VITAL and HEALTH STATISTICS

DATA FROM THE NATIONAL HEALTH SURVEY

Series 11 • Number 165

NCHS

NATIONAL CENTER FOR HEALTH STATISTICS

NCHS Growth Curves for Children

Birth-18 Years

United States

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

Library of Congress Cataloging in Publication Data

Hamill, Peter V. V.
NCHS growth curves for children.

(Vital and health statistics: Series 11, Data from the National Health Survey; no. 165) (DHEW publication; (PHS) 78-1650)

Includes bibliographical references.

1. Children—Growth. 2. Children—Growth—Charts, diagrams, etc. 3. Children in the United States—Anthropometry. I. Hamill, Peter V. V. II. Title. III. Series: United States. National Center for Health Statistics. Vital and health statistics: Series 11, Data from the National Health Survey, Data from the health examination survey; no. 165. IV. Series: United States. Dept. of Health, Education, and Welfare. DHEW publication; (PHS) 78-1650.

RA407.3.A347 no. 165 [RJ131] 312'.0973s 77-8931
ISBN 0-8406-0100-X [612.6'5'0212]

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Stock No. 017-022-00[illegible]-0

Data from the
NATIONAL HEALTH SURVEY

Series 11
Number 165

NCHS Growth Curves for Children

Birth-18 Years

United States

Smoothed percentile distributions of body size (weight, length or stature, and head circumference) attained at specific chronologic ages from birth to 18 years and body weight for length are presented and discussed. Height and weight data for adults 18-24 years are also presented in the tables.

DHEW Publication No. (PHS) 78-1650

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
National Center for Health Statistics
Hyattsville, Md. November 1977

NATIONAL CENTER FOR HEALTH STATISTICS

DOROTHY P. RICE, *Director*

ROBERT A. ISRAEL, *Deputy Director*
JACOB J. FELDMAN, Ph.D., *Associate Director for Analysis*
GAIL F. FISHER, *Associate Director for the Cooperative Health Statistics System*
ELIJAH L. WHITE, *Associate Director for Data Systems*
JAMES T. BAIRD, JR., Ph.D., *Associate Director for International Statistics*
ROBERT C. HUBER, *Associate Director for Management*
MONROE G. SIRKEN, Ph.D., *Associate Director for Mathematical Statistics*
PETER L. HURLEY, *Associate Director for Operations*
JAMES M. ROBEY, Ph.D., *Associate Director for Program Development*
PAUL E. LEAVERTON, Ph.D., *Associate Director for Research*
ALICE HAYWOOD, *Information Officer*

DIVISION OF HEALTH EXAMINATION STATISTICS

MICHAEL A. W. HATTWICK, M.D., *Director*
PETER V. V. HAMILL, M.D., *Medical Adviser*
JEAN ROBERTS, *Chief, Medical Statistics Branch*
ROBERT MURPHY, *Chief, Survey Planning and Development Branch*

COOPERATION OF THE U.S. BUREAU OF THE CENSUS

In accordance with specifications established by the National Center for Health Statistics, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing.

Vital and Health Statistics-Series 11-No. 165

DHEW Publication No. (PHS) 78-1650
Library of Congress Catalog Card Number 77-8931

CONTENTS

LIST OF FIGURES

SYMBOLS

Data not available	- - -
Category not applicable	. . .
Quantity zero	-
Quantity more than 0 but less than 0.05	0.0
Figure does not meet standards of reliability or precision	*

NCHS GROWTH CURVES FOR CHILDREN BIRTH-18 YEARS

Peter V. V. Hamill, M.D., M.P.H., Terence A. Drizd, M.S.P.H., and
Clifford L. Johnson, M.S.P.H., *Division of Health Examination Statistics;*
Robert B. Reed, Ph.D., Professor of Biostatistics, *Harvard University;* and
Alex F. Roche, Ph.D., M.D., Senior Scientist, *Fels Research Institute,*
Yellow Springs, Ohio

INTRODUCTION

In 1974 the National Academy of Sciences[1] urged that new growth charts for infants and children be prepared using current data for the nutritional assessment of populations of infants and children in the United States. The Academy recommended using the data on growth and development collected over the past decade by the Health Examination Surveys (HES) of the National Center for Health Statistics (NCHS), supplemented by age-appropriate sets of height and weight data on infants and children from the Fels Research Institute and from an Ohio State University team headed by Dr. George Owen. Earlier (1971), a study group, cosponsored by the American Academy of Pediatrics and the Maternal and Child Health Program, Public Health Service, Department of Health, Education, and Welfare (DHEW), had made similar recommendations.[2] This latter report emphasized the use of such data in the clinical assessment of the growing infant and child, thereby supplementing nutritional screening and other epidemiologic assessments of populations of children. Again, in 1975, a research-oriented study group sponsored by the National Institute of Child Health and Human Development made similar recommendations.[3] Furthermore, each of the groups recommended that one set of data for all races would be sufficient for practical purposes, despite the small but actual differences in body measurements noted among racial groupings.

In addition to these recommendations, there were other pressing reasons for constructing new growth charts for today's children to replace the venerable Stuart-Meredith charts of the 1940's. New charts would serve the urgent program needs of two DHEW agencies that administer many important community programs: the Nutrition Surveillance Program of the Center for Disease Control (CDC) and the Bureau of Community Health Services. Furthermore, new charts could make optimal use of HES data on the growth and development of children, including the most recent data from the Health and Nutrition Surveys (HANES). Thus an NCHS task force of experts from outside of government and from CDC and NCHS was formed to construct a new set of growth charts. The task force members were R. Reed, Professor of Biostatistics, Harvard University; A. Roche, Senior Scientist, Fels Research Institute; G. Owen, Professor of Pediatrics, University of New Mexico; M. Lane, M. Nichaman, and J. Goldsby, Nutrition Surveillance Program, CDC; T. Drizd, J-P Habicht, C. Johnson, A. McDowell, and P. Hamill, chairman, all representing NCHS. The resulting growth charts[a] accompany this report (figures I-XIV in appendix I and tables 1-19).

[a]More precisely, the product of this activity is a set of smoothed percentile distributions of body size (weight, length or stature, and head circumference), attained at any given chronologic age from birth to 18 years and body weight by length for prepubescent children. Graphs representing these curves are presented as

(Continued)

The new charts and tables were constructed using current body measurement data and exploiting the most recent advances in data analysis and computer technology. These data are derived either from the Fels Research Institute or from the Health Examination Surveys of the National Center for Health Statistics. One set of charts for children from birth to 3 years (figures I-VIII) is based on body measurements collected at Fels Research Institute during the 1929-75 period. The set of charts for children 2-18 years of age (figures IX-XIV) is based on NCHS data which were collected between 1963 and 1974.

The NCHS task force benefited from the advice offered by many interested agencies and individuals; most importantly they benefited from the Preschool Nutrition Survey of 1968-70. In this survey, body measurements of 3,500 children aged 1-5 years were collected by the Ohio State University team headed by Dr. Owen.[4] His group collected body measurements in a manner similar to Fels and NCHS. These data were very useful as interim data and for comparative purposes until the HANES data on preschool children became available. However, these data were not used in constructing the new growth charts because the task force tried to avoid pooling data sets wherever possible, keeping the number of reference populations to a minimum.

The first two groups of charts (figures I-VIII), which cover the period birth-36 months separately by sex, present curves for body weight by age, recumbent length by age, weight by length (assuming an approximate independence of chronologic age under 4.0 years),[b] and head circumference by age. These data were derived from the body measurements of 867 children who were followed in a longitudinal study conducted at the Fels Research Institute from birth to 24 years by serial examination: at birth, 1 month, 3 months, 6 months, 9 months, 1 year, 1½ years, 2 years, 2½ years, 3 years of age, and every year or two thereafter.[c] The sample children were drawn from middle-class white families who lived within a convenient distance to Yellow Springs, Ohio (about 25 miles east of Dayton), to be studied for many years in this longitudinal study. These children were the products of essentially normal births[d] and were in reasonably good health. As will be considered more fully in the Discussion section of this report, the biases introduced by this imperfect sampling design were judged not of sufficient magnitude to disqualify the use of these data, especially since there were no suitable alternative data for the first year of life. Other factors, such as the technical reliability of the measurements, the large sample size, and the availability

---

(Footnote a continued)
well as data from selected points on the smoothed percentile curves in tabular form. As will also be explained, these curves are "contained" in a deck of 308 computer cards.

The term "growth charts" is commonly used (and misused) in referring to several types of data by which children's growth status is assessed. Sizes *attained* at a given age are the bases of these NCHS "charts" and should be distinguished from *growth velocity charts,* which can only be constructed from, and used for, longitudinally obtained incremental data. Specialists in growth disorders need growth velocity charts because growth velocity charts are more sensitive indicators of slight changes in growth status than the more visual "sizes-attained" growth records. Of course, the more sensitive "charts" are also more sensitive to errors in both their original construction and their application, and they are more difficult to interpret. The more common NCHS type of curve is based on cross-sectional data; these curves are used most properly to compare body sizes of children at one given point in time as well as to chart clinically the growth curve of the individual child. These more common curves provide a good approximation until the erratically phased pubertal growth spurts begin.

[b]As will be discussed further, this growth statistic assumes an approximate age independence from infancy until the occurrence of the marked changes in body proportions that begin in early pubescence and continue past puberty. Its most immediate practical use is for those areas of the world where the children being assessed do not have accurately recorded birth dates.

[c]Some children were not measured at every examination period; the average number examined at any given age under 18 years was between 700 and 800.

[d]There was a purposeful overrepresentation of multiple births in the Fels study population. There were 4 sets of triplets, all of whom were excluded from these analyses; however, 14 sets of twins were retained because their body measurements were not significantly different from those of the other children. There was no exclusion for low birth weight (40 of the 867 children, or 4.6 percent, weighed less than 2,500 grams; only 1 child weighed less than 1,500 grams).

of all the data in a computer-compatible form more than compensated for the sampling deficiencies for these purposes.

The sex-specific charts for children 2-18 years include curves for body weight by age, stature by age, and weight by stature (only for prepubescent children).[e] NCHS data from three separate surveys were used in their construction: HES Cycle II of children ages 6-11 years (1963-65), HES Cycle III of youths ages 12-17 years (1966-70), and HANES I of children ages 1-17 years (1971-74) (a chronologic age subset of the total data, ages 1-74 years). Because of the similarity and efficiency of the stratified probability sample designs, the data from the three NCHS surveys (see tables 18 and 19, figures XV-XVIII) could be both melded for consecutive age groupings and combined when certain age groups overlapped (i.e., after separate study of their comparability, which is described in appendix II, the data of HANES children 6-17 years were "pooled" with those of HES Cycle II and HES Cycle III). The nationally representative nature of these HES data has been described in published reports.[5-8]

Of the sets of data used to prepare the growth charts, only the HES data on heights and weights of children 6-17 years, collected in 1963-70, have been reported previously.[9,10] Parts of the Fels data have been used in other publications,[11-15] and data from the first half of the HANES I sample were included in a previous preliminary report.[16] Both of these groups of data are presented in this report and will be compared with each other and with the HES data at common points of age overlap.

The seven percentile curves (i.e., 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles) in each chart are based on percentile points of observed data grouped by age, which were smoothed by a *least squares cubic spline technique* developed at the University of Wisconsin by DeBoors and Rice.[17] "Splining" is a term borrowed from carpentry and mechanics to describe a mode of joining two independent pieces by a third piece which becomes common to both. In this mathematical application, the "pieces" are polynomials of a degree n, connected at selected points (knots) and each pair of successive polynomials having at the knot identical values of their function and of the first $n-1$ derivatives. Thus, in the cubic spline functions used in this case, two cubics have the same value, the same slope or velocity, and the same acceleration at the knot where they are joined. The number and placement of these knots requires both knowledge of the properties of the data and pragmatic tests of the results.

The program used in this work provides for choosing either a fixed or a variable knot mode of placement. With fixed knots, the program iterates to obtain a least squares fit subject to the specified locations of the knots. With variable knots, the program varies the knot locations from an initially specified set in order to achieve the least squares fit with the minimal residual.

The NCHS task force tested many combinations of optimally fitting the smoothed curves to the data. Repeatedly, they varied the number and location of the knots, using both the fixed knot and the variable knot programs and evaluated many delineations of the various data sets. Although some general rules usually suggested at least an approximate knot selection (see appendix II), the best choices were ultimately made by comparing the predicted curves against concomitantly printed overlays of the observed data points and by using minimum residuals. The goal was to achieve a maximal smoothing consonant with the least distortion of the plotted percentile points in the original observed data. With these data it was found that fixed knots at the same ages for all percentiles in a given chart (e.g., weight by age, birth-36

[e]As is discussed elsewhere, there is an assumption of approximate age independence in the relationship of weight by length from infancy until the occurrence of the marked changes in body proportions which begin in early pubescence and continue past puberty. Its most immediate practical use is for those areas of the world where accurate birth dates have not been recorded for the children being assessed. To maximize the range of the applicable population while minimizing distortion of the data by pubescent children, the curves were constructed using the following sets of HES-HANES data: (1) all girls taller than 90 centimeters but shorter than 137 centimeters (which was the 95th percentile in stature for HES girls 8 years of age) and ages 10 years or less; and (2) all boys taller than 90 centimeters but shorter than 145 centimeters (which was the 95th percentile in stature of HES boys at age 9.5 years) and ages 11.5 years or less.

months) produced percentile lines that were not locally distorted while yielding a good fit to the observed data.

The metric scale was generally used throughout the life of these data in terms of data generation (i.e., the original body measurements), data preparation, data analysis, and chart construction. However, to help the task force members, the data would occasionally be converted to pounds and inches. The basic scaling of the charts is metric; however, for the convenience of those users who are steadfastly rooted in the English system of weights and measurements, supplementary designations in pounds and inches are provided as well.

METHOD

The measuring techniques are essentially as described in the National Academy of Sciences subcommittee report[1] published by CDC. The minor differences in instrumentation and technique used by the Fels Research Institute and by the National Center for Health Statistics have all been taken into account and will be described separately within this report.

Fels Research Institute Data

Weight.—Nude body weight was accurately measured using a regularly calibrated beam balance. The children were measured nude up to 2 years of age. Two- and three-year-olds wore standardized clothing; the weight of this clothing was subtracted from the observed data.

Recumbent length.—Recumbent lengths were obtained on most subjects from birth to 24 years of age, and two examiners were always employed to help with the proper alignment of the subject and to hold the younger children properly. The subject was stretched out fully on a specially constructed measuring table, his head touching the fixed headboard, and the flattening of any lumbar lordosis was attempted. Keeping the child's knees as extended as possible, the examiner brought the footboard up firmly against the soles of the feet to create a right angle. The head circumference was taken with a steel tape placed 1 inch above the glabella in front and at the maximum diameter of the occiput. The tape was carefully kept in one horizontal plane and drawn snugly.

In this serial study, every effort was made to assure independence of observations of measurements from one visit to another. The measurers did not have access to previous data at the time of measurement. At each visit every child was measured twice (i.e., by two anthropometrists who worked cooperatively and also exchanged measuring roles). Interobserver differences are known to be small.

Stature.—At about 2½ years of age, or when the subjects could stand erectly, stature was measured in addition to recumbent length. It was measured in the standard manner: with the head in the Frankfort plane, the child stood tall and erect without upward pressure exerted on the mastoids, and he obeyed the examiner's instruction to "Take a deep breath and hold it."

Thus, from approximately 3 years of age most of the subjects had a dual set of linear measurements: recumbent length and stature. However, the Fels stature measurements were not used in the construction of the charts; they were used only for analysis and in discussion of technical problems.

NCHS Data

Weight.—A Toledo self-balancing scale, which prints the weight directly onto a permanent record, minimized observer and recorder error. The printed weight was later transferred to a punched card and subsequently to magnetic tape. Although all body weight data from Fels represent nude weights, those from HES *include* light, standardized examination clothing with the following approximate weights at various ages: 0.05 kilograms at 1 and 2 years, 0.09 kilograms at 3-5 years, and 0.11 to 0.30 kilograms from 6 to 18 years.

Stature.—Stature (standing height) was measured on a stadiometer. In the standard manner (used also in the Fels measurement collection) the child stood in stocking feet with feet together and back and heels against the upright bar of the stature scale. In neither the Fels study nor in the Health Examination Survey (HES) was upward pressure exerted on the subjects' mastoids by the examiner to purposefully "stretch everyone in a standard manner" as has been done in other studies.[18-20]

However, the HES equipment had different characteristics from that used in the Fels study.

It consisted of a level platform onto which was attached a vertical bar with a steel tape. A horizontal bar, which was connected to the vertical bar, was brought down snugly on the examinee's head. A Polaroid camera, attached to another bar in the same plane as the horizontal measuring bar, recorded the subject's identification number next to the pointer on the scale, giving a precise reading. This objective and permanent recording eliminated parallax and reduced observer and recording error.

Recumbent length.—Although the data were not actually used in this report, HANES also obtained recumbent length by using a specially constructed body measurement board on all children aged 12-24 months and on many of the children aged 24-36 months using essentially the same technique described for the Fels study. These recumbent length data have been useful for quality control purposes in relation to the data sets used to prepare the charts. These data will be considered further in the Discussion section of this report.

RESULTS

The List of Detailed Tables that follows the text of this report provides good information about the data presented in this report. The list that follows summarizes the population reference data tabulated as observed (i.e., before smoothing).

Population Reference Data

I. Fels Research Institute Data (tables 1-5)

  A. Recumbent length: birth-20 years, table 1
  B. Body weight: birth-20 years, table 2
  C. Stature: 2½-20 years, table 3
  D. Head circumference: birth-7 years, table 4
  E. Relationship between body weight and recumbent length: birth-48 months, table 5

II. NCHS data (tables 6-8)

  A. Stature: 2-24 years, table 6
  B. Body weight: 2-24 years, table 7
  C. Relationship between body weight and stature: prepubescent children, table 8

Comparable smoothed data are also presented in tables 9-15 where points along the smoothed percentile curves are listed. Other sets of data which have been used for comparisons and discussion of technical problems are presented in tables 16-19.

Growth Charts

Fourteen charts have been produced: four for boys, four for girls aged birth-3 years; three for boys aged 2-18 years; and three for girls aged 2-18 years. The set of charts for infants from birth-36 months was all based, after appropriate smoothing techniques, on data collected by the Fels Research Institute from 1929-75 (figures I-VIII). The format for the recumbent length by age, body weight by age, and head circumference by age is traditional and requires no further explanation. However, the weight for length presentation is unusual: The construction of these charts assumes approximate chronologic age independence, as has been stated, and pools all the data from ages birth-48 months,[f] rearranging them in length intervals by 2-centimeter groupings. Within each 2-centimeter grouping, the associated body weights are then distributed in the seven percentile curves. So in clinical assessment, for any child under approximately 4 years for whom recumbent length has been measured, the appropriate length is found on the sex-appropriate graph, and his body weight can be compared with that of all children of the same sex having a similar recumbent length, by percentile placement.

The group of sex-specific charts of children ages 2-18 years, based on the HANES data, ages 2-5 years, and the pooled HANES and HES Cycles II and III data, ages 6-17 years, are depicted in figures IX-XIV. The sex-specific charts

[f]The additional 12 months' data from 36-48 months were added to construct these charts not only to round out the weight and length distributions, especially for the larger children near 36 months, but also to stabilize the ends of the curves by counteracting a tendency of the spline curve smoothing technique to "whip the ends."

of stature by age[g] and weight by age use similar data sets, but the chart of weight by stature of the boys is somewhat different from the chart of weight by stature for girls. Because girls reach puberty and the onset of pubescence 1½-2 years before boys (an estimated 19 months earlier according to HES data[10]), the two data sets for prepubescence had to be selected and defined differently.

In construction of these weight-by-length charts, approximate chronologic age independence of this relationship has been assumed from birth until the marked changes in body size and proportions occurring at the pubertal growth spurt. But in cross-sectional data as that jointly provided by HES and HANES, there are no serial body measurements on each subject from which to construct individual growth charts, which would clearly indicate when this growth spurt has started. In addition, data about the presence or absence of the correlated phenomena of pubescence were not obtained on children under 12 years of age. Consequently, the truncation of the upper end of the data set could only be defined by chronologic age and body size measurements, and separately for boys and girls.

Very few girls would have reached the earliest pubescent growth changes in stature or weight by 8.0 years of age so that their effect on the data set is negligible. For example, the first effects of the pubescent growth spurt of sufficient magnitude affecting enough girls to influence *cross-sectional population data* have been estimated to occur at 10.25 years.[10] But rather than truncating the NCHS reference population at age 8.0 years, an attempt was made to maximize the age range of the population for which these data are appropriate (i.e., to include *most prepubescent girls, regardless of chronologic age*). The most precocious maturers would likely be the tallest because those children who have been largest since birth tend to mature at an early age and also because those who do mature early consequently become larger than the rest. By excluding the tallest members of the population, the chronologic age could safely be extended to 10.0 years with very little risk of data contamination by pubescent girls. Consequently, if only those girls whose stature was greater than 137 centimeters (i.e., above the 95th percentile at age 8 years by HES data) were excluded from the NCHS data set, the height and weight measurements from the remaining girls could safely serve as a prepubescent reference population. Thus, the concomitant constraints of chronologic age and stature enable production of the largest and most broadly applicable NCHS data set, commensurate with a very high safeguard against distortion by the somatic changes in pubescent girls.

Analogous constraints were used to arrive at the appropriate data set for boys. But, because the boys lag behind the girls in maturity by approximately 19 months,[10] both the chronologic age limit (i.e., 11.5 years rather than 10.0 years) and the age at which the height constraint of 146 centimeters was chosen (i.e., 95th percentile at 9.5 years opposed to 8.0 years) were placed 18 months later than those of the girls. Hence, although the data sets upon which the two charts are constructed are somewhat different (and as can readily be seen comparing figure XIII with figure XIV, the relevant stature range is 9 centimeters greater for boys than for girls), the most important biologic constraint is common for both. The appearance of the earliest signs of pubescence,[h] regardless of chronologic age, invalidates the applicability of these charts of weight by stature to that individual.

DISCUSSION

Weight Distributions by Length

Attempts to separate populations of people into groups expressing degrees of leanness or fatness with quantitative precision have usually related measurement of weight to height in some way. "Ponderal index" (height cubed/weight)

[g]Until almost 3.0 years of age, those data are a mixture of recumbent length and stature measurements and may, therefore, be as much as 2 centimeters higher than if all were stature measurements. This will be discussed in further detail in this section.

[h]The signs of early pubescence are breast budding; testicular enlargement; and growth, coarsening, and pigmenting of axillary and pubic hair. (Pubic hair development is frequently the most useful single indicator in field studies.)

has been used frequently and offers some conceptual appeal by cubing the unidimensional measure (stature) making it three dimensional and, hopefully, more like a three-dimensional volumetric measure which might afford a more appropriate comparison with weight. However, in practice, this index is limited because it behaves differently within the two sexes and at different ages as the axis by which excessively lean or excessively fat children and/or adults are distinguished from the "normals." In this report neither the ponderal index nor any of the other ratios or formulas are presented: not interpretive quantitative indices but the more descriptive percentile distributions of body weights by sex are used for a given length or stature.

This report is not proclaiming a new biologic principle that the relationship between weight and height is essentially linear and age independent from birth to the beginning of the pubertal growth spurt (at which time body proportions and the relationships of weight to stature begin to change dramatically[21]). On the contrary, a subsequent report will demonstrate that this is not quite true, at least for children from 2 years and older. In a normal population of growing children of the same height, those who are chronologically older will also be slightly heavier. It is considered, however, that the age independence of the relationship is close enough so that body weight distributed by stature groupings is a useful statistical device for classifying populations especially into various categories of nutritionally related growth disturbances. It can be most useful when other critical information such as chronologic age is either unknown or unreliably reported, and if weight and height are the only body measurements that can be obtained accurately (especially when lacking an accurate measure of triceps or subscapular skinfold, or even a reliable upper arm circumference).

Uses and Reliability of NCHS Smoothed Percentiles Curves for Attained Body Size

The NCHS tables are based on current and high quality growth data as well as on the most recent advances in data processing and analysis. These charts should be worthy replacements for the venerable Stuart-Meredith charts, which first appeared in 1946.[22] All the steps of data handling and chart production are uniquely documentable and reproducible—from sampling design and execution to measurement milieu, from data editing to final data set selection, and from the selection and modification of the curve-smoothing process to the production of the final computerized curves. In addition, the generation of the equations and the plotting of the curves may be duplicated on any large digital computer with plotting capability, either to produce charts or for computer storage to analyze data from new studies. The information necessary to reproduce the percentile curves is contained in a deck of 308 computer cards that could be supplied by NCHS. For clinical use, however, accurate growth charts for widespread dissemination based on the NCHS percentiles have already been produced by the Ross Laboratories, Columbus, Ohio. Several major research and service projects, which will be facilitated by computer processing of large amounts of anthropometric, clinical, and nutritional data in comparison with the NCHS reference data, are already underway using the deck of computer cards. The Nutrition Surveillance Program of CDC, having contributed significantly to the development of these percentile curves, has been, of course, the first to exploit this resource in their program. During the past several decades researchers at Harvard collected extensive anthropometric data on more than 800 cases of congenital heart disease, both pre- and post-operatively. These data will now be quantified with the NCHS reference points and many crucial questions (e.g., optimal age of surgical intervention in specified conditions to minimize permanent growth retardation) can be systematically worked on. In addition, several programs are under way for measuring the positive growth effects of nutritional and medical care intervention, utilizing the deck of NCHS computer cards.

The widespread use of this common standard reference will facilitate the much needed comparative and standardized studies of populations, both on national and international levels. The practical advantage of reproducibility facilitates widespread computer use and creates a "common coinage," another virtue of articulating and documenting such a complex process. With future new information, new concepts, or more efficient ways of organizing and looking at these kinds of growth data, the steps in the production of those percentile curves can be retraced; the juncture of major decisions can be reexamined; and modifications can rationally be applied on firm grounds without distorting the integrity of the remaining body of data. This degree of definition and articulation is also valuable epidemiologically by enabling clear and detailed comparisons of this body of reference data, which also includes a host of other biologic and socioeconomic variables associated with growth and development in the data of the Health Examination Surveys, with other bodies of growth data, including their associated variables.

New charts, which accurately represent the growth[i] of children in the United States, will probably not have to be constructed for a long time because of the technical quality of these charts as population estimates and also because children's growth rates, which had been increasing for the past century or more, have apparently stabilized, at least for the present. (See the section, "Secular Trends," for further discussion of this latter point.)

High as this task force claims the overall quality of these charts to be, all segments of all charts are not of identical statistical quality or quality of population estimate. Some segments are better than others. The better segments will continue to be used after segments of lesser quality have been replaced or modified.

The parameters of body weight, length, stature, and head circumference, by increasing chronologic age arranged in percentile distributions, have been very useful and probably will continue to be useful for many years to come. The capability of presenting them in smoothed percentile curves (of the articulated quality in this report) represents a distinct advance over presentation of these variables with a central tendency (mean or median) and standard deviations or synthetically generated or hand-smoothed percentiles. The relationship between weight and length is complex, and in this first large-scale organization of data, the task force was aware of walking on thin ice. The assumption of age independence over the age span used is only approximately true, at best. In addition, there were many alternative ways to define the ages and body sizes considered, each with somewhat different consequences. Some of the uses and abuses have been foreseen, but certainly not all of them. As more detailed epidemiologic, clinical, and experimental data (metabolic and growth) are applied to these reference data, much will be learned, and modifications and alterations will probably be made. However, the basic population estimates as defined and presented here are good data.

Because of the nature and efficiency of the samples, all the NCHS data provide somewhat more reliable population estimates, and of known quality and reliability, than are provided by the corresponding data from the Fels Research Institute. The sampling design of the Fels data is acknowledged to be limited geographically, culturally, socioeconomically, and genetically. In addition, careful comparisons of the Fels body measurements with NCHS data show that, although the median values are quite similar, both the low and high outer percentiles are slightly restricted in the Fels data; that is, the Fels population is slightly less heterogeneous than is the more nationally representative NCHS sample. However, birth weights of the Fels study subjects compared with a nationally representative set available from the National Center for Health Statistics[j] were remarkably similar when

---

[i]Growth charting, in the context of this paper, as stated in the "Introduction," always means *distance curves* or size *attained* at a given age (or length) as distinguished from *growth velocity curves*, which are incremental or rate estimates and can only be constructed from longitudinal data. This distinction becomes most critical at the pubertal growth spurt.[9,10,23-26]

[j]A recently available 5-percent sample (not yet published) of all live birth weights in the United States in 1974 stratified by race, region, and socioeconomic level. The median birth weight for the total U.S. sample was 3.32 kilograms (3.36 kilograms for whites alone), while that of the Fels sample was also 3.32 kilograms. The sex-specific medians agreed almost as well: 3.40 kilograms for both Fels and U.S. males and 3.25 and 3.26 kilograms for Fels and U.S. females, respectively. When children with low birth weights (i.e., less than 2,500 grams) were compared, the two samples were, again, very similar: about 7.4 percent of the U.S. sample and about 7.9 percent of the Fels children fell in this category. Interestingly, when the two samples were

(Continued)

adjusted for race and multiple births, with only slightly less than the expected 5 percent of the Fels babies above the U.S. 95th percentile.

Beginning at age 1 year (the earliest point at which there are comparable data from Fels and HES), there is a slight restriction at the extreme percentiles of the Fels data. This restricted distribution is slightly greater for weight and weight by length than it is for length. This slightly augments the restriction of the 90th and 95th percentiles of Fels data of weight by length compared with NCHS data of weight by stature, when appropriately repositioning and adjusting the overlapping charts for the known systematic differences between recumbent length and stature measurements. Some of this disjuncture at the highest percentile is due in part to a Fels sampling bias as well as to inherent problems, especially at these ages, when attempting to compare recumbent length with stature measurements. (This will be discussed further in the text.)

Although there were no technical reasons to doubt the reliability of the head circumference population estimates based on the Fels data, either by evidence of internal inconsistencies of the data or when compared with other available data from highly imperfect samples, the confidence with which these data can be offered is diminished by the fact that there were no other reliable NCHS types of population estimates to which they could be compared at any age. (The NCHS head circumference data available at this time are known to be technically flawed.) Therefore, our confidence cannot be as great for these data as it is for the data on stature by age and the body weight by age percentiles, especially between ages 6 and 18 years when there was almost perfect agreement between the two corresponding sets of NCHS data (HANES and HES), each of which, in itself, provided highly reliable estimates of those population parameters.

(Footnote j continued)
modified to achieve maximum comparability (i.e., U.S. whites against Fels sample adjusted to reflect the U.S. proportion of twinning because the Fels study purposefully had contained an excess of twins), the percentages of low birth weights were almost identical for the United States and Fels (6.3 and 6.4 percent).

In summary, although there is some variation in the degree of confidence in the permanency, the reliability, and present usefulness of the data and the charts as population estimates, there are only three small known exceptions to our claim that these charts represent highly accurate population estimates. First, there is very slight limitation of the variation or heterogeneity of the Fels study participants in body weight. Second, due to this slight sampling restriction and also to some probable biases and technical problems in both measurement of recumbent length and statures, and selection of samples between ages 2 and 3 years, there is a limitation of the 90th and 95th percentile of weight by length, most pronounced at those body lengths corresponding approximately to ages 2 and 3 years. And third, as will be discussed in more detail, there is an upward distortion of the stature-by-age curves between 2 and 3 years because of an unavoidable admixture of recumbent lengths and stature measurements which is most marked nearest to 2 years of age where the upward distortion is approximately 1.5 to 2 centimeters, and it approaches zero distortion at 3 years. The judgment of the NCHS task force was to adhere strictly to a policy of no data adjustments, and to describe deficiencies we knew about, indeed, to bring them clearly to the attention of those who would be using our charts.

