQUES EMPLOYED

Every attempt was made to have the observations of these boys and girls as accurate as possible. In order to accomplish this purpose, uniform methods of collecting the material and editing the schedules were used.

No attempt will be made to describe each of the observations.[30] On the other hand, the most important items—namely, clinical judgment of the child's nutrition and anthropometric measurements—will be described in some detail.

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[30] Instructions for making the physical examinations, for taking the anthropometric measurements, and for obtaining socioeconomic data, together with the schedules for recording these observations may be obtained upon request from the Children's Bureau, U. S. Department of Labor.

Clinical assessment.

For many years clinical judgment has been the accepted method of assessing a child's physical fitness. With increasing knowledge, improvements have been made in the procedures used in the examination and in the method of arriving at a final judgment of the child's general nutritional status. But the physical examination which forms a part of the usual school health program does not always include these techniques, because they may require specially trained personnel or new equipment or both, and because some of them consume considerable time in the examining room or in the laboratory. In other words, such tests are costly, and most school budgets have not expanded sufficiently to support so expensive a program. These more elaborate procedures [31] were excluded, therefore, from the present study in order to have the physical examinations comparable to the examinations included in the ordinary school health program.

There were two other reasons which made it advisable to exclude these specialized tests. First, they present many administrative and technical problems. Thus specific permission must be obtained from parents or guardians of the children before some of the procedures may be applied. Second, some of the tests have not been standardized sufficiently to permit accurate interpretation.

But even if these considerations could have been eliminated, the first reason still remained; namely, the advantage of having the physical examinations of the boys and girls in this study comparable to examinations which it is administratively practical to employ in a school health program today. If the physical examinations are made in this way, the four indices included in the study can then be compared with the type of examination which they would ordinarily be used to supplement or replace. Furthermore, a study of the objectivity of clinical judgment of general nutritional status based on this type of examination might furnish some clues as to how to improve the physical examination without the addition of elaborate and expensive tests. In short, it was considered more important to use carefully a method which the average school physician can and must employ than to set up an elaborate and costly procedure which it is not at present practical to adopt in examining large groups of school children.

In order to make the examination as objective and accurate as possible, detailed written instructions were prepared for the pediatrician's use concerning the number of items to be included in the examination and the method of evaluating each item. In addition, a 5-point scale was devised for judging the child's general nutritional status (see chart entitled "Grading of General Nutritional Status" p. 43).

[31] Except for hemoglobin and red-blood-cell determinations made on the first day of the check-up examinations on 133 children (70 boys and 63 girls) who were included in the study.

GRADING OF GENERAL NUTRITIONAL STATUS

1. Excellent.	2. Good.	3. Borderline.	4. Poor.	5. Very poor.
Good color. Excellent muscle. Excellent fat.	Good color. Excellent muscle. Thin fat.	Good color. Excellent muscle. Very thin fat.	Good color. Flabby muscle. Thin fat.	Pale color. Flabby muscle. Very thin fat.
Good color. Excellent muscle. Satisfactory fat.	Good color. Firm muscle. Fair fat.	Good color. Firm muscle. Thin fat.	Good color. Flabby muscle. Very thin fat.	
Good color. Excellent muscle. Fair fat.	Good color. Flabby muscle. Excellent fat.	Good color. Firm muscle. Very thin fat.	Pale color. Excellent muscle. Thin fat.	
Good color. Excellent muscle. Excessive fat.		Good color. Flabby muscle. Satisfactory fat.	Pale color. Excellent muscle. Very thin fat.	
Good color. Firm muscle. Excellent fat.		Good color. Flabby muscle. Fair fat.	Pale color. Firm muscle. Thin fat.	
Good color. Firm muscle. Satisfactory fat.		Pale color. Excellent muscle. Fair fat.	Pale color. Firm muscle. Very thin fat.	
		Pale color. Firm muscle. Satisfactory fat.	Pale color. Flabby muscle. Thin fat.	

This scale was based on (1) color of mucous membranes,[32] (2) quality of muscle,[33] and (3) amount of fat,[34] and was used as a guide in evaluating nutrition. Other items, including posture, condition of the skin and hair, and general development, were given consideration in arriving at a final clinical judgment of the child's general nutritional status.[35]

Anthropometric measurements.

The anthropometric measurements necessary for determining the Baldwin-Wood, Nutritional Status, ACH, and Pryor Indices were made according to the methods recommended by the investigators [36] with the following exceptions:

Weight.—After his shoes, sweater, and coat were removed, the child was weighed on a balance scale located in the school and his weight was recorded to the nearest quarter of a pound. This is the procedure used for the Baldwin-Wood, the ACH, and the Nutritional Status Indices. In calculating the Pryor Index, there is a correction to allow for clothing if weight is not taken in the nude. This adjustment has been made for each boy and girl included in the present study.

Iliac crests.—When the children were 7 years old the crest measurements were taken next to the skin, according to the prescribed techniques, with a sliding wooden caliper. However, during the first 3 months of the study (October through December 1934), the bi-iliac diameter was taken over the clothing with an obstetric metal caliper. This difference in technique will not affect the indices, because the incorrect technique was used only in the first 3 of the 5 months during which the examinations of the 6-year-old children were made, whereas the indices were derived from measurements made when these children were 7 years of age.

The instruments used in taking the measurements were checked frequently; that is, the steel tape equipped with a Gulick spring handle, used in making the Franzen and ACH measurements, and the subcutaneous-tissue calipers for the Franzen Indices, were compared at weekly intervals with standardized instruments. About every 2 months they were returned to the factory for replacement of springs or for calibration. In addition, the scales located in each of the schools were balanced at frequent intervals.

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[32] Color of mucous membranes was assessed as "good" or "definitely pale."

[33] Clinical judgment of muscle which was graded as "excellent," "firm," or "flabby," was based on a combination of muscle pull and muscle tone.

[34] Clinical judgment of fat which was graded as "excessive," "excellent," "satisfactory," "fair," "thin," or "very thin," was based on an average of the amount of arm and abdomen fat.

[35] Diagnoses based on physical examinations were not used in arriving at a judgment of the child's general nutritional status except insofar as they affected the clinical items entering into the assessment. Nevertheless, such diagnoses may have influenced the pediatrician unconsciously, although every effort was made to base the assessment wholly on the items specified in the instructions.

[36] For a detailed description of the methods of taking the anthropometric measurements necessary for computing each index, see the following references given in Appendix H: Baldwin-Wood Tables—(*5*) Baldwin, p. 1; ACH Index—(*35*) Franzen and Palmer, pp. 9–11; Nutritional Status Indices—(*75*) Nutritional Status Indices, pp. 7–12; and Pryor Width-Weight Tables—(*88*) Pryor and Stolz, p. 3, and (*86*) Pryor, p. 8.

ACCURACY OF THE TECHNIQUES EMPLOYED

Clinical assessment.

It will be remembered that all the physical examinations were made during both years of the study by one pediatrician, who used detailed written instructions as an aid in arriving at her assessment of the children. Since her judgment of general nutritional status has been used both as a method of assessment and as a criterion for evaluating the four indices of body build, it is important to determine both its objectivity and its stability. In order to study these two problems, check-up examinations were made of some of the children after the physical examinations were completed in March 1936. They consisted of two parts: (1) An initial and repeat examination of some of the children (51 boys and 52 girls) by the same pediatrician who made all the physical examinations during both years of the study, in order to check the stability of her judgment; and (2) examinations of these same children and of 105 others (56 boys and 49 girls) by the same physician and by two additional pediatricians, in order to determine the extent of agreement in judgment among the three physicians. The findings are presented in a later section of this report. (See pp. 82–87.)

Anthropometric measurements.

At the same time that the check-up examinations were made, the accuracy of the anthropometric measures was studied in this manner:[37] One hundred children (50 boys and 50 girls) were measured twice by anthropometrist D, who made all the measurements during both years of the study, and between D's initial and repeat observations were measured by another anthropometrist, E.

In order to study the *variability* of the anthropometric data, the initial measurements of each anthropometric characteristic made by anthropometrist D have been compared with the measurements of the other observer, E. This comparison has been made in terms of the means and standard deviations of the two distributions; that is, if D and E measured the children with an equal degree of accuracy, the means as well as the standard deviations of the distributions should coincide. Conversely, if the two observers' measurements were not made with the same precision, the means or the standard deviations or both will not be identical. Usually, however, the means coincide, and under these circumstances the anthropometrist whose measurements have the smaller standard deviation is the more accurate of the two.

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[37] For evidence concerning the variability and consistency of anthropometric measurements see Appendix H: (*12*) Boyd, (*45*) Hejinian and Hatt, (*56*) Lincoln, (*66*) Marshall, and (*67*) Meredith.

To illustrate this method the reader is reminded that D and E each measured the bitrochanteric width of 50 7-year-old boys. Analysis shows that the average or mean bitrochanteric width for D's observations is 21.9 cm. (table 18); and their dispersion, measured in terms of the standard deviation, is 1.36 cm. If this value is added to and subtracted from the mean, the limits obtained, 20.5 and 23.3 cm., define an interval that includes slightly more than two-thirds of D's measurements.

TABLE 18.—*Means and standard deviations of anthropometric measurements made by observers D and E on 50 boys and 50 girls*

Anthropometric measurement	Boys				Girls			
	Mean		Standard deviation		Mean		Standard deviation	
	Observer—		Observer—		Observer—		Observer—	
	D	E	D	E	D	E	D	E
Arm girth [1] (cm.)	35.4	35.1	3.45	3.37	35.4	35.1	3.61	3.42
Bi-iliac crests (width) (cm.)	20.0	19.6	1.20	1.22	19.9	19.8	1.02	1.12
Bitrochanteric width (cm.)	21.9	21.8	1.36	1.42	22.1	22.1	1.20	1.22
Chest breadth [1] (cm.)	38.9	39.3	1.86	2.03	38.4	38.9	2.21	2.28
Chest depth [1] (cm.)	28.3	28.8	1.63	1.94	27.8	28.5	1.91	1.91
Height (in.)	47.3	47.3	2.19	2.18	47.6	47.7	2.00	1.98
Subcutaneous tissue [1]	23.5	24.3	3.39	3.32	26.0	27.7	4.41	4.84
Weight (lb.)	52.9	53.0	8.73	8.68	52.9	53.0	8.12	8.04

[1] This anthropometric characteristic is the sum of 2 measurements. See Appendix II: (75) Nutritional Status Indices, pp. 7–12, for a description of this measure.

A similar analysis made of E's observations shows that the mean is 21.8 cm., and the standard deviation, 1.42 cm., compared with 21.9 and 1.36 cm. for D's measurements. (Table 18.) Now, if this standard deviation, 1.42 cm., is added to and subtracted from the mean, 21.8 cm., the limits obtained, 20.4 and 23.2 cm., are about the same as those for D's observations (20.5 and 23.3). These findings indicate that there is excellent agreement between the two anthropometrists' measurements of the bitrochanteric width of 7-year-old boys. The data for the 50 girls included in these anthropometric examinations also show close agreement between the two observers. (Table 18.)

Similar analyses of the other anthropometric characteristics of these boys and girls are shown in table 18. It may be seen upon examination of this table that the largest errors for the boys were made in measuring chest depth, chest breadth, and arm girth, in the order named, and for girls, in subcutaneous tissue, arm girth, and width of the iliac crests. As a whole, however, the observations of D and E were in very close agreement.[38]

[38] For any given anthropometric characteristic the error of the measurement has been assumed to be directly proportional to the difference between the number of scale units within the interval defined by the mean, plus and minus 1 standard deviation, for the measurements made by each of the observers, D and E.

The stability of D's measurements has been studied in terms of the error involved in making repeat measurements of each anthropometric characteristic (except weight and height) on the 50 boys and the 50 girls included in the anthropometric check-up observations.

If it is assumed that each of these two measurements, the first and repeat observations, contains chance, uncorrelated errors, the stability of D's measurements may be tested in terms of a statistical constant, which estimates their dispersion or variability. This constant, known as the standard deviation of a difference ($\sigma_{diff.}$), may be used to estimate the standard deviation of the error of measurement.[39] More specifically, if D makes no errors in measuring an anthropometric characteristic, her first and repeat measurements are equal and the difference between them is zero; but if she makes chance errors only, her initial measurement may be larger or smaller than the repeat observation, and the difference between them will vary both in direction and size. As a result, the average or mean difference between the initial and repeat measurements of any given anthropometric characteristic will be zero, and the dispersion of the errors can be estimated in terms of the standard deviation of the error of measurement. This standard deviation of the error of measurement can then be added to and subtracted from the average or mean error, zero, to indicate the limits between which slightly more than two-thirds of D's errors are likely to occur. If this standard error is added to and subtracted from any single observation, the resulting scale values give the limits within which the true value of the observation is likely to occur.

Table 19 gives this estimate of the standard deviation of the error of measurement for each anthropometric characteristic except weight and height. It may be seen that subcutaneous tissue is the most unstable, then the chest measurements and the arm girth; but the maximum standard deviation of the error of measurement for any of these six anthropometric characteristics is less than 0.5 cm.

TABLE 19.— *Standard deviations of the error of measurement of six anthropometric measurements of 50 boys and 50 girls (observer D)*

Anthropometric measurement	Standard deviation of the error of measurement	
	Boys	Girls
Arm girth [1] (cm.)	0.189	0.170
Bi-iliac crests (width) (cm.)	.0725	.0962
Bitrochanteric width (cm.)	.135	.116
Chest breadth [1] (cm.)	.218	.196
Chest depth [1] (cm.)	.257	.295
Subcutaneous tissue [1]	.265	.365

[1] This anthropometric characteristic is the sum of 2 measurements. See Appendix II (35) Nutritional Status Indices, pp. 7-12, for a description of this measure.

[39] For a description of the method of estimating the standard deviation of the error of measurement, see Appendix II: (79) Palmer, pp. 227-228.

This analysis indicates that D's measurements are unusually stable. This finding, together with the fact that her measurements agree well with those of the other observer, E, furnishes convincing evidence that D is an extremely careful and accurate worker and that her measurements are a satisfactory basis for deriving the indices included in this study.

Socioeconomic and related data.

The socioeconomic data were checked and verified by different methods, depending on the type of material and the sources available. For example, statements about illnesses were checked against hospital and clinic reports, the files of the Visiting Nurses' Association, and the records of the Divisions of Tuberculosis and Venereal Diseases of the New Haven Department of Health.

Data on income and assistance could be verified only for families who reported that they had received assistance during the year preceding each home visit or who were known to public or private agencies in New Haven giving direct or work relief. During the course of the study all the families with an income under $1,000, those reporting relief assistance, families with members suffering from severe illness, and those whose income estimates appeared to be grossly inaccurate were cleared through the Social Service Exchange of New Haven. This means that the source and amount of income of these families, the number of persons living on the income, and the type and amount of assistance were checked against the records of the social agencies, both public and private, administering any form of assistance in New Haven.

School absences and progress were verified from school records.

The office clerk also checked relevant data against one another and against the files of the health and welfare agencies of the city. For example, wherever possible the birth date of the child as well as his legitimacy and the age of his parents were compared with the records of the Bureau of Vital Statistics of the City Health Department; other facts about the parents, with the files of the school nurses and agencies granting assistance.

Data obtained at the first home visit which did not tally with information derived from other sources were checked by the economic analysts at the second home visit.

In general, the socioeconomic data are fairly reliable and accurate. Such inaccuracies as occur are due for the most part to the failure of the mother to remember the child's history or to the fact that, as the child had previously lived in another city, records for checking were not available. Some inaccuracies have also resulted from the employment of several economic analysts for collecting the data. Inso-

far as possible, however, the observations were checked against one another and against the records of public and private agencies in New Haven.

Summary of Material and Methods

In the preceding pages an attempt has been made to outline the purpose of the study and the method of collecting the observations as well as the procedures used in checking the material and editing the schedules.

Before proceeding to an analysis of these observations it may be well to review the plan and objectives of the investigation: The plan was to observe a group of 713 children living in New Haven, Conn., from September 1934 through May 1936, who were 7 years of age at the time of the second annual physical examination and were attending the public or parochial schools of the city. The purpose was to study the efficiency of each of several methods of assessing physical fitness (clinical judgment and four indices of body build) in identifying children who at 7 years of age were likely to be in poor physical condition.