Recumbent Length or Stature

The relationship between the two major modes of estimating the linear extent of the long axis of the body—recumbent length measured on a board and stature measured on a stadiometer—is complex. In those few studies in which both measurements were performed on a subject at the same visit, the median recumbent length was usually 1 centimeter to approximately 1½ centimeters greater than was the median of stature. But as Roche and Davila[11] have pointed out, even the median differences are quite study specific. The overall median differences reported in only four separate studies ranged from 0.7 centimeter to 1.7 centimeters. However, the range of median differences was greater and varied by sex and age. The median differences were greatest among the youngest children (2- and 3-year-olds), and tended to be slightly greater among girls and to be less among the fatter and possibly also the tall children at any given age.

The exact reasons why measurements of recumbent length, which momentarily relieves the upright body from gravitational pressure, are approximately 1 to 1.5 centimeters greater than those for stature for most people, are not completely clear. Increase in the intervertebral disk spaces due to relief from gravitational pressure probably requires more recumbent time than the few minutes usually allotted for these kinds of examinations. A large part of the cause is probably not related to this strictly physical-mechanical explanation, but rather to a more dynamically postural one which includes muscle tone and body set. Some of the known sources of variation are sex, age, time of day of measurement, length of time (recumbent versus upright), body size, postural attitude and psychological set of the subject, and the subtle and complex differences between the two techniques as employed by different examiners and in different examination settings.

Because of this complex set of factors and from the examination of median differences, Roche and Davila rightly conclude in their report that directly recording each of the two variables is the ideal.[11] But when only one measurement is available, and when, for the sake of continuity, it is necessary to convert, then a reasonable adjustment can be made in most cases, if there are sufficient sets of dual measurements and a proper analysis of the data *from the same study*. In other words, each study must calibrate its own median differences. Otherwise, the adjustments will be very crude (between 1.5 and 2 centimeters for most of the youngest children and approximately 1 centimeter for most of the adolescents and adults if standard measuring techniques are accurately applied for both sets of measurements).

The situation is actually more complex than the examination of median differences and a cursory look at correlation coefficients would suggest. A preliminary examination of the distribution of the differences between these two examinations by individual subject is even more confusing and warrants a more detailed discussion than is possible here. The differences are startlingly large for a small part of the sample, large enough in these particular subjects to invalidate any conversion from one mode to the other, using a median adjustment, even a study-specific one. In these extreme pairs it is difficult to determine what part is situational (measuring technique and milieu and also the subject's cooperation and behavior), and what part reflects true biologic variation (which could also include some postural deformity). When a series of dual measurements is available on the same subject at repeated visits, it would seem that if only one pair were in the extreme range, then it would most likely be related to the measuring technique. If the difference between recumbent length and stature is consistently large or small in the absence of known structural, postural, or behavioral defects, then it must be concluded that the subject is a true variant, in which case a correction factor that is specific for that individual could be imputed, if necessary, for the missing one of a pair of measurements.

The consideration of these complexities was forced upon us in trying to interpret the significant defect observed when attempting to merge the weight-by-recumbent-length curves with the weight-by-stature curves, after adjusting for a median difference resulting from the two techniques.

As shown in figure 1 after this adjustment was made, the curves for the 5th percentile through the 75th percentile all connected well. However, the 90th and 95th percentiles of weight by recumbent length (Fels data) were substantially lower than the corresponding curves for weight by stature (NCHS data), i.e., the 95th percentile of the weight by recumbent length connected at the 87th percentile of weight by stature. When the set of differences among those Fels children who had both measurements were examined, for those children in the 90th percentile and above in *body weight* as compared to those in the 10th percentile and below, it was found that the average mean difference between the two kinds of measurements was much less among the heavier children (1.2 centimeters

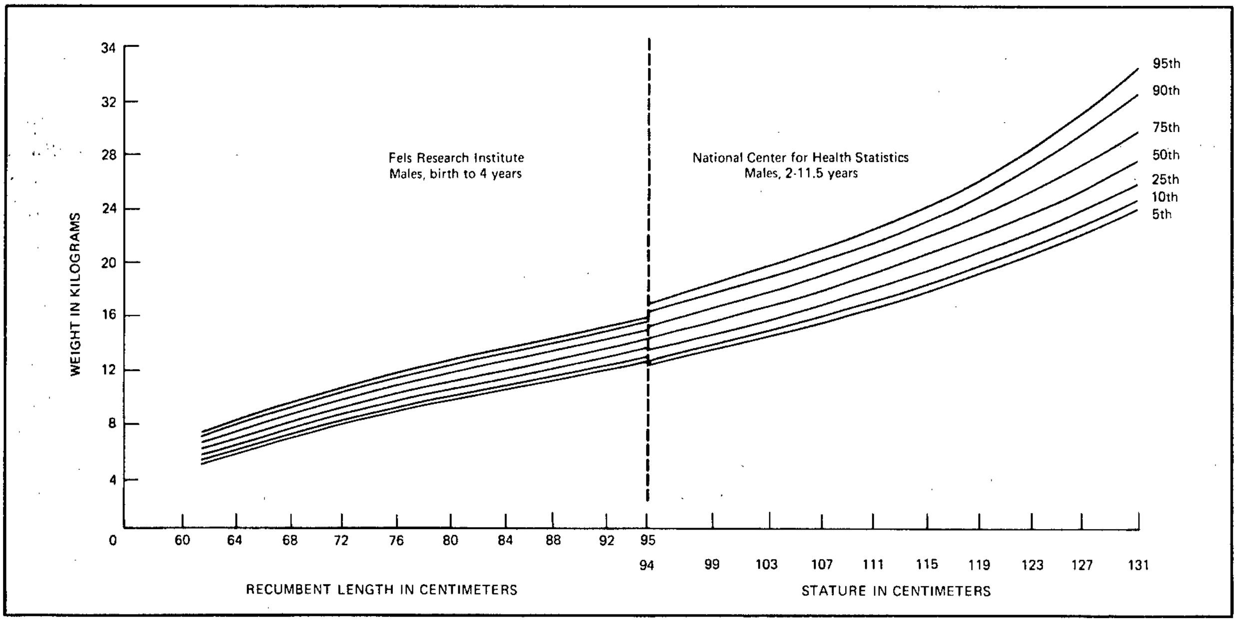


Figure 1. Comparison of selected percentiles of weight for recumbent length with weight for stature, including a 1-centimeter adjustment as a typical median difference between recumbent length and stature: Males, birth-4 years, Fels Research Institute data; males, 2-11.5 years, National Center for Health Statistics data.

versus 1.7 centimeters for the lightest ones). But when plotting the *statures* of these Fels children on to the stature data of comparable HES children, they are found to be very similar. This is paradoxical because it suggests that recumbent length was either consistently underestimated which, in turn, would produce an overestimate of the weight/recumbent length ratio (going in the opposite direction of explaining the observed differences) or that there was sample bias in the distribution of body weight and weight for length in the Fels data (i.e., that there were fewer Fels children who were extremely heavy for their length than would be found in a national sample representative of all regions, socioeconomic levels, and racial and cultural groups).

Further vigorous analysis of these relationships within the Fels and HES data resulted in more confusion than clarity except for one additional fact illustrated in figure 2. When measurements at later ages of the Fels boys are plotted onto the NCHS percentiles (up to 11½ years), for some reason the worst congruence for the Fels 95th percentile of height for stature is at the youngest (or smallest) boys, where the merger would take place (i.e., Fels at the 95th, HES at the 87th); but after statures corresponding to approximately age 3 years the two sets agree much better (Fels 95th, HES 91st-93rd percentile). However, Fels' boys always remain *below* the 95th. Because of insufficient information on Fels data, we stopped searching for an explanation of this poor congruence. Specifically, while the original study design at Fels had the enormous strength to express linear somatic growth in terms of recumbent length from birth to cessation of growth at adulthood, because of its *laissez faire* start in obtaining the correlative stature measurements, the data beg the practical question: How are body size, behavioral maturity, motivation and attitudes, and body proportion (specifically, weight for length) of the various subjects systematically related to the presence or absence and/or the technical quality of stature measurements among the youngest Fels children?

Apparently, a specially designed study will be required for clarification.

If a subject's greatest linear extent were always skillfully measured in the recumbent

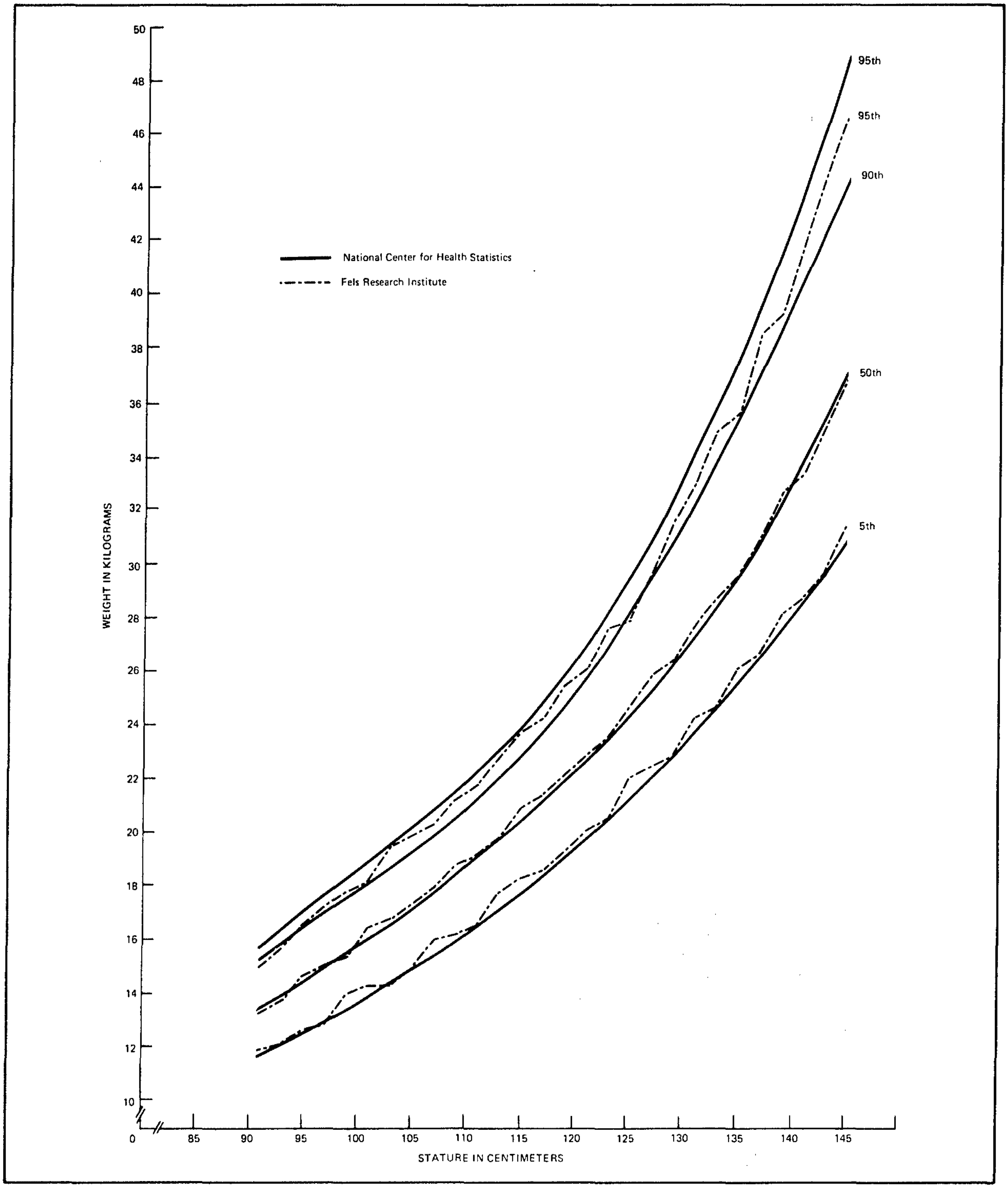


Figure 2. Selected percentiles of weight by stature for prepubescent males: Observed data, Fels Research Institute; smoothed data, National Center for Health Statistics.

position from birth onwards, as was done in the Fels study, these considerations would be academic. Of course, stature (standing height) is the almost universal mode of measuring the linear extent of older children and adults, both in growth studies and in clinical practice. Because infants and most children younger than 2 years cannot stand well enough to allow satisfactory upright measurements, that group must be measured in the recumbent position. If charts were constructed selecting only those children who could stand properly for stature measurements, distorted reference data biased toward the most mature and biggest children (those who could stand upright) would result. In clinical practice and for epidemiologic comparisons (both in interpreting the sets of reference data from which these charts were constructed and then estimating the length or stature of individual young children), the awkward transition period cannot be avoided. Some problems are sure to occur in selecting the measurement technique and interpreting the data; whatever the measurement mode used, the quality of the measurement may be poor. The only approach to the dilemma is to do one's best, aware of the limitations.

Even in the skilled hands of the National Center for Health Statistics, that part of the HANES data that deals with linear measurement of children between the ages of 2 and 3 years is flawed. Over the 3-year period when the HANES data were being collected, several teams of researchers operated in different parts of the United States in three separate caravans of trailers. All had the same set of instructions, but all did not interpret those instructions in identical ways. A measuring board was used by all teams to measure recumbent length of infants between 1 and 2 years of age; all children 3 years of age and older were measured standing upright. However, the instructions required that a *dual* set of measurements (recumbent length *and* stature) be taken on children between 2 and 3 years of age. This was not universally done, and in most cases the mode of measurement for the 2-3-year age group was not recorded. Therefore, we do not know if the linear measurements recorded for that group represent recumbent or stature data. These data have all been treated as *stature,* both in the stature-by-age charts (2-18 years) and the weight-by-stature charts (prepubescent).

On careful reconstruction of the operational records and internal inspection of the HANES data and also by comparing them with data from the Owens study and from the Fels study, with special attention to the relationship of recumbent length-stature measurements, the following conclusion was made about this small subset of HANES data: Nearest age 2 years most of the measurements are recumbent (but selectively biased toward the smallest and least mature children); the proportion of statures increases from age 2 until at age 2.9 years almost all the measurements are probably statures. We deliberated long about this particular segment of data and were tempted to make an exception to our rule of "no adjustments to observed data." Recognizing that adjusting this bit of data would introduce more problems than would be solved (there is a selective bias across the weight and height percentiles, of an unknown magnitude, that would require a differential adjustment at different percentiles), we made no adjustment. Because the body weight estimates are perfectly sound for this age segment, and because it was predicted that the length of many children would be measured standing (more convenient and likely to yield better technical results in all but the most experienced examination centers—assuming the child is able to stand properly), it was judged desirable to include stature percentiles beginning at 2 years of age and to present the data as the best available at the present time with the following caveat: the median is 1.5 to 2 centimeters too large at 2 years of age (i.e., greater than it would have been if all values had actually been stature measurements and if all children were capable of proper stature measurements at that age), but this discrepancy progressively diminishes and disappears at approximately 2.9 years of age.

This is the only known technical defect in all these data. The fact that it occurs at the difficult transition between 2 and 3 years of age (between the recumbent and stature years), where the two sets of charts overlap by age, and where measuring precision is low, somewhat eases the practical impact of the problem.

Curve Smoothing

The NCHS task force decided that appropriately smoothed growth curves not only look better but, if the smoothing process does not distort the basic data, they represent reality better. Although mathematical techniques for systematically smoothing curves (like moving averages or fitting the observations to a Gompertz curve) have been used for many years for a variety of purposes, most growth experts have smoothed their curves by hand to minimize distorting the data by unknown mathematical factors.

Perhaps the chief disadvantage of expert smoothing by hand is that, like all great art, it is not quantifiable and not reproducible. But with the availability of computers and iterative plotting devices, there is the possibility of systematic smoothing with checkpoints against the observed data to see if the final results reasonably represent the data. The goal resembles that of the ideal noise filter for phonograph or radio: to eliminate all of the noise but none of the music—"noise" being those jagged deviations from a smoothed line which are solely due to sampling variation, "music" being a true deflection representing reality (such as the upward inflection of the height-by-age curves in boys just after age 11½ years due to the beginning of the adolescent growth spurt).

Two basic methods of systematic, computerized curve smoothing were considered: (1) spline polynomial smoothing of the observed percentiles and (2) smoothing by means of the Pearson curve system using polynomials in age to estimate the first four moments. The first is a well-documented method readily available for the computer, even though it had never been applied before to growth data and had several limitations which would require adjustment and modification. The primary objection to this system in the beginning was that it, apparently, did not develop any coherent relationship between the different percentile lines. The second system, while very sensitive to the enormous amount of information contained in the median or central tendency, would possibly be oversensitive to outlying values (although many outlying values are valid, this region usually presents the greatest frequency of spurious data); but this method would have required much more developmental work to adapt it for the present purpose than would the more fully developed cubic spline regression technique. It was considered that, without the constraints of time and resources, a third, and better, alternative would probably be to raise the degree of the existing spline polynomial system from cubic to quartic and thus allow a better interrelationship between the percentile lines. Later it was realized that the existing cubic spline technique had another strength: two modes (fixed or variable) of placing the knots. Using the fixed (constant) knot subroutine ultimately gave some degree of parallellism and interrelationship between the percentiles. With much trial and error (feasible with a computer) and testing the resulting fits to see if they reasonably represent the data (only possible with the data plotter), the cubic spline technique was finally employed to the eventual satisfaction of the NCHS task force. A brief description of this spline system, together with a listing of some of its strengths and weaknesses when applied to these kinds of data, and a full discussion of the modifications employed in our application appear in appendix II.

Secular Trend

In the analysis of these data, the marked diminution and near cessation of the trend to constantly increasing size of successive generations of American children is the most dramatic and significant finding relating to human biology and human growth in general. This secular trend to ever-increasing size and earlier maturation (a universal finding among the countries of the western world for the past century that has become a good biologic index of the degree of technological and socioeconomic advance of the developing countries) has been extensively discussed many times.[9,10,26-42]

From his careful comparisons of many generations of incoming Harvard students, Damon in 1968[27] was the first to seriously suggest the cessation, or at least a marked diminution, in this trend in America.

Damon's observations and those of several others[36,43,44] were limited to data from the upper socioeconomic segments of society, where the cessation apparently first occurred. The present findings both confirm those of Damon and extend them to include most segments of the American population.

A small but definite correlation was demonstrated in earlier NCHS data[26] between the body size of children in the United States and the annual income and educational level of their parents. Because the most recent data show a very slight increase in statures in the 5th and 10th percentiles (and possibly even a faint increase at the 25th percentile as well) over that of children born 5 or 10 years earlier and essential stabilization (of statures, at least) for the rest of the population, a firmer statement is now warranted of Damon's speculation, "The end may be in sight."[28]

However, the precise dating of this cessation (which may be either temporary or permanent or may even yield to a reversal) is difficult because there were no data yielding reliable population estimates (such as the present ones) on the growth of children before 1963 on which to make projections. In a detailed analysis comparing that first cycle of HES children[26] with other available data (all of which had varying degrees of sampling limitations), we concluded at that time, from data collected on children born before 1950, that the secular trend, although possibly abating in the United States, had not yet ceased. From the analysis of our current sets of data the congruence (as seen in tables 18-19 between the statures and weights of children from HES Cycles II and III and those from HANES I, born almost 10 years later) is not limited to identical median values but applies to most of the distribution of statures from at least the 25th to the 95th percentiles. Whatever complex of factors had been producing the secular trend to increasing body size of children (and adults) from the prenatal period onward, had ceased to be of sufficient magnitude by 1955 or 1956 to affect these rather sensitive data across most socioeconomic levels of the American population. When the stragglers will finally achieve their genetic potential to full stature can probably be better predicted by economic and social factors than by biologic ones.

REFERENCES

[1]Committee on Nutrition Advisory to CDC, FNB, NAS-NRC: Comparison of body weights and lengths or heights of groups of children. *Nutr. Rev.* 32:284, Mar. 1974.

[2]Owen, G. M.: The assessment and recording of measurements of growth of children: Report of a small conference. *Pediatrics* 51(3):461-466, Mar. 1973.

[3]Roche, A. F., and McKigney, J. I.: Physical growth of ethnic groups comprising the U.S. population. *Am. J. Dis. Child.* 130:62, 1976.

[4]Owen, G. M. et al.: A study of nutritional status of preschool children in the United States, 1968-1970. *Pediatrics* 53:597, 1974.

[5]National Center for Health Statistics: Plan and initial program of the Health Examination Survey. *Vital and Health Statistics.* Series 1-No. 4. DHEW Pub. No. (HRA) 74-1038. Health Resources Administration. Washington. U.S. Government Printing Office, Nov. 1973.

[6]National Center for Health Statistics: Plan, operation, and response results of a program of children's examinations. *Vital and Health Statistics.* PHS Pub. No. 1000-Series 1-No. 5. Public Health Service. Washington, U.S. Government Printing Office, Oct. 1967.

[7]National Center for Health Statistics: Plan and operation of a health examination survey of U.S. youths 12-17 years of age. *Vital and Health Statistics.* Series 1-No. 8. DHEW Pub. No. (HRA) 75-1018. Health Resources Administration. Washington. U.S. Government Printing Office, Sept. 1974.

[8]National Center for Health Statistics: Plan and operation of the Health and Nutrition Examination Survey, United States, 1971-73. *Vital and Health Statistics.* Series 1-No. 10a. DHEW Pub. No. (HSM) 73-1310. Health Services and Mental Health Administration. Washington. U.S. Government Printing Office, Feb. 1973.

[9]National Center for Health Statistics: Height and weight of children, United States. *Vital and Health Statistics.* Series 11-No. 104. DHEW Pub. No. (HRA) 75-1093. Health Resources Administration. Washington. U.S. Government Printing Office, Sept. 1970.

[10]National Center for Health Statistics: Height and weight of youths 12-17 years, United States. *Vital and Health Statistics.* Series 1-No. 124. DHEW Pub. No. (HSM) 73-1606. Health Services and Mental Health Administration. Washington. U.S. Government Printing Office, Jan. 1973.

[11]Roche, A. F., and Davila, G. H.: Differences between recumbent length and stature within individuals. *Growth* 38:313-320, 1974.

[12]Roche, A. F., and Davila, G. H.: Pre-pubertal and post-pubertal growth, in D. B. Cheek, ed., *Fetal and Postnatal Growth–Hormones and Nutrition.* New York. John Wiley and Sons, Inc., 1975. pp. 409-414.

[13]Roche, A. F., and Davila, G.: Late adolescent growth in stature. *Pediatrics* 50:874-880, 1972.

[14]Roche, A. F.: Some aspects of adolescent growth and maturation in H. N. Munroe, and J. I. McKigney, eds., *Nutrient Requirements in Adolescents.* Cambridge, Massachusetts. Massachusetts Institution of Technology Press, 1975. pp. 33-56.

[15]Thissen, D., Bock, R. D., Waynor, H., and Roche, A. F.: Individual growth in stature: A comparison of four United States growth studies. *Ann. Hum. Biol.* 3:529-542, 1976.

[16]National Center for Health Statistics: Preliminary findings of the first Health and Nutrition Examination Survey, United States, 1971-1972, Dietary Intake and Biochemical Findings. DHEW Pub. No. (HRA) 74-1219-1. Health Resources Administration. Washington. U.S. Government Printing Office, Jan. 1974.

[17]DeBoor, C., and Rice, J. R.: *Least Squares Cubic Spline Approximation I-Fixed Knots.* Technical Report No. 20, Computer Science Dept., Purdue University, W. Lafayette, Ind., Apr. 1968.

[18]Tanner, J. M.: Personal communication.

[19]Krogman, W. M.: A handbook of the measurement and interpretation of height and weight in the growing child. *Monogr. Soc. Res. Child Dev.* 13(3), 1950.

[20]Tanner, J. M., Hiernaux, J., and Jarman, S.: Growth and physique studies, in J. S. Weiner and J. A. Lourie, eds., *Human Biology, A Guide to Field Methods.* IBP Handbook #9, Philadelphia. F. A. Davis Co., 1969.

[21]National Center for Health Statistics: Body weight, stature, and sitting height: White and Negro youths 12-17 years, United States. *Vital and Health Statistics.* Series 11-No. 126. DHEW Pub. No. (HRA) 74-1608. Health Resources Administration. Washington. U.S. Government Printing Office, Aug. 1973.

[22]Stuart, H. C., and Meredith, H. V.: Use of body measurements in the school health program. *Am. J. Public Health* 36:1365, 1946.

[23]Tanner, J. M., Whitehouse, R. H., and Takaishi, M.: Standards from birth to maturity for height, weight, height velocity, and weight velocity: British children, 1965. *Arch. Dis. Child.* 4:454, 1966.

[24]Shuttleworth, F. K.: Sexual maturation and the physical growth of girls age six to nineteen. *Monogr. Soc. Res. Child Dev.* 2(5), 1937.

[25]Boas, F.: The growth of children. *Science* 19:256-257, 281-282; 20:351-352, 1892.

[26]National Center for Health Statistics: Height and weight of children: Socioeconomic status, United States. *Vital and Health Statistics.* Series 11-No. 119. DHEW Pub. No. (HSM) 73-1601. Health Services and Mental Health Administration. Washington. U.S. Government Printing Office, Oct. 1972.

[27]Damon, A.: Secular trend in height and weight within old American families at Harvard, 1870-1965. *Am. J. Phys. Anthropol.* 29(1):45-50, 1968.

[28]Damon, A.: Larger body size and earlier menarche: The end may be in sight. *Soc. Biol.* 21(1):8-11, 1974.

[29]Meredith, H. V.: Change in stature and body weight of North American boys during the last 80 years, in L. Lipsitt and C. Spiker, eds., *Advances in Child Development and Behavior,* Vol. 1. New York. Academic Press, 1963. pp. 69-114.

[30]Meredith, H. V.: Findings from Asia, Australia, Europe, and North America on secular change in mean height of children, youths and young adults. *Am. J. Phys. Anthropol.* 44(2):315-326, 1976.

[31]Meredith, H. V., and Meredith, E. M.: The stature of Toronto children half a century ago and today. *Hum. Biol.* 16:126-131, 1944.

[32]Tanner, J. M.: *Growth at Adolescence,* 2d ed. Oxford. Blackwell Scientific Pub., 1962.

[33]Tanner, J. M.: The secular trend towards earlier physical maturation. *Tijdschr. Soc. Geneesk.* 44:524-539, 1966.

[34]Tanner, J. M.: Earlier maturation in man. *Sci. Am.* 218(1):21-27, Jan. 1968.

[35]Tanner, J. M.: Trend toward earlier menarche in London, Oslo, Copenhagen, the Netherlands and Hungary. *Nature* 243:95-96, 1973.

[36]Maresh, M. M.: A forty-five year investigation for secular changes in physical maturation. *Am. J. Phys. Anthropol.* 36(1):103-109, Jan. 1972.

[37]Amundsen, D. W., and Diers, C. J.: The age of menarche in classical Greece and Rome. *Hum. Biol.* 41(1):125-132, Feb. 1969.

[38]Krogman, W. M.: Growth of head, face, trunk, and limbs in Philadelphia white and Negro children of elementary and high school age. *Monogr. Soc. Res. Child Dev.* 35(3) Serial No. 136, 1970.

[39]Van Wieringen, J. C.: *Seculaire Groeiverschuiving: Lengte and Gewicht Surveys 1964-1966 in Netherlands in Historisch Perspectief.* Leiden. Netherlands Institute voor Praeventive Geneeskunde TNO, 1972.

[40]Boas, F.: Observations on growth of children. *Science* 72:44-48, 1930.

[41]Gruelich, W. W.: Some secular changes in the growth of "American born" and native Japanese children. *Am. J. Phys. Anthropol.* 45(3):553-568, 1976.

[42]Kano, K., and Chung, C. S.: Do American born Japanese children still grow faster than native Japanese? *Am. J. Phys. Anthropol.* 43(2):187-194, Sept. 1975.

[43]Garn, S. M.: *Magnitude of Secular Trend in the Fels Population: Stature and Weight.* Private printing. Yellow Springs, Ohio, 1967.

[44]Bakwin, H., and McLaughlin, S. D.: Secular increase in height. Is the end in sight? *Lancet* 2:1195-1196, 1964.

[45]Daniel, C., and Wood, F.: *Fitting Equations to Data.* New York. Wiley-Interscience, 1971.

LIST OF DETAILED TABLES

Table 1. Observed percentiles of recumbent length (in centimeters), by sex and age: Fels Research Institute, birth-20 years

Sex and age	n	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Male		Recumbent length in centimeters						
Birth	156	45.6	47.1	48.6	49.9	51.5	53.3	54.2
1 month	274	51.1	51.7	53.3	54.8	56.2	57.6	58.4
3 months	438	56.2	57.4	59.2	61.2	63.2	64.8	65.8
6 months	425	63.6	64.4	66.1	67.6	69.4	71.1	72.1
9 months	365	68.2	69.3	70.7	72.4	74.2	75.8	76.8
1 year	374	71.7	72.9	74.5	76.2	77.7	80.1	81.4
1½ years	472	77.4	78.5	80.3	82.3	84.3	86.5	88.2
2 years	425	82.3	83.5	85.6	87.7	89.8	92.2	93.5
2½ years	392	87.2	88.4	90.3	92.3	94.7	97.1	99.1
3 years	364	91.1	92.2	94.1	96.5	98.8	101.4	102.9
3½ years	336	94.3	95.3	97.8	100.5	103.3	105.8	107.6
4 years	319	97.9	99.0	101.2	103.6	106.6	109.0	111.2
4½ years	316	100.8	102.3	104.4	107.4	110.1	112.5	114.4
5 years	302	104.0	105.5	108.0	110.9	113.9	116.7	118.9
5½ years	277	107.1	108.9	111.3	114.2	117.6	120.8	122.4
6 years	266	110.1	111.8	114.4	117.4	120.6	123.4	125.8
6½ years	239	113.6	115.2	117.8	120.6	124.3	127.3	129.3
7 years	265	116.2	118.1	120.4	123.6	127.3	130.0	132.1
7½ years	227	118.5	120.9	123.7	126.7	130.7	133.7	135.3
8 years	242	121.2	123.8	126.2	129.5	133.4	136.4	139.1
8½ years	206	124.5	126.6	129.4	132.6	136.6	139.7	142.0
9 years	159	126.6	129.0	131.7	135.2	139.5	142.8	147.2
9½ years	127	129.2	131.5	134.8	137.7	141.4	145.9	149.6
10 years	147	132.2	134.0	137.4	140.4	145.2	147.8	151.3
10½ years	143	135.1	136.2	140.1	142.8	147.6	150.5	154.6
11 years	139	137.3	138.6	142.0	145.6	150.7	154.2	157.3
11½ years	135	139.2	140.9	145.2	148.7	153.5	158.8	162.4
12 years	148	141.7	143.3	147.2	151.0	156.3	161.7	165.2
12½ years	140	144.2	145.9	150.7	154.5	160.1	165.3	168.2
13 years	143	146.4	148.5	153.7	158.3	163.9	170.4	173.0
13½ years	142	149.0	152.9	157.6	162.5	167.4	174.6	178.0
14 years	146	152.9	154.5	161.7	166.1	171.7	178.5	181.5
14½ years	138	154.7	158.1	165.5	170.0	175.2	180.7	184.1
15 years	134	160.2	163.3	168.4	173.9	177.8	183.1	186.1
15½ years	131	163.0	166.2	170.8	176.4	180.2	184.1	187.3
16 years	126	166.1	169.2	173.3	178.4	181.6	185.5	187.7
16½ years	122	167.2	171.0	174.4	180.0	184.0	187.2	188.8
17 years	132	169.3	172.1	175.2	179.7	183.9	187.5	188.6
17½ years	107	170.0	172.3	175.8	180.6	184.2	188.3	189.1
18 years	124	170.5	172.6	176.2	181.1	184.8	188.7	191.7
20 years	84	169.4	172.3	177.2	182.0	185.0	189.3	191.1

NOTE: *n* = sample size.

Table 1. Observed percentiles of recumbent length (in centimers), by sex and age: Fels Research Institute, birth-20 years—Con.

Sex and age	n	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Female		Recumbent length in centimeters						
Birth	142	44.6	46.1	47.6	49.3	50.5	51.7	52.9
1 month	251	49.8	50.6	52.3	53.8	55.1	56.1	56.7
3 months	426	55.1	56.0	57.7	59.6	61.4	62.9	63.7
6 months	409	61.6	62.5	64.1	65.7	67.6	69.2	70.1
9 months	347	66.3	67.2	68.7	70.6	72.5	73.8	74.8
1 year	335	70.1	71.0	72.6	74.4	76.3	78.3	79.2
1½ years	463	75.6	76.8	78.6	80.8	83.0	84.8	86.1
2 years	410	81.4	82.6	84.4	86.5	88.7	90.8	92.1
2½ years	383	86.2	87.2	88.1	91.4	93.7	95.7	96.7
3 years	357	89.8	90.8	93.1	95.5	98.1	99.9	101.6
3½ years	309	93.0	94.2	96.4	99.1	101.6	104.0	105.8
4 years	319	96.4	98.0	99.9	103.0	105.5	108.3	109.8
4½ years	291	99.4	101.4	103.5	106.2	109.2	111.7	113.0
5 years	291	102.5	104.0	107.0	109.8	112.9	115.4	116.8
5½ years	276	106.0	107.5	110.1	112.8	116.1	119.1	121.2
6 years	263	108.8	110.4	113.4	116.4	119.4	122.4	124.9
6½ years	222	112.0	113.5	116.2	119.6	122.6	126.6	128.2
7 years	247	115.6	116.6	119.3	122.4	125.1	129.1	131.4
7½ years	220	117.6	119.2	122.0	125.4	128.6	132.2	135.0
8 years	228	120.7	122.1	125.0	128.2	131.4	135.5	138.3
8½ years	210	123.4	124.7	127.3	130.9	134.1	137.9	141.5
9 years	153	125.6	127.4	129.5	133.8	136.9	140.5	143.9
9½ years	141	128.6	130.0	132.5	136.3	139.4	143.2	147.4
10 years	140	130.9	132.3	135.2	139.6	142.7	147.9	149.8
10½ years	141	133.6	135.0	138.0	142.5	145.8	151.7	154.9
11 years	131	136.2	137.3	140.7	145.0	149.7	155.4	157.6
11½ years	128	138.7	140.3	143.7	148.7	153.9	158.3	161.4
12 years	135	142.4	143.8	148.0	151.8	157.8	161.0	164.9
12½ years	126	146.2	147.5	151.3	155.2	160.7	165.1	169.2
13 years	126	149.6	151.8	155.1	159.3	163.4	167.7	170.5
13½ years	129	152.6	154.4	157.0	161.4	165.3	170.1	172.9
14 years	120	155.1	157.0	159.1	163.0	167.1	171.0	174.0
14½ years	104	156.1	157.9	159.9	165.1	167.4	172.1	175.7
15 years	114	157.2	158.4	160.8	165.9	168.0	173.0	175.4
15½ years	101	158.0	158.9	161.7	165.8	169.6	174.2	176.5
16 years	108	158.3	159.3	162.5	166.5	169.8	173.9	177.1
16½ years	98	159.2	159.9	162.6	166.4	170.6	174.3	176.5
17 years	117	158.6	159.2	162.6	166.5	171.1	175.4	177.6
17½ years	94	158.9	160.1	163.3	166.6	170.6	175.4	177.0
18 years	101	158.4	159.7	163.0	166.7	170.7	174.6	176.0
20 years	73	158.4	159.8	163.2	167.0	170.8	174.5	175.3

NOTE: *n* = sample size.

Table 2. Observed percentiles of weight (in kilograms), by sex and age: Fels Research Institute, birth-20 years

Sex and age	n	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Male		Weight in kilograms						
Birth	300	2.53	2.68	3.06	3.40	3.79	4.12	4.38
1 month	296	3.19	3.50	3.78	4.21	4.66	4.95	5.23
3 months	496	4.38	4.75	5.35	6.01	6.58	7.20	7.42
6 months	458	6.22	6.60	7.17	7.82	8.50	9.07	9.46
9 months	386	7.62	7.98	8.59	9.28	9.92	10.63	10.94
1 year	385	8.38	8.85	9.51	10.10	10.88	11.46	11.98
1½ years	486	9.54	9.88	10.62	11.45	12.32	13.04	13.44
2 years	431	10.33	10.81	11.60	12.57	13.53	14.33	14.79
2½ years	398	11.31	11.74	12.61	13.62	14.62	15.57	16.08
3 years	367	12.20	12.69	13.54	14.61	15.64	16.65	17.35
3½ years	337	13.02	13.46	14.43	15.57	16.82	17.97	18.80
4 years	320	13.66	14.23	15.26	16.55	17.88	19.16	19.82
4½ years	316	14.63	15.21	16.25	17.60	18.83	20.35	21.20
5 years	302	15.37	16.09	17.29	18.70	20.22	21.78	22.77
5½ years	279	16.35	17.11	18.43	19.90	21.71	23.37	24.63
6 years	272	17.56	18.23	19.45	20.84	22.75	24.61	26.17
6½ years	240	18.46	19.20	20.53	22.35	24.04	26.33	28.12
7 years	266	19.33	20.19	21.63	23.54	25.55	28.20	30.09
7½ years	226	20.47	21.40	22.89	25.13	27.28	29.62	32.61
8 years	244	21.40	22.46	24.28	26.30	28.82	32.20	35.45
8½ years	210	22.49	23.57	25.51	28.11	30.95	33.99	36.62
9 years	230	23.54	24.69	26.87	29.31	32.65	35.99	39.37
9½ years	199	24.90	26.26	28.20	30.99	35.02	38.44	42.02
10 years	213	26.09	27.50	29.65	32.96	36.73	40.20	44.35
10½ years	208	27.09	28.71	31.26	34.61	39.46	43.07	46.59
11 years	209	28.74	30.26	32.94	36.90	41.96	48.10	51.18
11½ years	197	29.94	31.48	34.66	38.95	43.97	50.64	54.23
12 years	205	31.21	32.93	36.58	40.37	46.71	53.49	57.68
12½ years	192	32.53	34.80	38.54	43.49	49.40	55.59	61.46
13 years	189	34.61	36.71	40.91	46.74	52.59	60.52	65.54
13½ years	190	36.90	39.33	44.06	49.40	56.82	64.66	70.49
14 years	189	39.27	41.72	47.14	52.93	59.58	66.61	73.54
14½ years	181	42.01	45.54	50.56	56.30	62.85	70.45	78.94
15 years	175	46.15	49.30	54.12	59.87	66.37	72.82	77.25
15½ years	167	50.43	51.89	57.35	62.25	68.64	76.30	80.64
16 years	159	52.28	53.72	59.22	64.93	70.62	78.54	81.75
16½ years	153	54.21	57.07	60.64	66.94	73.95	80.35	83.45
17 years	162	56.02	58.24	62.71	68.30	74.25	79.97	84.30
17½ years	138	55.97	58.55	63.35	69.16	76.16	81.79	89.05
18 years	150	55.87	59.66	64.89	69.85	76.49	84.66	89.49
20 years	90	59.12	60.99	66.12	70.99	78.89	85.99	92.25

NOTE: *n* = sample size.

Table 2. Observed percentiles of weight (in kilograms), by sex and age: Fels Research Institute, birth-20 years—Con.

Sex and age	n	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Female		Weight in kilograms						
Birth	296	2.22	2.53	2.89	3.25	3.60	3.89	3.98
1 month	281	3.08	3.25	3.62	3.97	4.30	4.49	4.81
3 months	482	4.11	4.45	4.86	5.41	5.93	6.44	6.78
6 months	438	5.81	6.10	6.61	7.20	7.80	8.40	8.74
9 months	365	7.10	7.43	7.89	8.54	9.26	9.79	10.11
1 year	350	7.72	8.14	8.81	9.57	10.23	10.91	11.29
1½ years	474	9.01	9.31	10.02	10.78	11.52	12.25	12.72
2 years	412	9.72	10.23	11.14	11.97	12.79	13.66	14.13
2½ years	391	10.90	11.29	12.12	12.93	13.91	14.84	15.41
3 years	357	11.47	12.08	13.01	13.95	15.10	16.01	16.67
3½ years	310	12.17	12.76	13.70	14.90	16.01	17.04	17.71
4 years	322	13.19	13.69	14.66	15.99	17.34	18.46	19.39
4½ years	293	13.96	14.40	15.42	16.81	18.41	19.67	20.39
5 years	291	14.61	15.26	16.41	17.90	19.54	21.24	21.96
5½ years	278	15.49	16.20	17.42	18.99	20.77	22.48	23.51
6 years	264	16.41	17.19	18.58	20.12	22.28	23.69	25.40
6½ years	222	17.40	18.11	19.55	21.42	23.49	25.52	26.97
7 years	247	18.37	19.26	20.61	22.49	24.81	27.44	28.93
7½ years	221	19.50	20.25	21.72	23.76	26.74	29.13	31.94
8 years	231	20.41	21.27	22.98	25.16	28.09	31.27	33.36
8½ years	216	21.40	22.44	24.15	26.63	29.77	33.79	36.79
9 years	218	22.44	23.43	25.46	27.95	31.81	36.05	39.54
9½ years	221	23.80	24.69	26.79	29.85	34.17	39.07	43.64
10 years	215	24.11	25.76	28.32	31.42	36.59	41.16	45.41
10½ years	214	25.53	26.98	29.61	33.82	39.37	44.84	47.64
11 years	201	27.00	28.45	31.29	35.71	42.30	47.31	49.94
11½ years	199	28.42	29.83	33.26	38.46	45.21	51.61	54.02
12 years	201	30.17	31.84	35.91	41.91	48.15	55.18	59.47
12½ years	185	32.41	34.50	37.49	43.34	52.11	57.37	64.37
13 years	183	33.46	36.29	40.75	46.45	54.08	61.24	64.61
13½ years	184	36.10	39.07	43.62	48.99	55.44	62.79	67.94
14 years	172	39.14	41.15	45.27	50.74	56.59	64.40	69.79
14½ years	152	41.02	42.59	46.59	51.27	58.20	65.40	70.20
15 years	158	43.11	44.16	48.58	52.85	58.37	65.05	71.69
15½ years	141	43.05	45.22	48.87	53.54	59.62	65.94	69.94
16 years	147	43.45	45.23	48.93	53.85	59.06	66.64	70.82
16½ years	134	43.92	46.20	50.07	54.49	60.12	65.92	70.82
17 years	151	44.88	46.36	50.54	55.05	60.45	66.63	71.81
17½ years	118	43.97	46.40	50.12	54.99	61.08	67.73	69.81
18 years	125	45.06	46.82	51.04	55.64	61.37	68.16	72.37
20 years	77	45.92	47.56	52.08	56.49	62.87	69.15	73.15

NOTE: *n* = sample size.

Table 3. Observed percentiles of stature (in centimeters), by sex and age: Fels Research Insitute, 2-20 years

Sex and age	*n*	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Male		Stature in centimeters						
2 years	29	81.2	81.9	84.2	85.6	87.8	92.0	92.7
2½ years	86	85.1	85.8	88.8	91.4	93.3	96.3	97.8
3 years	262	89.7	90.7	93.1	95.4	97.5	100.3	101.9
3½ years	288	92.5	94.0	96.3	99.1	101.7	104.4	106.2
4 years	293	96.3	97.6	99.7	102.3	105.1	107.7	109.8
4½ years	295	99.4	101.2	103.3	105.7	108.7	111.5	113.6
5 years	297	102.9	104.1	106.7	109.3	112.6	115.2	117.6
5½ years	274	105.6	107.4	109.8	112.7	116.1	118.8	121.4
6 years	271	109.1	110.7	113.2	116.1	119.5	123.1	124.8
6½ years	238	112.1	114.0	116.3	119.3	122.7	125.8	127.8
7 years	268	115.1	116.6	119.4	122.4	125.8	128.7	131.1
7½ years	227	117.8	119.6	122.5	125.9	129.3	132.7	134.7
8 years	244	120.4	122.5	125.2	128.3	132.4	135.5	138.2
8½ years	211	123.5	125.2	128.3	131.6	135.1	138.4	141.2
9 years	230	126.1	127.9	131.2	134.3	138.2	141.7	144.5
9½ years	199	128.9	130.5	134.0	137.3	140.8	144.3	146.6
10 years	213	131.3	133.1	136.5	139.8	143.7	147.2	149.7
10½ years	208	134.1	135.4	139.1	142.3	146.6	149.7	152.8
11 years	209	136.1	137.7	141.8	144.9	149.0	152.5	156.0
11½ years	197	138.3	139.9	144.2	147.5	151.8	155.4	159.1
12 years	205	140.6	141.9	146.3	150.3	154.6	158.4	162.6
12½ years	192	143.1	145.0	149.3	153.4	158.2	162.9	166.7
13 years	191	145.4	147.5	152.7	157.0	161.7	168.8	171.3
13½ years	190	148.4	150.9	156.3	160.5	165.9	172.4	175.5
14 years	189	151.7	153.7	160.0	164.7	170.1	176.0	178.8
14½ years	181	153.6	157.0	163.7	168.6	173.6	178.4	181.9
15 years	175	159.5	162.1	167.1	171.7	175.8	181.5	184.1
15½ years	167	162.5	165.2	169.3	174.5	178.2	181.7	185.2
16 years	159	164.9	167.6	171.3	176.3	179.4	183.6	185.5
16½ years	152	166.7	169.0	172.5	177.4	180.9	184.9	187.2
17 years	163	168.0	169.6	173.2	177.5	181.6	185.6	187.4
17½ years	134	169.1	170.3	173.9	178.8	182.2	186.2	188.1
18 years	149	168.3	170.3	174.4	179.0	182.4	186.7	188.3
20 years	92	168.5	170.1	175.2	180.1	183.4	186.8	189,6

NOTE: *n* = sample size.

Table 3. Observed percentiles of stature (in centimeters), by sex and age: Fels Research Institute, 2-20 years—Con.

Sex and age	n	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Female		Stature in centimeters						
2 years	26	81.6	82.5	85.2	87.2	89.2	89.8	90.6
2½ years	107	84.6	85.6	88.2	90.4	92.4	94.6	95.8
3 years	248	89.0	90.2	92.2	94.5	96.8	99.2	100.2
3½ years	255	92.4	93.5	95.5	98.0	100.4	102.9	104.5
4 years	289	95.1	96.6	99.1	101.8	104.3	106.7	108.4
4½ years	277	98.1	99.5	102.1	105.1	107.6	110.4	112.0
5 years	286	101.4	103.3	105.7	108.5	111.6	114.3	115.9
5½ years	270	104.7	106.3	109.1	111.5	114.6	117.6	119.6
6 years	265	107.7	109.2	112.2	115.1	118.3	120.8	123.8
6½ years	222	110.7	112.3	115.2	118.2	121.2	125.1	127.4
7 years	248	114.0	115.4	117.9	121.3	124.3	127.7	130.4
7½ years	221	116.6	118.1	120.9	124.4	127.2	131.3	133.6
8 years	232	119.3	121.0	123.8	127.1	130.2	134.4	137.3
8½ years	216	122.2	123.5	126.4	130.0	133.3	137.1	140.8
9 years	219	125.1	126.4	129.3	132.6	136.0	140.6	143.6
9½ years	221	127.7	129.2	131.9	135.8	138.8	144.1	146.6
10 years	216	129.4	131.3	134.5	138.5	142.1	147.3	150.3
10½ years	214	131.9	133.7	137.1	141.1	145.3	151.8	154.0
11 years	201	134.7	136.2	140.2	144.1	148.8	154.9	157.9
11½ years	199	137.4	139.2	143.3	147.5	153.0	159.5	162.0
12 years	202	140.6	142.4	147.1	151.1	156.3	162.6	164.4
12½ years	186	143.5	145.5	149.8	154.4	159.1	164.2	167.6
13 years	184	146.7	149.1	153.6	157.4	161.5	165.8	169.8
13½ years	185	149.6	152.2	155.6	159.4	163.3	167.8	170.8
14 years	173	152.8	154.4	157.3	161.2	164.4	168.8	171.4
14½ years	152	153.7	156.1	158.2	162.1	165.3	168.9	172.4
15 years	159	154.9	156.9	159.1	163.0	166.5	171.0	173.0
15½ years	142	156.2	157.4	159.7	163.5	167.2	170.8	173.9
16 years	147	156.3	157.5	160.4	164.0	167.5	170.8	173.7
16½ years	134	157.1	158.1	160.6	164.3	168.2	171.5	174.1
17 years	155	156.2	157.4	160.5	164.3	168.3	172.7	175.1
17½ years	119	156.7	157.9	160.9	164.3	168.4	172.5	175.0
18 years	126	157.1	158.3	160.6	166.4	168.2	171.7	172.9
20 years	79	156.6	157.9	161.4	165.4	168.5	172.0	175.0

NOTE: n = sample size.

Table 4. Observed percentiles of head circumference (in centimeters), by sex and age: Fels Research Institute, birth-7 years

Sex and age	n	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Male		Head circumference in centimeters						
Birth	155	32.2	32.6	33.6	34.6	35.5	36.4	37.2
1 month	276	35.2	35.7	36.4	37.3	38.2	39.2	39.6
3 months	436	38.2	38.7	39.6	40.6	41.6	42.5	43.1
6 months	421	41.6	42.0	42.8	43.7	44.7	45.6	46.2
9 months	362	43.6	44.1	44.9	45.8	46.7	47.4	48.0
1 year	366	44.7	45.2	46.1	47.1	47.8	48.8	49.3
1½ years	459	46.2	46.7	47.4	48.3	49.3	50.2	50.6
2 years	415	47.2	47.7	48.3	49.2	50.2	50.9	51.3
2½ years	332	48.1	48.5	49.2	50.0	51.1	51.8	52.3
3 years	240	48.5	48.8	49.6	50.4	51.4	52.2	52.7
3½ years	202	48.9	49.2	50.0	50.9	51.9	52.7	53.3
4 years	185	49.3	49.6	50.1	51.0	52.1	53.0	53.2
4½ years	181	49.5	50.0	50.4	51.4	52.5	53.4	54.1
5 years	158	49.7	50.0	50.6	51.7	52.6	53.6	54.1
5½ years	134	50.0	50.4	51.2	52.0	53.0	53.9	54.5
6 years	138	50.2	50.5	51.2	52.2	53.2	54.0	55.3
6½ years	48	50.5	50.6	51.5	52.5	53.3	54.0	54.2
7 years	130	50.6	50.7	51.6	52.5	53.4	54.2	54.6
Female								
Birth	145	31.5	32.4	33.2	34.1	34.7	35.6	35.9
1 month	243	34.6	35.1	35.8	36.5	37.2	37.8	38.3
3 months	405	37.1	37.7	38.6	39.5	40.4	41.2	41.7
6 months	398	40.4	40.8	41.6	42.4	43.3	44.2	44.6
9 months	341	42.3	43.0	43.6	44.4	45.2	46.0	46.3
1 year	320	43.5	44.1	44.8	45.6	46.4	47.2	47.7
1½ years	439	45.0	45.5	46.2	47.1	47.8	48.2	49.1
2 years	395	46.1	46.6	47.3	48.1	48.8	49.6	50.2
2½ years	332	47.0	47.3	47.9	48.7	49.5	50.3	50.8
3 years	226	47.6	47.9	48.6	49.3	49.9	50.8	51.4
3½ years	177	47.9	48.4	48.8	49.6	50.5	51.2	51.8
4 years	178	48.0	48.5	49.0	50.0	50.8	51.6	52.2
4½ years	157	48.4	48.9	49.5	50.3	51.0	51.9	52.5
5 years	148	48.6	49.0	49.6	50.5	51.4	52.0	52.6
5½ years	129	48.8	49.4	50.0	50.9	51.8	52.4	53.2
6 years	130	49.0	49.5	50.1	51.2	52.0	52.8	53.5
6½ years	51	48.9	49.5	50.1	51.4	51.8	52.8	53.2
7 years	123	49.4	49.7	50.5	51.6	52.3	53.4	54.2

NOTE: n = sample size.

Table 5. Observed percentiles of weight (in kilograms), by sex and recumbent length (in centimeters): Fels Research Institute, birth-48 months

Sex and recumbent length	n	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Male		Weight in kilograms						
48-50 centimeters	59	*	*	2.87	3.20	3.54	*	*
50-52 centimeters	74	*	*	3.24	3.53	3.82	*	*
52-54 centimeters	92	*	*	3.37	3.78	4.33	*	*
54-56 centimeters	123	3.60	3.71	4.03	4.37	4.71	4.92	4.99
56-58 centimeters	96	3.75	4.06	4.30	4.70	5.24	5.73	5.89
58-60 centimeters	113	4.24	4.45	5.03	5.45	5.87	6.51	6.84
60-62 centimeters	128	5.02	5.14	5.47	6.03	6.58	6.91	7.11
62-64 centimeters	120	5.33	5.73	6.18	6.55	6.93	7.56	7.82
64-66 centimeters	123	6.08	6.20	6.57	7.14	7.61	7.89	7.99
66-68 centimeters	166	6.58	6.85	7.23	7.68	8.27	8.78	8.94
68-70 centimeters	156	7.04	7.17	7.54	8.16	8.72	9.24	9.67
70-72 centimeters	169	8.01	8.10	8.38	8.85	9.47	9.87	10.04
72-74 centimeters	184	8.07	8.26	8.84	9.41	9.89	10.53	10.80
74-76 centimeters	192	8.34	8.72	9.23	9.72	10.42	10.97	11.55
76-78 centimeters	172	9.09	9.25	9.73	10.36	10.89	11.59	11.87
78-80 centimeters	140	9.31	9.53	10.11	10.66	11.32	11.81	11.97
80-82 centimeters	153	9.75	10.07	10.45	11.11	11.87	12.55	12.80
82-84 centimeters	172	10.07	10.25	10.78	11.49	12.23	12.82	13.15
84-86 centimeters	153	10.36	10.72	11.29	11.93	12.80	13.54	13.82
86-88 centimeters	165	11.00	11.16	11.63	12.34	12.97	13.65	13.87
88-90 centimeters	169	11.18	11.41	12.07	12.72	13.48	13.97	14.50
90-92 centimeters	186	11.59	12.06	12.51	13.23	13.87	14.56	14.84
92-94 centimeters	174	12.09	12.36	13.09	13.72	14.42	14.86	15.14
94-96 centimeters	178	12.43	12.98	13.39	14.07	14.83	15.53	15.81
96-98 centimeters	177	13.09	13.39	14.12	14.74	15.50	16.02	16.60
98-100 centimeters	168	13.31	13.80	14.47	15.27	15.91	16.69	16.98
100-102 centimeters	154	13.95	14.32	15.12	15.73	16.59	17.40	17.80
102-104 centimeters	121	14.22	14.56	15.48	16.42	17.15	17.87	18.23
Female								
48-50 centimeters	68	*	*	3.02	3.30	3.58	*	*
50-52 centimeters	79	*	*	3.24	3.52	3.81	*	*
52-54 centimeters	96	*	*	3.62	3.95	4.43	*	*
54-56 centimeters	122	3.54	3.62	3.88	4.28	4.66	4.89	4.96
56-58 centimeters	104	4.02	4.09	4.32	4.70	5.19	5.69	5.86
58-60 centimeters	123	4.10	4.31	4.92	5.35	5.73	5.96	6.42
60-62 centimeters	139	5.01	5.09	5.33	5.72	6.27	6.78	6.94
62-64 centimeters	132	5.15	5.34	5.88	6.37	6.80	7.19	7.46
64-66 centimeters	147	6.02	6.13	6.48	7.05	7.58	7.89	8.03
66-68 centimeters	151	6.25	6.54	7.13	7.56	8.03	8.66	8.86
68-70 centimeters	163	7.02	7.14	7.51	8.13	8.67	9.04	9.55
70-72 centimeters	160	7.42	7.61	8.10	8.59	9.18	9.72	9.90
72-74 centimeters	175	7.73	8.10	8.56	9.21	9.67	9.95	10.43
74-76 centimeters	157	8.17	8.39	9.03	9.54	10.13	10.78	11.01
76-78 centimeters	129	8.73	9.09	9.46	10.07	10.60	10.91	11.19
78-80 centimeters	136	9.04	9.20	9.67	10.34	10.91	11.61	11.88
80-82 centimeters	147	9.20	9.48	10.14	10.74	11.42	11.86	12.06
82-84 centimeters	142	9.84	10.11	10.54	11.21	11.79	12.48	12.87
84-86 centimeters	155	9.97	10.29	11.06	11.53	12.03	12.67	12.89
86-88 centimeters	164	10.41	10.95	11.37	12.02	12.68	13.29	13.72
88-90 centimeters	163	10.76	11.15	11.74	12.38	12.89	13.59	13.88
90-92 centimeters	162	11.20	11.60	12.22	12.76	13.51	14.12	14.65
92-94 centimeters	194	11.54	12.04	12.54	13.29	13.92	14.63	14.89
94-96 centimeters	176	12.07	12.44	13.16	13.72	14.45	14.96	15.48
96-98 centimeters	162	12.37	13.03	13.59	14.37	15.04	15.75	15.99
98-100 centimeters	160	13.07	13.37	14.12	14.82	15.65	16.44	16.88
100-102 centimeters	130	14.02	14.24	14.90	15.58	16.37	16.99	17.54
102-104 centimeters	*	*	*	*	*	*	*	*

NOTE: *n* = sample size.

Table 6. Observed percentiles of stature (in centimeters), by sex and age: National Center for Health Statistics, 2-24 years

Sex and age	N[1]	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Male		Stature in centimeters						
2.00-2.25 years	419	82.6	83.5	86.1	87.8	90.3	91.9	97.3
2.25-2.75 years	945	86.1	87.0	89.0	91.2	93.8	97.3	98.3
2.75-3.25 years	785	88.9	90.5	92.4	95.1	97.2	100.1	101.2
3.25-3.75 years	857	92.1	93.3	95.7	98.2	101.1	102.8	104.4
3.75-4.25 years	856	96.2	97.3	100.0	102.6	105.3	107.5	110.8
4.25-4.75 years	937	98.0	100.2	103.4	105.8	108.6	111.8	113.2
4.75-5.25 years	874	100.7	103.2	105.5	108.8	112.4	115.4	116.5
5.25-5.75 years	878	106.2	107.7	110.1	113.5	116.1	118.2	119.5
5.75-6.25 years	908	108.5	110.1	112.8	117.0	119.4	122.2	123.1
6.25-6.75 years	1,033	108.9	110.0	114.8	118.2	121.9	125.0	127.1
6.75-7.25 years	988	114.1	115.6	118.5	122.3	125.9	128.3	129.8
7.25-7.75 years	1,120	115.6	118.3	120.8	124.5	127.9	131.4	133.4
7.75-8.25 years	1,014	119.3	121.0	123.8	127.9	131.7	134.9	138.0
8.25-8.75 years	902	121.2	123.4	126.2	129.6	133.2	136.4	138.8
8.75-9.25 years	943	121.1	124.5	127.5	132.8	136.3	139.4	141.9
9.25-9.75 years	958	125.2	127.7	131.2	135.0	138.7	142.7	144.7
9.75-10.25 years	1,030	127.3	130.0	133.7	138.6	142.1	145.9	149.0
10.25-10.75 years	1,070	130.5	132.5	135.8	139.4	144.1	148.4	151.4
10.75-11.25 years	1,052	132.5	135.3	138.7	143.5	147.9	151.4	154.0
11.25-11.75 years	952	135.1	138.0	141.4	145.8	150.8	154.5	156.1
11.75-12.25 years	1,010	138.5	140.1	144.1	148.6	153.7	159.4	162.6
12.25-12.75 years	1,092	139.3	141.8	146.4	152.1	157.2	162.6	165.5
12.75-13.25 years	1,155	142.2	144.8	149.7	154.8	159.6	165.3	167.8
13.25-13.75 years	1,056	145.6	148.6	153.6	160.0	166.5	172.2	175.5
13.75-14.25 years	954	149.2	153.0	157.7	164.4	169.9	175.1	177.6
14.25-14.75 years	1,019	152.9	156.4	161.1	167.6	173.1	177.8	179.4
14.75-15.25 years	1,112	155.0	157.6	163.0	169.4	173.8	178.2	181.8
15.25-15.75 years	914	158.8	161.4	166.6	171.6	175.4	180.4	183.4
15.75-16.25 years	1,051	160.5	164.3	169.0	173.5	177.8	181.5	185.8
16.25-16.75 years	876	163.8	165.5	170.6	174.9	179.5	183.3	186.4
16.75-17.25 years	1,054	164.4	166.2	170.7	176.8	181.8	184.6	187.3
17.25-17.75 years	935	163.3	167.7	172.1	176.4	181.0	185.0	187.8
17.75-18.25 years	866	166.5	170.1	173.1	176.0	180.2	186.1	187.3
18.25-19.00 years	1,067	166.8	169.3	172.0	175.8	180.1	185.9	186.8
19.00-20.00 years	1,770	162.8	166.9	171.6	177.2	180.8	185.0	186.2
20.00-21.00 years	1,668	159.4	168.4	172.2	177.4	181.2	183.6	185.8
21.00-22.00 years	1,703	166.2	168.3	172.5	177.3	181.1	184.8	190.0
22.00-23.00 years	1,662	167.2	167.7	171.3	177.1	180.6	187.1	192.0
23.00-24.00 years	1,589	161.3	165.3	172.3	176.8	183.0	188.5	189.2
24.00-25.00 years	1,595	165.4	168.5	172.9	178.1	183.0	186.7	189.5

[1]Sample size expressed in thousands. The *N*'s of those cells containing subjects from both HANES I and HES II or HES III have been cut in half to maintain representativeness.

Table 6. Observed percentiles of stature (in centimeters), by sex and age: National Center for Health Statistics, 2-24 years—Con.

Sex and age	N^1	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Female		Stature in centimeters						
2.00-2.25 years	440	81.3	82.5	84.6	86.8	89.9	93.6	94.6
2.25-2.75 years	972	84.2	85.3	87.1	90.3	93.4	94.8	96.4
2.75-3.25 years	622	90.2	90.7	92.7	95.3	96.7	99.1	100.6
3.25-3.75 years	887	91.8	92.8	95.0	97.4	99.8	102.1	103.6
3.75-4.25 years	775	94.8	96.2	97.9	100.5	103.8	106.0	108.2
4.25-4.75 years	848	96.8	97.6	100.5	103.8	106.2	109.4	112.0
4.75-5.25 years	876	99.1	101.1	105.2	108.1	111.6	113.7	114.7
5.25-5.75 years	890	103.8	106.1	108.4	111.8	115.5	118.7	121.3
5.75-6.25 years	866	107.1	109.0	111.9	115.4	118.8	122.1	124.6
6.25-6.75 years	1,025	109.3	111.6	114.3	117.7	121.7	125.2	126.9
6.75-7.25 years	945	111.7	113.2	117.4	120.8	124.3	126.8	128.6
7.25-7.75 years	952	115.8	117.2	120.0	123.7	127.9	131.7	134.2
7.75-8.25 years	1,004	117.8	119.5	122.8	127.5	130.6	132.9	134.6
8.25-8.75 years	968	118.9	121.4	124.4	129.2	133.4	135.8	138.0
8.75-9.25 years	988	122.2	124.8	128.4	132.7	137.7	141.0	142.3
9.25-9.75 years	885	126.6	127.6	131.1	135.1	139.8	144.4	147.6
9.75-10.25 years	1,092	129.0	130.3	134.4	138.5	143.0	147.0	149.8
10.25-10.75 years	1,086	129.4	131.1	135.2	140.6	144.7	149.8	152.4
10.75-11.25 years	870	132.1	134.8	139.5	143.9	148.8	153.7	157.0
11.25-11.75 years	862	134.5	135.8	141.7	147.3	152.6	157.1	158.8
11.75-12.25 years	1,082	139.4	142.2	146.7	151.8	156.4	161.4	165.9
12.25-12.75 years	1,019	141.7	145.9	150.8	154.8	159.7	164.0	165.7
12.75-13.25 years	1,058	143.7	147.7	153.0	157.5	161.4	165.5	167.4
13.25-13.75 years	1,120	149.4	151.6	155.4	159.6	163.8	165.9	169.2
13.75-14.25 years	1,080	149.8	151.6	155.7	160.0	163.4	167.1	168.7
14.25-14.75 years	951	150.3	153.2	157.4	161.6	165.4	169.5	171.1
14.75-15.25 years	1,012	151.5	153.3	157.2	161.2	166.3	171.2	174.9
15.25-15.75 years	980	152.6	154.8	157.9	162.9	167.6	172.1	176.2
15.75-16.25 years	959	152.5	154.8	158.2	163.6	167.7	170.7	172.3
16.25-16.75 years	836	150.7	153.3	157.6	162.1	166.5	171.5	172.6
16.75-17.25 years	1,108	151.8	154.6	158.0	161.8	166.5	171.6	173.8
17.25-17.75 years	810	150.7	154.3	158.0	162.6	166.6	170.0	172.5
17.75-18.25 years	826	152.2	155.5	159.8	163.9	168.0	171.0	171.8
18.25-19.00 years	1,420	154.9	157.8	161.2	165.3	167.2	172.4	174.2
19.00-20.00 years	1,384	155.0	155.9	159.9	163.0	166.8	170.6	173.1
20.00-21.00 years	1,771	152.3	155.1	159.0	163.2	168.8	172.4	175.3
21.00-22.00 years	1,818	152.0	154.6	158.5	162.5	167.0	170.8	173.0
22.00-23.00 years	1,734	150.4	153.0	156.9	162.8	167.2	171.2	174.5
23.00-24.00 years	1,800	154.2	156.0	158.6	163.1	166.8	170.5	172.6
24.00-25.00 years	1,796	152.3	155.4	158.3	162.3	167.4	170.4	171.6

[1]Sample size expressed in thousands. The N's of those cells containing subjects from both HANES I and HES II or HES III have been cut in half to maintain representativeness.