The evaluation of these methods of assessing the child's well-being has been made in terms of the findings when the children were 7 years old for two reasons. First, the indices of body build have been computed from measurements of the boys and girls taken at the age of 7 years, as the Nutritional Status Indices and the ACH Index apply to 7-year-old children and not to boys and girls 6 years of age.[40] Second, if the various methods of assessment are tested on the boys and girls at 7 years of age, a whole series of clinical, anthropometric, and socioeconomic data, based on observations made over a period of 20 months, are available for evaluating the physical fitness of the children.

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[40] In other words, these 2 methods are probably most efficient in testing children of the same age as the boys and girls from whose measurements the indices have been derived.

Results

Indices of Body Build

THE PROBLEM OF TESTING THE INDICES

Two serious difficulties stand in the way of any attempt to test the four indices of body build included in this study. The first, discussed in detail in the early part of the report, is based on the fact that none of these indices attempts to identify every child who is in poor physical condition. In fact, they measure the child's physical fitness only insofar as it is related to such characteristics as his weight, subcutaneous tissue, or arm girth. Consequently, if the indices are to be given a fair but rigorous test, it is necessary to apply them to a large group of children. The success or failure of the indices can then be measured by comparing the children they identify with the boys and girls who are likely to be in very poor physical condition.

The selection of such a group constitutes the second difficulty in studying these indices. It is apparent that some standard is needed for identifying children on whom the indices are to be tested, but unfortunately, as has been indicated, such a standard of physical fitness is lacking. In fact, it is this very need for a reliable measure which meets both the statistical requirements of objectivity and reliability, and the practical requirements of unprohibitive cost, ease of application, and expediency that the indices now being studied were designed to meet. In the true sense, then, the solution to the problem of the efficiency of these indices is indeterminate, since no entirely satisfactory criterion of reference is at hand.

CRITERIA FOR TESTING THE INDICES

Nevertheless, many of the factors which go to make up this complex state are known and can be measured. They can be used for deriving approximations to the true standard of physical fitness which may serve as criteria for testing the indices. Such a procedure—namely, setting up several arbitrary but well-defined criteria for identifying children who are likely to be physically unfit—has been adopted in this investigation.

Observations used in deriving criteria.

Before defining the specific criteria which have been used in this study, it may be well to restate the material and methods and to describe some of the estimates of growth and development which

have been used in deriving these criteria. It will be remembered (1) that during a 19- or 20-month period of observation beginning September 1934 one pediatrician examined 713 school children at 6 and again at 7 years of age; (2) that the physician described each child's general nutritional status as "excellent," "good," borderline," "poor," or "very poor"; (3) that at each physical examination the pediatrician indicated whether the child was in need of medical care, dental care, or both; (4) that an anthropometrist took eight measurements when the two annual physical examinations were made; (5) that each child was weighed at frequent intervals during the 19- or 20-month period of observation.

The anthropometric measurements have been used to derive the following growth estimates:

1. The absolute increase or decrease in each anthropometric characteristic. For example, if a boy's arm girth was 33.2 cm.[1] at the age of 6 and 34.3 cm. at the age of 7, his arm girth increased approximately 1.1 cm. during the 12-month period.

2. The relative percentage increase or decrease in each of these anthropometric characteristics. Thus, the arm girth of this same child increased about 3.3 percent in a year (1.1 cm./33.2 cm.).[2]

3. A more refined estimate of gain in weight. In order to determine each child's average percentage gain in weight per month,[3] an equation has been fitted to his successive weighings made at frequent intervals during the 19- or 20-month period of observation.[4] This equation measures the child's relative gain in weight much more accurately than an estimate derived from the two weighings made at the annual physical examinations because it is based on a larger number of measurements (five to nine) made at more frequent intervals.

Some of these data, both the clinical observations and the growth estimates, have been used to derive provisional criteria of physical fitness which will make it possible to appraise the effectiveness of the four indices of body build used in this study—namely, the Baldwin-Wood Height-Weight-Age Tables, the ACH Index, the Nutritional Status Indices, and the Pryor Width-Weight Tables.

Description of the criteria.

Five empirical criteria of physical fitness have been established.

Criterion I is based on clinical judgment of the child's general nutritional status. Any boy or girl found by the examining physician to be in poor or very poor general nutritional condition at 7 years of age was "selected" by this criterion. Only the boys and girls who were poorly or very poorly nourished as distinguished from those who

[1] The sum of 2 measurements made according to the Franzen technique. See Appendix II (55) Nutritional Status Indices, pp. 7–8.

[2] For a distribution of percentage change in arm girth per year, see supplementary table IV, Appendix I, p. 101.

[3] For a distribution of average percentage gain in weight per month, see supplementary table III, Appendix I, p. 101.

[4] See Appendix I, pp. 98–99, for a description of the method used in fitting the exponential equation to the consecutive weighings of each child.

were in a borderline state of nutrition have been used for testing the indices, on the assumption that if an index fails to select obvious cases—that is, children who are in poor physical condition—it will also fail to identify children who are in borderline physical condition. Unfortunately, it is these very "borderline" children who constitute the major problem in assessing physical fitness, but until the adequacy of an index in selecting poorly nourished children is established there is no reason for testing it on a child who is in borderline nutritional condition. "Selected," as used here and as it will be used in describing the results of testing the indices, means that on the basis of a given method of evaluating physical fitness—in this case, general nutritional status at 7 years of age—a child is found to be physically unfit and is, therefore, in need of medical attention or nutritional advice and assistance.

Criterion II is a refinement of Criterion I. Any child who was found by the examining physician to be in a state of poor or very poor nutrition at 6 and at 7 years of age was selected by Criterion II.

Criteria III and IV are based on the child's average percentage weight gain and percentage change in arm girth. Although estimates were made of the increase or decrease in each of seven anthropometric characteristics of these boys and girls, only weight and arm girth have been used in deriving criteria of physical fitness. Weight has been used because it is a measurement which is easy to make accurately and because it has been carefully studied, although it has the limitation of being a three-dimensional or volumetric characteristic, which may be more closely related to the child's skeletal development than to his physical fitness. Arm girth has been selected not only because it is easily measured and the error of measurement is relatively small (table 19) but also because it reflects the child's increase in musculature and in subcutaneous tissue as well as his skeletal development. It has another advantage in its large relative variation. Next to weight and subcutaneous tissue, arm girth has the largest coefficient of variation of any of the eight anthropometric measurements included in this study.[5] In other words, there is considerable variation in the

[5] The coefficients of variation for the measurements made when the boys and girls were 7 years of age are as follows:

Measurement	Coefficient	
	Boys	Girls
Arm girth	8.39	10.23
Bi-iliac crests	5.39	5.59
Bitrochanteric width	5.30	6.20
Chest breadth	4.77	5.43
Chest depth	5.70	6.27
Height	4.73	4.16
Subcutaneous tissue	13.30	14.81
Weight	14.02	16.85

arm girth of the boys and girls which may have biological as well as clinical significance.

According to *Criterion III* children have been selected who exhibited an "unsatisfactory" gain in weight. If a child's average percentage increase in weight per month is exceeded by at least 90 percent of the boys or the girls included in this study,[6] his weight gain has been arbitrarily defined as unsatisfactory.[7] In other words, only about 10 percent of the children exhibited an average percentage increase in weight as small as or smaller than that of the child in question. This definition is empirical and open to criticism, but, on the other hand, it seems reasonable to assume that a child of this age who exhibits so small a gain in weight is not in good physical condition.[8]

Criterion IV is based on percentage change in arm girth. Any child whose percentage change in arm girth between 6 and 7 years of age was in the lowest 10 percent [9] of the group of boys or girls included in the study is selected by Criterion IV. All the children identified by this criterion exhibited a percentage *decrease* in arm girth.

Criterion V is the most restricted of the five criteria. It is a modification of two of the others and involves both clinical judgment and growth estimates. Any child who was found by the pediatrician to be in poor or very poor nutritional condition (Criterion I) and in need of medical and dental care when examined at the age of 7 years, and who exhibited an unsatisfactory percentage change in arm girth, as in Criterion IV, is selected by Criterion V.

Number of children selected by the criteria.

The numbers of boys and of girls identified by these five criteria vary considerably. (Table 20.) Criterion III (average relative monthly gain in weight) selects the largest number of boys, 37 (10.1 percent), and girls, 37 (10.6 percent); Criterion V, based on clinical judgment of general nutritional status, need for medical and dental care at 7 years, and percentage change in arm girth, selects the smallest number of children, 4 boys (1.1 percent) and 5 girls (1.4 percent).

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[6] Theoretically, the lowest 10 percent of the children of each sex were to be selected. This would mean identifying 37 boys and 35 girls. However, it was necessary to select 37 instead of 35 girls because of the limitations resulting from grouping the material. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[7] This estimate of percentage weight gain is a more refined measure than the one used in the preliminary report of this study. See Appendix II: (*106*) Souther, Eliot, and Jenss, p. 437.

[8] Although it may well be that an exceptionally rapid percentage gain in weight is as significant as an exceptionally small gain, a child whose weight gain is exceeded by approximately 90 percent of the boys or girls included in the study is not likely to be in very good health.

[9] Theoretically the lowest 10 percent of the children of each sex were to be selected. This would mean identifying 37 boys and 35 girls. However, it was necessary to select 32 instead of 35 girls because of the limitations resulting from grouping the data. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

TABLE 20. *Number and percent of the 365 boys and 348 girls selected by each of five criteria of physical fitness*

Criterion	Boys		Girls	
	Number	Percent	Number	Percent
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	7.7	40	11.5
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	4.9	23	6.6
III. "Unsatisfactory" [1] average percentage gain in weight per month	37	10.1	37	10.6
IV. "Unsatisfactory" [2] percentage change in arm girth per year	37	10.1	32	9.2
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory" [2] percentage change in arm girth per year	4	1.1	5	1.4

[1] The lowest 10 percent of the group of boys and girls included in the study have been considered selected by this criterion. This would mean identifying 37 boys and 35 girls. However, it was necessary to select 37 instead of 35 girls because of the limitations resulting from grouping the data.
All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.
[2] The lowest 10 percent of the group of boys and girls included in the study have been considered selected by this criterion. This would mean identifying 37 boys and 35 girls. However, it was necessary to select 32 instead of 35 girls because of the limitations resulting from grouping the material.
All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

Evaluation of the criteria.

None of these criteria is a very satisfactory measure of the child's physical fitness, although each has certain relative advantages and disadvantages. For example, the clinical examination might identify a child with flabby muscles who probably would not be selected by a growth estimate such as percentage gain in weight. On the other hand, clinical judgment does not measure dynamic aspects of the child's growth and development so accurately as growth measures based on seriatim observations of the child.

As none of these criteria is ideal and there is no valid measure to be used as a standard, the reader is left to choose for himself the criterion or criteria which he is willing to accept as a more or less satisfactory measure of physical fitness. He may, of course, find himself unwilling to accept unreservedly any one of these criteria. In that case, however, he will certainly not reject all five as without some value, since the factors on which they are based are generally known to be closely related to physical fitness. In other words, although the failure of an index to agree with any particular criterion may not prove that the index is inefficient, the reader will probably concede that its failure to agree to a considerable extent with all five methods of assessing a child's well-being justifies the conclusion that the index is not efficient in identifying children who may be in need of medical attention or nutritional advice and assistance.

TESTING THE INDICES

Because the several indices measure different aspects of physical fitness and use different methods of identifying children who are in poor physical condition (pp. 10–17), it will be necessary to describe the association between each index and the five criteria separately.

The Baldwin-Wood Tables.

It will be remembered that the Baldwin-Wood Tables give the child's expected weight in terms of his height for his age and sex; that the child's actual weight is compared with his expected weight and the difference between them is expressed as a percentage of the expected measurement;[10] and that if the observed weight is 6 or more percent less than the expected, the child is selected by this index as being underweight.

Methods of analysis.—Before evaluating the efficiency of this index in selecting children identified by each of the five criteria, it may be well to digress for a moment for the purpose of outlining the methods used in presenting the results. The data were first analyzed in the form of "fourfold" tables (table 21), which are useful in presenting observations when the frequencies of each of the four possible combinations of two attributes are known in respect to presence or absence. To cite an example based on the Baldwin-Wood Tables:

> The girls included in this study have been classified into two groups on the basis of clinical judgment of nutrition at 7 years of age—namely, girls who were poorly or very poorly nourished (clinical judgment) and girls who were not. They have also been classified, according to the Baldwin-Wood Index, into two other independent groups consisting of girls selected by the index as underweight, and girls who were not. These two classifications (based on clinical judgment of general nutritional status and on the Baldwin-Wood Index) can be further refined and interrelated to determine the number of girls who were in poor or very poor nutritional condition who were also selected by the Baldwin-Wood Index; the number of girls who were identified by the criterion (clinical judgment) but not selected by the index; those identified by the index and not selected by the criterion; and, finally, the girls selected by neither the index nor the criterion. This type of analysis is illustrated in table 21.

According to this table the criterion classifies only 40 of the 347 girls [11] as poorly or very poorly nourished at 7 years of age; the index identifies 25 (62.5 percent) of these 40 children as underweight for their height and age, although it selects 52 other girls as underweight whom the physician did not consider poorly or very poorly nourished. In other words, although the index selects nearly twice as many children as the criterion [12] it fails to identify 15 (37.5 percent) of the 40 girls whom the physician judged to be poorly or very poorly nourished.

[10] For a distribution of these relative differences see supplementary table XIV, Appendix I, p. 121.

[11] The Baldwin-Wood Index could not be applied to 1 of the 348 girls included in the study as her height exceeded the measurements given in the Baldwin-Wood Table.

[12] The index selected 77 girls; the criterion, 40.

TABLE 21.—*Association between clinical estimate of nutritional status and the Baldwin-Wood Tables for 347 [1] 7-year-old girls [2]*

Clinical estimate of nutritional status	Baldwin-Wood Tables		Total
	Selected as underweight [3]	Not selected	
Poor or very poor	25	15	40
Other [4]	52	255	307
Total	77	270	347

[1] 348 girls were included in the study, but the index could not be tested on 1 girl whose height exceeded the measurements in the table.
[2] For the Baldwin-Wood Tables age at nearest birthday was used; at the physical examinations age was defined in completed years.
[3] 6 percent or more underweight.
[4] "Other" included children whose nutritional status was estimated as excellent, good, or borderline.

This method of analyzing the data (in the form of fourfold tables) may be condensed [13] for inclusion in the table which gives the results of testing the index (table 22) to show the number of children selected by each of the five criteria, the number identified by the index, and the number selected by both the criterion and the index. This table also gives the children identified by both the criterion and the index as a percentage of those selected by the criterion and shows the percentage of the boys or girls included in the study who must be screened by the index to include all the boys or girls identified by each of the criteria.

In interpreting the results of testing this or any other index, it should be remembered that to be effective as a method of assessment, an index must have both specificity and sensitivity. If an index is specific, every child who is selected is in poor physical condition but not every child who is in poor physical condition is necessarily selected. On the other hand, if the index is sensitive, it will identify all the children who are in poor physical condition, but not every child it selects is necessarily physically unfit. To put it in another way, there are two requirements which a satisfactory index must fulfill. When applied to a group of children, it must pick out all or nearly all the children who are in poor physical condition, and in addition it must reject all or nearly all the children who are physically fit. Does the Baldwin-Wood Index meet these requirements? This question will be answered for each of the 5 criteria.

[13] It is important to point out that the original fourfold table used in testing the index can be derived from the summary tables. For example, according to table 22 there were 347 girls on whom the index was tested. Criterion 1 selected 40 girls; the index identified 77; 25 girls were selected by both the criterion and the index, and 15 girls identified by the criterion were not selected by the index. Similarly, 52 girls identified by the index were not selected by the criterion. Now, if the index identified 77 girls and it was tested on 347, it necessarily follows that the index did not select 270 girls. Similarly, if the criterion identified 40 girls it failed to select 307; and finally, if 307 were rejected by the criterion of whom 52 were selected by the index, 255 were rejected by both the criterion and the index. These observations form all the necessary data for completing the fourfold table which shows the association between Criterion 1 and the Baldwin-Wood Index.

TABLE 22.—*Comparison of each of five criteria of physical fitness and the Baldwin-Wood Tables applied to 7-year-old children,*[1] *365 boys and 347 girls*[2] *(6 percent selection by the index)*[3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	65	77	15	25	53.6	62.5	276	75.6	276	79.5
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	65	77	10	14	55.6	60.9	236	64.7	276	79.5
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	65	77	8	9	21.6	24.3	352	96.4	337	97.1
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	65	77	6	8	16.2	25.0	352	96.4	333	96.0
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	65	77	1	3	25.0	60.0	185	50.7	208	59.9

[1] Age at nearest birthday.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 girl whose height exceeded the measurements given in the table.

[3] According to this index a child is selected if he is 6 percent or more underweight.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

Criterion I.—It may be seen from table 22 that the Baldwin-Wood Index identified as 6 or more percent underweight 77 of the 347 girls on whom it was tested; that Criterion I (clinical judgment) selected 40 girls as poorly nourished and that only 25 girls were identified by both the criterion and the index. In other words, of the 40 girls whom a competent physician judged to be poorly nourished at 7 years of age, 25, or approximately 62 percent, were identified by the Baldwin-Wood Index as being 6 or more percent underweight. It follows that 52, or approximately 68 percent, of the 77 girls identified by the Baldwin-Wood Index were not poorly nourished according to the physician's judgment and that 15, or approximately 38 percent, of the 40 girls who were selected by the physician were rejected by the index.

In interpreting these results it is appropriate to refer to a question asked by A. Bradford Hill in discussing R. Huws Jones' paper, "Physical Indices and Clinical Assessment of the Nutrition of School Children," read before the Royal Statistical Society in London on November 16, 1937. Hill asked: "If the test fails to pick out certain boys clinically assessed as bad or picks out certain others clinically assessed as good, is it because the test is bad or the clinical assessment is bad?" [14]

In order to minimize the errors inherent in clinical judgment, all the physical examinations of the children included in this study were made by one well-trained pediatrician and included the evaluation of many factors commonly agreed upon to be basic elements in physical fitness. Furthermore, the stability and reliability of her clinical findings have been investigated and found to be as objective as can reasonably be expected.[15] If, then, her judgment is accepted as a more or less satisfactory criterion of physical fitness, one may conclude that (1) the Baldwin-Wood Index failed to identify nearly 40 percent of the girls who were poorly nourished, and (2) more than two-thirds of the girls it selected were not physically unfit according to the physician's judgment.

The index was even less efficient in identifying boys selected by this criterion (clinical judgment). Only 15, or about 54 percent, of the 28 boys whom the pediatrician judged to be poorly nourished were identified by the index; while 50, or approximately 77 percent, of the 65 boys who were selected by the index were not identified by the criterion. In other words, the Baldwin-Wood Tables are not an efficient index if clinical judgment is used as a standard of physical fitness.

[14] See Appendix II: (*51*) Jones, p. 35.

[15] A detailed discussion of the stability and reliability of the pediatrician's judgment is presented on pp. 82–87.

The Baldwin-Wood Tables have been tested in another way by determining the number and percentage of the boys or girls who must be screened by the index in order to identify all the children selected by the criterion. For example, according to Criterion I, 40 girls were identified as poorly nourished (by clinical judgment) at 7 years of age. If, as has been pointed out, the Baldwin-Wood Index is set to identify girls who are 6 or more percent underweight, it selects only 25, or about 62 percent, of these 40 girls. On the other hand, if the index is required to select all the 40 children whom the pediatrician judged to be physically unfit, it will also identify 236 girls whom the pediatrician did not select, a ratio of about 1 to 6. If a similar test is made for the 365 boys included in the study, the ratio is approximately 1 boy who was poorly nourished to every 10 who were not. This evidence confirms the previous findings and demonstrates even more clearly the low sensitivity of the index in identifying the group of New Haven children included in this study, if it is tested in terms of clinical judgment.

Criterion II.—Children identified by Criterion II were judged by the pediatrician to be in poor or very poor nutritional condition at 6 and also at 7 years of age. This criterion is theoretically a more rigorous test than Criterion I, for although they are both based on clinical judgment of general nutritional status, Criterion II refers to both physical examinations (that is, the examinations made at 6 and again at 7 years of age) while Criterion I applies only to the findings at 7 years (table 22). According to this table the Baldwin-Wood Index identified about 56 percent of the 18 boys and about 61 percent of the 23 girls selected by the criterion. In other words, it failed to identify nearly half the children selected by the criterion as poorly or very poorly nourished at both 6 and 7 years of age. If one considers the additional fact that 63, or about 82 percent, of the girls and 55, or about 85 percent, of the boys who were identified by the index were not selected by the criterion, it is quite clear that the Baldwin-Wood Tables are neither a selective nor a sensitive measure of the physical fitness of the boys and girls included in the study, if clinical judgment at both 6 and 7 years of age is used as a criterion.

Criterion III.—The Baldwin-Wood Index identified only about 24 percent of the 37 girls and about 22 percent of the 37 boys whose weight gain was unsatisfactory (Criterion III).[16] In interpreting these results it should be remembered that (1) the weight-gain estimates are exceptionally accurate, for they are based on an average of eight weighings made over approximately a 2-year period; (2) about

[16] These estimates of average relative gain in weight per month are probably more accurate than the estimates of percentage gain in weight per year used in the preliminary report (see Appendix II (10) Souther, Eliot, and Jenss, p. 437). Consequently the results of testing the indices in terms of these 2 forms of the criterion are not strictly comparable.

90 percent of the boys and of the girls included in the study exhibited a larger average percentage increase in weight per month during the 19- or 20-month period of observation than the boys and girls selected by the criterion; and (3) these children were probably in poorer physical condition than the boys and girls whose weight gain was more satisfactory, although not all children who are in poor physical condition necessarily exhibit a small weight gain. As has been pointed out, however, the Baldwin-Wood Tables identified only about 20 to 25 percent of the boys and girls selected by this criterion. If the index is set to identify all the boys and girls who exhibited an unsatisfactory weight gain, it would identify about 96 percent of the boys and about 97 percent of the girls included in the study. In other words, practically all the children would have to be selected by the index if it is to identify the small number whose weight gain was unsatisfactory.

Criterion IV.—This criterion, percentage change in arm girth,[17] has none of the virtues which result from widespread application and study such as the weight-gain estimates have. It has been used in this investigation, however, because it has the probable advantage, in comparison with weight-gain estimates, of not being influenced to the same extent by the child's skeletal development. In addition, the percentage change in the arm girth of these children varied considerably. The range for boys was from a decrease of 6.3 percent per year to an increase of 21.6 percent, with a mean increase of 3.12 percent and a standard deviation of 3.58 percent. Corresponding figures for the girls are as follows:

	Percent
Range	−9. 1 to +19. 5
Mean	3. 63
Standard deviation	3. 64

In other words, the variation in this growth estimate is large enough to assume biological and perhaps clinical significance, for there are some indications that marked changes in a child's physical well-being are often reflected in his arm girth. It is for these reasons that percentage change in arm girth has been used, as Criterion IV, for identifying boys and girls who are likely to be in need of medical attention or nutritional advice and assistance.

For the application of this criterion, the boys and girls were each grouped in order of percentage change in arm girth per year. Then the children who were in approximately the lowest 10 percent of each group were arbitrarily selected, as showing an unsatisfactory percentage change in arm girth (a decrease of 1.3 or more percent for boys and 0.7 percent or more for girls) between 6 and 7 years of age.

[17] The sum of 2 measurements according to the technique described in Appendix II: (*75*) Nutritional Status Indices, pp. 7–8.

The Baldwin-Wood Index identified only about 16 percent of these 37 boys and 25 percent of the 32 girls who were selected by the criterion. If the index is required to select all these children who showed an unsatisfactory change in arm girth, it must identify about 96 percent of the boys and the same percentage of the girls included in the study.

Criterion V.—The limitations of each of the four criteria which have been studied are well recognized. Two of these criteria are entirely dependent on clinical judgment; the other two are dependent on growth estimates. It was, therefore, decided to employ a criterion (Criterion V) which involves both clinical judgment and estimates of growth, and, in addition, includes the physician's judgment of the child's need for medical and dental care. In order to make the test very rigorous, the following requirements for selection by the criterion were made: (1) The child's general nutritional status was judged by the pediatrician to be poor or very poor at 7 years of age; (2) the child needed both medical and dental care at the age of 7 years when the pediatrician made the physical examinations; and (3) each child was in approximately the lowest 10 percent of the group of boys or girls included in the study with respect to percentage change in arm girth between 6 and 7 years of age.

As would be expected, only a small number of children—4 of the 365 boys and 5 of the 347 girls—on whom the index was tested, were selected by this criterion. Examination of their anthropometric schedules, physical examinations, medical histories, and socioeconomic schedules indicates that these 9 children were in very poor physical condition. Yet the index failed to identify 3 of the 4 boys and 2 of the 5 girls. If it does not select these children who are extreme cases, will it identify other boys and girls who are physically unfit?

The ACH Index.

The next index to be tested is the ACH Index. It is based on an empirical procedure developed by the American Child Health Association for identifying children with a small amount of musculature and subcutaneous tissue relative to body build. According to this procedure a child may be selected as falling in the lowest 10, 14, 20, or 25 percent of a group of boys or girls of the same age and hip width. Such selection is dependent on the difference between the child's arm girth and his chest depth relative to his hip width. In order to make the results of testing this index roughly comparable to the findings which pertain to the Nutritional Status Indices and to the Pryor Tables, each of which has been arbitrarily set to identify the lowest 15 percent of a large group of boys and girls, the ACH Index has been set to select the lowest 14 percent of a group of children of the same

sex, age, and hip width.[18] At this level only 9 of the 712 children[19] on whom the index was tested, 4 boys (1.1 percent) and 5 girls (1.4 percent), were identified by the index.

According to table 23 the ACH Index does not agree very well with any of the five criteria. When the index was tested on the girls, there was maximum agreement (10.0 percent) with clinical judgment of nutritional status at 7 years (Criterion I). On the other hand, for three of the criteria—namely, unsatisfactory weight gain (Criterion III), unsatisfactory change in arm girth (Criterion IV), and Criterion V, based on clinical judgment and need for medical and dental care at 7 years of age as well as unsatisfactory change in arm girth—none of the girls selected by the criterion were identified by the ACH Index. It was somewhat more efficient in identifying boys, but the maximum agreement was only 25 percent (Criterion V).[20] In other words, evidence derived from this study indicates that the index is not sufficiently sensitive because it identified so small a number of children. In terms of the five criteria used in this study, it is also not a highly selective procedure.

The Nutritional Status Indices.

The three Nutritional Status Indices utilize the principle of comparing (1) weight; (2) muscle size as indicated by the girth of the upper arm; and (3) amount of subcutaneous tissue over the biceps with the child's expected weight, arm girth, or subcutaneous tissue judged in relation to his sex, age, and body build measured in terms of his height, chest depth, chest breadth, and hip width. The method of computing and evaluating the child's relative standing, or "score," in any one of these three anthropometric measures is described in the monograph, Nutritional Status Indices.[21] Table X of that publication gives the child's score and his relative standing in a group of his skeletal peers of the same sex and age,[22] but the authors do not give instructions for interpreting the significance of the child's standing in terms of his physical fitness. Neither is there a definite statement in the monograph concerning the relative value of each of the three indices. In order, therefore, to test the indices in terms of their agreement with the five criteria, it was necessary to make the following

[18] Supplementary table V, Appendix I, p. 102, tests the index set to select 20 instead of 14 percent of the children. It may be seen upon examination of this table that the results agree in general with those presented in table 23.

[19] 713 children were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown.

[20] The ACH Index does not permit analysis to determine the percentages of the children screened by the index in order to select all the children identified by a criterion.

[21] See Appendix II: (75) Nutritional Status Indices, pp. 14–18.

[22] The Nutritional Status Indices were constructed to show the number of children in 1,000, but in this monograph the number of children in 100 is used in order to present the results in percentage form.

TABLE 23.—*Comparison of each of five criteria of physical fitness and the ACH Index applied to 7-year-old children,[1] 364 boys and 348 girls[2] (14 percent selection by the index)* [3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion	
	Criterion		Index		Criterion and index			
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	4	5	3	4	10.7	10.0
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	4	5	2	2	11.1	8.7
III. "Unsatisfactory" [4] average percentage gain in weight per month	37	37	4	5	0	0	.0	.0
IV. "Unsatisfactory" [5] percentage change in arm girth per year	37	32	4	5	1	0	2.7	.0
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory" [5] percentage change in arm girth per year	4	5	4	5	1	0	25.0	.0

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown.

[3] According to this index a child is selected if the difference between his arm girth and chest depth falls in the lowest 14 percent of a group of boys or girls of the same age and hip width.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

arbitrary decisions about both the child's score and the three Nutritional Status Indices:

1. A child has been considered selected by any one of these three indices if his score shows him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age as shown in Table X of the monograph, Nutritional Status Indices.[23]

2. Each index and every possible combination of the three indices have been used in comparing the Nutritional Status Indices with the criteria. (*a*) The weight index; (*b*) the index for arm girth; (*c*) the index for subcutaneous tissue; (*d*) the indices for weight and subcutaneous tissue; (*e*) the indices for weight and arm girth; (*f*) the indices for arm girth and subcutaneous tissue; and (*g*) the indices for weight, arm girth, and subcutaneous tissue have been compared with each of the five criteria.

The results of testing these indices are given in tables 24 to 30, inclusive.

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[23] See pp. 14–16 for method of computing score.

TABLE 24.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Index for Weight applied to 7-year-old children,*[1] *364 boys and 347 girls*[2] *(15 percent selection by the index)*[3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	4	1	0	1	0.0	2.5	357	98.1	309	89.0
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	4	1	0	0	.0	.0	357	98.1	309	89.0
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	4	1	0	0	.0	.0	357	98.1	342	98.6
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	4	1	0	0	.0	.0	357	98.1	337	97.1
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	4	1	0	0	.0	.0	357	98.1	309	89.0

[1] Age in completed years.

[2] 715 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

A child has been considered selected by this index if his score shows him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

TABLE 25.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Index for Arm Girth applied to 7-year-old children,*[1] *364 boys and 347 girls*[2] *(15 percent selection by the index)*[3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	4	2	2	2	7.1	5.0	202	55.5	292	84.1
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	4	2	1	2	5.6	8.7	202	55.5	292	84.1
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	4	2	0	0	.0	.0	352	96.7	347	100.0
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	4	2	1	1	2.7	3.1	352	96.7	332	95.7
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	4	2	1	1	25.0	20.0	134	36.8	110	31.7

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by this index if his score shows him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

TABLE 26.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Index for Subcutaneous Tissue applied to 7-year-old children,[1] 364 boys and 347 girls[2] (15 percent selection by the index)[3]*

Criterion	Number of children identified by						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index							
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys		Girls	
									Number	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	24	25	1	2	3.6	5.0	341	93.7	323	93.1
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	24	25	0	1	.0	4.3	341	93.7	323	93.1
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	24	25	2	3	5.4	8.1	358	98.4	332	95.7
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	24	25	5	1	13.5	3.1	336	92.3	323	93.1
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	24	25	1	0	25.0	.0	326	89.6	315	90.8

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by this index if his score shows him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

TABLE 27.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Indices for Weight and Arm Girth applied to 7-year-old children,[1] 364 boys and 347 girls[2] (15 percent selection by the index)[3]*

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	0	0	0	0	0.0	0.0	202	55.5	281	81.0
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	0	0	0	0	.0	.0	202	55.5	281	81.0
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	0	0	0	0	.0	.0	349	95.9	342	98.6
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	0	0	0	0	.0	.0	349	95.9	329	94.8
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	0	0	0	0	.0	.0	134	36.8	110	31.7

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by both these indices if his scores show him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

TABLE 28.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Indices for Weight and Subcutaneous Tissue applied to 7-year-old children,[1] 364 boys and 347 girls [2] (15 percent selection by the index)* [3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	2	0	0	0	0.0	0.0	339	93.1	294	84.7
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	2	0	0	0	.0	.0	339	93.1	294	84.7
III. "Unsatisfactory" [4] average percentage gain in weight per month	37	37	2	0	0	0	.0	.0	353	97.0	327	94.2
IV. "Unsatisfactory" [5] percentage change in arm girth per year	37	32	2	0	0	0	.0	.0	334	91.8	314	90.5
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory" [5] percentage change in arm girth per year	4	5	2	0	0	0	.0	.0	324	89.0	289	83.3

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by both these indices if his scores show him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

TABLE 29.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Indices for Arm Girth and Subcutaneous Tissue applied to 7-year-old children,[1] 364 boys and 347 girls [2] (15 percent selection by the index)[3]*

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	2	0	1	0	3.6	0.0	198	54.4	280	80.7
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	2	0	0	0	.0	.0	198	54.4	280	80.7
III. "Unsatisfactory" [4] average percentage gain in weight per month	37	37	2	0	0	0	.0	.0	349	95.9	332	95.7
IV. "Unsatisfactory" [5] percentage change in arm girth per year	37	32	2	0	1	0	2.7	.0	332	91.2	314	90.5
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory" [5] percentage change in arm girth per year	4	5	2	0	1	0	25.0	.0	128	35.2	109	31.4

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by both these indices if his scores show him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

TABLE 30.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Indices for Weight, Arm Girth, and Subcutaneous Tissue applied to 7-year-old children,[1] 364 boys and 347 girls [2] (15 percent selection by the index)[3]*

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	0	0	0	0	0.0	0.0	198	54.4	270	77.8
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	0	0	0	0	.0	.0	198	54.4	270	77.8
III. "Unsatisfactory" [4] average percentage gain in weight per month	37	37	0	0	0	0	.0	.0	346	95.1	327	94.2
IV. "Unsatisfactory" [5] percentage change in arm girth per year	37	32	0	0	0	0	.0	.0	331	90.9	312	89.9
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory" [5] percentage change in arm girth per year	4	5	0	0	0	0	.0	.0	128	35.2	109	31.4

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by all 3 of the indices if his scores show him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth· 1.3 or more for boys, 0.7 or more for girls.