Table 7. Observed percentiles of weight (in kilograms), by sex and age: National Center for Health Statistics, 2-24 years

Sex and age	N[1]	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Male		Weight in kilograms						
2.00-2.25 years	419	9.97	11.10	11.63	12.67	14.05	14.85	15.47
2.25-2.75 years	945	11.31	11.89	12.63	13.53	14.57	15.69	16.80
2.75-3.25 years	785	12.28	12.84	13.55	14.43	15.34	16.39	17.37
3.25-3.75 years	857	12.70	13.34	14.33	15.39	16.46	17.77	18.63
3.75-4.25 years	856	13.83	14.70	15.46	16.64	17.85	18.87	20.62
4.25-4.75 years	937	14.42	15.09	16.02	17.71	19.17	20.45	21.51
4.75-5.25 years	874	14.99	15.52	16.91	18.47	20.22	21.02	22.59
5.25-5.75 years	878	17.01	17.31	18.33	19.88	21.39	23.21	25.32
5.75-6.25 years	908	16.87	17.80	19.53	21.21	22.85	24.98	26.40
6.25-6.75 years	1,033	17.21	17.82	19.70	21.59	23.41	26.21	28.18
6.75-7.25 years	992	18.59	19.39	21.37	22.93	25.22	28.74	30.72
7.25-7.75 years	1,120	18.76	20.07	22.04	24.33	26.48	29.08	32.31
7.75-8.25 years	1,014	20.20	21.47	23.47	25.65	28.70	31.36	35.15
8.25-8.75 years	902	21.71	22.63	24.35	26.31	29.27	33.08	34.96
8.75-9.25 years	943	22.01	22.98	25.13	27.89	31.75	36.62	40.23
9.25-9.75 years	958	23.11	24.30	26.40	29.65	33.63	38.58	45.67
9.75-10.25 years	1,030	24.40	25.63	27.98	31.83	36.09	41.08	43.69
10.25-10.75 years	1,070	26.09	27.73	29.49	32.57	36.39	40.75	45.66
10.75-11.25 years	1,052	27.98	28.79	31.23	35.86	39.68	44.71	51.83
11.25-11.75 years	952	28.17	30.14	34.07	37.48	41.94	47.16	52.45
11.75-12.25 years	1,010	30.10	31.18	34.21	38.75	46.43	55.24	62.43
12.25-12.75 years	1,092	31.72	32.98	36.18	41.98	47.30	54.05	58.45
12.75-13.25 years	1,155	32.17	34.61	38.43	43.62	50.17	59.22	64.29
13.25-13.75 years	1,056	36.24	37.80	42.92	49.23	58.38	63.44	68.39
13.75-14.25 years	954	38.25	41.47	46.98	51.65	60.77	67.04	76.61
14.25-14.75 years	1,019	40.52	43.64	49.70	55.32	62.62	72.69	77.03
14.75-15.25 years	1,112	42.14	44.93	50.35	56.35	63.63	71.27	76.91
15.25-15.75 years	914	46.26	49.12	54.29	58.92	66.68	75.40	81.81
15.75-16.25 years	1,051	46.83	51.29	55.79	61.74	69.33	76.78	86.07
16.25-16.75 years	876	50.46	53.22	56.77	64.71	72.28	81.62	87.57
16.75-17.25 years	1,054	52.15	55.42	60.65	65.90	73.76	81.72	91.23
17.25-17.75 years	935	51.80	55.53	60.81	66.64	75.36	83.35	92.16
17.75-18.25 years	866	54.76	58.18	62.04	68.96	75.49	88.36	94.71
18.25-19.00 years	1,067	54.96	60.35	63.62	69.88	78.67	92.66	99.60
19.00-20.00 years	1,770	55.40	57.38	65.91	70.66	76.43	87.01	96.48
20.00-21.00 years	1,668	55.86	57.71	65.04	71.89	78.44	88.86	94.84
21.00-22.00 years	1,703	52.66	58.17	65.29	72.12	80.96	89.04	96.13
22.00-23.00 years	1,662	55.02	59.14	65.09	71.77	79.66	90.57	96.93
23.00-24.00 years	1,589	59.16	60.69	65.54	74.71	82.44	94.05	105.35
24.00-25.00 years	1,595	60.87	63.96	67.96	79.37	85.69	97.60	103.19

[1]Sample size expressed in thousands. The N's of those cells containing subjects from both HANES I and HES II or HES III have been cut in half to maintain representativeness.

Table 7. Observed percentiles of weight (in kilograms), by sex and age: National Center for Health Statistics, 2-24 years—Con.

Sex and age	N^1	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Female		Weight in kilograms						
2.00-2.25 years	440	10.06	10.66	11.41	12.21	12.86	13.84	14.57
2.25-2.75 years	972	10.77	11.20	11.98	12.76	13.94	14.74	15.09
2.75-3.25 years	622	12.14	12.40	13.12	13.93	15.61	16.84	17.74
3.25-3.75 years	887	12.29	13.03	13.58	14.60	15.93	17.54	18.28
3.75-4.25 years	775	13.13	13.63	14.51	15.68	17.15	18.22	18.94
4.25-4.75 years	848	13.45	14.05	15.04	16.57	17.78	19.35	20.26
4.75-5.25 years	876	14.33	15.21	16.48	17.73	19.66	21.23	22.10
5.25-5.75 years	890	15.18	16.20	17.47	18.92	20.96	23.44	25.01
5.75-6.25 years	866	15.99	17.09	18.21	20.19	22.39	24.88	28.71
6.25-6.75 years	1,025	17.02	17.71	19.24	21.06	23.55	26.17	27.89
6.75-7.25 years	945	17.86	18.74	20.20	22.13	23.98	26.91	29.58
7.25-7.75 years	952	18.84	19.60	21.33	23.72	26.54	29.61	31.55
7.75-8.25 years	1,004	20.11	20.79	22.49	24.89	27.73	32.63	35.20
8.25-8.75 years	968	20.47	21.50	23.30	26.39	29.69	33.65	36.45
8.75-9.25 years	988	22.20	23.17	25.27	28.79	33.40	39.66	42.69
9.25-9.75 years	885	23.29	24.72	26.92	30.26	34.54	39.87	43.62
9.75-10.25 years	1,092	24.34	25.25	28.03	31.68	36.38	43.16	45.92
10.25-10.75 years	1,086	25.28	26.69	29.42	33.00	37.63	45.90	48.37
10.75-11.25 years	870	26.73	28.32	32.09	36.13	42.27	47.72	54.49
11.25-11.75 years	862	27.44	29.45	32.88	37.97	44.38	50.77	58.09
11.75-12.25 years	1,082	29.72	32.74	36.42	41.70	48.78	57.77	64.79
12.25-12.75 years	1,019	32.59	34.97	39.46	45.37	51.40	58.10	63.21
12.75-13.25 years	1,058	34.21	37.17	41.44	47.06	54.79	62.20	66.61
13.25-13.75 years	1,120	37.72	39.45	45.00	50.30	56.81	67.05	75.78
13.75-14.25 years	1,080	37.74	39.86	44.86	50.22	56.44	66.44	74.70
14.25-14.75 years	951	40.77	42.96	47.21	53.03	60.95	68.88	78.43
14.75-15.25 years	1,012	41.14	43.65	47.48	53.29	59.72	71.57	75.36
15.25-15.75 years	980	42.99	46.11	48.98	55.25	60.80	71.45	77.78
15.75-16.25 years	959	43.64	45.74	49.22	54.92	61.58	67.70	78.03
16.25-16.75 years	836	43.86	45.69	49.46	54.97	62.64	72.37	83.10
16.75-17.25 years	1,108	43.87	45.57	50.76	56.49	62.22	72.45	84.19
17.25 17.75 years	810	42.90	45.36	50.56	55.23	61.59	70.62	84.82
17.75-18.25 years	826	45.05	47.89	52.68	57.68	62.32	69.62	75.86
18.25-19.00 years	1,420	44.83	45.89	51.03	56.97	63.16	72.62	78.70
19.00-20.00 years	1,384	48.65	48.83	51.62	57.24	63.48	76.33	83.48
20.00-21.00 years	1,771	44.40	47.23	51.70	57.22	63.94	72.15	75.89
21.00-22.00 years	1,818	46.08	48.54	52.15	58.36	64.64	72.88	81.76
22.00-23.00 years	1,734	42.86	46.18	51.35	58.82	67.38	75.54	85.35
23.00-24.00 years	1,800	45.59	47.77	52.16	59.87	64.64	72.80	84.62
24.00-25.00 years	1,796	46.65	48.13	52.06	58.88	66.33	77.17	86.04

[1]Sample size expressed in thousands. The N's of those cells containing subjects from both HANES I and HES II or HES III have been cut in half to maintain representativeness.

Table 8. Observed percentiles of weight (in kilograms), by stature (in centimeters) and sex: National Center for Health Statistics, 2-10.0 years (females) or 2-11.5 years (males)

Sex and stature	N[1]	Observed percentile						
		5th	10th	25th	50th	75th	90th	95th
Male, 2-11.5 years		Weight in kilograms						
90-92 centimeters	330	12.02	12.22	12.81	13.80	14.90	15.56	15.79
92-94 centimeters	451	12.06	12.22	12.71	13.51	14.61	15.51	15.81
94-96 centimeters	451	12.31	12.66	13.68	14.66	15.46	15.94	16.61
96-98 centimeters	555	12.31	13.08	14.28	15.04	15.80	17.12	17.77
98-100 centimeters	359	13.70	14.05	14.50	15.26	16.10	18.04	19.06
100-102 centimeters	557	13.92	14.20	14.82	15.87	17.12	17.88	18.96
102-104 centimeters	414	14.31	14.64	15.63	16.66	17.51	18.19	19.30
104-106 centimeters	561	14.45	14.91	16.14	17.16	18.30	19.33	19.67
106-108 centimeters	553	15.51	15.83	16.56	17.70	18.98	19.76	20.53
108-110 centimeters	702	16.20	16.43	17.10	18.31	19.77	22.13	23.16
110-112 centimeters	641	16.15	16.50	17.57	18.83	19.91	21.50	22.37
112-114 centimeters	706	16.94	17.78	18.66	19.85	21.27	22.63	23.85
114-116 centimeters	912	18.04	18.32	19.16	20.41	21.39	21.98	23.22
116-118 centimeters	1,013	18.36	18.80	20.06	21.03	22.01	23.41	23.88
118-120 centimeters	1,284	18.43	19.01	20.29	21.43	22.81	23.76	24.64
120-122 centimeters	1,194	19.49	20.23	21.31	22.85	24.40	25.76	26.85
122-124 centimeters	1,430	20.42	21.12	22.42	23.62	25.19	26.78	27.95
124-126 centimeters	647	21.50	22.19	22.95	24.33	26.15	27.80	30.14
126-128 centimeters	1,565	22.30	22.92	24.31	25.55	27.31	29.91	31.05
128-130 centimeters	1,277	22.84	23.91	24.79	26.22	28.32	31.31	34.33
130-132 centimeters	1,524	23.96	24.35	25.41	27.29	29.35	31.17	31.96
132-134 centimeters	1,443	24.45	25.33	26.74	28.54	31.33	34.75	35.82
134-136 centimeters	1,554	24.65	25.46	27.45	29.55	32.18	37.22	39.83
136-138 centimeters	1,281	26.47	27.21	28.68	30.52	33.40	36.53	37.73
138-140 centimeters	1,184	28.11	28.48	29.59	31.91	33.85	37.25	39.62
140-142 centimeters	1,356	28.65	29.46	31.19	33.87	36.81	40.96	48.32
142-144 centimeters	1,043	29.82	31.10	32.82	35.24	38.80	42.37	44.39
144-146 centimeters	709	30.45	31.47	34.24	37.28	40.89	44.51	48.88
Female, 2-10 years								
90-92 centimeters	332	11.73	12.08	12.46	13.08	13.70	14.71	15.84
92-94 centimeters	429	12.04	12.19	12.66	13.45	14.51	15.51	15.85
94-96 centimeters	566	12.08	12.30	12.97	14.09	15.25	15.94	16.49
96-98 centimeters	608	13.08	13.22	13.66	14.53	15.49	16.35	17.21
98-100 centimeters	522	12.49	12.99	14.20	15.17	16.33	17.57	17.99
100-102 centimeters	421	14.03	14.26	14.95	16.12	17.36	18.79	22.16
102-104 centimeters	425	14.14	14.38	15.09	16.32	17.62	18.92	19.50
104-106 centimeters	524	14.38	14.95	16.19	17.00	17.81	19.08	19.66
106-108 centimeters	522	14.81	15.73	16.47	17.34	18.46	19.51	19.86
108-110 centimeters	533	14.55	15.40	16.42	17.33	18.55	19.78	20.87
110-112 centimeters	651	16.09	16.36	17.16	18.42	19.51	20.64	21.45
112-114 centimeters	793	16.28	16.92	18.30	19.41	20.89	22.04	23.14
114-116 centimeters	909	17.35	18.13	18.81	19.95	21.34	22.70	23.79
116-118 centimeters	1,099	18.09	18.37	19.23	20.63	21.93	23.65	25.07
118-120 centimeters	1,162	18.39	18.86	20.15	21.40	23.18	25.02	25.90
120-122 centimeters	1,277	19.43	20.16	21.09	22.56	23.90	25.65	27.36
122-124 centimeters	1,246	19.96	20.39	21.59	23.02	24.61	26.58	28.67
124-126 centimeters	1,319	20.47	21.47	22.59	23.77	25.72	27.74	29.72
126-128 centimeters	1,219	21.53	22.25	23.28	25.35	27.42	29.51	31.19
128-130 centimeters	1,327	22.52	23.28	24.62	26.21	28.73	31.21	33.04
130-132 centimeters	1,102	23.66	24.30	25.39	27.20	29.73	33.45	35.21
132-134 centimeters	1,088	24.47	25.30	26.67	28.42	32.47	35.43	38.82
134-136 centimeters	969	25.25	26.30	28.18	30.51	33.03	36.17	39.20
136-138 centimeters	667	26.05	26.75	28.47	30.70	34.32	37.65	42.36
138-140 centimeters	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
140-142 centimeters	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
142-144 centimeters	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
144-146 centimeters	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

[1]Sample size expressed in thousands. The *N*'s of those cells containing subjects from both HANES I and HES II or HES III have been cut in half to maintain representativeness.

Table 9. Smoothed percentiles of recumbent length (in centimeters), by sex and age: Statistics from National Center for Health Statistics and data from Fels Research Institute, birth-36 months

Sex and age	Smoothed[1] percentile						
	5th	10th	25th	50th	75th	90th	95th
	Recumbent length in centimeters						
Male							
Birth	46.4	47.5	49.0	50.5	51.8	53.5	54.4
1 month	50.4	51.3	53.0	54.6	56.2	57.7	58.6
3 months	56.7	57.7	59.4	61.1	63.0	64.5	65.4
6 months	63.4	64.4	66.1	67.8	69.7	71.3	72.3
9 months	68.0	69.1	70.6	72.3	74.0	75.9	77.1
12 months	71.7	72.8	74.3	76.1	77.7	79.8	81.2
18 months	77.5	78.7	80.5	82.4	84.3	86.6	88.1
24 months	82.3	83.5	85.6	87.6	89.9	92.2	93.8
30 months	87.0	88.2	90.1	92.3	94.6	97.0	98.7
36 months	91.2	92.4	94.2	96.5	98.9	101.4	103.1
Female							
Birth	45.4	46.5	48.2	49.9	51.0	52.0	52.9
1 month	49.2	50.2	51.9	53.5	54.9	56.1	56.9
3 months	55.4	56.2	57.8	59.5	61.2	62.7	63.4
6 months	61.8	62.6	64.2	65.9	67.8	69.4	70.2
9 months	66.1	67.0	68.7	70.4	72.4	74.0	75.0
12 months	69.8	70.8	72.4	74.3	76.3	78.0	79.1
18 months	76.0	77.2	78.8	80.9	83.0	85.0	86.1
24 months	81.3	82.5	84.2	86.5	88.7	90.8	92.0
30 months	86.0	87.0	88.9	91.3	93.7	95.6	96.9
36 months	90.0	91.0	93.1	95.6	98.1	100.0	101.5

[1]Smoothed by cubic-spline approximation, as described in appendix II.

Table 10. Smoothed percentiles of weight (in kilograms), by sex and age: Statistics from National Center for Health Statistics and data from Fels Research Institute, birth-36 months

Sex and age	Smoothed[1] percentile						
	5th	10th	25th	50th	75th	90th	95th
	Weight in kilograms						
Male							
Birth	2.54	2.78	3.00	3.27	3.64	3.82	4.15
1 month	3.16	3.43	3.82	4.29	4.75	5.14	5.38
3 months	4.43	4.78	5.32	5.98	6.56	7.14	7.37
6 months	6.20	6.61	7.20	7.85	8.49	9.10	9.46
9 months	7.52	7.95	8.56	9.18	9.88	10.49	10.93
12 months	8.43	8.84	9.49	10.15	10.91	11.54	11.99
18 months	9.59	9.92	10.67	11.47	12.31	13.05	13.44
24 months	10.54	10.85	11.65	12.59	13.44	14.29	14.70
30 months	11.44	11.80	12.63	13.67	14.51	15.47	15.97
36 months	12.26	12.69	13.58	14.69	15.59	16.66	17.28
Female							
Birth	2.36	2.58	2.93	3.23	3.52	3.64	3.81
1 month	2.97	3.22	3.59	3.98	4.36	4.65	4.92
3 months	4.18	4.47	4.88	5.40	5.90	6.39	6.74
6 months	5.79	6.12	6.60	7.21	7.83	8.38	8.73
9 months	7.00	7.34	7.89	8.56	9.24	9.83	10.17
12 months	7.84	8.19	8.81	9.53	10.23	10.87	11.24
18 months	8.92	9.30	10.04	10.82	11.55	12.30	12.76
24 months	9.87	10.26	11.10	11.90	12.74	13.57	14.08
30 months	10.78	11.21	12.11	12.93	13.93	14.81	15.35
36 months	11.60	12.07	12.99	13.93	15.03	15.97	16.54

[1]Smoothed by cubic-spline approximation, as described in appendix II.

Table 11. Smoothed percentiles of head circumference (in centimeters), by sex and age: Statistics from National Center for Health Statistics and data from Fels Research Institute, birth-36 months

Sex and age	Smoothed[1] percentile						
	5th	10th	25th	50th	75th	90th	95th
	Head circumference in centimeters						
Male							
Birth	32.6	33.0	33.9	34.8	35.6	36.6	37.2
1 month	34.9	35.4	36.2	37.2	38.1	39.0	39.6
3 months	38.4	38.9	39.7	40.6	41.7	42.5	43.1
6 months	41.5	42.0	42.8	43.8	44.7	45.6	46.2
9 months	43.5	44.0	44.8	45.8	46.6	47.5	48.1
12 months	44.8	45.3	46.1	47.0	47.9	48.8	49.3
18 months	46.3	46.7	47.4	48.4	49.3	50.1	50.6
24 months	47.3	47.7	48.3	49.2	50.2	51.0	51.4
30 months	48.0	48.4	49.1	49.9	51.0	51.7	52.2
36 months	48.6	49.0	49.7	50.5	51.5	52.3	52.8
Female							
Birth	32.1	32.9	33.5	34.3	34.8	35.5	35.9
1 month	34.2	34.8	35.6	36.4	37.1	37.8	38.3
3 months	37.3	37.8	38.7	39.5	40.4	41.2	41.7
6 months	40.3	40.9	41.6	42.4	43.3	44.1	44.6
9 months	42.3	42.8	43.5	44.3	45.1	46.0	46.4
12 months	43.5	44.1	44.8	45.6	46.4	47.2	47.6
18 months	45.0	45.6	46.3	47.1	47.9	48.6	49.1
24 months	46.1	46.5	47.3	48.1	48.8	49.6	50.1
30 months	47.0	47.3	48.0	48.8	49.4	50.3	50.8
36 months	47.6	47.9	48.5	49.3	50.0	50.8	51.4

[1]Smoothed by cubic-spline approximation, as described in appendix II.

Table 12. Smoothed percentiles of weight (in kilograms), by sex and recumbent length (in centimeters): Statistics from National Center for Health Statistics and data from Fels Research Institute, birth-48 months

Sex and recumbent length	Smoothed[1] percentile						
	5th	10th	25th	50th	75th	90th	95th
Male	Weight in kilograms						
48-50 centimeters	*	*	2.86	3.15	3.50	*	*
50-52 centimeters	*	*	3.16	3.48	3.86	*	*
52-54 centimeters	*	*	3.52	3.88	4.28	*	*
54-56 centimeters	3.49	3.65	3.95	4.34	4.76	5.13	5.33
56-58 centimeters	3.90	4.09	4.43	4.84	5.29	5.69	5.88
58-60 centimeters	4.37	4.58	4.94	5.38	5.84	6.28	6.47
60-62 centimeters	4.88	5.10	5.49	5.94	6.42	6.88	7.08
62-64 centimeters	5.43	5.65	6.05	6.52	7.02	7.50	7.72
64-66 centimeters	5.99	6.20	6.62	7.11	7.63	8.13	8.36
66-68 centimeters	6.55	6.76	7.19	7.70	8.23	8.75	8.99
68-70 centimeters	7.10	7.31	7.75	8.27	8.82	9.35	9.62
70-72 centimeters	7.63	7.84	8.28	8.82	9.39	9.93	10.21
72-74 centimeters	8.13	8.33	8.78	9.33	9.92	10.48	10.77
74-76 centimeters	8.58	8.78	9.24	9.81	10.43	10.99	11.29
76-78 centimeters	9.00	9.21	9.68	10.27	10.91	11.48	11.78
78-80 centimeters	9.40	9.62	10.09	10.70	11.36	11.94	12.25
80-82 centimeters	9.77	10.01	10.49	11.12	11.80	12.39	12.69
82-84 centimeters	10.14	10.39	10.88	11.53	12.23	12.83	13.13
84-86 centimeters	10.49	10.76	11.27	11.93	12.65	13.26	13.56
86-88 centimeters	10.85	11.14	11.67	12.34	13.07	13.69	14.00
88-90 centimeters	11.22	11.53	12.08	12.76	13.50	14.13	14.44
90-92 centimeters	11.60	11.94	12.52	13.20	13.94	14.58	14.90
92-94 centimeters	12.00	12.37	12.97	13.65	14.40	15.05	15.39
94-96 centimeters	12.42	12.81	13.45	14.14	14.88	15.54	15.90
96-98 centimeters	12.88	13.28	13.96	14.66	15.39	16.06	16.43
98-100 centimeters	13.37	13.78	14.50	15.21	15.94	16.62	17.00
100-102 centimeters	13.90	14.30	15.06	15.81	16.54	17.22	17.60
102-104 centimeters	14.48	14.85	15.65	16.45	17.18	17.87	18.24
Female							
48-50 centimeters	*	*	3.02	3.29	3.59	*	*
50-52 centimeters	*	*	3.25	3.55	3.89	*	*
52-54 centimeters	*	*	3.56	3.89	4.26	*	*
54-56 centimeters	3.54	3.64	3.93	4.29	4.70	5.02	5.21
56-58 centimeters	3.93	4.05	4.37	4.76	5.20	5.55	5.77
58-60 centimeters	4.38	4.50	4.85	5.27	5.73	6.12	6.36
60-62 centimeters	4.85	4.99	5.37	5.82	6.30	6.70	6.95
62-64 centimeters	5.35	5.50	5.91	6.39	6.89	7.30	7.55
64-66 centimeters	5.87	6.03	6.47	6.97	7.48	7.90	8.15
66-68 centimeters	6.38	6.56	7.02	7.55	8.07	8.50	8.75
68-70 centimeters	6.89	7.08	7.56	8.11	8.64	9.08	9.33
70-72 centimeters	7.37	7.58	8.08	8.64	9.18	9.63	9.88
72-74 centimeters	7.82	8.05	8.56	9.14	9.68	10.15	10.41
74-76 centimeters	8.24	8.49	9.00	9.59	10.14	10.63	10.91
76-78 centimeters	8.62	8.90	9.42	10.02	10.57	11.08	11.39
78-80 centimeters	8.99	9.29	9.81	10.41	10.97	11.51	11.85
80-82 centimeters	9.34	9.67	10.19	10.80	11.37	11.93	12.29
82-84 centimeters	9.68	10.04	10.57	11.18	11.75	12.35	12.72
84-86 centimeters	10.03	10.41	10.94	11.56	12.15	12.76	13.15
86-88 centimeters	10.39	10.78	11.33	11.95	12.55	13.19	13.57
88-90 centimeters	10.76	11.17	11.74	12.36	12.98	13.63	14.01
90-92 centimeters	11.16	11.58	12.17	12.80	13.45	14.10	14.45
92-94 centimeters	11.59	12.02	12.63	13.27	13.95	14.61	14.92
94-96 centimeters	12.05	12.48	13.12	13.77	14.48	15.14	15.42
96-98 centimeters	12.55	12.98	13.64	14.31	15.04	15.71	15.99
98-100 centimeters	13.10	13.51	14.19	14.87	15.63	16.32	16.64
100-102 centimeters	13.68	14.08	14.77	15.46	16.25	16.96	17.39
102-104 centimeters	...	...	...	...	...	...	...

[1]Smoothed by cubic-spline approximation, as described in appendix II.

Table 13. Smoothed percentiles of stature (in centimeters), by sex and age: Data and statistics from National Center for Health Statistics, 2 to 18 years

Sex and age	Smoothed[1] percentile						
	5th	10th	25th	50th	75th	90th	95th
	Stature in centimeters						
Male							
2.0 years[2]	82.5	83.5	85.3	86.8	89.2	92.0	94.4
2.5 years	85.4	86.5	88.5	90.4	92.9	95.6	97.8
3.0 years	89.0	90.3	92.6	94.9	97.5	100.1	102.0
3.5 years	92.5	93.9	96.4	99.1	101.7	104.3	106.1
4.0 years	95.8	97.3	100.0	102.9	105.7	108.2	109.9
4.5 years	98.9	100.6	103.4	106.6	109.4	111.9	113.5
5.0 years	102.0	103.7	106.5	109.9	112.8	115.4	117.0
5.5 years	104.9	106.7	109.6	113.1	116.1	118.7	120.3
6.0 years	107.7	109.6	112.5	116.1	119.2	121.9	123.5
6.5 years	110.4	112.3	115.3	119.0	122.2	124.9	126.6
7.0 years	113.0	115.0	118.0	121.7	125.0	127.9	129.7
7.5 years	115.6	117.6	120.6	124.4	127.8	130.8	132.7
8.0 years	118.1	120.2	123.2	127.0	130.5	133.6	135.7
8.5 years	120.5	122.7	125.7	129.6	133.2	136.5	138.8
9.0 years	122.9	125.2	128.2	132.2	136.0	139.4	141.8
9.5 years	125.3	127.6	130.8	134.8	138.8	142.4	144.9
10.0 years	127.7	130.1	133.4	137.5	141.6	145.5	148.1
10.5 years	130.1	132.6	136.0	140.3	144.6	148.7	151.5
11.0 years	132.6	135.1	138.7	143.3	147.8	152.1	154.9
11.5 years	135.0	137.7	141.5	146.4	151.1	155.6	158.5
12.0 years	137.6	140.3	144.4	149.7	154.6	159.4	162.3
12.5 years	140.2	143.0	147.4	153.0	158.2	163.2	166.1
13.0 years	142.9	145.8	150.5	156.5	161.8	167.0	169.8
13.5 years	145.7	148.7	153.6	159.9	165.3	170.5	173.4
14.0 years	148.8	151.8	156.9	163.1	168.5	173.8	176.7
14.5 years	152.0	155.0	160.1	166.2	171.5	176.6	179.5
15.0 years	155.2	158.2	163.3	169.0	174.1	178.9	181.9
15.5 years	158.3	161.2	166.2	171.5	176.3	180.8	183.9
16.0 years	161.1	163.9	168.7	173.5	178.1	182.4	185.4
16.5 years	163.4	166.1	170.6	175.2	179.5	183.6	186.6
17.0 years	164.9	167.7	171.9	176.2	180.5	184.4	187.3
17.5 years	165.6	168.5	172.4	176.7	181.0	185.0	187.6
18.0 years	165.7	168.7	172.3	176.8	181.2	185.3	187.6
Female							
2.0 years[2]	81.6	82.1	84.0	86.8	89.3	92.0	93.6
2.5 years	84.6	85.3	87.3	90.0	92.5	95.0	96.6
3.0 years	88.3	89.3	91.4	94.1	96.6	99.0	100.6
3.5 years	91.7	93.0	95.2	97.9	100.5	102.8	104.5
4.0 years	95.0	96.4	98.8	101.6	104.3	106.6	108.3
4.5 years	98.1	99.7	102.2	105.0	107.9	110.2	112.0
5.0 years	101.1	102.7	105.4	108.4	111.4	113.8	115.6
5.5 years	103.9	105.6	108.4	111.6	114.8	117.4	119.2
6.0 years	106.6	108.4	111.3	114.6	118.1	120.8	122.7
6.5 years	109.2	111.0	114.1	117.6	121.3	124.2	126.1
7.0 years	111.8	113.6	116.8	120.6	124.4	127.6	129.5
7.5 years	114.4	116.2	119.5	123.5	127.5	130.9	132.9
8.0 years	116.9	118.7	122.2	126.4	130.6	134.2	136.2
8.5 years	119.5	121.3	124.9	129.3	133.6	137.4	139.6
9.0 years	122.1	123.9	127.7	132.2	136.7	140.7	142.9
9.5 years	124.8	126.6	130.6	135.2	139.8	143.9	146.2
10.0 years	127.5	129.5	133.6	138.3	142.9	147.2	149.5
10.5 years	130.4	132.5	136.7	141.5	146.1	150.4	152.8
11.0 years	133.5	135.6	140.0	144.8	149.3	153.7	156.2
11.5 years	136.6	139.0	143.5	148.2	152.6	156.9	159.5
12.0 years	139.8	142.3	147.0	151.5	155.8	160.0	162.7
12.5 years	142.7	145.4	150.1	154.6	158.8	162.9	165.6
13.0 years	145.2	148.0	152.8	157.1	161.3	165.3	168.1
13.5 years	147.2	150.0	154.7	159.0	163.2	167.3	170.0
14.0 years	148.7	151.5	155.9	160.4	164.6	168.7	171.3
14.5 years	149.7	152.5	156.8	161.2	165.6	169.8	172.2
15.0 years	150.5	153.2	157.2	161.8	166.3	170.5	172.8
15.5 years	151.1	153.6	157.5	162.1	166.7	170.9	173.1
16.0 years	151.6	154.1	157.8	162.4	166.9	171.1	173.3
16.5 years	152.2	154.6	158.2	162.7	167.1	171.2	173.4
17.0 years	152.7	155.1	158.7	163.1	167.3	171.2	173.5
17.5 years	153.2	155.6	159.1	163.4	167.5	171.1	173.5
18.0 years	153.6	156.0	159.6	163.7	167.6	171.0	173.6

[1]Smoothed by cubic-spline approximation, as described in appendix II.