Examination of these tables permits the following broad generalizations: (1) There is some variation (from zero to 7.2 percent) in the number and percentage of boys and girls who were identified by each of the Nutritional Status Indices or by any combination of these indices:

Nutritional Status Index	Number of children selected by the index	
	Boys	Girls
Weight	4	1
Arm girth	4	2
Subcutaneous tissue	24	25
Weight and arm girth	None	None
Weight and subcutaneous tissue	[1] 2	None
Arm girth and subcutaneous tissue	[1] 2	None
Weight, arm girth, and subcutaneous tissue	None	None

[1] The 2 children identified by both weight and subcutaneous-tissue indices were not identified by the arm-girth and subcutaneous-tissue indices.

(2) Probably the only index that identifies a sufficient number of children to justify a detailed comparison with any of the five criteria is the Nutritional Status Index for Subcutaneous Tissue, which selects 24 boys and 25 girls out of the 364 boys and 347 girls on whom the index was tested. It is surprising that so few children were selected by the other six indices. Although no attempt has been made to determine the reasons why the indices failed to identify more children, there is some evidence that the Nutritional Status Index for Weight and the Index for Arm Girth do not satisfactorily describe New Haven boys and girls. According to Table X of the monograph, Nutritional Status Indices, the scores of any large group of children tested by either of these two indices should be distributed according to the normal probability curve, with a mean or average score of 50.0 and a standard deviation of 10.0.

If a frequency distribution is made of the weight or arm-girth scores of the boys and girls included in this study, the distribution is not normal, the mean is not 50.0, and the spread of the scores, as measured in terms of their standard deviation, is not 10.0.[24] In fact, the whole curve is shifted to the right and is skew in the positive direction.[25]

The reason for these differences is not known because the Nutritional Status monograph does not describe the 7-year-old children whose measurements were used in deriving the indices. It may be

[24] The mean and the standard deviation can be translated into x/σ values of 0 and 1, respectively. See supplementary tables XV, XVI, and XVII, Appendix I, pp. 111–112, which give the observed values of the mean and the standard deviation of the distributions of the Nutritional Status Indices for the New Haven children included in this study.

[25] A personal communication from Dr. C. E. Palmer, U. S. Public Health Service, states that the Nutritional Status scores for Hagerstown school children also fail to approximate the normal error curve. See Appendix II: (*81*) Palmer.

said, however, that the New Haven children included in this study form a selected group [26] and that the majority represent two quite distinct nationality groups. About 46 percent of the children were Italian,[27] and approximately 18 percent were American boys and girls. This large proportion of Italian children may partly explain the failure of the indices to identify 7-year-old New Haven boys and girls, but, whatever the reason, the number of boys and girls selected by the weight or the arm-girth index is so small that the value of the index is immediately subject to question.

In table 26, which presents the results of testing the Nutritional Status Index for Subcutaneous Tissue, it is found that although this index identified 24 boys and 25 girls, it selected only a small percentage of the children identified by any of the five criteria. Indeed, the maximum agreement between this index and the criteria was only 25 percent. When the index is tested in terms of the percentage of the boys or girls who must be screened in order to identify all the children selected by a criterion, the minimum is almost 90 percent. In other words, there can be little doubt concerning the low selectivity and sensitivity of the Nutritional Status Index for Subcutaneous Tissue in assessing the nutrition of these New Haven boys and girls.

To summarize:

1. The Nutritional Status Indices, either singly or in combination, failed to select most of the children identified by any of the five criteria.

2. The maximum agreement is 25 percent for Criterion V.

3. The maximum agreement for any of the other four criteria is only about 14 percent.

4. In 50 (71.4 percent) of the 70 tests (five criteria for each of the seven Nutritional Status Indices for the two sexes) in which the children identified by the Nutritional Status Indices (tables 24–30, inclusive) were compared with the boys and girls selected by the five criteria, the index failed to identify a single child who was selected by a criterion.

5. If any of these indices is set to select all the children identified by any one of the criteria, the minimum number of children which the index must select in order to include all the children identified by any of the criteria is about 31 percent; the maximum, 100 percent; and the average, about 81 percent. In other words, there is considerable evidence that the Nutritional Status Indices are neither selective nor sensitive if any one of the five criteria used in this study is accepted as an approximate standard of physical fitness.[28]

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[26] See pp. 27ff. for description of the children included in this study.

[27] For definition see p. 25.

[28] These indices have also been tested by using a criterion which selects the lowest 20 instead of the lowest 15 percent of the boys and of the girls. See supplementary tables VI–XII, Appendix I, pp. 103–109. In general these tables confirm the findings based on the selection of the lowest 15 percent of the children.

The Pryor Width-Weight Tables.

The Pryor Tables are logically an elaboration of the Baldwin-Wood Tables which estimate a child's weight for his sex, age, and height. The Pryor Tables take one more variable into account in evaluating a child's expected weight; namely, his bi-iliac diameter. In other words, they use two variables (height and width of the iliac crests) instead of only one (height) in judging weight.

Although the instructions for using these tables do not prescribe a method of selecting boys or girls who may be underweight or of comparing a child with other boys and girls of the same age, sex, and body build, Pryor has approved the use of a procedure which approximates the one used by Franzen and his coworkers in deriving the Nutritional Status Indices. It utilizes the principle of subtracting the child's expected weight from his observed weight and expressing this difference in terms of the standard deviation of the regression equation for weight on height and width of the iliac crests.[29] It has been arbitrarily decided that a child is selected by the Pryor Index if his relative standing or score by this method of scoring shows him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.[30]

With this selection point in use, the Pryor Tables have been compared with each of the five criteria. (Table 31.) It may be seen from this table that there was not a close agreement between the index and any of the criteria. The maximum agreement was 32.1 percent; the minimum, 10.8 percent. If the index is set to include all the children selected by the criteria, the minimum percentage identified by the index is 67.7 percent; the maximum, 97.5 percent.

One would expect this index to be as satisfactory as the Baldwin-Wood Tables, but it must be remembered that (1) the New Haven children on whom the index was tested may include a larger percentage of Italian boys and girls than the children whose measurements were used in deriving the Pryor Tables; and (2) these tables are an elaboration of the Baldwin-Wood standard, in terms of the widths of the iliac crests of a group of California boys and girls who may not be comparable to the children included in the Baldwin-Wood Tables. But whatever the reason or reasons, the Pryor Index is not an entirely satisfactory method of identifying New Haven children of this age who may be physically unfit.

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[29] See Appendix I, pp. 97–98, for a detailed description of this method. See also supplementary table XVIII, Appendix I, p. 112, for a distribution of the x/σ values of the Pryor Index for the boys and girls included in this study.

[30] The index has also been set to select the lowest 20 percent of the children. See supplementary table XIII, Appendix I, p. 110.

TABLE 31.—*Comparison of each of five criteria of physical fitness and the Pryor Index applied to 7-year-old children,*[1] *365 boys and 347 girls*[2] *(15 percent selection by the index)*[3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	54	31	9	11	32.1	27.5	306	83.8	284	81.8
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	54	31	5	7	27.8	30.4	251	68.8	284	81.8
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	54	31	7	4	18.9	10.8	346	94.8	338	97.4
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	54	31	4	4	10.8	12.5	356	97.5	334	96.3
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[4] percentage change in arm girth per year	4	5	54	31	1	1	25.0	20.0	251	68.8	235	67.7

[1] Age at nearest birthday.
[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 girl whose height exceeded the measurements given in the table.
[3] A child has been considered selected by this index if his score shows him to be in the lowest 15 percent of a group of his skeletal peers of the same sex and age.
[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.
[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

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SUMMARY

Although the four indices included in this study—namely, the Baldwin-Wood, the ACH, the Nutritional Status, and the Pryor Indices—differ so markedly in type that it would be manifestly unfair to compare their performance, one fact emerges clearly from the study: There is little agreement between these four indices and any of the five criteria. None of these criteria is an entirely satisfactory standard, but the failure of the indices to identify a considerable proportion of the children selected by all five criteria together with the identification by the indices of an even larger number of boys and girls who were rejected by the criteria means that the indices are probably neither a selective nor a sensitive method of assessing the physical fitness of the 7-year-old New Haven children included in this study.

Clinical Judgment

THE EXPERIMENTAL DATA

As has been stated (p. 45), it is important to determine both the objectivity and the stability of the clinical judgment of the pediatrician designated as "A" who made all the physical examinations during both years of the study. In order to investigate this problem, 208 children (107 boys and 101 girls) [31] were included in a series of check-up examinations which were made in March and April 1936 after the tests and examinations of the children at the age of 7 years were completed.

These check-up examinations may be discussed under two headings: (1) Examinations of each of the 208 children by three pediatricians, A, B, and C, in order to study the variability of clinical judgment of general nutritional status; and (2) reexamination of 103 (51 boys and 52 girls) of these 208 children by pediatrician A in order to measure the stability of her judgment.

To make these tests comparable with the annual physical examinations the following precautions were taken: (1) The distribution of the nationality of the 208 children included in the check-up examinations corresponded roughly to the nationality of the 713 boys and girls on whom the indices were tested (table 32); (2) the three pediatricians (two women, A and B, and one man, C) who made the examinations were exceptionally well qualified for the task, having had similar training and experience, especially in examining New Haven children—a factor of considerable importance in studying the variability of their clinical judgment; (3) each physician was provided with the set of instructions used by pediatrician A in completing the annual

[31] A few of these 208 children, 21 boys and 18 girls, were not included in the group on which the indices were tested.

physical examinations; (4) the importance of following the instructions in arriving at a judgment of general nutritional status was stressed, although the physicians did not work together before beginning the check-up examinations to test their interpretations of the instructions or to compare their methods of assessment; and finally, (5) no time limit was set for completing an examination.

TABLE 32.—*Nationality of 107 boys and 101 girls included in the check-up examinations*

Nationality [1]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	208	100.0	107	100.0	101	100.0
Italian	90	43.3	47	43.9	43	42.6
American	44	21.2	22	20.6	22	21.8
Russian	18	8.7	9	8.4	9	8.9
Polish	8	3.8	5	4.7	3	3.0
Irish	13	6.2	6	5.6	7	6.9
All others	35	16.8	18	16.8	17	16.8

[1] Classification was based on the birthplace of 3 of the child's grandparents. The classification "American" includes not only children 3 of whose grandparents were born in the United States but also children whose parents and 2 of whose grandparents were born here.

The routine adopted for making the observations was as follows: On the first day of observation the child was examined by pediatrician A.[32] On the following day he was to be examined by B, and also by C. Unfortunately, it was administratively impossible to have A's reexamination made immediately after the three physical examinations by A, B, and C. An interval of 13 days elapsed, on the average, before A reexamined the children. Table 33 shows the number and percentage of these children according to the interval between A's original and repeat examinations.

TABLE 33.—*Interval between the initial and repeat check-up examinations of 51 boys and 52 girls made by pediatrician A*

Interval (in days)	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	103	100.0	51	100.0	52	100.0
7	10	9.7	7	13.7	3	5.8
8	6	5.8	3	5.9	3	5.8
9	0	.0	0	.0	0	.0
10	7	6.8	3	5.9	4	7.7
11	8	7.8	2	3.9	6	11.5
12	16	15.5	10	19.6	6	11.5
13	0	.0	0	.0	0	.0
14	8	7.8	4	7.8	4	7.7
15	36	34.9	16	31.4	20	38.5
16	7	6.8	5	9.8	2	3.8
17	5	4.9	1	2.0	4	7.7

[32] On the same day some of these children were also measured by anthropometrists D and E. See p. 45.

It would have been more satisfactory, of course, if the repeat examinations had been made earlier. Only a few of the children, however, were ill during the interval between examinations, none of them seriously enough to produce a clinically recognizable change in their general physical condition.

Although this routine was carefully followed, it was impossible to make all the examinations as planned. Made during school hours, they had to be fitted into the teaching program. Likewise, children who were examined on Friday by physician A could not be examined by B and C until Monday. In addition, one of the pediatricians, C, became ill and was unable to examine 52 boys and 53 girls until A made her reexaminations. The resulting maximum interval of time between A's first examination and the examination made by one of the other two physicians is given in table 34.

TABLE 34.—*Maximum interval between initial check-up examination of 107 boys and 101 girls by pediatrician A and examination by pediatrician B or C*

Interval (in days)	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	208	100.0	107	100.0	101	100.0
1	79	38.0	44	41.1	35	34.5
2	0	.0	0	.0	0	.0
3	24	11.5	11	10.3	13	12.9
4	0	.0	0	.0	0	.0
5	0	.0	0	.0	0	.0
6	0	.0	0	.0	0	.0
7	11	5.3	8	7.5	3	3.0
8	6	2.9	3	2.8	3	3.0
9	0	.0	0	.0	0	.0
10	7	3.4	3	2.8	4	4.0
11	8	3.8	2	1.9	6	5.9
12	16	7.7	10	9.3	6	5.9
13	0	.0	0	.0	0	.0
14	8	3.8	4	3.7	4	4.0
15	36	17.3	16	15.0	20	19.8
16	7	3.4	5	4.7	2	2.0
17	5	2.4	1	.9	4	4.0
18	0	.0	0	.0	0	.0
19	0	.0	0	.0	0	.0
20	0	.0	0	.0	0	.0
21	0	.0	0	.0	0	.0
22	1	.5	0	.0	1	1.0

From this table it may be seen that, on the average, a period of 7 days elapsed between the physical examinations of A and B, or A and C, although about 50 percent of the children were examined within 3 days and 38 percent during a 1-day period.

REVIEW OF THE LITERATURE

Before turning to a discussion of the variability of these findings, it may be well to review rather briefly some of the studies bearing on this point which have appeared recently in the literature of the subject.

One study is described in an article by Mayhew Derryberry (*25*) entitled "Reliability of Medical Judgments on Malnutrition," pub-

lished in Public Health Reports (U. S. Public Health Service) for February 18, 1938. The article may be summarized, in part, as follows:

Six experienced pediatricians examined, independently, 108 11-year-old boys who represented the entire 11-year-old population—both resident and nonresident—of an institution in New York City. There was no time limit for making these examinations; the boys were usually stripped to the waist, and their nutrition was graded according to the Dunfermline scale [33] as "excellent," "good," "fair," or "poor." The physicians who made these examinations differed markedly in the number of children they found to be poorly nourished. The number each physician selected was as follows: 2, 6, 7, 10, 12, and 15.

"But even more confusing was the fact," writes Derryberry, "that children classed as malnourished by one physician frequently were not the same children that were rated malnourished by another physician * * * In all there were 25 of the 108 boys rated 'poor' by at least one of the physicians but only 1 who was so rated by the entire group of doctors * * * Two of the cases were given every rating in the scale." [34] Derryberry confirmed these findings [35] by the analysis of a similar series of examinations made by five women physicians on 113 girls [36] attending an institution in New Jersey.

In summarizing the results of this study Derryberry concludes that whether or not a boy or girl is rated as malnourished depends more on the physician who is the examiner than it does on the actual condition of the child.

Another study, made by R. Huws Jones (*51*) and reported in the Journal of the Royal Statistical Society, Part I, 1938, is also concerned, among other subjects, with the variability of clinical judgment. Pertinent sections of this report may be summarized as follows:

The observations were made in three localities, Liverpool, Manchester, and Prescot. In Liverpool 142 white boys [37] who were attending two schools in a poor district were examined by four experienced male members of the Medical Department of the Liverpool Education Committee. These physicians were asked to assess nutrition as they would in ordinary routine examinations and to place a child in one of eight nutrition grades: 5, 4+ (excellent); 4, 4− (normal); 3+, 3 (subnormal); and 3−, 2+ (bad). Although they discussed the definitions and points of procedure before making the examinations, their judgment varied considerably.

The results of these examinations may be summarized as follows: Although all four physicians agreed on 34 percent of the children, most of them were normal in nutrition; the number of cases of excellent nutrition ranged from 1 to 17 and of subnormal or bad nutrition from 8 to 23; for 12 of the 142 boys there was a difference of three or more grades in the physicians' assessments, and for one child, a difference of five grades. Of 30 boys whose nutrition was graded as subnormal or bad by one or more of the four physicians, only 3 were there by agreement of all four.

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[33] See Appendix II; (*25*) Derryberry, p. 265.

[34] Id.

[35] There was more uniformity in the proportion of children classified as poor than in the previous experiment, but the disagreement in the ratings of different physicians was even more striking.

[36] Age unknown.

[37] Age unknown.

The second series of observations were made at Manchester, where four assistant school medical officers—two men and two women—examined 168 boys,[38] the entire population of the senior boys' department of a Manchester school. These physicians classified nutrition in only one of four grades instead of eight as in Liverpool: A, excellent; B, normal; C, slightly subnormal; D, bad. One of them was unable to place certain boys in any but two grades and classified them as either good or poor. Nevertheless, the Manchester inquiry in general confirms the Liverpool findings.

The third test was made at a school in Prescot, where four male medical officers, one from the staff of each of the four local authorities cooperating in the study, examined 155 boys, [39] using the Board of Education's classification of four nutritional grades. It is interesting to note that although these physicians came from four areas, they agreed somewhat better than the physicians in Liverpool and Manchester.

This same English study contains also an evaluation of the consistency or stability of clinical judgment. This part of Jones' report may be summarized as follows:

Five of the members of the school medical staff of the Cheshire County Council—two men and three women—examined twice each of 193 boys attending two schools in Norwich, one in a good district and the other in a poor district. There was an interval of a week between the first and repeat examinations made by each physician.

Some of the results of this study are pertinent to the present discussion. In the second examination every one of these physicians found a greater percentage of boys in excellent nutritional condition, and four out of five found a smaller percentage whose nutrition was subnormal. This difference may be due to the fact that at the initial examinations the children attending the school in the good district were examined first, but when the repeat examinations were made the procedure was reversed.

In other words, it is possible that after examining the boys from the poor district the physicians were all the more impressed by the condition of the children in the other school. Thus, the second physician, when he reexamined the same children, decreased by about one-half the number of boys whose nutrition he judged to be subnormal.

The analyses of these data also show that one of the five physicians changed his assessment in 20 percent of the cases, and the other four, in 27 to 31 percent. This means that, on the average, they placed one boy in four in a different grade at the second examination. One of the physicians even changed a "slightly subnormal" diagnosis into a diagnosis of "excellent" and another an "excellent" into a diagnosis of "slightly subnormal." Further analysis shows that for children found to be malnourished by one or more physicians, consistency of judgment varied from 8 percent for the first physician to 70 percent for the fourth.

These findings were verified by the results of a second experiment undertaken at Bolton, where two local school medical officers and three others (three women and two men physicians) from Leigh, Southport, and Wigan conducted the examinations of 200 boys [40] under conditions which were similar to those at Norwich, with the exception of the fact that the differences between the boys from the good and the poor districts were not so great.

The results of this study confirm in general the investigation made at Norwich, although the consistency of clinical judgment at Bolton was greater, owing in part

[38] Age, race, and socioeconomic status unknown.

[39] Age, race, and socioeconomic status unknown.

[40] Age unknown.

to the fact that a larger percentage of the boys in Bolton were normal in nutrition. Thus, three of the physicians were consistent in 50 percent of the cases of subnormal nutrition, the others in 70 and 76 percent, but one physician changed a child two grades—from "bad" to "normal."

In this article Jones summarizes his findings on the subject of clinical judgment, in these words:

Perhaps the most important part of the work reported in this paper is that concerned with the reliability of clinical assessments. It has been shown that the distribution of nutrition found in a given population, and the number and identity of the boys assessed subnormal, are largely dependent upon the particular doctor who makes the assessments. The doctors compared in this inquiry were, with one exception, persons of long experience, and all were urged to take as much time as they wanted over the assessment of each boy. Nevertheless, these doctors show important disagreements not only with each other but also with their own assessments of the same population after a short time interval. The present criticism is directed against the method, not against the doctors concerned; in fact, the care these doctors would take, knowing the purpose of the inquiry, leads one to fear that the results set out in the previous pages may show the position in an unduly favorable light. * * *

As a result of this inquiry, one may venture to claim that the method of assessing nutrition at present followed by school medical officers, on the direction of the Board of Education, is unreliable. The results obtained by that method are, to say the least, of doubtful value.[41]

Investigations by Betenson (*8*) and Herd (*46*) confirm these findings. Betenson writes:

The experiment of mine which he [Harris [42]] was good enough to mention was, I think, the first of this nature to demonstrate what faulty conclusions can be arrived at by various doctors using a classification which had no scientific basis at all. I expect you know that our Board of Education in London about 3 years ago wished us to classify all our school children into four categories called (A) excellent, (B) normal, (C) slightly subnormal, and (D) bad, and it was on purpose to find out how a definite area in South Wales was responding to this classification that I suggested that three medical men, one from each county, and the same of medical women should meet together in one of my schools. The meeting accordingly took place, the children were selected unknown to any of us by a school nurse, and these children passed in turn before all six of us, who were spaced quite a considerable distance apart from one another in a fairly large room, the object being that we should not have any discussion at all on any of the children or see one another's classifications until all the 100 had been seen.

When these examinations were completed, the average agreement between any pair of observers was found to be as low as two out of five.[43]

The other investigation reported by Herd (*46*) showed clinical assessment by medical officers to be "absolutely fallacious." Thus, in one test in which 36 children were graded as excellent, only 3 were

[41] See Appendix II: (*51*) Jones, p. 33.
[42] See Appendix II: (*44*) Harris, p. 226.
[43] See Appendix II: (*44*) Harris, p. 226.

agreed upon by all the medical officers, and the variability was even greater in the normal and slightly subnormal nutritional groups.[44]

Each of these studies has certain limitations. For example, the interval between the physical examinations was too long in the Cheshire County experiment; Derryberry did not indicate the length of time which intervened between the examinations made in New York City; and different numbers of nutritional grades were used in Liverpool and in Manchester, so that the findings for these two cities are not directly comparable. Similarly, no information is available concerning the socioeconomic status of the children examined in the study reported by Herd. Even more important is the fact that in some instances, so far as is known, there were no detailed instructions for making the physical examinations; this seems to be the case in Jones' investigations. Nevertheless, in spite of these shortcomings, the studies all indicated that clinical judgment is liable to considerable error and that as a result it is not always a satisfactory criterion of physical fitness.

Do the check-up examinations made on some of the boys and girls included in this study confirm these findings?

VARIABILITY OF CLINICAL JUDGMENT IN THE PRESENT STUDY

In answering the question asked in the preceding section it should be borne in mind that pediatrician A made all the annual physical examinations during both years of the study. Consequently, it is important to know how her clinical judgment of nutrition compares with the judgment of the other pediatricians, B and C. This problem is, of course, somewhat different from the one in which Jones, Derryberry, Herd, and others were interested, because they were concerned with the variability and reliability of clinical judgment as such, rather than with the accuracy of one pediatrician's judgment.

It will be remembered in this connection that A, B, and C each examined 208 7-year-old children—107 boys and 101 girls—and that they graded nutrition as excellent, good, borderline, poor, or very poor (See p. 36).

Table 35 shows the results of these examinations. In evaluating this table it is well to keep in mind the fact that if clinical judgment is to be used as a criterion of physical fitness for identifying children in need of medical attention or nutritional assistance, it is especially important to consider the number of boys and girls each physician judged to be in poor or very poor nutritional conditon. This table indicates that the pediatricians disagreed concerning the number of

[44] This statement is contained in a discussion of a paper by Woolham. See Appendix II: (*126*) Woolham, p. 260.

children, especially boys, whom they placed in these two nutrition grades. A selected 8; B, 41; C, 22 of the 107 boys as poorly or very poorly nourished. (Corresponding figures for the girls are A, 13; B, 22; and C, 18.) [45]

TABLE 35.—*Nutritional status of 107 boys and 101 girls as estimated by pediatricians A, B, and C at the check-up examinations*

Nutritional status	Boys						Girls					
	Pediatrician—						Pediatrician—					
	A		B		C		A		B		C	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	107	100.0	107	100.0	107	100.0	101	100.0	101	100.0	101	100.0
Excellent	2	1.9	3	2.8	4	3.7	3	3.0	4	4.0	10	9.9
Good	29	27.1	19	17.8	13	12.1	34	33.6	20	19.8	14	13.9
Borderline	68	63.5	44	41.1	68	63.6	51	50.5	55	54.4	59	58.4
Poor	8	7.5	40	37.4	22	20.6	13	12.9	20	19.8	18	17.8
Very poor	0	.0	1	.9	0	.0	0	.0	2	2.0	0	.0

These findings should be interpreted cautiously, for they do not indicate how frequently the three pediatricians agreed on any one child's nutritional status. For example, it is impossible to determine from the preceding table whether the eight boys selected by A were also selected by B or by C. Table 36 [46] answers these questions for

[45] A and C did not select any children as very poorly nourished; B identified 2 girls and 1 boy. One may infer from these figures *either* that the physicians agreed that very few of the children were very poorly nourished or that they were classifying the children into 4 instead of 5 nutritional grades.

[46] This table has been derived from a large number of more detailed tabulations. It may be used to derive additional information concerning the check-up examinations. For example, it is possible to determine the number of boys A classified as poorly or very poorly nourished whom B placed in one of the other nutritional grades, and the number of boys B classified as poorly or very poorly nourished whom A placed in one of the other grades. It is also possible to ascertain the total number of boys B graded as in borderline, good, and excellent nutritional condition, as well as the number A placed in these 3 grades. Thus, A classified 8 boys as poorly or very poorly nourished; 5 of these 8 boys were also judged to be poorly or very poorly nourished by pediatrician B. In other words, B placed 3 of these 8 boys in one of the other 3 nutritional grades; likewise, the 36 out of 41 boys B graded as poorly or very poorly nourished, A placed in one of the other nutritional grades. Similarly, if A judged 8 boys to be poorly or very poorly nourished and she examined 107 boys, she must have placed 99 boys in the other nutritional grades, and so forth. These figures form the necessary data for making fourfold tables of the following type:

Association between the estimates made by pediatricians A and B of the nutritional status of 107 boys at the check-up examinations

Estimates by pediatrician A	Estimates by pediatrician B		
	Poor or very poor	Other	Total
Poor or very poor	5	3	8
Other [1]	36	63	99
Total	41	66	107

[1] "Other" included children whose nutritional status was estimated as excellent, good, or borderline.

only two grades, poor and very poor nutrition.[47] For example, it shows that both A and B selected 5 boys as poorly or very poorly nourished, although A classified a total of 8 and B, 41 boys in this grade; C selected 22 boys but agreed with A on only 3 as being in poor or very poor nutritional condition. Similarly, A and B and A and C also identified 9 girls as poorly or very poorly nourished, although A placed 13, B, 22, and C, 18 in these nutritional classes.

TABLE 36.—*Agreement among pediatricians A, B, and C in their estimates of poor or very poor nutritional status among the 107 boys and 101 girls at the check-up examinations*

Pediatricians	Boys		Girls	
	Number	Percent	Number	Percent
A	8	7.5	13	12.9
B	41	38.3	22	21.8
C	22	20.6	18	17.8
A and B	5	4.7	9	8.9
A and C	3	2.8	9	8.9
B and C	18	16.8	14	13.9
A, B, and C	3	2.8	8	7.9

It is clear from these tables that A was the most conservative and B the least conservative of the three pediatricians, and that variability of clinical judgment appears to be considerably greater for the boys than for the girls.

It is interesting to reexamine this material also in terms of the amount of disagreement between the nutritional ratings made by two pairs of observers—namely, A and B, and A and C—without taking into account either the nutritional grades or the direction of the differences; that is, whether B or C graded a child as better or more poorly nourished than A.

According to tables 37 and 38, if the pediatricians disagreed, their judgment usually differed by only one grade. It should be remembered, however, that a difference of one grade may determine whether a child is or is not selected as poorly or very poorly nourished and in need of medical attention or nutritional advice and assistance.

TABLE 37.—*Difference between the estimates made by pediatricians A and B of the nutritional status of 107 boys and 101 girls at the check-up examinations*

Difference in estimates	Boys		Girls	
	Number	Percent	Number	Percent
Total	107	100.0	101	100.0
None	44	41.1	57	56.4
1 grade	62	58.0	43	42.6
2 grades	1	.9	1	1.0

[47] See supplementary tables XIX–XXIV, Appendix I, pp. 112–114: for a more detailed analysis of the physicians' ratings.

TABLE 38.—*Difference between the estimates made by pediatricians A and C of the nutritional status of 107 boys and 101 girls at the check-up examinations*

Difference in estimates	Boys		Girls	
	Number	Percent	Number	Percent
Total	107	100.0	101	100.0
None	63	58.9	64	63.4
1 grade	44	41.1	37	36.6
2 grades	0	.0	0	.0

At this point in the discussion it may be well to ask, in summary, how frequently these three physicians agreed concerning a child's nutritional status. Table 39 shows that they agreed on 31 of the 107 boys and 46 of the 101 girls, but 22 of these 31 boys and 32 of the 46 girls were in borderline nutrition. To express these findings somewhat differently: The agreement between the three pediatricians was least satisfactory for children who deviated markedly from the average; namely, those who were judged to be good or excellent in nutrition and those whose nutritional status was poor or very poor. All this evidence confirms the findings of Jones, Derryberry, Betenson, and others [48] that clinical judgment of nutrition is subject to considerable variation and is not always consistent.

TABLE 39.—*Extent of agreement among pediatricians A, B, and C in their estimates of nutritional status of the boys and girls at the check-up examinations* [1]

Estimates of nutritional status	Children on whom 3 pediatricians agreed			
	Boys		Girls	
	Number	Percent	Number	Percent
Total	31	29.0	46	45.5
Excellent	0	0.0	0	0.0
Good	7	6.5	8	7.9
Borderline	22	20.6	32	31.7
Poor	2	1.9	6	5.9
Very poor	0	.0	0	.0

[1] The 3 pediatricians agreed on the ratings of 31 of the 107 boys and 46 of the 101 girls included in the check-up examinations.

STABILITY OF CLINICAL JUDGMENT IN THE PRESENT STUDY

Although A often disagreed with B or C, her own judgment was relatively stable. The findings at her first and repeat physical examinations of 103 children, 51 boys and 52 girls, are shown in table 40. This table indicates that at each examination A classified about the same number of boys in good and borderline nutritional condition, but did not identify the same number as likely to be poorly nourished.