[2]Because of a logistic problem the percentiles of stature for children under 2.5 years are not highly reliable. The age interval represented is 2.00-2.25 years.

Table 14. Smoothed percentiles of weight (in kilograms), by sex and age: Data and statistics from National Center for Health Statistics, 1.5 to 18 years

Sex and age	Smoothed[1] percentile						
	5th	10th	25th	50th	75th	90th	95th
Male	Weight in kilograms						
1.5 years	9.72	10.18	10.51	11.09	12.02	12.95	14.42
2.0 years	10.49	10.96	11.55	12.34	13.36	14.38	15.50
2.5 years	11.27	11.77	12.55	13.52	14.61	15.71	16.61
3.0 years	12.05	12.58	13.52	14.62	15.78	16.95	17.77
3.5 years	12.84	13.41	14.46	15.68	16.90	18.15	18.98
4.0 years	13.64	14.24	15.39	16.69	17.99	19.32	20.27
4.5 years	14.45	15.10	16.30	17.69	19.06	20.50	21.63
5.0 years	15.27	15.96	17.22	18.67	20.14	21.70	23.09
5.5 years	16.09	16.83	18.14	19.67	21.25	22.96	24.66
6.0 years	16.93	17.72	19.07	20.69	22.40	24.31	26.34
6.5 years	17.78	18.62	20.02	21.74	23.62	25.76	28.16
7.0 years	18.64	19.53	21.00	22.85	24.94	27.36	30.12
7.5 years	19.52	20.45	22.02	24.03	26.36	29.11	32.73
8.0 years	20.40	21.39	23.09	25.30	27.91	31.06	34.51
8.5 years	21.31	22.34	24.21	26.66	29.61	33.22	36.96
9.0 years	22.25	23.33	25.40	28.13	31.46	35.57	39.58
9.5 years	23.25	24.38	26.68	29.73	33.46	38.11	42.35
10.0 years	24.33	25.52	28.07	31.44	35.61	40.80	45.27
10.5 years	25.51	26.78	29.59	33.30	37.92	43.63	48.31
11.0 years	26.80	28.17	31.25	35.30	40.38	46.57	51.47
11.5 years	28.24	29.72	33.08	37.46	43.00	49.61	54.73
12.0 years	29.85	31.46	35.09	39.78	45.77	52.73	58.09
12.5 years	31.64	33.41	37.31	42.27	48.70	55.91	61.52
13.0 years	33.64	35.60	39.74	44.95	51.79	59.12	65.02
13.5 years	35.85	38.03	42.40	47.81	55.02	62.35	68.51
14.0 years	38.22	40.64	45.21	50.77	58.31	65.57	72.13
14.5 years	40.66	43.34	48.08	53.76	61.58	68.76	75.66
15.0 years	43.11	46.06	50.92	56.71	64.72	71.91	79.12
15.5 years	45.50	48.69	53.64	59.51	67.64	74.98	82.45
16.0 years	47.74	51.16	56.16	62.10	70.26	77.97	85.62
16.5 years	49.76	53.39	58.38	64.39	72.46	80.84	88.59
17.0 years	51.50	55.28	60.22	66.31	74.17	83.58	91.31
17.5 years	52.89	56.78	61.61	67.78	75.32	86.14	93.73
18.0 years	53.97	57.89	62.61	68.88	76.04	88.41	95.76
Female							
1.5 years	9.02	9.16	9.61	10.38	10.94	11.75	12.36
2.0 years	9.95	10.32	10.96	11.80	12.73	13.58	14.15
2.5 years	10.80	11.35	12.11	13.03	14.23	15.16	15.76
3.0 years	11.61	12.26	13.11	14.10	15.50	16.54	17.22
3.5 years	12.37	13.08	14.00	15.07	16.59	17.77	18.59
4.0 years	13.11	13.84	14.80	15.96	17.56	18.93	19.91
4.5 years	13.83	14.56	15.55	16.81	18.48	20.06	21.24
5.0 years	14.55	15.26	16.29	17.66	19.39	21.23	22.62
5.5 years	15.29	15.97	17.05	18.56	20.36	22.48	24.11
6.0 years	16.05	16.72	17.86	19.52	21.44	23.89	25.75
6.5 years	16.85	17.51	18.76	20.61	22.68	25.50	27.59
7.0 years	17.71	18.39	19.78	21.84	24.16	27.39	29.68
7.5 years	18.62	19.37	20.95	23.26	25.90	29.57	32.07
8.0 years	19.62	20.45	22.26	24.84	27.88	32.04	34.71
8.5 years	20.68	21.64	23.70	26.58	30.08	34.73	37.58
9.0 years	21.82	22.92	25.27	28.46	32.44	37.60	40.64
9.5 years	23.05	24.29	26.94	30.45	34.94	40.61	43.85
10.0 years	24.36	25.76	28.71	32.55	37.53	43.70	47.17
10.5 years	25.75	27.32	30.57	34.72	40.17	46.84	50.57
11.0 years	27.24	28.97	32.49	36.95	42.84	49.96	54.00
11.5 years	28.83	30.71	34.48	39.23	45.48	53.03	57.42
12.0 years	30.52	32.53	36.52	41.53	48.07	55.99	60.81
12.5 years	32.30	34.42	38.59	43.84	50.56	58.81	64.12
13.0 years	34.14	36.35	40.65	46.10	52.91	61.45	67.30
13.5 years	35.98	38.26	42.65	48.26	55.11	63.87	70.30
14.0 years	37.76	40.11	44.54	50.28	57.09	66.04	73.08
14.5 years	39.45	41.83	46.28	52.10	58.84	67.95	75.59
15.0 years	40.99	43.38	47.82	53.68	60.32	69.54	77.78
15.5 years	42.32	44.72	49.10	54.96	61.48	70.79	79.59
16.0 years	43.41	45.78	50.09	55.89	62.29	71.68	80.99
16.5 years	44.20	46.54	50.75	56.44	62.75	72.18	81.93
17.0 years	44.74	47.04	51.14	56.69	62.91	72.38	82.46
17.5 years	45.08	47.33	51.33	56.71	62.89	72.37	82.62
18.0 years	45.26	47.47	51.39	56.62	62.78	72.25	82.47

[1]Smoothed by cubic-spline approximation, as described in appendix II.

Table 15. Smoothed percentiles of weight (in kilograms), by sex and stature (in centimeters): Data and statistics from National Center for Health Statistics, prepubescent males and females

Sex and stature	Smoothed[1] percentile						
	5th	10th	25th	50th	75th	90th	95th
Male	Weight in kilograms						
90-92 centimeters	11.70	11.97	12.59	13.41	14.35	15.25	15.72
92-94 centimeters	12.07	12.36	13.03	13.89	14.84	15.87	16.41
94-96 centimeters	12.46	12.77	13.49	14.38	15.34	16.45	17.06
96-98 centimeters	12.87	13.21	13.98	14.89	15.87	17.01	17.69
98-100 centimeters	13.31	13.67	14.48	15.43	16.41	17.56	18.29
100-102 centimeters	13.77	14.15	15.00	15.98	16.98	18.11	18.89
102-104 centimeters	14.25	14.65	15.54	16.55	17.57	18.67	19.50
104-106 centimeters	14.76	15.18	16.10	17.13	18.18	19.25	20.12
106-108 centimeters	15.30	15.73	16.68	17.74	18.82	19.86	20.76
108-110 centimeters	15.85	16.31	17.28	18.37	19.49	20.51	21.45
110-112 centimeters	16.43	16.91	17.90	19.02	20.18	21.22	22.18
112-114 centimeters	17.04	17.53	18.54	19.70	20.91	21.98	22.98
114-116 centimeters	17.66	18.18	19.20	20.39	21.66	22.82	23.85
116-118 centimeters	18.32	18.85	19.89	21.11	22.45	23.73	24.80
118-120 centimeters	18.99	19.55	20.60	21.85	23.28	24.73	25.83
120-122 centimeters	19.70	20.28	21.34	22.63	24.15	25.80	26.96
122-124 centimeters	20.43	21.03	22.11	23.45	25.07	26.96	28.18
124-126 centimeters	21.20	21.82	22.92	24.32	26.05	28.18	29.50
126-128 centimeters	21.99	22.64	23.77	25.24	27.10	29.48	30.92
128-130 centimeters	22.82	23.50	24.67	26.22	28.21	30.86	32.44
130-132 centimeters	23.69	24.39	25.62	27.26	29.41	32.31	34.07
132-134 centimeters	24.59	25.32	26.62	28.38	30.68	33.82	35.81
134-136 centimeters	25.53	26.30	27.68	29.58	32.05	35.40	37.67
136-138 centimeters	26.51	27.32	28.80	30.86	33.51	37.05	39.65
138-140 centimeters	27.53	28.38	29.99	32.23	35.08	38.77	41.74
140-142 centimeters	28.59	29.48	31.25	33.70	36.75	40.55	43.97
142-144 centimeters	29.70	30.64	32.58	35.27	38.54	42.39	46.32
144-146 centimeters	30.86	31.85	34.00	36.95	40.45	44.29	48.80
Female							
90-92 centimeters	11.45	11.67	12.28	13.14	14.11	14.98	15.74
92-94 centimeters	11.86	12.10	12.74	13.63	14.63	15.57	16.42
94-96 centimeters	12.26	12.53	13.21	14.12	15.14	16.13	17.05
96-98 centimeters	12.66	12.97	13.70	14.62	15.66	16.69	17.65
98-100 centimeters	13.06	13.42	14.19	15.13	16.19	17.24	18.23
100-102 centimeters	13.48	13.88	14.69	15.65	16.73	17.80	18.80
102-104 centimeters	13.91	14.36	15.21	16.20	17.28	18.38	19.38
104-106 centimeters	14.36	14.85	15.75	16.75	17.86	18.98	19.98
106-108 centimeters	14.84	15.37	16.30	17.33	18.46	19.62	20.61
108-110 centimeters	15.35	15.91	16.87	17.94	19.09	20.30	21.29
110-112 centimeters	15.90	16.48	17.47	18.56	19.76	21.03	22.03
112-114 centimeters	16.48	17.09	18.08	19.22	20.47	21.81	22.84
114-116 centimeters	17.11	17.72	18.72	19.91	21.23	22.67	23.73
116-118 centimeters	17.77	18.40	19.40	20.64	22.04	23.60	24.71
118-120 centimeters	18.48	19.11	20.11	21.42	22.92	24.62	25.81
120-122 centimeters	19.22	19.85	20.87	22.25	23.88	25.73	27.03
122-124 centimeters	19.99	20.64	21.68	23.13	24.91	26.95	28.37
124-126 centimeters	20.80	21.47	22.54	24.09	26.05	28.27	29.87
126-128 centimeters	21.65	22.34	23.47	25.11	27.28	29.71	31.51
128-130 centimeters	22.53	23.25	24.46	26.22	28.63	31.28	33.33
130-132 centimeters	23.44	24.22	25.52	27.40	30.09	32.99	35.33
132-134 centimeters	24.38	25.22	26.66	28.68	31.68	34.84	37.53
134-136 centimeters	25.35	26.28	27.88	30.06	33.41	36.84	39.93
136-138 centimeters	26.34	27.39	29.19	31.54	35.29	39.01	42.54
138-140 centimeters	...	...	...	...	...	...	...
140-142 centimeters	...	...	...	...	...	...	...
142-144 centimeters	...	...	...	...	...	...	...
144-146 centimeters	...	...	...	...	...	...	...

[1]Smoothed by cubic-spline approximation, as described in appendix II.

Table 16. Cumulative frequency distributions of recumbent length-stature differences for children from 2.25 to 7.25 years of age, by sex and age: Fels Research Institute

Recumbent length-stature difference	Age in years									
	2¼-2¾	2¾-3¼	3¼-3¾	3¾-4¼	4¼-4¾	4¾-5¼	5¼-5¾	5¾-6¼	6¼-6¾	6¾-7¼
Male	Cumulative frequency distribution									
0.0 centimeter	0.0	0.4	0.0	1.0	0.7	0.3	1.1	1.1	0.4	0.4
0.1 centimeter	3.7	1.2	2.1	1.7	1.7	0.7	1.8	2.6	2.0	1.9
0.2 centimeter	4.9	1.6	2.8	2.1	1.7	0.7	2.2	2.6	2.4	2.2
0.3 centimeter	6.1	3.1	3.8	3.8	3.4	2.0	3.3	5.2	4.5	7.5
0.4 centimeter	6.1	3.9	4.5	4.1	4.1	2.0	4.1	5.5	6.5	9.0
0.5 centimeter	9.8	5.8	8.4	6.2	7.1	6.0	7.4	10.3	13.8	13.4
0.6 centimeter	9.8	10.5	12.5	9.6	13.3	12.6	11.1	17.6	19.1	22.0
0.7 centimeter	11.0	10.8	13.6	10.0	14.3	13.3	12.2	19.1	21.1	23.9
0.8 centimeter	11.0	16.7	17.1	13.4	20.1	19.6	20.3	26.5	27.6	30.6
0.9 centimeter	11.0	19.0	18.5	14.4	20.8	21.6	21.8	27.2	29.7	32.8
1.0 centimeter	18.3	27.1	27.2	19.2	29.2	30.6	29.2	33.8	39.0	42.9
1.1 centimeters	19.5	36.4	32.4	27.5	34.7	35.6	40.2	44.1	46.8	52.2
1.2 centimeters	20.7	38.8	33.8	31.6	35.7	37.2	41.7	46.7	48.0	54.1
1.3 centimeters	25.6	43.4	41.1	40.2	44.2	45.5	50.9	55.5	56.1	63.1
1.4 centimeters	25.6	44.2	42.9	41.9	45.6	49.2	53.1	58.1	56.9	66.0
1.5 centimeters	29.3	50.0	48.4	49.5	53.4	59.1	61.2	65.1	63.4	72.4
1.6 centimeters	39.0	57.4	55.8	58.8	61.2	66.1	66.4	72.1	72.0	77.6
1.7 centimeters	39.0	58.1	57.5	59.4	62.2	66.8	68.3	73.9	72.4	78.4
1.8 centimeters	42.7	70.5	65.5	67.7	69.4	71.8	76.0	79.8	79.7	84.3
1.9 centimeters	43.9	72.9	67.6	68.7	72.4	73.1	77.1	79.8	79.7	86.2
2.0 centimeters	51.2	79.8	73.9	73.9	77.9	80.4	84.1	86.0	86.2	91.4
2.1 centimeters	59.8	84.5	79.8	80.1	81.3	84.7	90.4	90.4	90.2	95.2
2.2 centimeters	63.4	84.5	80.8	82.1	83.3	85.4	90.8	91.5	90.2	95.2
2.3 centimeters	65.8	87.6	83.3	85.2	89.1	88.4	93.7	93.4	93.9	95.9
2.4 centimeters	67.1	89.2	84.7	86.2	89.5	89.4	93.7	93.4	93.9	96.3
2.5 centimeters	75.6	89.9	87.5	89.7	91.5	91.4	95.2	96.0	95.9	96.6
2.6 centimeters	78.0	92.6	92.0	92.1	94.6	94.0	95.9	97.1	97.2	96.6
2.7 centimeters	79.3	92.6	92.7	92.8	94.9	94.4	95.9	97.1	97.2	96.6
2.8 centimeters	84.2	94.6	93.7	94.8	96.6	95.0	97.4	97.1	98.0	97.4
2.9 centimeters	85.4	94.6	93.7	95.2	96.9	95.0	97.8	97.1	98.4	97.4
3.0 centimeters	90.2	95.0	95.8	95.9	98.0	95.4	98.5	97.4	98.4	98.1
3.1-3.2 centimeters	93.9	96.5	96.2	98.3	98.3	96.0	99.3	98.2	98.8	98.5
3.3-3.4 centimeters	93.9	97.3	97.2	98.3	98.6	97.7	99.3	98.9	99.2	99.6
3.5-3.6 centimeters	95.1	98.1	97.9	99.3	99.0	99.7	99.6	98.9	99.2	99.6
3.7-3.8 centimeters	100.0	98.4	97.9	99.7	99.0	99.7	100.0	99.3	99.6	100.0
3.9-4.0 centimeters	100.0	99.2	98.6	100.0	100.0	99.7	100.0	99.3	100.0	100.0
4.1-4.2 centimeters	100.0	99.6	98.6	100.0	100.0	100.0	100.0	99.3	100.0	100.0
4.3-4.4 centimeters	100.0	100.0	99.0	100.0	100.0	100.0	100.0	99.6	100.0	100.0
4.5 centimeters and over	100.0	100.0	99.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Median	1.98	1.50	1.52	1.51	1.46	1.41	1.29	1.24	1.22	1.08

Table 16. Cumulative frequency distributions of recumbent length-stature differences for children from 2.25 to 7.25 years of age, by sex and age: Fels Research Institute—Con.

Recumbent length-stature difference	Age in years									
	2¼-2¾	2¾-3¼	3¼-3¾	3¾-4¼	4¼-4¾	4¾-5¼	5¼-5¾	5¾-5¼	5¼-6¾	6¾-7¼
Female	Cumulative frequency distribution									
0.0 centimeter	2.0	0.4	0.0	0.3	1.1	1.0	1.5	0.1	.09	1.2
0.1 centimeter	3.0	2.4	1.9	2.1	1.4	4.5	4.1	3.7	2.6	3.3
0.2 centimeter	5.0	2.4	2.7	2.8	2.9	4.5	4.4	5.2	4.4	4.1
0.3 centimeter	8.1	3.6	6.2	5.8	5.0	6.3	9.6	7.5	7.9	9.4
0.4 centimeter	10.1	4.4	6.2	6.2	6.1	7.3	9.6	8.2	9.2	11.5
0.5 centimeter	12.1	8.0	8.5	10.6	9.3	10.8	12.2	13.4	13.2	17.2
0.6 centimeter	14.1	12.0	12.3	14.8	16.5	16.4	18.1	19.8	20.2	22.5
0.7 centimeter	16.2	12.8	12.7	16.2	17.6	18.1	21.0	21.3	22.4	24.6
0.8 centimeter	19.2	19.3	20.0	22.3	22.2	25.4	25.5	28.0	29.0	31.2
0.9 centimeter	23.2	19.7	21.2	23.7	22.9	26.8	27.3	31.0	31.6	33.2
1.0 centimeter	28.3	25.7	28.8	29.6	28.7	33.1	34.3	40.3	39.0	42.6
1.1 centimeters	32.3	34.9	33.5	36.8	36.9	39.4	42.4	46.6	45.2	52.9
1.2 centimeters	32.3	36.6	36.2	37.5	38.4	41.1	44.3	49.2	46.9	54.1
1.3 centimeters	38.4	42.6	41.2	43.3	44.4	50.9	50.9	58.2	58.3	64.3
1.4 centimeters	39.4	43.4	43.5	46.4	47.3	51.9	52.4	61.6	60.5	66.4
1.5 centimeters	45.4	50.2	50.4	53.3	56.6	57.8	60.2	68.7	67.5	72.5
1.6 centimeters	56.6	60.6	57.7	58.4	63.8	66.9	69.7	75.4	75.9	78.7
1.7 centimeters	56.6	63.4	60.4	61.5	64.9	68.3	72.7	76.9	76.8	80.7
1.8 centimeters	61.6	68.3	67.7	69.4	72.0	72.8	79.3	82.5	79.4	84.8
1.9 centimeters	62.6	70.3	69.6	71.5	73.5	73.5	80.8	83.6	80.7	86.9
2.0 centimeters	69.7	73.1	76.9	77.7	77.8	79.4	86.0	88.4	86.8	90.6
2.1 centimeters	73.7	77.9	83.5	84.2	83.5	83.3	90.4	92.9	89.0	94.3
2.2 centimeters	75.8	79.1	85.0	85.6	85.0	84.0	90.8	94.0	89.9	95.1
2.3 centimeters	77.8	85.1	89.2	89.0	87.8	87.1	93.4	96.6	90.8	97.1
2.4 centimeters	77.8	85.5	90.0	90.0	88.9	87.8	93.7	97.4	91.7	97.5
2.5 centimeters	83.8	86.8	91.2	92.1	91.0	91.6	95.2	97.4	95.2	98.4
2.6 centimeters	87.9	89.2	93.5	94.8	92.5	93.0	95.6	98.9	96.0	98.8
2.7 centimeters	87.9	90.8	94.2	95.2	92.8	94.1	96.7	98.9	96.0	98.8
2.8 centimeters	90.9	92.8	95.4	96.2	95.7	96.5	96.7	99.2	96.9	99.2
2.9 centimeters	90.9	93.6	95.4	96.9	95.7	97.2	97.0	99.2	96.9	99.2
3.0 centimeters	92.9	93.6	96.2	97.2	97.1	99.0	98.2	99.2	97.4	99.2
3.1-3.2 centimeters	95.0	95.2	96.9	98.3	97.8	99.3	98.2	100.0	98.7	99.2
3.3-3.4 centimeters	96.0	98.0	97.7	99.3	98.2	99.3	98.5	100.0	98.7	99.2
3.5-3.6 centimeters	97.0	98.8	98.8	99.7	99.3	99.6	99.6	100.0	99.1	99.6
3.7-3.8 centimeters	98.0	98.8	98.8	99.7	99.3	99.6	99.6	100.0	99.1	100.0
3.9-4.0 centimeters	98.0	98.8	98.8	99.7	99.3	100.0	100.0	100.0	99.6	100.0
4.1-4.2 centimeters	99.0	99.6	99.2	99.7	100.0	100.0	100.0	100.0	99.6	100.0
4.3-4.4 centimeters	100.0	100.0	99.2	99.7	100.0	100.0	100.0	100.0	99.6	100.0
4.5 centimeters and over	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Median	1.54	1.50	1.49	1.45	1.43	1.29	1.29	1.21	1.23	1.07

Table 17. Means, standard deviation, Pearson statistics, and Pearson-derived percentiles of stature for U.S. males 6 to 18 years of age: United States, 1963-70

Age	$\bar{X}$	s	$\sqrt{\beta_1}$	β_2	Pearson-derived percentile				
					5th	25th	50th	75th	95th
					Stature in centimeters				
6.00-6.25 years	116.2	4.8	.2015	[1]-8.7183	([1])	([1])	([1])	([1])	([1])
6.25-6.50 years	118.2	4.8	.0769	[1]-2.5400	([1])	([1])	([1])	([1])	([1])
6.50-6.75 years	118.7	4.7	.0049	[1]0.5889	([1])	([1])	([1])	([1])	([1])
6.75-7.00 years	121.0	5.5	.0393	2.2825	113.3	117.3	120.8	124.2	128.4
7.00-7.25 years	122.0	4.3	.0673	3.2335	114.1	118.7	121.9	125.2	130.1
7.25-7.50 years	123.4	5.2	.0855	3.7735	114.9	119.9	123.1	126.4	131.6
7.50-7.75 years	125.4	5.3	.0972	4.0748	115.9	121.1	124.4	127.8	133.3
7.75-8.00 years	126.6	5.7	.1046	4.2323	116.9	122.3	125.7	129.2	134.9
8.00-8.25 years	128.4	5.0	.1090	4.3013	117.9	123.5	127.0	130.6	136.6
8.25-8.50 years	129.1	6.1	.1114	4.3149	119.0	124.8	128.4	132.1	138.3
8.50-8.75 years	130.4	4.8	.1122	4.2936	120.1	126.0	129.8	133.8	140.0
8.75-9.00 years	131.3	6.2	.1118	4.2506	121.2	127.3	131.2	135.2	141.6
9.00-9.25 years	134.1	6.5	.1107	4.1944	122.4	128.6	132.6	136.7	143.3
9.25-9.50 years	134.7	6.2	.1089	4.1306	123.6	130.0	134.1	138.3	145.0
9.50-9.75 years	136.1	7.0	.1067	4.0629	124.8	131.3	135.5	139.8	146.7
9.75-10.00 years	137.3	6.7	.1040	3.9937	126.1	132.7	137.0	141.4	148.4
10.00-10.25 years	138.4	6.4	.1011	3.9249	127.4	134.2	138.5	142.9	150.1
10.25-10.50 years	139.5	6.6	.0980	3.8574	128.7	135.6	140.2	144.5	151.8
10.50-10.75 years	140.7	6.1	.0948	3.7920	130.1	137.1	141.6	146.2	153.6
10.75-11.00 years	143.1	6.5	.0914	3.7292	131.5	138.5	143.1	147.8	155.2
11.00-11.25 years	143.2	6.5	.0879	3.6692	132.9	140.0	144.7	149.5	157.0
11.25-11.50 years	144.6	7.3	.0844	3.6123	134.3	141.5	146.2	151.0	158.6
11.50-11.75 years	148.0	5.8	.0808	3.5584	135.7	143.1	147.8	152.8	160.3
11.75-12.00 years	147.0	6.7	.0773	3.5077	137.2	144.5	149.4	154.4	162.0
12.00-12.25 years	149.7	8.2	.0738	3.4600	138.6	146.0	150.9	155.9	163.6
12.25-12.50 years	149.7	7.9	.0703	3.4153	140.1	147.5	152.5	157.2	165.4
12.50-12.75 years	153.5	8.3	.0668	3.3735	141.5	149.0	153.9	159.1	166.9
12.75-13.00 years	155.2	8.3	.0635	3.3346	143.0	150.6	155.6	160.8	168.6
13.00-13.25 years	156.3	8.7	.0602	3.2985	144.5	152.0	157.1	162.3	170.2
13.25-13.50 years	159.8	8.4	.0571	3.2650	145.9	153.5	158.6	163.8	171.7
13.50-13.75 years	160.1	9.1	.0542	3.2341	147.4	155.0	160.1	165.4	173.2
13.75-14.00 years	162.7	8.6	.0514	3.2056	148.7	156.3	161.5	166.8	174.7
14.00-14.25 years	164.5	9.0	.0488	3.1795	150.2	157.8	163.0	168.3	176.2
14.25-14.50 years	166.9	8.8	.0465	3.1557	151.6	159.2	164.4	169.7	177.6
14.50-14.75 years	167.0	8.3	.0445	3.1340	152.9	160.5	165.7	171.0	178.9
14.75-15.00 years	169.1	7.6	.0429	3.1144	154.2	161.8	167.0	172.3	180.2
15.00-15.25 years	169.7	8.6	.0416	3.0968	155.4	163.1	168.3	173.6	181.4
15.25-15.50 years	171.7	6.9	.0409	3.0811	156.8	164.3	169.5	174.8	182.6
15.50-15.75 years	171.3	7.3	.0408	3.0671	158.0	165.5	170.7	176.0	183.8
15.75-16.00 years	173.3	6.5	.0413	3.0547	159.2	166.6	171.8	177.1	184.8
16.00-16.25 years	173.7	7.2	.0426	3.0439	160.2	167.6	172.9	178.1	185.8
16.25-16.50 years	174.1	7.3	.0448	3.0344	161.3	168.7	173.8	179.1	186.7
16.50-16.75 years	174.6	6.1	.0481	3.0262	162.3	169.6	174.7	179.9	187.5
16.75-17.00 years	175.0	7.3	.0526	3.0190	163.2	170.4	175.5	180.7	188.2
17.00-17.25 years	175.4	7.0	.0587	3.0127	164.1	171.3	176.3	181.4	188.9
17.25-17.50 years	176.3	6.8	.0665	3.0069	164.8	171.9	176.9	182.0	189.4
17.50-17.75 years	175.0	7.0	.0764	3.0014	165.5	172.4	177.4	182.4	189.8
17.75-18.00 years	176.2	7.3	.0888	2.9959	166.1	173.0	177.9	182.9	190.2

[1] $\sqrt{\beta_1}$ or β_2 is beyond the range of the Pearson distribution system making estimation of percentiles impossible.

NOTE: $\bar{X}$ = mean; s = standard deviation; $\sqrt{\beta_1}$ and β_2 = Pearson statistics.

Table 18. Selected observed percentiles of stature (in centimeters), by sex and age, for HES II (1963-65), HES III (1966-70), and HANES I (1971-74): United States

Survey, sex, and age	N	n	$\bar{X}$	s	5th	10th	25th	50th	75th	90th	95th
					Observed percentile						
					Stature in centimeters						
HES II											
Male											
6½ years	1,065	294	118.3	4.6	110.9	112.4	115.2	118.4	121.5	124.0	125.6
7 years	1,028	304	121.6	5.1	112.9	114.9	118.1	121.4	125.3	128.5	130.2
7½ years	1,088	327	124.4	5.4	115.5	117.8	120.9	124.4	127.7	131.5	133.7
8 years	975	295	127.8	5.5	118.6	120.4	124.2	128.0	131.3	135.1	137.0
8½ years	1,003	307	130.0	5.4	121.6	123.2	126.6	129.8	133.6	136.7	138.8
9 years	1,033	312	132.5	6.6	122.6	124.9	128.3	132.4	136.7	141.1	143.5
9½ years	1,025	308	135.4	6.6	124.6	126.7	131.9	135.5	139.5	143.0	145.4
10 years	997	300	137.4	6.9	126.5	128.8	132.9	138.1	141.9	145.1	147.3
10½ years	1,022	297	140.1	6.4	129.4	131.6	136.2	140.4	144.1	148.5	150.5
11 years	913	281	143.0	6.7	132.7	134.7	138.8	143.3	147.3	151.4	153.6
11½ years	904	303	146.1	6.7	134.2	136.6	141.7	146.4	150.8	154.6	157.1
Female											
6½ years	1,057	278	117.6	5.6	108.3	110.5	114.1	117.5	121.3	125.0	127.0
7 years	1,087	316	120.8	5.6	111.4	113.4	117.2	120.8	124.7	127.5	129.4
7½ years	952	287	123.7	5.6	114.5	116.4	120.3	123.7	127.5	130.9	133.0
8 years	1,042	312	126.3	5.6	117.3	118.9	122.3	126.1	130.3	133.1	135.2
8½ years	1,022	324	129.1	6.6	118.7	121.3	125.1	129.5	133.5	137.2	139.3
9 years	971	294	132.4	6.2	122.4	124.7	127.9	132.6	136.7	140.3	142.7
9½ years	929	281	135.6	7.0	125.5	127.3	130.6	134.9	140.4	145.5	147.4
10 years	1,025	307	138.5	6.8	128.2	130.8	134.8	137.8	142.3	147.6	149.7
10½ years	916	283	140.6	7.2	129.5	131.8	135.3	140.9	145.2	149.7	152.3
11 years	882	271	144.1	7.5	131.8	134.7	139.8	144.4	149.1	153.4	155.5
11½ years	814	245	144.7	7.7	135.4	139.0	143.3	147.3	152.5	157.7	160.1
HES III											
Male											
12½ years	1,057	344	151.5	7.8	138.8	141.4	146.3	152.1	156.4	161.2	163.8
13 years	1,089	337	155.5	8.6	141.8	145.3	150.0	155.6	161.1	166.6	170.3
13½ years	1,041	328	160.1	8.9	145.8	149.1	153.5	159.3	165.9	173.0	175.3
14 years	891	271	163.5	8.7	148.9	151.9	157.1	163.4	169.9	174.6	177.7
14½ years	1,011	326	166.7	8.7	152.2	155.0	159.8	167.9	173.0	177.2	179.8
15 years	988	317	169.4	7.9	155.6	158.6	163.8	169.7	175.0	178.9	181.7
15½ years	991	322	171.4	7.0	159.0	161.9	167.1	171.6	175.6	180.7	183.3
16 years	981	293	173.3	6.8	161.5	164.2	169.1	173.8	177.8	180.8	183.4
16½ years	823	255	174.5	6.5	164.1	166.3	170.7	174.6	178.7	182.7	185.0
17 years	895	260	175.3	7.1	163.1	166.2	170.1	175.8	180.0	183.8	186.7
17½ years	850	239	175.5	7.1	162.8	166.6	170.5	175.7	179.8	185.1	188.0
Female											
12½ years	1,068	291	155.2	7.6	141.0	144.5	150.7	155.6	160.6	164.4	167.1
13 years	1,081	314	157.0	7.1	145.1	147.7	152.3	157.1	161.6	166.3	168.5
13½ years	967	288	159.2	6.8	147.1	150.5	154.7	159.5	163.9	168.2	170.2
14 years	956	290	160.0	6.4	148.6	151.3	156.1	160.5	164.5	167.8	169.8
14½ years	893	283	161.5	6.2	151.1	153.7	157.2	161.3	165.2	169.9	171.6
15 years	917	266	161.8	6.3	151.8	154.2	157.2	161.7	166.5	169.7	171.8
15½ years	958	253	162.6	7.4	151.5	153.0	157.2	162.5	167.7	171.7	173.6
16 years	987	282	162.3	6.4	151.2	153.4	157.9	162.6	166.8	170.1	171.9
16½ years	774	238	162.4	6.4	151.4	153.7	157.9	162.8	166.7	170.9	173.0
17 years	991	275	163.1	6.4	151.4	154.6	158.8	163.7	167.2	171.5	174.2
17½ years	810	224	162.7	6.1	151.9	154.5	158.4	163.3	167.2	170.7	172.4

NOTE: N = estimated number of persons in population in thousands; n = sample size; $\bar{X}$ = mean; s = standard deviation.