[48] See Appendix II: (*91*) Roberts, Stone, and Bowler. See also references given on pp. 86ff.

The table also shows that A's judgment was probably less consistent for girls than for boys.[49]

TABLE 40.—*Estimates made by pediatrician A of the nutritional status of 51 boys and 52 girls at the initial and repeat check-up examinations*

Nutritional status	Boys				Girls			
	Initial examination		Repeat examination		Initial examination		Repeat examination	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	51	100.0	51	100.0	52	100.0	52	100.0
Excellent	0	0.0	0	0.0	2	3.8	2	3.8
Good	13	25.5	14	27.5	16	30.8	14	26.9
Borderline	34	66.7	35	68.6	28	53.9	34	65.5
Poor	4	7.8	2	3.9	6	11.5	2	3.8
Very poor	0	.0	0	.0	0	.0	0	.0

The association between the nutritional ratings made of each child at the examinations designed to check the stability of the pediatrician's judgment is shown in tables 41 and 42. These tables indicate that A's judgment was most stable for boys and girls in a borderline nutritional condition and least stable for those who were likely to be poorly nourished.

If these tables are examined in terms of the number of boys or girls who were placed in the same nutritional grade at both initial and repeat physical examinations, expressed as a percentage of the number who were placed in this grade at the initial examination, it may be seen that at the repeat examination A gave a borderline nutritional rating to about 88 percent of the boys whom she placed in this same grade at the initial examination; a good rating to about 77 percent and a poor nutritional rating to only 50 percent of the boys classified in this grade at the initial examination. Corresponding figures for the girls were about 89 percent, 69 percent, and 33 percent, respectively. In other words, there is considerable evidence that A's judgment was least stable for the children whom it was most important to identify; namely, those who were likely to be in poor nutritional condition.

TABLE 41.—*Association between the estimates made by pediatrician A of the nutritional status of 51 boys at the initial and repeat check-up examinations*

Estimates at initial examination	Estimates at repeat examination					Total
	Excellent	Good	Borderline	Poor	Very poor	
Excellent	0	0	0	0	0	0
Good	0	10	3	0	0	13
Borderline	0	4	30	0	0	34
Poor	0	0	2	2	0	4
Very poor	0	0	0	0	0	0
Total	0	14	35	2	0	51

[49] The number of boys and girls classified as poorly nourished is small and the results must be interpreted cautiously.

TABLE 42.—*Association between the estimates made by pediatrician A of the nutritional status of 52 girls at the initial and repeat check-up examinations*

Estimates at initial examination	Estimates at repeat examination					Total
	Excellent	Good	Borderline	Poor	Very poor	
Excellent	2	0	0	0	0	2
Good	0	11	5	0	0	16
Borderline	0	3	25	0	0	28
Poor	0	0	4	2	0	6
Very poor	0	0	0	0	0	0
Total	2	14	34	2	0	52

In interpreting these findings it is well to bear in mind that the pediatrician who made all the examinations in this study was exceptionally well-trained and had had considerable experience in examining school children, particularly boys and girls living in New Haven. Certainly her clinical judgment is as satisfactory as that of many other physicians. It is also well to point out that even if her judgment was not always consistent and objective, it is probably a more satisfactory criterion than the individual judgments of several physicians would have been. A real advantage exists, therefore, in having had the clinical data for this study collected by one observer.

Nevertheless, the evidence indicates that A's judgment was liable to considerable error and should be followed with reservations as a criterion for evaluating indices of physical fitness or nutrition.

OPINIONS AND RECOMMENDATIONS OF OTHERS

To sum up this discussion of clinical judgment, it is illuminating to survey the opinions and recommendations of other investigators.

Various writers have pointed out the necessity for improving the clinical examination. Lishman states it this way:

> We have tended in the past to rely too much when making our assessment upon "general impressions," and the more striking skeletal defects arising from insufficient food, as distinct from imperfect functioning of the many processes involved in nutrition, to the exclusion of specific signs of probable nutritional deficiency revealed after questioning the parent or teacher and examining the child.[50]

Brewer is more specific in his criticism. He points out that the average physician has been taught in medical school to diagnose pathological conditions and has had limited experience in examining healthy children. Brewer continues: " * * * though we have hundreds of specialists in children's diseases, we have few in children's health and these few are not counted as specialists unless they approach their function through pathology." [51]

[50] See Appendix II: (*58*) Lishman, p. 341.

[51] See Appendix II: (*13*) Brewer, p. 93.

The White House Conference of 1930 has pointed out the necessity for making seriatim examinations and appraising the individual child in terms of the progress made between examinations. Improvement in his condition, the Conference reported, is often of far greater significance than status at the moment.[52]

The Lancet takes a less conservative attitude in an editorial on the variability of clinical judgment of nutrition. This editorial interprets the problem as an "indictment of a system, not of the medical assessor, of whom the impossible, it seems, is being asked."[53]

Stuart, in a more detailed discussion, writes:

> The clinician is constantly comparing one child with a composite picture of children of similar age. This picture includes a wide range of variations which he has come to expect on the basis of experience. The way any one physician will interpret a child will depend both upon the accuracy of his observations and upon the extent and type of his personal experience.[54]

Eliot illustrates this aspect of the discussion in writing of the physical examinations made of Puerto Rican children by physicians accustomed to judging the nutritional status of New Haven, Conn., school children:

> That the usual standard of gauging the physical condition of the children was not adhered to (because of the preponderance of poorly nourished children), but that a standard based on the range within the group itself was unintentionally substituted, will be shown later. * * *
>
> It was without question the intention of the physicians who made the examinations in Puerto Rico to use the same standards for estimating subcutaneous fat as they had used in similar studies in New Haven, and so to have comparable data from the two places. However, in the face of the preponderance of poorly nourished children and the scarcity of really well-nourished ones, the judgment of the physicians with regard to estimating amounts of subcutaneous fat rapidly became warped, and unintentionally there occurred, in conformity with the variations within the group, a definite readjustment in their whole scale of values, as has been pointed out. Children who in New Haven would have been considered to have a "fair" amount of subcutaneous fat, were, because of this unconscious readjustment of standards, reported as having a "good" amount, and those who in New Haven would have been considered to have a "poor" amount were reported as having a "fair" amount. There is little doubt that the ratings of the fat of these Puerto Rican children are high as compared with the ratings given in New Haven by the same physicians.[55]

In discussing the situation in England, Herd expressed the same point of view:

> All children inspected in the routine age groups are assessed by the medical officers in regard to their state of nutrition * * *. This assessment is an attempt to gauge the general physical condition of the child, as apart from specific

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[52] See Appendix II (*119*) White House Conference on Child Health and Protection, Part IV, pp. 296, 300–301.

[53] See Appendix II: (*107*) State of nutrition, p. 1258.

[54] See Appendix II: (*111*) Stuart, p. 195.

[55] See Appendix II: (*115*) U. S. Children's Bureau, Publication No. 217, p. 25. See also Green (*43*) for discussion of this same subject.

defects. Some defects would count little or not at all in such an assessment, e. g., defects of the senses; on the other hand, the presence of a generalized defect like anemia would naturally place a child in a low grade nutritionally. Assessment is made partly by static qualities—stature, bulk, skin, color, muscle tone, etc.—partly by dynamic qualities—alertness, general liveliness, and activity. These qualities are not measurable, except stature and bulk, and it is even questionable whether such measurable quantities should be given much weight in the decision, especially stature, which is so eminently a hereditary quality. Assessment therefore has to be decided by individual judgment, based upon past experience. There is room therefore for considerable difference in the assessments made by individual medical officers and of this a good deal of evidence has been found.[56]

In other words, according to Cathcart:

There is no reliable objective measure of the state of nutrition. The physical measurements of the child do not give much help and the other generally accepted signs are in the main subjective, the gloss of the hair, the bloom of the skin, the brightness of the eye, the alertness of response, and so on. Each doctor forms his own mental standard and judges the children by this subjective measure. All subjective measures are liable to great distortion. They seem, no doubt, to the individual to be fixed and sure, but are indeed fluid. His judgment is warped by his immediately preceding stimulus. If he has examined a group of children who are fit and well and the next group is less satisfactory, he ranks the second group lower than he would have done had the first group been only very moderate. Until some objective standard can be devised it is quite impossible to expect any uniformity in assessment of nutrition in a wide area. Too often, as Bacon has said, the eye of the examiner "is bedewed with human passion." [57]

An interesting discussion of this aspect of the problem is also contained in a book entitled "National Fitness," edited by F. Le Gros Clark. In this report the author discusses the clinical significance of the term "normal nutrition" in these words:

We arranged for a letter to be sent to a number of school medical officers, asking them to explain to us how they and their assistants interpreted the term "normal" in their reports. Did the term imply that the children so classified reached a fair average standard for the district considered, or did it imply in their minds that the children approximated to a certain ideal standard? * * *

Fourteen of the officers * * * seemed * * * to mean by normal no more than a fair average for their area. One from a midland borough says: "Normal nutrition implies a fair average for the child population of the elementary schools of the area; it does not imply that the child so classified reaches any ideal standard of fitness." His colleague in a northern borough says much the same: "My own impression is that, in the absence of any accepted standard for the assessment of nutritional conditions, one is bound to be influenced by the general average standards of the children examined." A third from a southern borough gives his opinion that "the word normal as used in the service clearly means average or that usually seen." But even those who suggest that normal means to them the approximation to some ideal, frequently qualify their statements. Thus a doctor from a southern county remarks: "Normal nutrition * * * implies that the medical officer reviewing the child is satisfied that the child's condition is satisfactory in regard to nourishment, taking all the factors into consideration."

[56] See Appendix II: (64) Manchester [England] Education Committee, p. 11.

[57] See Appendix II: (17) Cathcart, p. 18.

"Normal," says a northern borough officer, "is interpreted as apparently satisfactory, *i. e.*, not showing any apparent evidence of malnutrition."

Actually, out of the 24 replies which were unambiguous, 4 seemed to define normal as in some respect "corresponding to an ideal in the mind of the officer examining." The remainder of the replies either qualify their statements or imply that the normal is at best the average for the child population of today, which is scarcely a high average; it has been described by many as a debased average.

We invite the reader's attention to further quotations from these same letters, if he would ponder the absolute confusion under which the whole problem is submerged. "I disapprove of the whole system of notation, particularly in its use of the word 'excellent.' The idea of supernormal nutrition repels me, for I don't believe it can exist" (northern borough). "The whole question of malnutrition depends upon the medical examiner" (northern borough). "I am inclined to think that the quality [*i. e.*, of the term nutrition] is so indefinite as to make it impossible to obtain a precise standard in any way applicable" (southern county). "I don't know what normal as applied to nutrition means. I wish I did" (northern borough).

[The author continues] * * * if the whole idea of this "nutrition assessment" creates such discomfort among its many officers, why on earth has the board insisted with such regularity on wasting their time in a valueless survey? [58]

Roberts emphasizes another aspect of the problem. She writes:

The physician's rating is the only one that attempts to recognize qualitative as well as quantitative aspects, and this is too subjective a method to be of value in situations where such rating scales are most desired. [59]

Wilkins is even more forceful in his criticism:

We may well ask whether anyone is justified in professing to be able to assess such a multiple functional complex during a few minutes' inspection of a child. In my opinion it amounts to little more than guesswork. * * * I contend that * * * the anatomical standards of the art student are an infinitely truer guide to nutritional normality than those of practitioners and medical officers who rely on the presence or absence of the usually accepted pathological signs.[60]

The periodical, The Medical Officer, in a recent editorial, raises the same question.

There is every justification for the author's [R. Huws Jones] [61] finding that "the method of assessing nutrition at present followed by school medical officers is unreliable. * * * " He leaves his readers with a fundamental question. Is the state of nutrition an entity capable of valid measurement? Many of us will answer this question with an emphatic "No." He does not believe that our inspectors are wanting in skill but he does believe that knowledge has not yet advanced far enough to provide us with a reliable yardstick which will give reasonably consistent results when accurately applied.[62]

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[58] See Appendix II: (*20*) Clark, p. 127–134.

[59] See Appendix II: (*89*) Roberts, p. 71.

[60] See Appendix II: (*121*) Wilkins, pp. 145, 147.

[61] See Appendix II: (*51*) Jones.

[62] See Appendix II: (*74*) Nutrition of school children, p. 64.

Dunstan expresses the same opinion when he writes:

These returns, being based on qualitative estimates, can never be more than measures of the variability of the personal equation.[63] * * * It is clear that some mensurational yardstick will need to be devised which will record and classify the physical status of the children by quantitative means.[64]

In summary, a passage from the report of the Chief Medical Officer of the Ministry of Health of Great Britain gives weight to the findings of this study of New Haven children. The Chief Medical Officer writes:

The assessment of the state of nutrition by clinical examination is beset with many difficulties because this method of evaluation involves reliance not on objective data but on subjective impressions and on the personal competence of the investigator. The standards of the examiner, as well as the results which he obtains, are mental concepts and therefore incapable of precise objective measurement. While different physicians will probably be in general agreement concerning children who are either very healthy or grossly malnourished, slight differences are likely to occur with children less clearly differentiated. The decision given will depend on the skill, experience, and judgment of the physician. If his conceptual standards remain reasonably constant consistent results will be obtained. But the constancy of the criteria of different clinicians is variable. They are liable to vary with the opinion of the physician, with the influence of his surroundings, and with his most recent clinical experience.[65]

The practical importance of this whole topic is outlined by the Committee Against Malnutrition:

In discussing the nutrition and health of school children, we have first to ask by what standard they are being judged. What is the optimum physique and health of a normal child? It is clear that, until we know this, we are comparing our children with a standard that may be "debased;" i. e., well below the optimum.

Meanwhile, it has been pointed out (1) that the conception of "malnutrition" as laid down for the school medical service is very unsatisfactory to the scientific mind; (2) that, however strenuously the officers may work, the school medical examinations are not adequate for assessing how far the children are actually undernourished; and (3) that there is grave cause for suspecting that the figures returned in different areas for "malnutrition" depend greatly on the subjective and personal impressions of the officers and have very little objective and scientific validity. * * * If our findings are correct, then it is clear that official figures, whatever else they may reveal, do *not* supply an answer to the vital question—how far are the children of this country underfed and malnourished? [66]

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[63] Returns from 31 classified areas exhibited widespread variation and a disconcerting degree of variability in assessment of nutrition. See reference to Memorandum of Committee Against Malnutrition, Oct. 1936, contained in Appendix II: (*29*) Dunstan, p. 55.

[64] See Appendix II: (*29*) Dunstan, p. 55.

[65] See Appendix II: (*42*) Great Britain Ministry of Health, Annual Report of the Chief Medical Officer, pp. 164–165.

[66] See Appendix II: (*73*) Nutrition of School Children, Committee Against Malnutrition, p. 28

THE NEED FOR IMPROVING CLINICAL JUDGMENT

If, as the preceding discussion indicates, the clinical examination as it is usually made does not satisfactorily assess the child's physical fitness, how can it be improved? [67] How can the examination be made more objective and stable? Can its value be increased without the addition of a number of expensive or elaborate laboratory procedures? What items in the physical examination are most accurate? Which ones are most likely to influence the pediatrician's judgment?

In order to answer these and related questions, analyses were made not only of the variability and stability of clinical judgment of general nutritional status but also of the specific clinical items which went to make up the physical examination. The interrelationships between these items have also been studied, as well as their correlation with the physician's judgment of the child's nutritional status. A subsequent report will incorporate findings on these points and will attempt to point out which clinical findings are most reliable and which ones are most likely to influence the pediatrician's judgment of the child's fitness. Does the physician agree with other physicians concerning such findings as the condition of a child's tonsils, his musculature, his subcutaneous tissue, the condition of his mouth and skin? Are his own findings stable? What value or weight does he give each one of these items in arriving at a final judgment of the child's fitness? Is he influenced by the child's size, by the color of his skin, by his posture, or by the child's attitude or his mental alertness?

A study of such questions as these may prove of value in indicating some of the problems of assessing physical fitness. As has been pointed out editorially in the Lancet (see p. 88), it is not the clinician who is at fault but the method which he is asked to use and the conditions under which he must work.

Is it not possible to develop more objective standards? For example, what is meant by enlarged tonsils? What is a satisfactory amount of subcutaneous tissue for a 7-year-old child? Do boys of this age have less subcutaneous fat than girls? Such questions as these must be answered either by establishing new norms or by deriving and employing better techniques, if the clinical examination is to be improved and the child's fitness is to be more satisfactorily assessed.

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[67] Recent attempts to improve the clinical examination include such studies as those of Lishman in England and Glazier in Boston. See Appendix II: (*57*) Lishman and (*57*) Glazier. Efforts are also being made to employ more specific and elaborate tests and thus make the clinical examination more detailed as well as more objective. See Appendix II: (*10*) Boone and Ciocco, (*52a*) Kruse, Palmer, Schmidt, and Wiehl, and (*102*) Schmidt.

On the other hand, even if such tools—new norms and better techniques—are available, they may be exacting and expensive to apply, requiring, as they do, elaborate, costly equipment. In addition, the expense involved in making satisfactory periodic examinations of a large group of boys and girls is prohibitive for most communities at the present time. For these reasons indices of body build and other preliminary screens have been developed.

The four screening methods tested in this monograph have not proved efficient. Some other procedures must be found.

Summary

Two methods of evaluating physical fitness: (1) Indices of body build, as exemplified by the Baldwin-Wood Weight-Height-Age Tables, the ACH Index of Nutritional Status, the Nutritional Status Indices, and the Pryor Width-Weight Tables; and (2) clinical judgment of general nutritional status have been tested in order to determine both their sensitivity and their selectivity.

The observations were made of 713 7-year-old children (365 boys and 348 girls) who were attending the public or parochial schools of New Haven, Conn., from September 1934 through May 1936. The boys and girls were first examined when they were 6 years of age. The observations included a physical examination made by one well-trained pediatrician, anthropometric measurements taken by one anthropometrist, and socioeconomic data obtained at home visits made by economic analysts. A second set of examinations were made a year later by the same pediatrician and anthropometrist, and by another group of economic analysts. In addition, the boys and girls were weighed at frequent intervals during the course of the study. Toward the end of the observational period, the objectivity and stability of (1) the pediatrician's judgment of general nutritional status and (2) the anthropometric measurements were studied.

The indices have been tested when the child was 7 years of age by comparison with five criteria, which involve clinical judgment of general nutritional status, need of medical and dental care, and an estimate of the child's gain in weight and change in arm girth. These criteria have been based on observations made of the children at both 6 and 7 years of age and on periodic weighings made at frequent intervals during a 19- or 20-month period of observation.

The results of the study may be summarized as follows:

1. In terms of any of these five more or less satisfactory criteria of physical fitness, none of the four indices of body build (the Baldwin-Wood Index, the ACH Index, the Nutritional Status Indices, and the Pryor Index) proves an efficient method of identifying children included in this study who, according to the criteria, are likely to be physically unfit. The indices are neither selective nor sensitive, as they fail to identify a considerable number of boys or girls whom a given criterion selects as likely to be in need of medical care or nutritional advice and assistance, and, in addition, they often identify children who were not selected by the criterion.

2. The clinical judgment of the pediatrician who made the examinations was liable to considerable error, in terms of both the variability and the stability of her judgment. This evidence confirms other studies and points to the necessity of improving the physical examination, particularly if need for medical care is to remain an objective of child-health programs. The importance of some measure of the child's growth, such as periodic weighings, is emphasized and the fundamental importance of the child's dietary habits is stressed. Any evaluation of physical fitness must include as a minimum these three aspects of the child's well-being—namely, his physical condition as found at clinical examination, his growth and development, and his dietary habits—if a more satisfactory assessment of physical fitness is to be made.

If this result is to be achieved, constant interchange of information and close cooperation of specialized skills are needed between professional workers who are in a position to contribute to the appraisal of the physical fitness of children.

Orr, director of the Imperial Bureau of Animal Nutrition, Rowett Institute, Aberdeen, emphasized this need in one of the Harben lectures he delivered recently at the institute. He said:

> The problems we have been discussing will not be solved until the laboratory worker, the expert clinician, skilled in detecting the earliest deviations from health, and the school medical officer, who has to deal with large numbers of children, the majority of whom are "border-line" cases of malnutrition, cooperate and pool their knowledge and experience.[68]

[68] See Appendix II: (*76a*) Orr, p. 23.

Appendix I

Statistical Methods

PROCEDURE USED IN DETERMINING A CHILD'S STANDING OR SCORE FOR THE PRYOR WIDTH-WEIGHT INDEX

The procedure used in determining the child's standing or score for the Pryor Width-Weight Index corresponds approximately to the procedure employed by Franzen in deriving the Nutritional Status Indices scores except that the standard deviation of the multiple-regression equation for weight on height and width of the bi-iliac crests is unknown. It has, therefore, been approximated by determining the differences between the observed weights and the theoretical or expected weights of all the children of each sex included in this Children's Bureau study, squaring these differences, and dividing by the number of boys or girls.[1] It would have been preferable to derive this statistical constant from the differences between the observed weights and the expected weights of the children from whose measurements the Pryor Index was derived or, better still, from the formula for the standard deviation of the regression surface, had the necessary data been available. Although this procedure necessarily introduces a certain amount of error, it furnishes a method for classifying the children according to the Pryor Index.[2]

In applying this method, it was necessary to calculate four such standard deviations, since the Pryor Tables define age at the nearest birthday, instead of age at the last birthday as in this study.

The computed standard deviations and the number of children on whose measurements they have been based are as follows:

Sex	Age (at nearest birthday)	Standard deviation	Number of children whose observations were used in computing the standard deviation [1]
Males	7 years	4.20	360
	8 years	6.13	26
Females	7 years	5.19	[2] 319
	8 years	5.36	16

[1] Observations of 39 children (21 boys and 18 girls) who were included in the check-up physical and anthropometric examinations but who were excluded from the group of 713 children on whom the I indices were tested, were included in making these estimates. This fact explains the difference between the number of children on whom the indices were tested and the number whose measurements were used in calculating the standard deviation.

[2] 1 girl whose height exceeded the measurements given in the table was excluded.

[1] The number of degrees of freedom was taken into account in calculating the standard deviations.

[2] This procedure has been approved by Dr. Pryor in a personal communication, dated February 3, 1938.

These standard deviations were used to derive each child's score: The difference between his observed weight and his theoretical weight was divided by the appropriate standard deviation to determine his score, or x/σ value, from which his standing or score relative to other children of the same sex, age, and skeletal build (judged in terms of height and width of the iliac crests) may be determined.

For example, the Italian boy, A. R., weighed 46 pounds at 7 years 1 month of age. According to the Pryor Tables, his expected weight was 45.6 pounds. The difference between these two weights is 0.4 pounds. When this number is divided by the appropriate standard deviation, 4.20 pounds, A. R.'s x/σ score is 0.1. According to the integral table for the normal-error curve, 54 boys in 100 of the same age and body build (height and width at the bi-iliac crests) would weigh less than A. R. This method corresponds basically to the one used by Franzen in setting up Table X, shown on p. 65 of the monograph, Nutritional Status Indices. It is based on the assumption that the distribution of the x/σ values follows the normal curve of error.

METHOD OF ESTIMATING EACH CHILD'S AVERAGE PERCENTAGE GAIN IN WEIGHT PER MONTH

Successive weighings of a child between the ages of 6 and 8 years exhibit a trend which, within the variability of the measurements, is approximately exponential in form. As a result, an estimate of the weight gain of each child included in this study may be made by fitting the exponential equation, $y=ae^{bx}$ to his 8 weighings, made at stated intervals [3] during a 19- or 20-month period of observation, beginning September 1934.[4]

In this equation y is the theoretical (as distinguished from the observed) weight in pounds and x is the child's age (measured in units of 1 month) when the weighing was made.

The parameters a and e^b have the following meaning: a is the value of y when x equals 0.0; $e^b=y_{(n+1)}/y_n$. In this problem the parameter e^b may be considered an arithmetic estimate of the child's weight at any given age expressed as a proportion of his weight the preceding month. If the child exhibits a continuous weight gain from month to month, e^b is greater than 1.0; the larger e^b, the more rapidly the child is gaining. If e^b equals 1.0, the child's weight remains about the same throughout the period of observation. If e^b is less than 1.0, the child is actually losing weight.

Since e is a mathematical constant (2.718), the value of e^b is determined by the value of the exponent, b, which is the relative instantaneous velocity $\left(\frac{dy}{dx}\Big/y\right)$. In other words, it is an estimate of the child's average percentage gain or loss in weight per month during the period of observation. For example, if b equals 0.008 (0.0077) or eight-tenths of 1 percent, the child's weight increased at a rate of 0.8 percent per month. In other words, if he weighed 50 pounds at 6 years 6 months of age, he probably weighed about 50.4 pounds at 6 years 7 months.

The parameters, b and a, have been determined under a least-squares criterion, as is illustrated in the following sample calculation and graph based on the observations for A. R., the Italian boy whose measurements have also been used to illustrate other parts of the text:

[3] Weights were taken at 4-month intervals, at the time both annual physical examinations were made, and about 6 months after the first physical examination.

[4] Number of weighings, period of observation, and dates are average figures. For more detailed description of these observations see pp. 25 and 26.

Age in months		Weight in lb.	Log y	$(x')^2$	x' log y
(x)	(x')*	(y)			
72. 70	12. 70	40. 75	1. 6101	161. 2900	20. 4483
73. 17	13. 17	41. 75	1. 6207	173. 4489	21. 3446
76. 63	16. 63	43. 50	1. 6385	276. 5569	27. 2483
79. 13	19. 13	43. 25	1. 6360	365. 9569	31. 2967
80. 77	20. 77	43. 50	1. 6385	431. 3929	34. 0316
84. 47	24. 47	44. 00	1. 6435	598. 7809	40. 2164
85. 20	25. 20	46. 00	1. 6628	635. 0400	41. 9026
88. 63	28. 63	47. 50	1. 6767	819. 6769	48. 0039
92. 77	32. 77	48. 00	1. 6812	1073. 8729	55. 0929
S	193. 47		14. 8080	4536. 0163	319. 5853

*An arbitrary x scale (x') has been used, with 60 months equal to 0.

Normal equations:

$$14.8080 = 9 \log a + 193.47 b \log e$$
$$319.5853 = 193.47 \log a + 4536.0163 b \log e$$

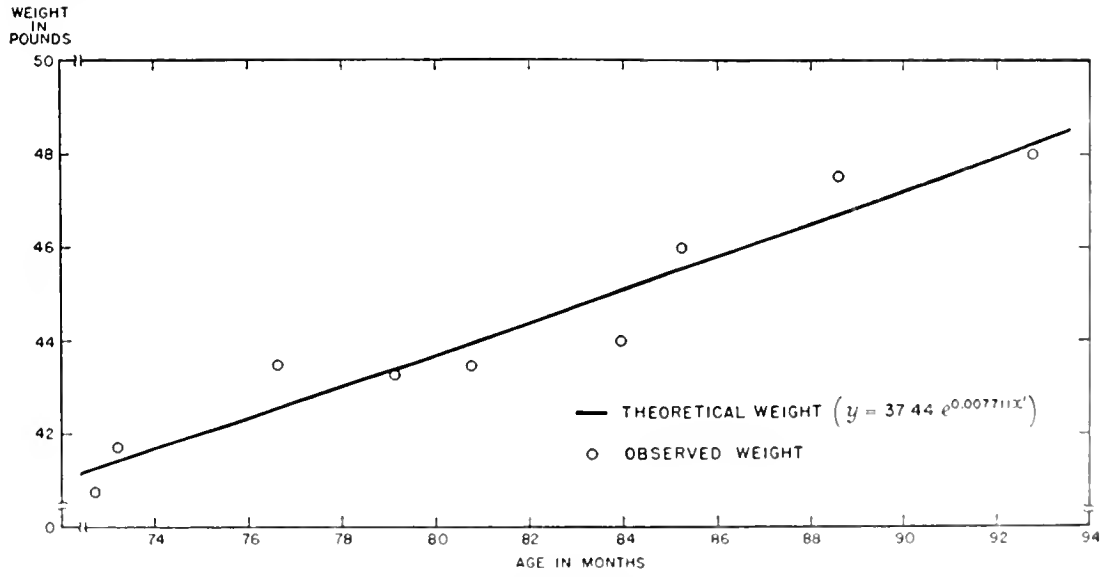
Solving:

$$b = 0.007711$$
$$a = 37.44$$

and

$$y = 37.44\, e^{0.007711x'}$$

Therefore, during the 20-month period of observation from 72.7 to 92.8 months of age, A. R.'s weight increased on the average 0.77 percent per month.



Weight of Italian Boy, A. R., Observed at Frequent Intervals From 72.7 to 92.8 Months of Age

Supplementary Tables

MATERIAL AND METHODS

SUPPLEMENTARY TABLE I.—*Nationality of the boys and girls*

Nationality [1]	Both sexes		Boys		Girls	
	Number	Percent	Number	Percent	Number	Percent
Total	713	100.0	365	100.0	348	100.0
Italian	330	46.3	166	45.5	164	47.1
American	130	18.2	65	17.8	65	18.7
Russian	66	9.3	34	9.3	32	9.2
Mixed European [2]	59	8.3	34	9.3	25	7.2
Polish	35	4.9	19	5.2	16	4.6
Irish	34	4.8	17	4.7	17	4.9
Mixed North European [3]	24	3.4	12	3.3	12	3.4
North European [4]	17	2.4	6	1.6	11	3.2
Central European [5]	9	1.2	5	1.4	4	1.1
South European [6]	9	1.2	7	1.9	2	.6

[1] Classification was based on the birthplace of 3 of the child's grandparents. The classification "American" includes not only children 3 of whose grandparents were born in the United States but also children whose parents and 2 of whose grandparents were born here.
[2] Did not have 3 grandparents from any 1 country.
[3] 3 grandparents from various North European countries.
[4] 3 grandparents from 1 North European country.
[5] 3 grandparents from 1 Central European country.
[6] 3 grandparents from 1 South European country.

SUPPLEMENTARY TABLE II.—*Bitrochanteric widths of the boys and girls*

Bitrochanteric width (in centimeters)	Boys				Girls			
	Total	Italian [1]	American [2]	Other [3]	Total	Italian [1]	American [2]	Other [3]
Total	[4] 364	166	64	134	348	164	65	119
18.0–18.4	0	0	0	0	2	1	0	1
18.5–18.9	1	1	0	0	0	0	0	0
19.0–19.4	3	2	1	0	1	1	0	0
19.5–19.9	11	5	3	3	17	10	2	5
20.0–20.4	31	15	7	9	25	14	8	3
20.5–20.9	31	19	5	7	53	32	11	10
21.0–21.4	51	24	10	17	51	28	11	12
21.5–21.9	78	41	12	25	56	26	8	22
22.0–22.4	62	27	10	25	47	17	9	21
22.5–22.9	40	13	3	24	33	10	7	16
23.0–23.4	24	10	5	9	27	11	5	11
23.5–23.9	15	6	3	6	11	6	2	3
24.0–24.4	10	1	3	6	14	5	1	8
24.5–24.9	3	1	0	2	3	1	0	2
25.0–25.4	3	1	1	1	2	1	0	1
25.5–25.9	1	0	1	0	3	1	0	2
26.0–26.4	0	0	0	0	1	0	0	1
26.5–26.9	0	0	0	0	0	0	0	0
27.0–27.4	0	0	0	0	1	0	0	1
27.5–27.9	0	0	0	0	1	0	1	0
Mean	21.9	21.7	21.9	22.1	21.9	21.6	21.7	22.3
Standard deviation	1.16	1.08	1.35	1.11	1.36	1.25	1.30	1.42

[1] 3 of the child's grandparents were born in Italy.
[2] 3 of the child's grandparents or 2 of his grandparents and both his parents were born in the United States.
[3] These children did not meet the definitions outlined in footnotes 1 and 2.
[4] Bitrochanteric width was unknown for 1 boy.

RESULTS

Growth estimates used in deriving Criteria III, IV, and V.