Table 18. Selected observed percentiles of stature (in centimeters), by sex and age, for HES II (1963-65), HES III (1966-70), and HANES I (1971-74): United States—Con.

Survey, sex, and age	N	n	$\overline{X}$	s	Observed percentile						
					5th	10th	25th	50th	75th	90th	95th
HANES I			Stature in centimeters								
Male											
2.00-2.25 years	419	77	88.3	3.8	82.6	83.5	86.1	87.8	90.3	91.9	97.3
2.25-2.75 years	945	157	91.4	4.0	86.1	87.0	89.0	91.3	93.8	97.3	98.3
2.75-3.25 years	785	147	95.0	3.7	88.9	90.5	92.4	95.1	97.2	100.1	101.2
3.25-3.75 years	857	146	98.1	4.1	92.1	93.3	95.7	98.2	101.1	102.8	104.4
3.75-4.25 years	856	152	102.7	4.3	96.2	97.3	100.0	102.6	105.3	107.5	110.8
4.25-4.75 years	937	162	105.7	4.5	98.0	100.2	103.5	105.9	108.6	111.9	113.2
4.75-5.25 years	874	135	108.9	5.0	100.7	103.2	105.5	108.8	112.4	115.4	116.5
5.25-5.75 years	878	146	113.0	4.3	106.2	107.7	110.1	113.5	116.1	118.3	119.5
5.75-6.25 years	867	126	116.1	4.7	108.8	109.8	112.7	117.3	119.2	121.6	122.7
6.25-6.75 years	1,001	81	117.8	6.1	108.5	109.0	113.0	117.8	122.7	125.7	127.2
6.75-7.25 years	957	79	122.6	4.7	114.9	116.4	118.9	122.9	126.4	128.2	129.6
7.25-7.75 years	1,153	84	124.5	5.2	115.4	118.3	120.9	124.7	128.3	131.5	132.8
7.75-8.25 years	1,053	80	128.1	5.7	119.6	121.0	123.5	127.8	132.1	135.6	139.1
8.25-8.75 years	801	74	129.3	5.0	121.8	123.2	125.8	128.5	132.7	136.3	138.6
8.75-9.25 years	853	74	131.6	6.2	119.4	124.1	126.9	133.8	135.9	139.1	140.2
9.25-9.75 years	892	84	134.3	5.4	125.2	128.4	130.7	133.8	137.5	141.9	144.4
9.75-10.25 years	1,064	93	138.8	6.3	127.2	130.9	134.4	139.3	142.8	145.6	150.8
10.25-10.75 years	1,117	89	139.8	6.0	131.5	132.9	135.6	138.7	142.8	148.2	151.5
10.75-11.25 years	1,192	92	143.4	6.2	132.8	134.9	139.0	143.8	147.9	151.2	154.5
11.25-11.75 years	1,001	84	146.4	6.9	136.3	140.1	141.4	145.3	151.1	154.7	155.6
11.75-12.25 years	1,082	90	149.9	7.6	138.3	140.4	145.0	149.4	153.9	160.6	166.2
12.25-12.75 years	1,128	103	152.6	8.0	139.1	142.3	146.7	152.1	157.9	163.7	167.1
12.75-13.25 years	1,221	98	154.2	7.2	142.5	144.4	149.3	154.4	158.8	163.1	165.6
13.25-13.75 years	1,071	86	160.4	8.9	145.1	148.3	153.6	160.4	166.8	171.2	176.1
13.75-14.25 years	1,018	91	164.2	8.9	149.0	153.1	158.8	165.2	170.0	175.3	177.5
14.25-14.75 years	1,027	86	167.6	7.5	154.6	158.3	162.5	167.3	172.8	178.2	179.2
14.75-15.25 years	1,235	94	167.8	8.4	153.1	155.8	162.8	168.7	173.1	177.7	181.6
15.25-15.75 years	837	72	170.9	7.0	159.5	160.9	165.9	171.2	175.2	180.1	184.0
15.75-16.25 years	1,121	89	173.2	7.8	160.1	164.6	168.7	173.3	177.8	181.8	186.6
16.25-16.75 years	931	81	175.1	7.4	163.4	164.8	170.1	175.0	180.5	183.7	190.1
16.75-17.25 years	1,212	97	176.8	7.2	164.6	166.1	172.1	177.3	182.5	185.0	188.3
17.25-17.75 years	1,020	87	176.9	6.6	166.2	168.6	172.8	177.2	181.8	184.8	187.2
17.75-18.25 years	755	63	177.0	5.5	170.1	171.1	173.4	176.2	179.6	186.4	187.2
18.25-19.00 years	1,067	98	176.5	6.4	166.8	169.3	172.0	175.8	180.1	185.9	186.8
19.00-20.00 years	1,770	135	176.3	6.7	162.8	166.9	171.6	177.2	180.8	185.0	186.2
20.00-21.00 years	1,668	104	176.5	7.0	159.4	168.4	172.2	177.4	181.2	183.6	185.8
21.00-22.00 years	1,703	112	177.1	6.6	166.2	168.3	172.5	177.3	181.1	184.8	190.0
22.00-23.00 years	1,662	107	177.1	7.5	167.2	167.7	171.3	177.1	180.6	187.1	192.0
23.00-24.00 years	1,589	94	177.2	9.1	161.3	165.3	172.3	176.8	183.0	188.5	189.2
24.00-25.00 years	1,595	96	178.0	7.0	165.4	168.5	172.9	178.1	183.0	186.7	189.5

NOTE: N = estimated number of persons in population in thousands; n = sample size; $\overline{X}$ = mean; s = standard deviation.

Table 18. Selected observed percentiles of stature (in centimeters), by sex and age, for HES II (1963-65), HES III (1966-70), and HANES I (1971-74): United States—Con.

Survey, sex, and age	N	n	X̄	s	Observed percentile						
					5th	10th	25th	50th	75th	90th	95th
HANES I—Con.			Stature in centimeters								
Female											
2.00-2.25 years	440	83	87.2	4.6	81.3	82.5	84.6	86.8	89.9	93.6	94.6
2.25-2.75 years	972	147	90.2	4.0	84.2	85.3	87.1	90.3	93.4	94.8	96.4
2.75-3.25 years	622	110	95.0	3.1	90.2	90.7	92.7	95.3	96.7	99.1	100.6
3.25-3.75 years	887	149	97.4	3.7	91.8	92.8	95.1	97.4	99.8	102.1	103.6
3.75-4.25 years	775	135	100.8	4.0	94.9	96.2	97.9	100.5	103.8	106.0	108.2
4.25-4.75 years	848	145	103.7	4.5	96.8	97.6	100.5	103.8	106.2	109.4	112.0
4.75-5.25 years	876	146	107.9	4.9	99.1	101.1	105.2	108.1	111.6	113.7	114.7
5.25-5.75 years	890	154	112.2	5.3	103.8	106.1	108.4	111.8	115.5	118.7	121.3
5.75-6.25 years	970	141	115.4	5.4	107.4	109.4	111.6	115.2	118.6	122.6	125.4
6.25-6.75 years	993	81	118.5	5.2	110.5	112.2	114.5	117.8	121.9	125.6	128.2
6.75-7.25 years	803	82	120.6	5.0	111.8	113.4	118.0	120.9	124.3	127.0	127.9
7.25-7.75 years	951	89	124.4	5.6	116.7	117.9	119.7	123.8	128.6	132.7	135.5
7.75-8.25 years	966	82	127.4	5.0	118.3	120.6	123.8	128.3	131.0	133.5	134.8
8.25-8.75 years	913	79	128.3	5.5	120.0	122.0	123.9	128.2	132.8	135.2	135.8
8.75-9.25 years	1,004	83	133.2	6.5	121.8	124.4	129.0	133.2	138.4	141.3	142.9
9.25-9.75 years	841	77	135.6	5.7	126.7	127.7	132.2	135.0	139.5	142.8	146.6
9.75-10.25 years	1,158	100	138.5	6.7	128.3	130.2	133.6	139.2	143.0	146.2	150.0
10.25-10.75 years	1,256	95	140.3	7.3	128.5	130.3	134.9	140.4	144.7	150.1	154.2
10.75-11.25 years	859	80	144.0	7.9	132.2	134.6	139.2	143.7	148.2	154.1	158.7
11.25-11.75 years	909	76	146.3	7.9	134.2	135.0	139.4	147.0	152.5	155.9	157.8
11.75-12.25 years	1,180	102	151.9	8.0	139.4	142.5	146.8	152.0	157.1	163.0	166.7
12.25-12.75 years	970	84	154.6	6.3	144.4	146.8	150.3	154.5	158.8	163.5	165.1
12.75-13.25 years	1,034	86	157.1	6.8	143.0	147.5	153.0	157.6	161.4	164.9	166.5
13.25-13.75 years	1,273	109	159.4	5.4	150.6	152.2	155.5	159.8	163.9	165.5	166.7
13.75-14.25 years	1,204	98	159.1	5.6	150.5	151.7	155.3	159.5	163.0	166.3	167.5
14.25-14.75 years	1,009	88	161.3	6.4	149.6	152.6	157.3	161.7	165.5	169.2	170.5
14.75-15.25 years	1,106	96	161.5	7.2	150.8	152.8	156.4	160.0	166.1	173.8	176.0
15.25-15.75 years	1,002	86	164.0	6.3	155.1	156.4	159.3	163.6	167.1	172.7	177.2
15.75-16.25 years	931	76	163.8	6.0	154.1	155.2	158.8	164.9	168.6	171.0	172.9
16.25-16.75 years	897	82	161.7	6.6	150.4	152.3	157.3	161.4	166.4	172.3	173.2
16.75-17.25 years	1,226	102	161.4	6.8	152.3	154.3	157.4	160.5	166.1	171.5	173.6
17.25-17.75 years	811	75	162.0	6.5	149.8	154.2	157.6	161.6	166.5	168.8	173.2
17.75-18.25 years	767	72	163.9	5.6	151.5	157.2	160.6	164.5	168.2	170.3	171.5
18.25-19.00 years	1,420	106	164.8	5.9	154.9	157.8	161.2	165.3	167.2	172.4	174.2
19.00-20.00 years	1,384	137	163.4	6.0	155.0	155.9	159.9	163.0	166.8	170.6	173.1
20.00-21.00 years	1,771	236	163.6	7.0	152.3	155.1	159.0	163.2	168.8	172.4	175.3
21.00-22.00 years	1,818	257	162.7	6.5	152.0	154.6	158.5	162.5	167.0	170.8	173.0
22.00-23.00 years	1,734	249	162.3	7.3	150.4	153.0	156.9	162.8	167.2	171.3	174.5
23.00-24.00 years	1,800	253	163.0	5.8	154.2	156.0	158.6	163.1	166.8	170.5	172.6
24.00-25.00 years	1,796	248	162.8	6.0	152.3	155.4	158.3	162.3	167.4	170.4	171.6

NOTE: N = estimated number of persons in population in thousands; n = sample size; $\bar{X}$ = mean; s = standard deviation.

Table 19. Selected observed percentiles of weight (in kilograms), by sex and age, for HES II (1963-65), HES III (1966-70), and HANES I (1971-74): United States

Survey, sex, and age	N	n	$\bar{X}$	s	Percentile						
					5th	10th	25th	50th	75th	90th	95th
			Weight in kilograms								
HES II											
Male											
6½ years	1,065	294	21.76	3.02	16.87	17.84	20.02	21.44	23.40	25.50	27.42
7 years	1,028	304	23.30	3.59	18.41	19.17	20.88	22.89	25.03	27.53	29.47
7½ years	1,088	327	24.67	4.06	18.93	19.94	22.19	24.23	26.80	29.47	31.61
8 years	975	295	26.36	4.51	20.60	21.66	23.46	26.01	28.41	31.40	33.75
8½ years	1,003	307	27.87	4.71	21.40	22.67	24.74	27.22	29.70	34.38	36.86
9 years	1,033	312	28.99	5.35	22.28	23.40	25.33	28.25	31.60	35.78	37.92
9½ years	1,025	308	31.20	6.74	23.42	24.61	26.95	29.69	33.36	39.33	46.06
10 years	997	300	32.29	6.58	24.28	25.38	28.09	31.17	35.13	39.24	43.40
10½ years	1,022	297	33.63	6.32	25.49	26.94	29.44	32.79	36.61	41.56	44.55
11 years	913	281	36.12	7.02	27.96	28.80	31.10	35.04	39.14	44.13	50.95
11½ years	904	303	38.15	7.74	27.87	29.57	32.90	36.69	41.80	47.75	53.09
Female											
6½ years	1,057	278	21.45	3.61	16.36	17.35	18.98	21.09	23.35	25.65	27.70
7 years	1,087	316	22.77	3.95	17.86	18.46	19.91	22.29	24.88	27.91	30.53
7½ years	952	287	24.44	4.31	18.59	19.66	21.41	23.75	26.67	29.89	31.75
8 years	1,042	312	25.39	4.42	19.35	20.36	22.22	24.72	27.87	31.42	33.98
8½ years	1,022	324	27.41	5.22	20.36	21.55	23.68	26.85	29.84	33.88	38.09
9 years	971	294	29.40	5.77	22.13	23.23	25.40	28.37	31.90	36.96	41.43
9½ years	929	281	31.52	7.02	22.75	24.34	26.70	30.01	34.97	41.66	45.76
10 years	1,025	307	33.55	7.51	24.32	25.34	28.16	31.91	37.48	44.51	47.63
10½ years	916	283	34.94	8.05	24.79	26.14	28.84	34.03	39.14	45.92	49.63
11 years	882	271	37.63	8.69	26.43	28.20	32.03	36.23	41.39	47.96	54.90
11½ years	814	245	39.81	9.07	28.28	30.13	33.30	37.98	45.00	51.68	59.18
HES III											
Male											
12½ years	1,057	344	42.43	9.18	30.95	32.64	35.92	40.72	47.24	55.64	59.97
13 years	1,089	337	45.45	9.71	31.42	34.45	38.45	44.28	50.61	58.72	62.34
13½ years	1,041	328	50.39	11.57	36.12	37.29	41.32	48.65	57.20	66.44	71.18
14 years	891	271	53.61	12.36	38.03	40.09	45.33	51.32	59.53	69.22	77.03
14½ years	1,011	326	56.85	12.66	39.30	41.52	49.18	55.38	62.77	71.32	78.75
15 years	988	317	59.31	11.24	43.14	46.10	50.57	58.30	66.52	74.00	76.66
15½ years	991	322	61.50	10.90	47.11	49.62	54.70	59.68	66.64	76.19	83.82
16 years	981	293	63.60	12.32	47.37	50.33	56.37	62.02	68.86	77.59	86.08
16½ years	823	255	64.19	10.17	49.83	52.15	57.12	62.42	69.86	78.22	81.73
17 years	895	260	66.46	11.66	50.15	52.63	59.13	64.75	72.62	80.64	85.67
17½ years	850	239	68.65	11.45	53.08	56.37	60.78	66.96	73.92	84.77	91.54
Female											
12½ years	1,068	291	46.42	9.89	31.88	35.23	39.23	45.61	52.36	59.33	63.63
13 years	1,081	314	48.56	10.27	35.01	37.39	41.55	46.95	53.53	62.31	67.65
13½ years	967	288	50.83	10.62	36.48	38.53	43.86	49.84	56.58	63.02	69.86
14 years	956	290	52.23	9.77	38.26	40.28	46.14	51.04	57.60	63.91	69.25
14½ years	893	283	54.39	11.31	40.58	42.88	47.07	52.40	59.83	67.95	71.78
15 years	917	266	54.83	9.49	41.18	44.08	47.97	53.91	59.81	66.46	71.40
15½ years	958	253	56.86	12.04	41.12	44.23	48.97	54.94	61.00	72.66	82.61
16 years	987	282	56.78	9.77	44.56	46.67	50.63	54.81	60.46	69.01	76.55
16½ years	774	238	57.88	11.77	45.03	46.70	50.41	55.20	62.66	70.68	79.39
17 years	991	275	58.53	12.09	44.51	46.57	50.15	57.19	62.27	74.06	83.48
17½ years	810	224	57.85	10.28	44.79	46.88	51.04	55.61	63.00	69.78	77.96

NOTE: N = estimated number of persons in population in thousands; n = sample size; $\bar{X}$ = mean; s = standard deviation.

Table 19. Selected observed percentiles of weight (in kilograms), by sex and age, for HES II (1963-65), HES III (1966-70), and HANES I (1971-74): United States—Con.

Survey, sex, and age	N	n	$\overline{X}$	s	Percentile 5th	10th	25th	50th	75th	90th	95th
HANES I			Weight in kilograms								
Male											
2.00-2.25 years	419	77	12.74	1.60	9.97	11.10	11.63	12.67	14.05	14.85	15.47
2.25-2.75 years	945	157	13.69	1.77	11.31	11.89	12.63	13.53	14.57	15.69	16.80
2.75-3.25 years	785	147	14.61	1.54	12.28	12.84	13.55	14.43	15.34	16.39	17.37
3.25-3.75 years	857	146	15.48	1.76	12.70	13.34	14.33	15.39	16.46	17.77	18.63
3.75-4.25 years	856	152	16.85	2.24	13.83	14.70	15.46	16.64	17.85	18.87	20.62
4.25-4.75 years	937	162	17.67	2.10	14.42	15.09	16.02	17.71	19.17	20.45	21.51
4.75-5.25 years	874	135	18.55	2.50	14.99	15.52	16.91	18.47	20.22	21.02	22.59
5.25-5.75 years	878	146	20.26	2.98	17.01	17.31	18.33	19.88	21.39	23.21	25.32
5.75-6.25 years	867	126	21.31	2.65	16.64	17.75	19.84	21.21	22.66	24.51	26.17
6.25-6.75 years	1,001	81	21.92	3.48	17.08	17.72	19.32	21.66	23.75	27.07	28.72
6.75-7.25 years	957	79	24.00	3.71	18.62	19.45	21.89	23.70	26.17	30.35	31.37
7.25-7.75 years	1,153	84	24.51	4.02	18.63	20.13	21.85	24.51	26.35	29.17	32.90
7.75-8.25 years	1,053	80	26.37	4.52	19.51	21.00	23.69	25.42	28.93	31.51	34.83
8.25-8.75 years	801	74	26.36	3.48	21.67	22.57	24.25	25.51	28.70	31.66	32.91
8.75-9.25 years	853	74	28.83	5.57	19.89	22.60	24.85	27.53	31.93	38.53	40.87
9.25-9.75 years	892	84	30.65	6.39	22.83	24.08	25.74	29.58	33.86	37.86	45.01
9.75-10.25 years	1,064	93	33.57	7.47	24.55	25.94	27.89	32.64	38.47	41.57	43.63
10.25-10.75 years	1,117	89	33.77	6.42	26.77	28.21	29.51	32.40	36.18	39.85	51.73
10.75-11.25 years	1,192	92	36.87	7.44	28.00	28.78	31.37	36.36	40.14	45.15	52.71
11.25-11.75 years	1,001	84	39.06	8.48	28.53	30.59	35.02	37.94	42.08	47.46	52.40
11.75-12.25 years	1,082	90	41.85	11.40	30.11	31.02	33.85	39.03	48.15	55.62	63.88
12.25-12.75 years	1,128	103	43.27	8.59	32.29	33.22	36.87	42.92	47.87	53.40	55.92
12.75-13.25 years	1,221	98	45.61	10.90	32.74	34.72	38.40	43.24	49.43	58.49	66.84
13.25-13.75 years	1,071	86	50.63	9.48	36.48	39.32	44.36	49.48	58.68	62.28	65.13
13.75-14.25 years	1,018	91	54.71	12.28	38.80	43.22	48.34	51.78	61.62	67.47	76.63
14.25-14.75 years	1,027	86	57.47	10.79	42.72	44.84	50.15	55.56	63.13	73.14	75.05
14.75-15.25 years	1,235	94	56.89	13.13	41.62	43.63	50.26	54.90	60.83	68.95	76.48
15.25-15.75 years	837	72	60.45	10.94	44.42	49.17	53.70	58.37	67.27	74.43	79.84
15.75-16.25 years	1,121	89	63.41	11.39	45.86	51.00	55.22	61.62	69.99	75.89	86.19
16.25-16.75 years	931	81	66.85	11.27	51.16	52.99	56.01	66.19	74.68	83.19	88.51
16.75-17.25 years	1,212	97	69.88	13.07	54.32	56.38	61.63	67.92	74.29	82.90	96.08
17.25-17.75 years	1,020	87	68.58	11.71	50.42	54.50	60.52	66.19	76.57	83.14	92.85
17.75-18.25 years	775	63	72.27	16.37	56.34	59.03	62.89	68.93	76.75	90.02	95.40
18.25-19.00 years	1,067	98	72.92	12.47	54.96	60.35	63.62	69.88	78.67	92.66	99.61
19.00-20.00 years	1,770	135	72.42	11.98	55.40	57.38	65.91	70.66	76.43	87.01	96.48
20.00-21.00 years	1,668	104	73.60	12.37	55.86	57.71	65.04	71.90	78.44	88.86	94.84
21.00-22.00 years	1,703	112	73.58	12.74	52.66	58.17	65.29	72.12	80.96	89.05	96.14
22.00-23.00 years	1,662	107	73.94	13.48	55.02	59.14	65.09	71.77	79.66	90.57	96.93
23.00-24.00 years	1,589	94	76.38	14.52	59.16	60.69	65.54	74.71	82.44	94.05	105.35
24.00-25.00 years	1,595	96	79.07	13.08	60.87	63.96	67.96	79.37	85.69	97.61	103.19

NOTE: N = estimated number of persons in population in thousands; n = sample size; $\overline{X}$ = mean; s = standard deviation.

Table 19. Selected observed percentiles of weight (in kilograms), by sex and age, for HES II (1963-65), HES III (1966-70), and HANES I (1971-74): United States—Con.

Survey, sex, and age	N	n	$\bar{X}$	s	Percentile						
					5th	10th	25th	50th	75th	90th	95th
HANES I–Con.					Weight in kilograms						
Female											
2.00-2.25 years	440	83	12.19	1.46	10.06	10.66	11.41	12.21	12.86	13.84	14.57
2.25-2.75 years	972	147	12.93	1.48	10.77	11.20	11.98	12.76	13.94	14.74	15.09
2.75-3.25 years	622	110	14.48	1.78	12.14	12.40	13.12	13.93	15.61	16.84	17.74
3.25-3.75 years	887	149	14.87	1.75	12.29	13.03	13.58	14.60	15.93	17.54	18.28
3.75-4.25 years	775	135	15.88	1.84	13.13	13.63	14.51	15.68	17.15	18.22	18.94
4.25-4.75 years	848	145	16.64	2.18	13.45	14.05	15.04	16.57	17.78	19.35	20.26
4.75-5.25 years	876	146	18.07	2.39	14.33	15.21	16.48	17.73	19.66	21.23	22.10
5.25-5.75 years	890	154	19.57	3.41	15.18	16.20	17.47	18.92	20.96	23.44	25.01
5.75-6.25 years	970	141	20.99	4.04	16.44	16.99	18.14	20.34	22.23	25.05	28.81
6.25-6.75 years	993	81	21.73	3.23	17.16	17.88	19.05	21.03	23.98	26.73	28.02
6.75-7.25 years	803	82	22.24	2.91	17.70	18.61	20.36	22.06	23.53	25.48	27.01
7.25-7.75 years	951	89	24.14	3.74	18.72	19.42	21.44	23.73	26.67	29.30	31.28
7.75-8.25 years	966	82	26.32	4.98	20.53	21.19	22.71	24.87	27.89	33.41	38.23
8.25-8.75 years	913	79	26.64	4.59	20.36	21.23	22.89	26.07	29.34	33.38	35.19
8.75-9.25 years	1,004	83	30.84	7.02	22.25	23.13	25.15	29.51	34.03	41.33	43.55
9.25-9.75 years	841	77	31.15	5.11	23.94	25.32	27.12	30.48	34.15	38.35	42.09
9.75-10.25 years	1,158	100	32.62	6.41	24.35	25.18	27.89	31.48	35.54	41.94	45.22
10.25-10.75 years	1,256	95	34.20	6.53	25.87	27.26	29.79	32.53	37.03	45.81	47.98
10.75-11.25 years	859	80	37.56	7.97	27.00	28.42	32.16	36.05	42.95	47.39	53.60
11.25-11.75 years	909	76	39.04	8.65	26.63	28.88	32.28	37.96	44.19	50.86	57.60
11.75-12.25 years	1,180	102	44.89	11.01	30.45	33.73	36.76	41.94	52.01	64.04	70.17
12.25-12.75 years	970	84	46.02	8.62	32.83	34.61	39.62	45.53	50.71	56.62	61.76
12.75-13.25 years	1,034	86	48.86	10.77	33.25	36.35	41.36	47.09	56.69	62.06	66.80
13.25-13.75 years	1,273	109	52.87	11.37	38.58	40.12	46.30	50.86	57.18	70.66	77.75
13.75-14.25 years	1,204	98	51.76	11.91	37.43	39.57	44.90	49.44	55.62	67.48	75.76
14.25-14.75 years	1,009	88	56.34	12.18	41.11	43.58	47.58	53.80	62.30	70.40	88.19
14.75-15.25 years	1,106	96	55.20	10.90	41.13	43.07	46.54	52.69	59.45	73.83	75.52
15.25-15.75 years	1,002	86	56.94	11.25	46.04	46.98	49.46	55.76	61.44	67.83	75.57
15.75-16.25 years	931	76	56.73	11.91	43.23	44.88	48.75	54.74	62.95	67.30	78.44
16.25-16.75 years	897	82	57.61	12.51	42.99	44.59	47.85	54.55	63.25	73.11	88.25
16.75-17.25 years	1,226	102	57.95	11.49	43.52	44.87	50.74	56.49	62.29	71.56	84.48
17.25-17.75 years	811	75	58.44	17.21	42.77	43.96	50.11	54.44	59.90	74.01	90.69
17.75-18.25 years	767	72	59.62	10.10	46.33	49.95	54.10	58.32	62.64	68.86	78.21
18.25-19.00 years	1,420	106	58.31	10.22	44.83	45.89	51.02	56.97	63.16	72.63	78.70
19.00-20.00 years	1,384	137	60.08	13.21	48.65	48.83	51.62	57.24	63.48	76.33	83.48
20.00-21.00 years	1,771	236	58.70	10.16	44.40	47.23	51.70	57.22	63.94	72.15	75.89
21.00-22.00 years	1,818	257	60.08	11.10	46.08	48.54	52.15	58.36	64.64	72.88	81.77
22.00-23.00 years	1,734	249	60.75	13.69	42.86	46.19	51.35	58.82	67.38	75.54	85.35
23.00-24.00 years	1,800	253	61.04	14.35	45.59	47.77	52.16	59.87	64.64	72.80	84.62
24.00-25.00 years	1,796	248	61.27	13.74	46.65	48.13	52.06	58.88	66.33	77.17	86.04

NOTE: N = estimated number of persons in population in thousands; n = sample size; $\bar{X}$ = mean; s = standard deviation.

APPENDIXES

CONTENTS

APPENDIX TABLE

LIST OF APPENDIX FIGURES

APPENDIX I

GROWTH CHARTS

Figure I. Length by age percentiles for girls aged birth-36 months.

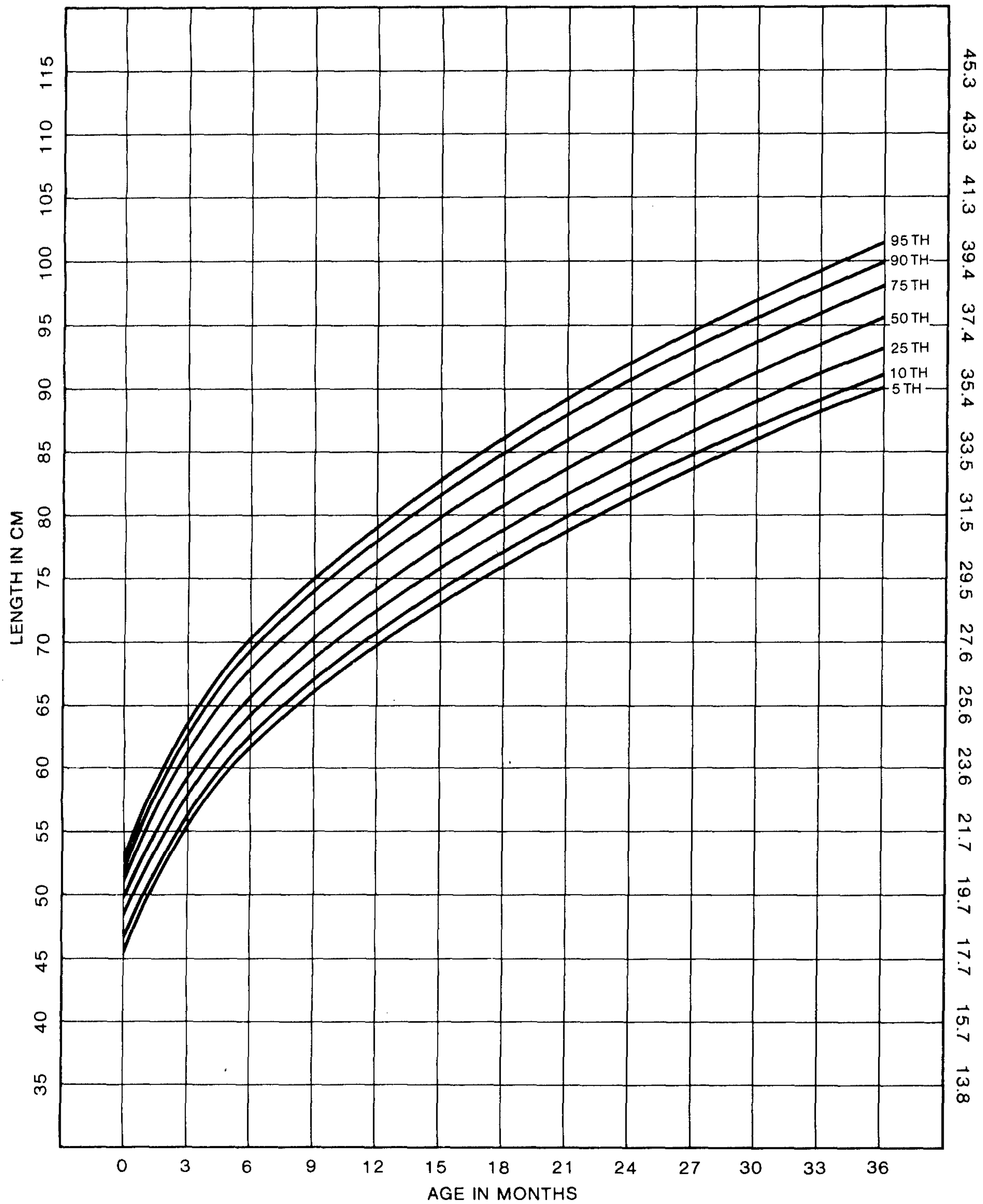


Figure 11. Length by age percentiles for boys aged birth-36 months.

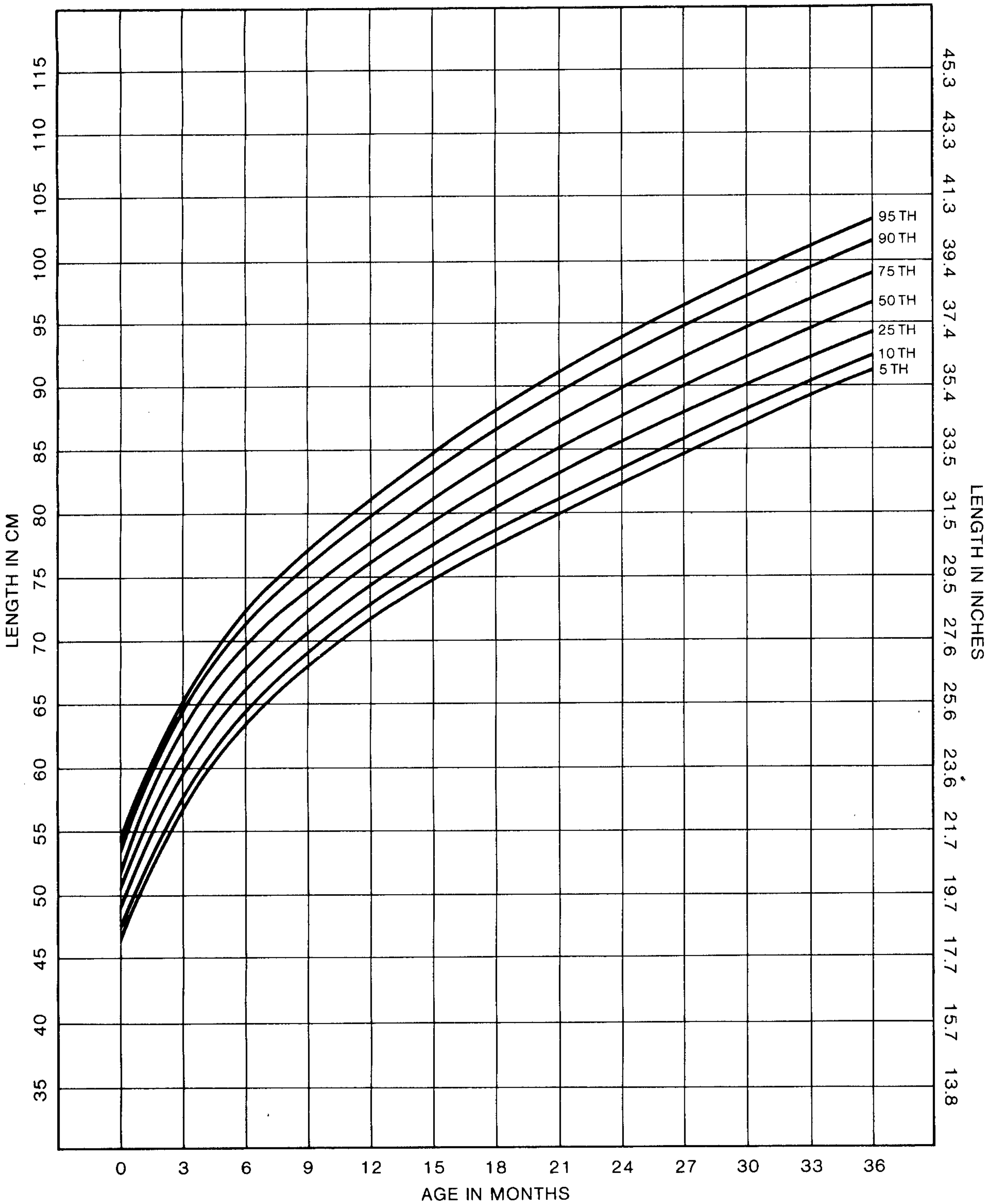


Figure III. Weight by age percentiles for girls aged birth-36 months.

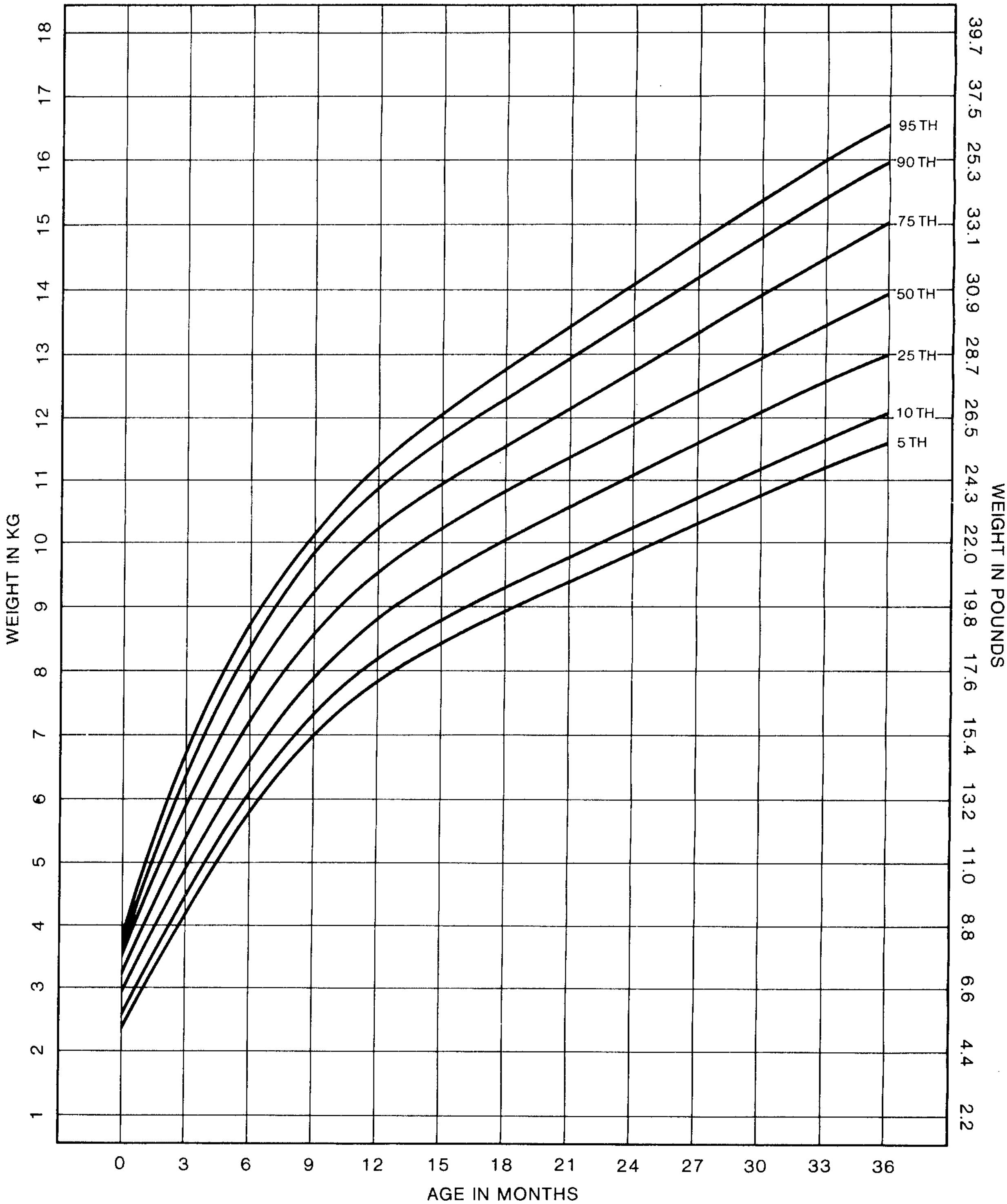


Figure IV. Weight by age percentiles for boys aged birth-36 months.

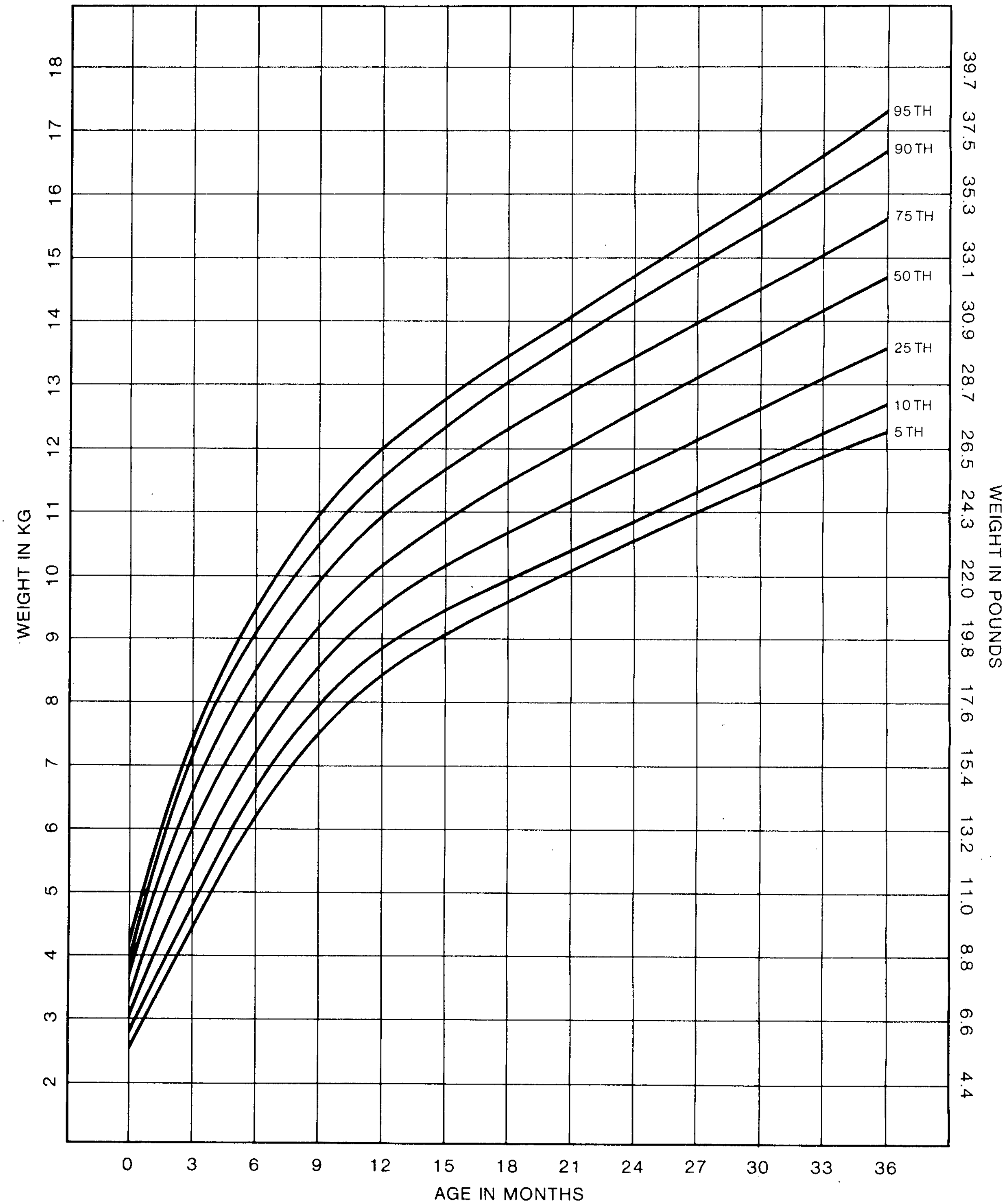


Figure V. Head circumference by age percentiles for girls aged birth-36 months.

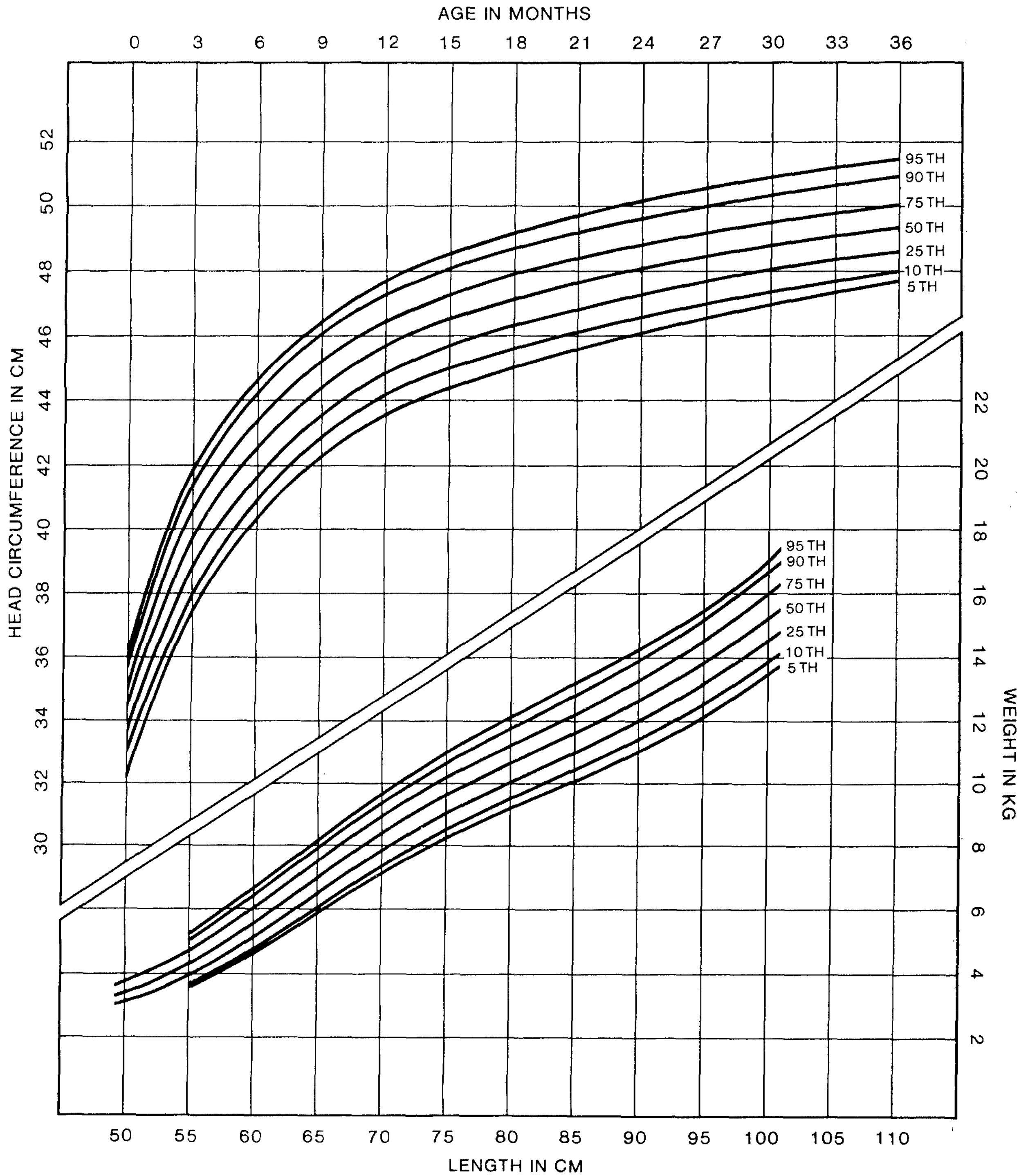


Figure VI. Weight by length percentiles for girls aged birth-36 months.

Figure VII. Head circumference by age percentiles for boys aged birth-36 months.

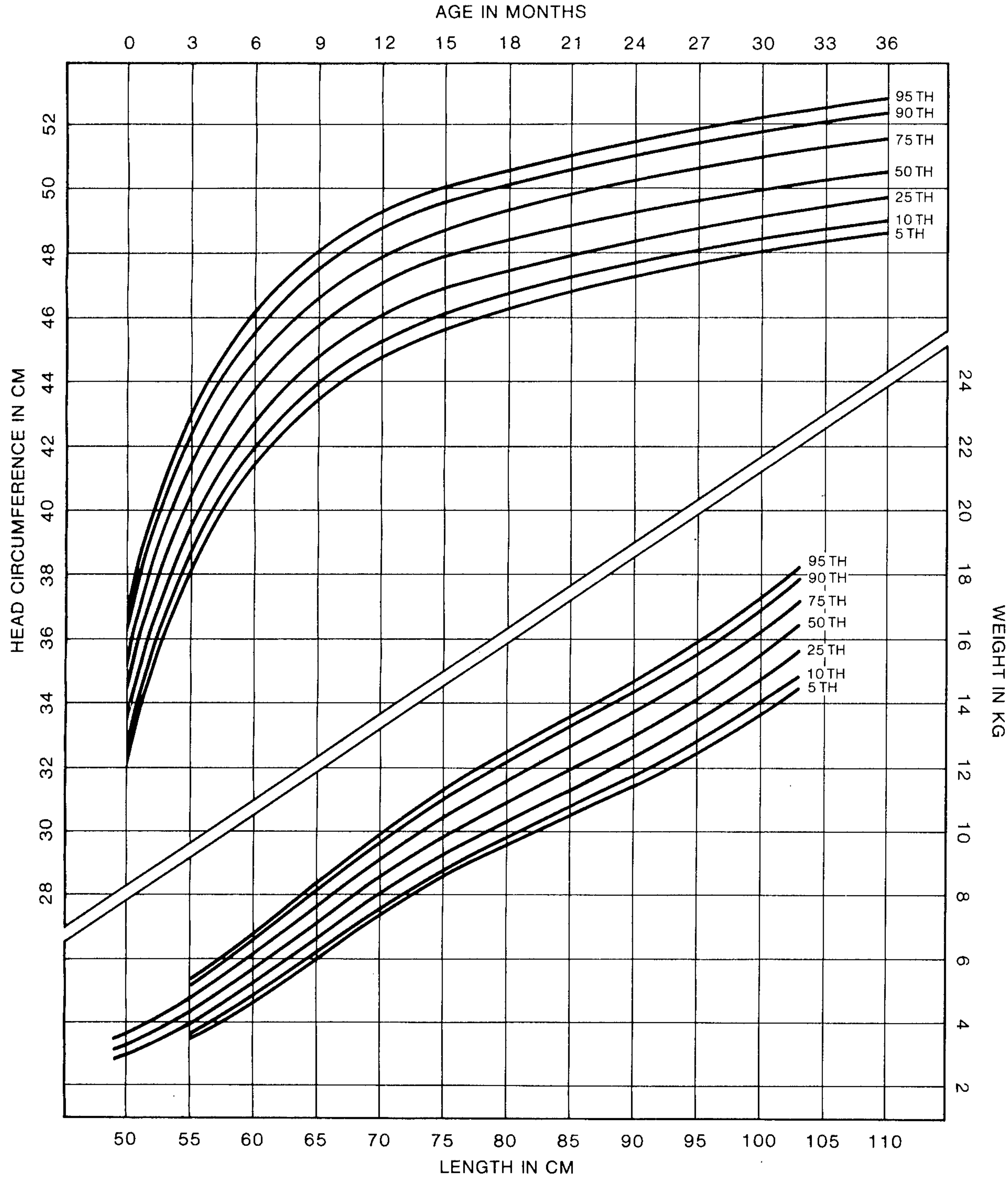


Figure VIII. Weight by length percentiles for boys aged birth-36 months.

Figure IX. Stature by age percentiles for girls aged 2 to 18 years.

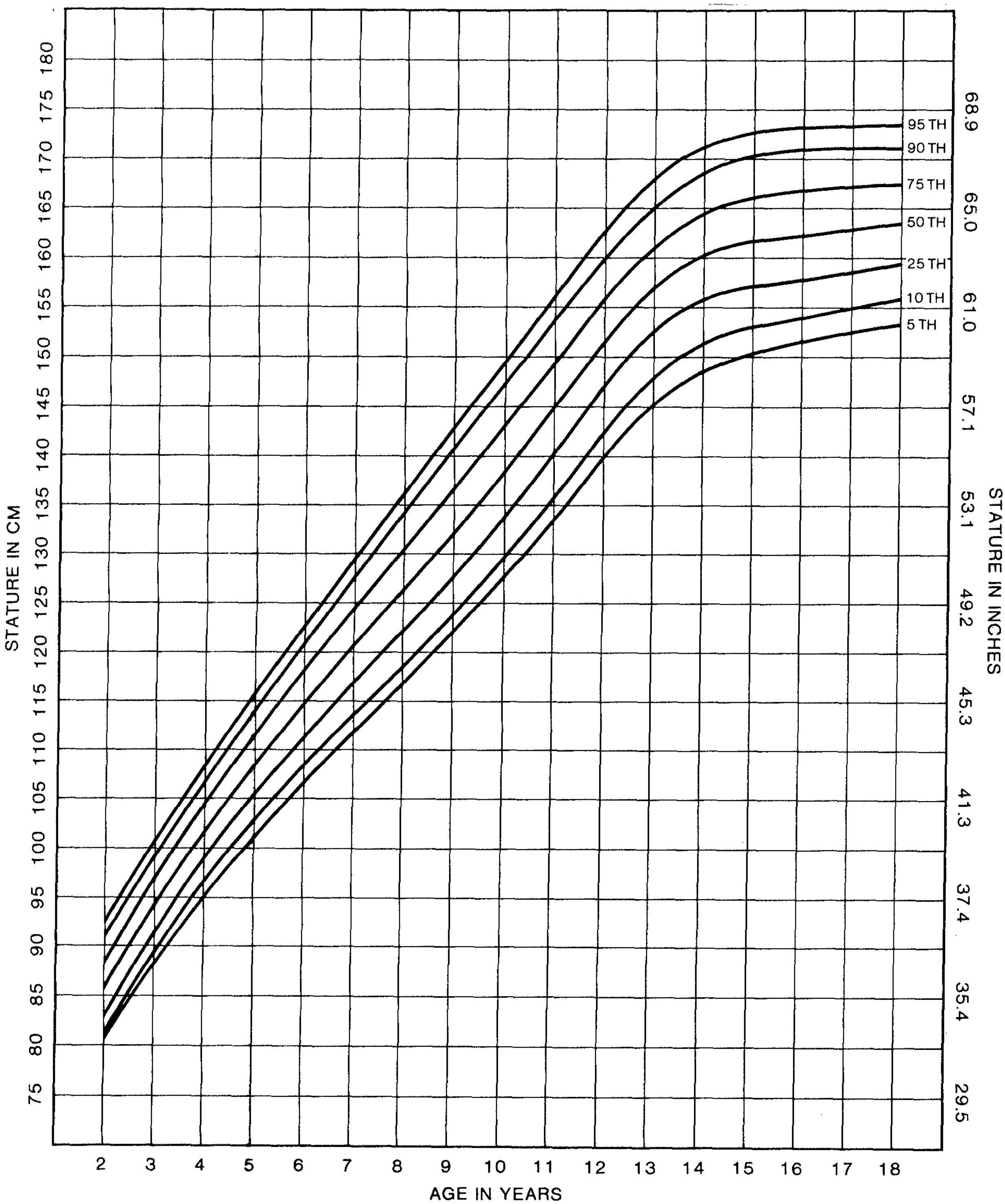


Figure X. Stature by age percentiles for boys aged 2 to 18 years.

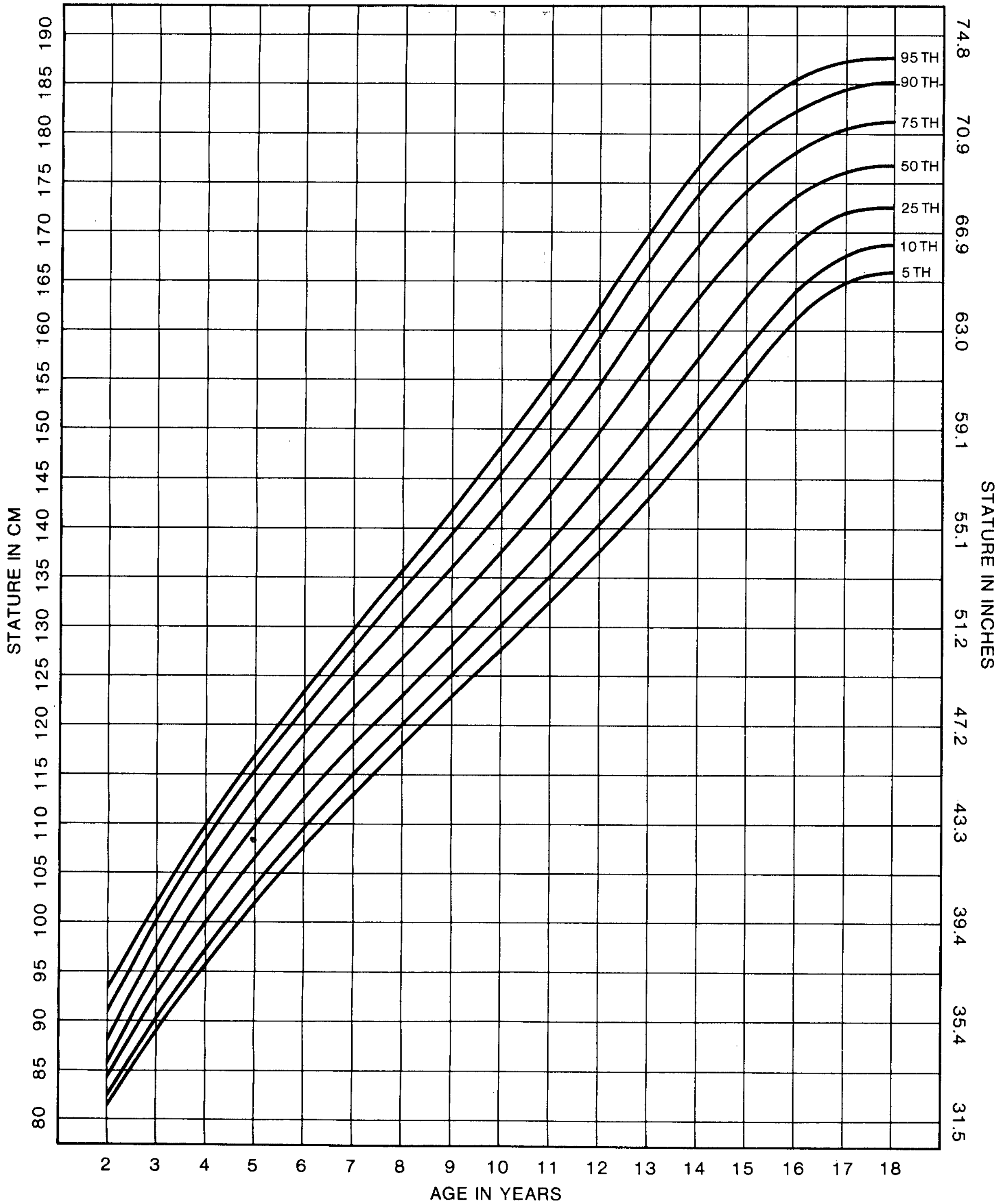


Figure XI. Weight by age percentiles for girls aged 2 to 18 years.

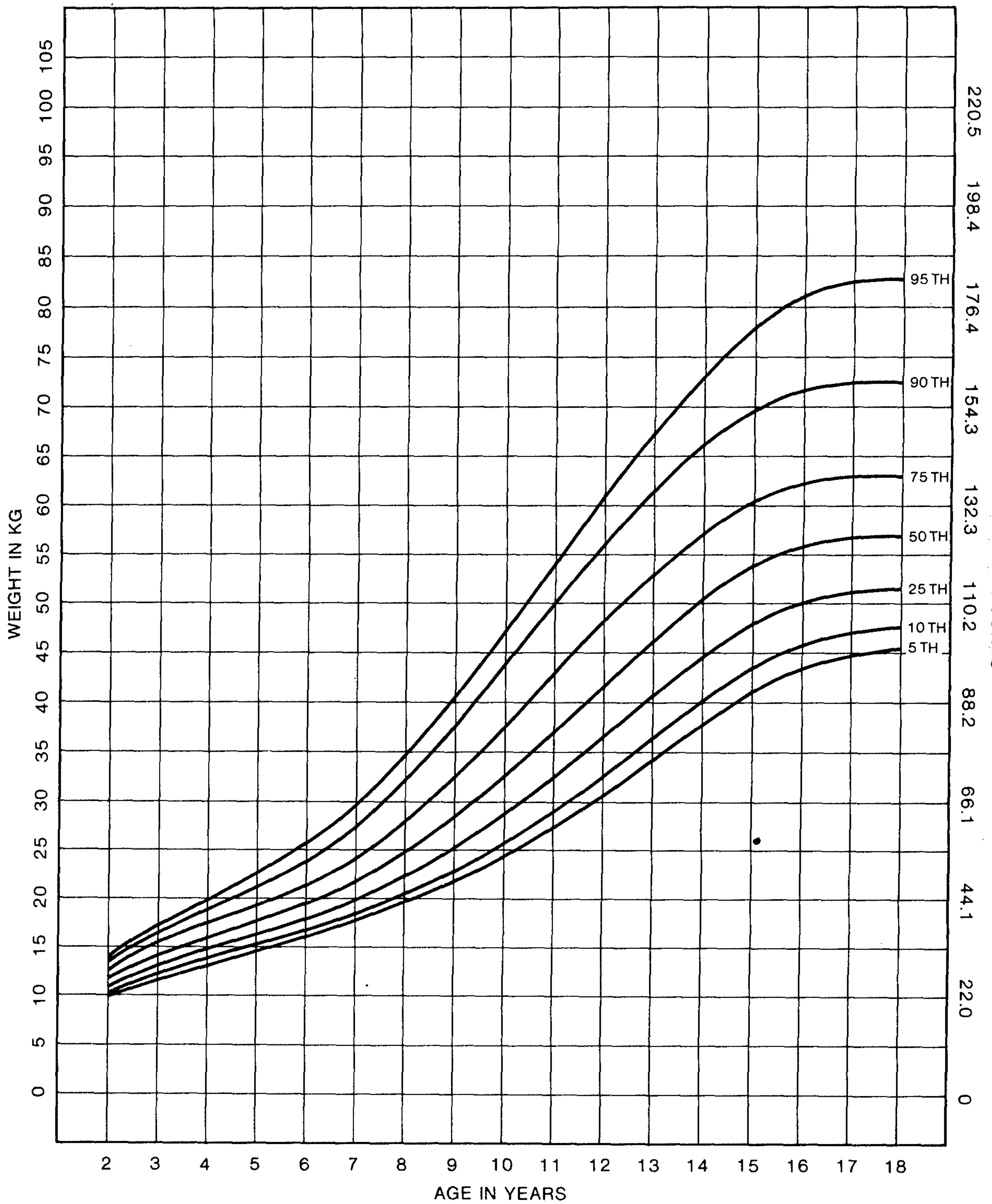


Figure XII. Weight by age percentiles for boys aged 2 to 18 years.