SUPPLEMENTARY TABLE III.—*Average percentage gain in weight per month of the boys and girls*

Average percentage gain	Boys	Girls
Total	365	348
0.20–0.39	1	2
0.40–0.59	17	13
0.60–0.79	106	90
0.80–0.99	144	127
1.00–1.19	63	68
1.20–1.39	20	22
1.40–1.59	9	16
1.60–1.79	4	6
1.80–1.99	0	3
2.00–2.19	1	0
2.20–2.39	0	1

SUPPLEMENTARY TABLE IV.—*Percentage change in arm girth per year of the boys and girls*

Percentage change	Boys	Girls
Total	365	348
−10.0 to −08.1	0	1
−08.0 to −06.1	2	1
−06.0 to −04.1	5	2
−04.0 to −02.1	17	13
−02.0 to −00.1	30	28
00.0 to 01.9	73	64
02.0 to 03.9	115	91
04.0 to 05.9	63	74
06.0 to 07.9	35	35
08.0 to 09.9	14	24
10.0 to 11.9	4	10
12.0 to 13.9	3	2
14.0 to 15.9	1	1
16.0 to 17.9	1	0
18.0 to 19.9	1	2
20.0 to 21.9	1	0

Indices of body build.

SUPPLEMENTARY TABLE V.—*Comparison of each of five criteria of physical fitness and the ACH Index applied to 7-year-old children,*[1] *364 boys and 348 girls* [2] *(20 percent selection by the index)* [3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion	
	Criterion		Index		Criterion and index			
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	6	8	4	5	14.3	12.5
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	6	8	3	3	16.7	13.0
III. "Unsatisfactory" [4] average percentage gain in weight per month	37	37	6	8	0	1	.0	2.7
IV. "Unsatisfactory" [5] percentage change in arm girth per year	37	32	6	8	1	0	2.7	.0
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory" [5] percentage change in arm girth per year	4	5	6	8	1	0	25.0	.0

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown.

[3] According to this index a child is selected if the difference between his arm girth and chest depth falls in the lowest 20 percent of a group of boys or girls of the same age and hip width.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE VI.— *Comparison of each of five criteria of physical fitness and the Nutritional Status Index for Weight applied to 7-year-old children,[1] 364 boys and 347 girls[2] (20 percent selection by the index)[3]*

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	11	4	2	1	7.1	2.5	357	98.1	309	89.0
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	11	4	2	0	11.1	.0	357	98.1	309	89.0
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	11	4	0	2	.0	5.4	357	98.1	342	98.6
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	11	4	0	0	.0	.0	357	98.1	337	97.1
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	11	4	0	0	.0	.0	357	98.1	309	89.0

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by this index if his score shows him to be in the lowest 20 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE VII.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Index for Arm Girth applied to 7-year-old children,[1] 364 boys and 347 girls [2] (20 percent selection by the index)* [3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	8	7	5	5	17.9	12.5	202	55.5	292	84.1
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	8	7	4	3	22.2	13.0	202	55.5	292	84.1
III. "Unsatisfactory" [4] average percentage gain in weight per month	37	37	8	7	0	0	.0	.0	352	96.7	347	100.0
IV. "Unsatisfactory" [5] percentage change in arm girth per year	37	32	8	7	1	1	2.7	3.1	352	96.7	332	95.7
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory" [5] percentage change in arm girth per year	4	5	8	7	1	1	25.0	20.0	134	36.8	110	31.7

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by this index if his score shows him to be in the lowest 20 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE VIII.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Index for Subcutaneous Tissue applied to 7-year-old children,*[1] *364 boys and 347 girls*[2] *(20 percent selection by the index)*[3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	43	42	3	7	10.7	17.5	341	93.7	323	93.1
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	43	42	1	4	5.6	17.4	341	93.7	323	93.1
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	43	42	2	4	5.4	10.8	358	98.4	332	95.7
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	43	42	7	3	18.9	9.4	336	92.3	323	93.1
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	43	42	1	2	25.0	10.0	326	89.6	315	90.8

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by this index if his score shows him to be in the lowest 20 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE IX.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Indices for Weight and Arm Girth applied to 7-year-old children,*[1] *364 boys and 347 girls* [2] *(20 percent selection by the index)* [3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	4	0	2	0	7.1	0.0	202	55.5	281	81.0
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	4	0	2	0	11.1	.0	202	55.5	281	81.0
III. "Unsatisfactory" [4] average percentage gain in weight per month	37	37	4	0	0	0	.0	.0	349	95.9	342	98.6
IV. "Unsatisfactory" [5] percentage change in arm girth per year	37	32	4	0	0	0	.0	.0	349	95.9	329	94.8
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory" [5] percentage change in arm girth per year	4	5	4	0	0	0	.0	.0	134	36.8	110	31.7

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by both these indices if his scores show him to be in the lowest 20 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE X.—*Comparison of each of five criteria of physical fitness and the Nutritional Status indices for Weight and Subcutaneous Tissue applied to 7-year-old children,*[1] *364 boys and 347 girls*[2] *(20 percent selection by the index)*[3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	6	0	0	0	0.0	0.0	339	93.1	294	84.7
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	6	0	0	0	.0	.0	339	93.1	291	84.7
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	6	0	0	0	.0	.0	353	97.0	327	94.2
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	6	0	0	0	.0	.0	334	91.8	314	90.5
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[4] percentage change in arm girth per year	4	5	6	0	0	0	.0	.0	324	89.0	289	83.3

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by both these indices if his scores show him to be in the lowest 20 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE XI.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Indices for Arm Girth and Subcutaneous Tissue applied to 7-year-old children,*[1] *364 boys and 347 girls*[2] *(20 percent selection by the index)*[3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	3	4	1	3	3.6	7.5	198	54.4	280	80.7
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	3	4	0	3	.0	13.0	198	54.4	280	80.7
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	3	4	0	0	.0	.0	349	95.9	332	95.7
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	3	4	1	1	2.7	3.1	332	91.2	314	90.5
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	3	4	1	1	25.0	20.0	128	35.2	109	31.4

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by both these indices if his scores show him to be in the lowest 20 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE XII.—*Comparison of each of five criteria of physical fitness and the Nutritional Status Indices for Weight, Arm Girth, and Subcutaneous Tissue applied to 7-year-old children,[1] 364 boys and 347 girls[2] (20 percent selection by the index)[3]*

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	1	0	0	0	0.0	0.0	198	54.4	270	77.8
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	1	0	0	0	.0	.0	198	54.4	270	77.8
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	1	0	0	0	.0	.0	346	95.1	327	94.2
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	1	0	0	0	.0	.0	331	90.9	312	89.9
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	1	0	0	0	.0	.0	128	35.2	109	31.4

[1] Age in completed years.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

[3] A child has been considered selected by all three of the indices if his scores show him to be in the lowest 20 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE XIII.—*Comparison of each of five criteria of physical fitness and the Pryor Index applied to 7-year-old children,*[1] *365 boys and 347 girls*[2] *(20 percent selection by the index)*[3]

Criterion	Number of children identified by—						Children identified by criterion and index as percent of those identified by criterion		Children screened by the index in order to include all the children identified by the criterion			
	Criterion		Index		Criterion and index				Boys		Girls	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	*Number*	*Percent*	*Number*	*Percent*
I. Clinical estimate of poor or very poor nutritional status at 7 years of age	28	40	77	46	11	11	39.3	27.5	306	83.8	284	81.8
II. Clinical estimate of poor or very poor nutritional status at both 6 and 7 years of age	18	23	77	46	7	7	38.9	30.4	251	68.8	284	81.8
III. "Unsatisfactory"[4] average percentage gain in weight per month	37	37	77	46	8	7	21.6	18.9	346	94.8	338	97.4
IV. "Unsatisfactory"[5] percentage change in arm girth per year	37	32	77	46	7	6	18.9	18.8	356	97.5	334	96.3
V. Clinical estimate of poor or very poor nutritional status at 7 years of age, need of both medical and dental care at 7 years of age, and "unsatisfactory"[5] percentage change in arm girth per year	4	5	77	46	1	1	25.0	20.0	251	68.8	235	67.7

[1] Age at nearest birthday.

[2] 713 children, 365 boys and 348 girls, were included in the study, but the index could not be tested on 1 girl whose height exceeded the measurements given in the table.

[3] A child has been considered selected by this index if his score shows him to be in the lowest 20 percent of a group of his skeletal peers of the same sex and age.

[4] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the boys who were selected showed an average percentage gain in weight per month of 0.657 or less; the girls, of 0.672 or less.

[5] Approximately the lowest 10 percent of the group of boys or girls included in the study have been considered selected by this criterion. All the children who were selected showed a percentage decrease in arm girth: 1.3 or more for boys, 0.7 or more for girls.

SUPPLEMENTARY TABLE XIV.—*Baldwin-Wood Index for the boys and girls*

Percent underweight or overweight	Boys	Girls
Total	365	[1] 347
−20.0 to −15.1	1	4
−15.0 to −10.1	19	27
−10.0 to − 5.1	56	50
− 5.0 to − 0.1	86	83
0.0 to 4.9	94	78
5.0 to 9.9	60	49
10.0 to 14.9	27	21
15.0 to 19.9	11	10
20.0 to 24.9	4	6
25.0 to 29.9	4	3
30.0 to 34.9	1	2
35.0 to 39.9	1	4
40.0 to 44.9	0	1
45.0 to 49.9	0	1
50.0 to 54.9	1	1
55.0 to 59.9	0	0
60.0 to 64.9	0	1
Mean	1.77	2.21
Standard deviation	8.70	11.2

[1] 348 girls were included in the study, but the index could not be tested on 1 girl whose height exceeded the measurements given in the table.

SUPPLEMENTARY TABLE XV.—*Nutritional Status Index for Weight of the boys and girls*

$x\ \sigma$ [1]	Boys	Girls
Total	[2] 364	[2] 347
−2.0 to −1.6	1	0
−1.5 to −1.1	3	1
−1.0 to −0.6	18	14
−0.5 to −0.1	43	38
0.0 to 0.4	91	91
0.5 to 0.9	95	97
1.0 to 1.4	62	56
1.5 to 1.9	33	35
2.0 to 2.4	10	10
2.5 to 2.9	8	2
3.0 to 3.4	2	5
Mean	0.672	0.715
Standard deviation	0.773	0.772

[1] See Appendix II: (75) Nutritional Status Indices, p. 65. Table X gives the child's index or score according to an arbitrary scale which may be expressed in terms of the abscissa of the normal curve. Table X score $= 10x\ \sigma + 50$.

[2] 365 boys and 348 girls were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

SUPPLEMENTARY TABLE XVI.—*Nutritional Status Index for Subcutaneous Tissue of the boys and girls*

$x\ \sigma$ [1]	Boys	Girls
Total	[2] 364	[2] 347
−2.0 to −1.6	6	2
−1.5 to −1.1	18	23
−1.0 to −0.6	80	59
−0.5 to −0.1	113	104
0.0 to 0.4	82	81
0.5 to 0.9	45	54
1.0 to 1.4	14	15
1.5 to 1.9	4	7
2.0 to 2.4	1	0
2.5 to 2.9	0	1
3.0 to 3.4	0	1
Mean	0.109	0.0137
Standard deviation	0.678	0.750

[1] See footnote 1, supplementary table XV.

[2] 365 boys and 348 girls were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

SUPPLEMENTARY TABLE XVII.—*Nutritional Status Index for Arm Girth of the boys and girls*

x/σ [1]	Boys	Girls
Total	[2] 364	[2] 347
−1.5 to −1.1	4	2
−1.0 to −0.6	8	18
−0.5 to −0.1	32	34
0.0 to 0.4	48	86
0.5 to 0.9	79	70
1.0 to 1.4	81	55
1.5 to 1.9	60	46
2.0 to 2.4	33	21
2.5 to 2.9	7	8
3.0 to 3.4	12	7
Mean	1.07	0.838
Standard deviation	0.904	0.905

[1] See footnote 1, supplementary table XV.
[2] 365 boys and 348 girls were included in the study, but the index could not be tested on 1 boy whose bitrochanteric width was unknown and on 1 girl whose chest breadth was less than the measurements given in the table.

SUPPLEMENTARY TABLE XVIII.—*Pryor Index for the boys and girls*

$x\sigma$ [1]	Boys	Girls
Total	365	[2] 347
−3.5 to −3.1	2	0
−3.0 to −2.6	0	0
−2.5 to −2.1	3	2
−2.0 to −1.6	18	5
−1.5 to −1.1	31	24
−1.0 to −0.6	56	73
−0.5 to −0.1	87	96
0.0 to 0.4	75	72
0.5 to 0.9	47	37
1.0 to 1.4	27	16
1.5 to 1.9	10	7
2.0 to 2.4	4	7
2.5 to 2.9	2	3
3.0 to 3.4	1	1
3.5 to 3.9	0	2
4.0 to 4.4	0	1
4.5 to 4.9	2	0
5.0 to 5.4	0	0
5.5 to 5.9	0	1
Mean	−0.0404	0.00216
Standard deviation	1.01	0.975

[1] For procedure followed in computing x/σ values see Appendix I, pp. 97-98.
[2] 348 girls were included in the study, but the index could not be tested on 1 girl whose height exceeded the measurements given in the table.

Clinical judgment of general nutritional status.

SUPPLEMENTARY TABLE XIX.—*Association between the estimates made by pediatricians A and B of the nutritional status of 107 boys at the check-up examinations*

Estimates by pediatrician A	Estimates by pediatrician B					Total
	Excellent	Good	Borderline	Poor	Very poor	
Excellent	0	2	0	0	0	2
Good	2	13	14	0	0	29
Borderline	1	4	27	36	0	68
Poor	0	0	3	4	1	8
Very poor	0	0	0	0	0	0
Total	3	19	44	40	1	107

SUPPLEMENTARY TABLE XX.—*Association between the estimates made by pediatricians A and B of the nutritional status of 101 girls at the check-up examinations*

Estimates by pediatrician A	Estimates by pediatrician B					Total
	Excellent	Good	Borderline	Poor	Very poor	
Excellent	0	3	0	0	0	3
Good	4	14	16	0	0	34
Borderline	0	2	36	13	0	51
Poor	0	1	3	7	2	13
Very poor	0	0	0	0	0	0
Total	4	20	55	20	2	101

SUPPLEMENTARY TABLE XXI.—*Association between the estimates made by pediatricians A and C of the nutritional status of 107 boys at the check-up examinations*

Estimates by pediatrician A	Estimates by pediatrician C					Total
	Excellent	Good	Borderline	Poor	Very poor	
Excellent	2	0	0	0	0	2
Good	2	11	16	0	0	29
Borderline	0	2	47	19	0	68
Poor	0	0	5	3	0	8
Very poor	0	0	0	0	0	0
Total	4	13	68	22	0	107

SUPPLEMENTARY TABLE XXII.—*Association between the estimates made by pediatricians A and C of the nutritional status of 101 girls at the check-up examinations*

Estimates by pediatrician A	Estimates by pediatrician C					Total
	Excellent	Good	Borderline	Poor	Very poor	
Excellent	2	1	0	0	0	3
Good	8	12	14	0	0	34
Borderline	0	1	41	9	0	51
Poor	0	0	4	9	0	13
Very poor	0	0	0	0	0	0
Total	10	14	59	18	0	101

SUPPLEMENTARY TABLE XXIII.—*Association between the estimates made by pediatricians B and C of the nutritional status of 107 boys at the check-up examinations*

Estimates by pediatrician C	Estimates by pediatrician B					Total
	Excellent	Good	Borderline	Poor	Very poor	
Excellent	1	2	1	0	0	4
Good	2	7	4	0	0	13
Borderline	0	10	35	23	0	68
Poor	0	0	4	17	1	22
Very poor	0	0	0	0	0	0
Total	3	19	44	40	1	107

SUPPLEMENTARY TABLE XXIV.—*Association between the estimates made by pediatricians B and C of the nutritional status of 101 girls at the check-up examinations*

Estimates by pediatrician C	Estimates by pediatrician B					Total
	Excellent	Good	Borderline	Poor	Very poor	
Excellent	3	7	0	0	0	10
Good	1	9	4	0	0	14
Borderline	0	4	47	8	0	59
Poor	0	0	4	12	2	18
Very poor	0	0	0	0	0	0
Total	4	20	55	20	2	101

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