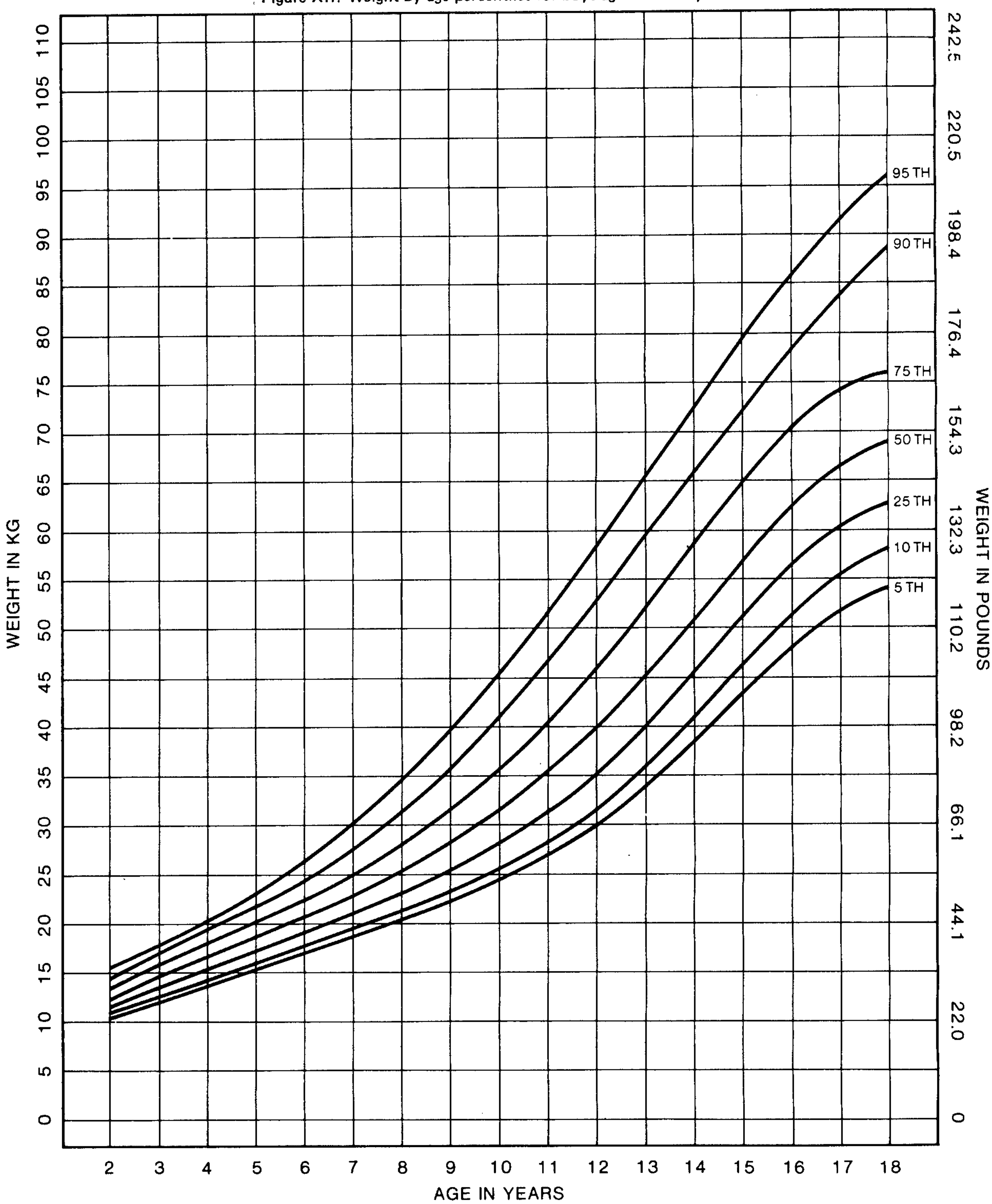


Figure XIII. Weight by stature percentiles for prepubescent girls.

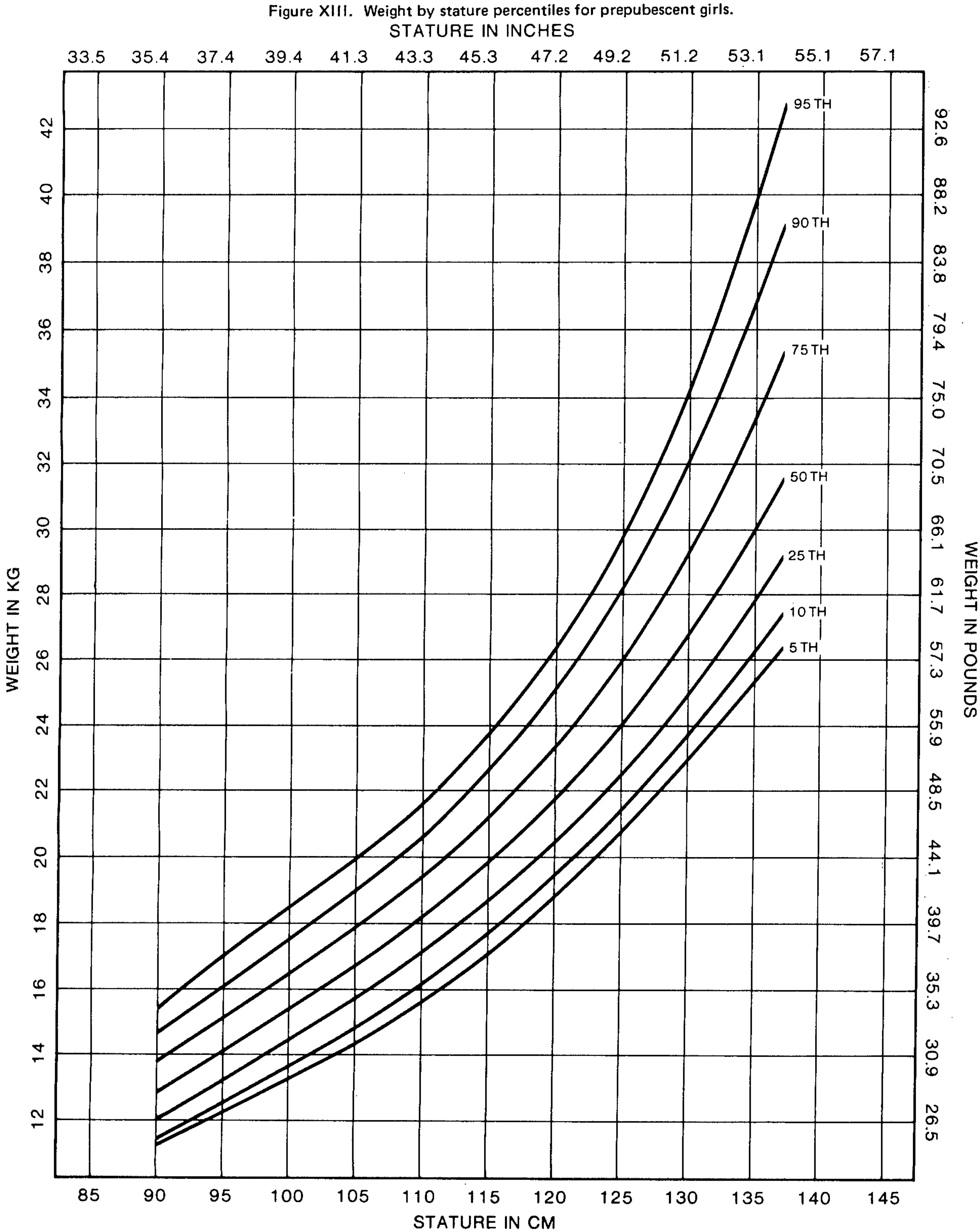
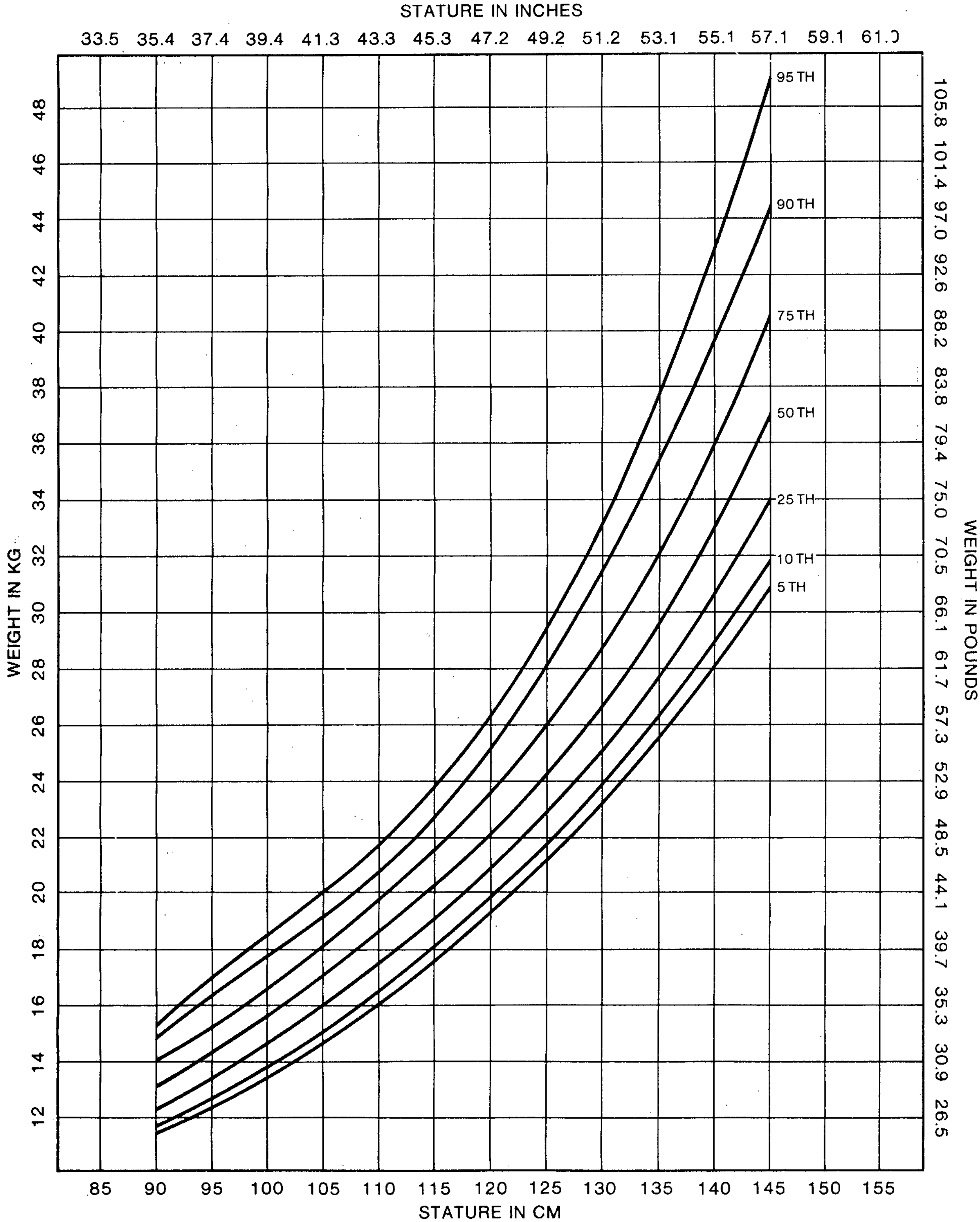


Figure XIV. Weight by stature percentiles for prepubescent boys.



APPENDIX II

TECHNICAL NOTES

Pooling of Data

As noted earlier, the NCHS data sets in the age range 2-24 years were pooled, and the observed percentiles were weighted to represent the U.S. population. Originally, there were three separate data sets; all have been described in earlier NCHS publications.[5-8] The data collected in Cycle II of the Health Examination Survey (HES) represent the U.S. population, aged 6-11 years. The data collected in HES Cycle III represent the U.S. population, aged 12-17 years. Finally, that data collected in Cycle I of the Health and Nutrition Examination Survey (HANES) represent the U.S. population, aged birth-74 years. Thus, the population segment aged 6-17 years is essentially doubly represented.

A number of considerations prompted the merging of the three data sets and the subsequent reweighting of combined statistical estimates. By far the most important was the desire to stabilize the extreme percentiles; these statistics are vulnerable to the effects of outliers if unusually large statistical weights are associated with the outliers. This phenomenon was observed particularly in the HANES I data; for example, one subject represented over 5 percent of the U.S. population of 20½-year-old females. The simple addition of more cases (with associated sample weights) normally will mitigate the effects of such unusual situations.

A second very important consideration was that of timeliness. The first two data sets were collected from 1963 to 1970. Although they are some of the best population data ever collected in this field, it was felt that the addition of the third data set would guarantee that any trends present could be detected and reported. Conversely, if no trends were detected, this could be reported as well.

This examination for trends actually preceded the generation of the spline curves. Most of the work is summed up in tables 18 and 19 and figures XV-XVIII and represent raw data. The small stature differences detected suggest that no secular trend toward greater stature is present except in the 5th and possibly 10th percentiles. The body weights show a very slight upward shift of the entire distribution, but for only one line was the shift statistically significant. Since the similarities far outweighed the differences, the merged data sets would provide percentiles much like those of the original data sets.

On the other hand, it could be argued that the inclusion of the two earlier data sets, if they were quite similar to the later data set, was redundant, and the estimates need be based only on the most up-to-date data. However, the data sets are of unequal quality, due to differences in the designs and response rates of the three surveys. Cycle II had the best response rate, about 95 percent, and Cycle III had the second best, about 90 percent. Unfortunately, the HANES I response rate dropped to barely 74 percent. In addition, as a result of the survey design, the HANES I sampling weights are far more variable than those of either HES II or HES III; the highest sampling weight is sometimes more than 40 times the lowest. This is particularly unfortunate for the estimation of percentiles, where, as

NOTE: A list of references follows the text.

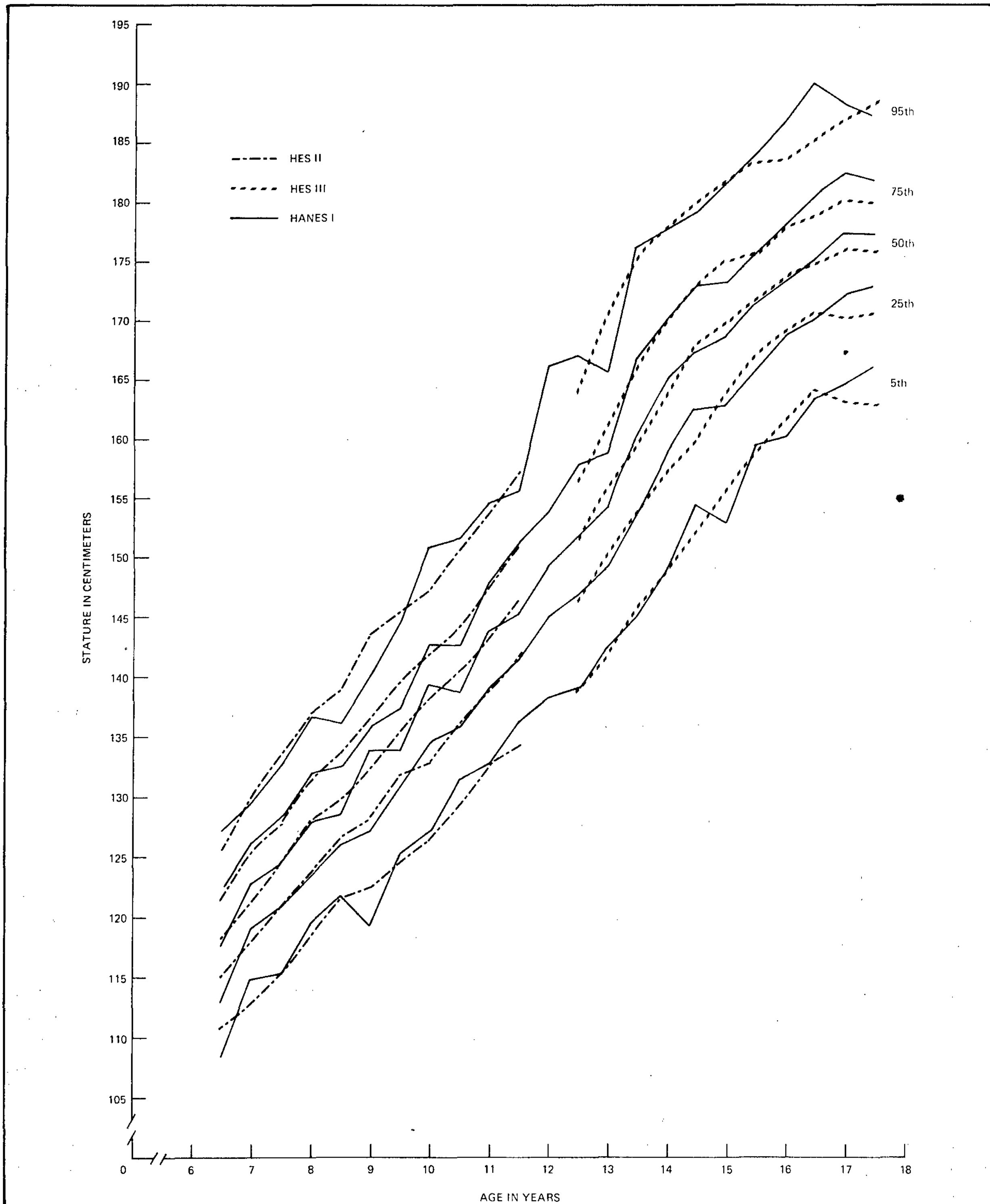


Figure XV. Observed percentiles of stature by age for males of HES II (6-11 years), HES III (12-17 years), and HANES I (6-17 years): United States.

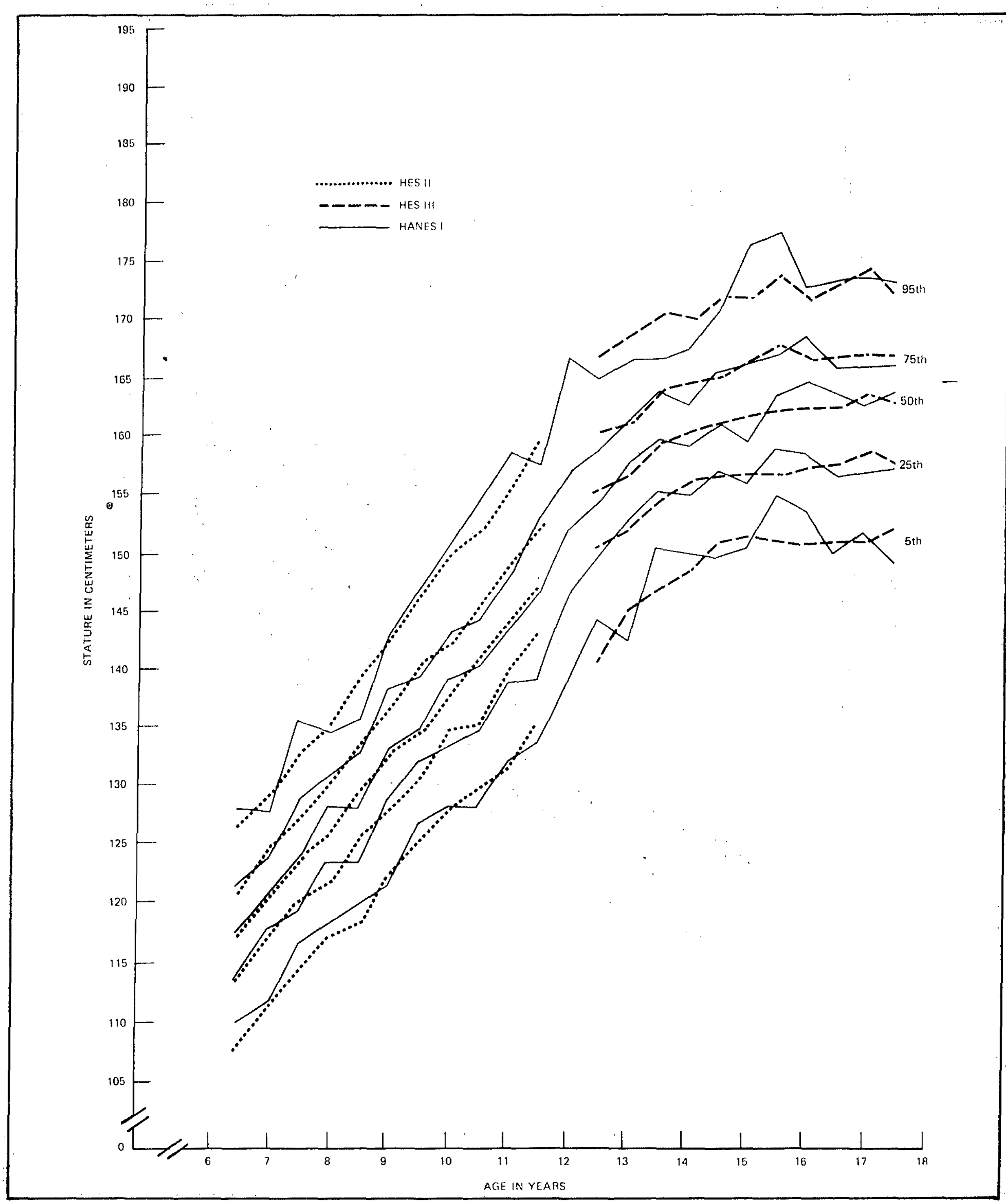


Figure XVI. Observed percentiles of stature by age for females of HES II (6-11 years), HES III (12-17 years), and HANES I (6-17 years): United States.

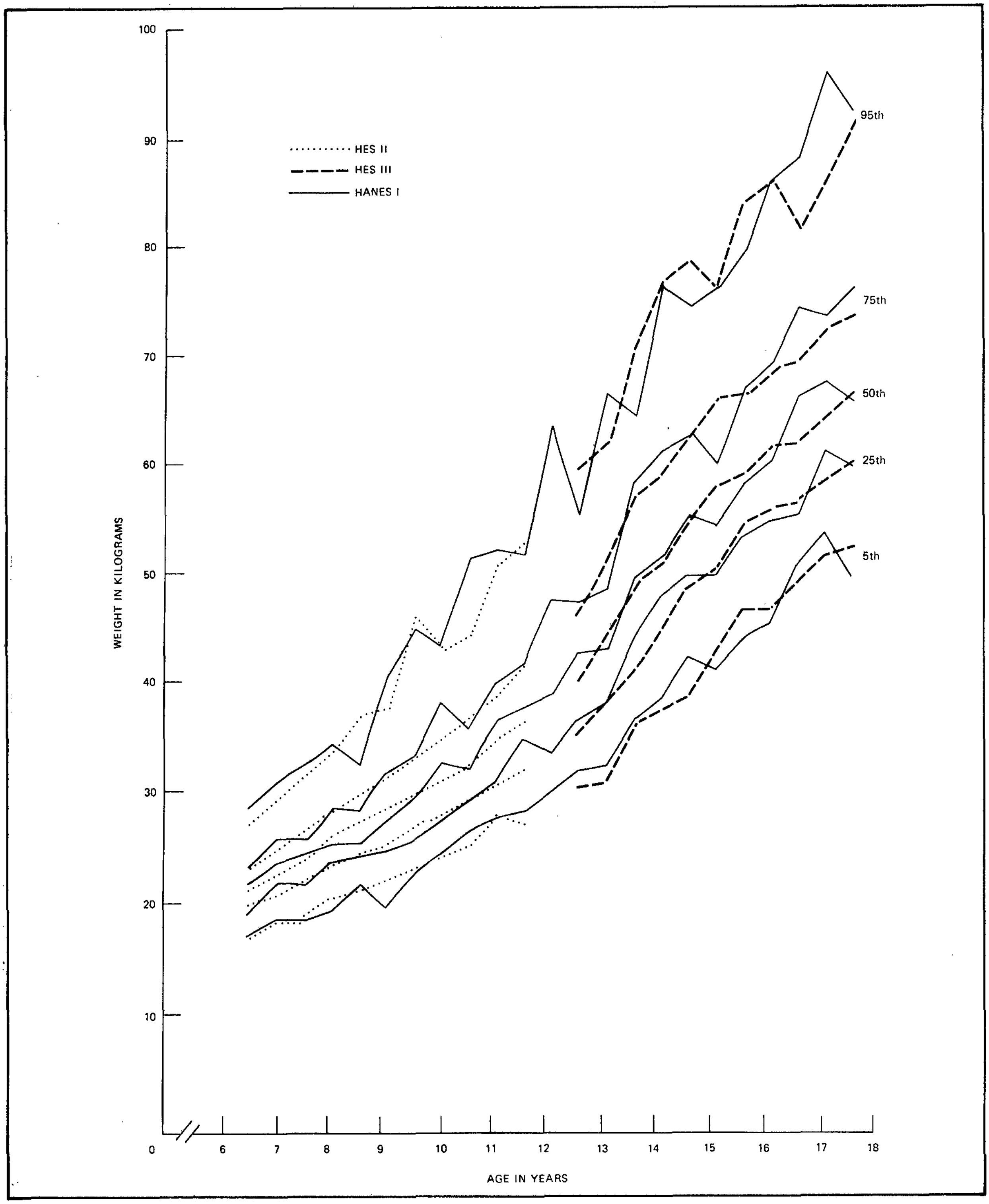


Figure XVII. Observed percentiles of weight by age for males of HES II (6-11 years), HES III (12-17 years), and HANES I (6-17 years): United States.

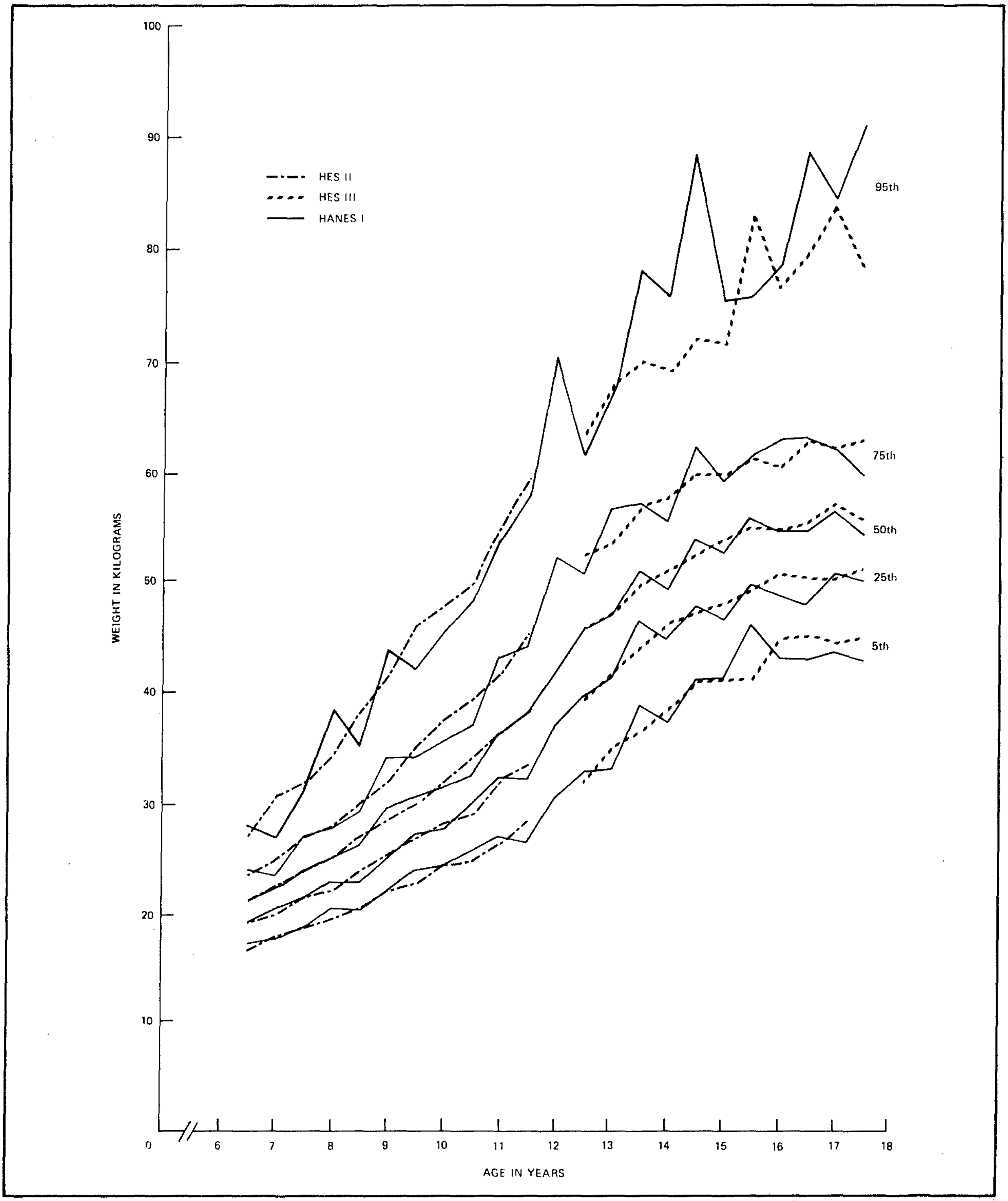


Figure XVIII. Observed percentiles of weight by age for females of HES II (6-11 years), HES III (12-17 years), and HANES I (6-17 years): United States.

noted, single very heavily weighted cases could distort the more extreme percentiles.

In summation, there was very little to argue against the merger of the three data sets, and a great deal to argue in favor of it. The three data sets, with their original sample weights, were literally concatenated into an overall data set of 20,749 subjects. The percentiles were computed with the original sample weights intact, but when reported, the sums of the statistical weights were reduced by half to return to an approximation of the U.S. population.

Splining

As described in the body of this report, splining is a mechanism used to fit curves to a body of data in such a way that no discontinuities (i.e., disjunctions or sharp angles at junctions) exist in the final curves. Splining is particularly useful in smoothing data that could not be fitted well with a single equation of relatively low degree, say, no more than cubic. In other circumstances an optimum fit may be achieved by the spline technique where the researcher is either unsure of the exact biologic phenomena underlying the relationship of the dependent and independent variables, or is not interested in mathematically describing that relationship in a way that makes biologic "sense." Another benefit, and it is one very significant for our purposes, is that the splining mechanism can fit curves to data that reflect almost any relationship (e.g., exponential, J-shaped, etc.), and that the researcher can achieve a certain degree of "commonality" between various percentiles of a given data set by specifying common parameters. Finally, the capacity to set these parameters as they seem most effective somewhat frees the researcher from slavish obedience to results generated by a nondiscriminating computer.

In order to illustrate the technique, the procedure which generated a single graph, that of weight by stature for males aged 2-11.5 years, will be described. The same procedure was used in all the other cases, each differing only in particulars.

The first step was to generate percentiles of weight by stature (2-centimeter intervals of stature for this example), and these values can be found in table 8. These statistics were weighted to represent the U.S. population whenever NCHS data were used, a decision discussed in the previous section. The seven observed percentile lines were then plotted (figure XIX), and the graph was inspected to estimate the location and number of points called "knots."

These knots are defined as the beginnings and ends of sections into which the original curve is broken. N-degree equations are then individually fit to these sections by the least squares method, with the additional constraints that, for all contiguous sections, the functions and their $n-1$ derivatives must agree at the knot. It is in the selection of these knots that the researcher's experience and prior knowledge of the phenomenon under consideration is the most helpful, but even then, some general rules are applicable. Given the large number of curves to be fit, and knowing growth to be a fairly "smooth" function, the authors always strove to use as few knots as possible, consonant with a good fit. Beyond this, knots were chosen where the curve showed the most change (i.e., where the second and third derivatives changed sign), and at endpoints. In the last case, since the fitted curves were least stable near the ends, data points beyond that eventually published were generated and fit whenever possible and the curves truncated to the last point of interest.

The program used for this fitting contained an optional routine for automatically varying the knot locations from those originally specified to optimize the fit. Unfortunately, the results obtained were somewhat erratic and not biologically meaningful. The reduction in mean residuals achieved was far too slight to justify the use of this somewhat mindless method.

Returning to the example, knots were chosen as in column 1 of table I. The fitted curves were generated and plotted; the observed data points were then overlaid on this plot (figure XX). Quantitative assessments were made of the mean and maximum residuals (a residual is the difference between an observed and a predicted value), and a qualitative assessment was made of the plot. The major consideration of the latter evaluation was the absence of any sustained but local over- or underestimations. In

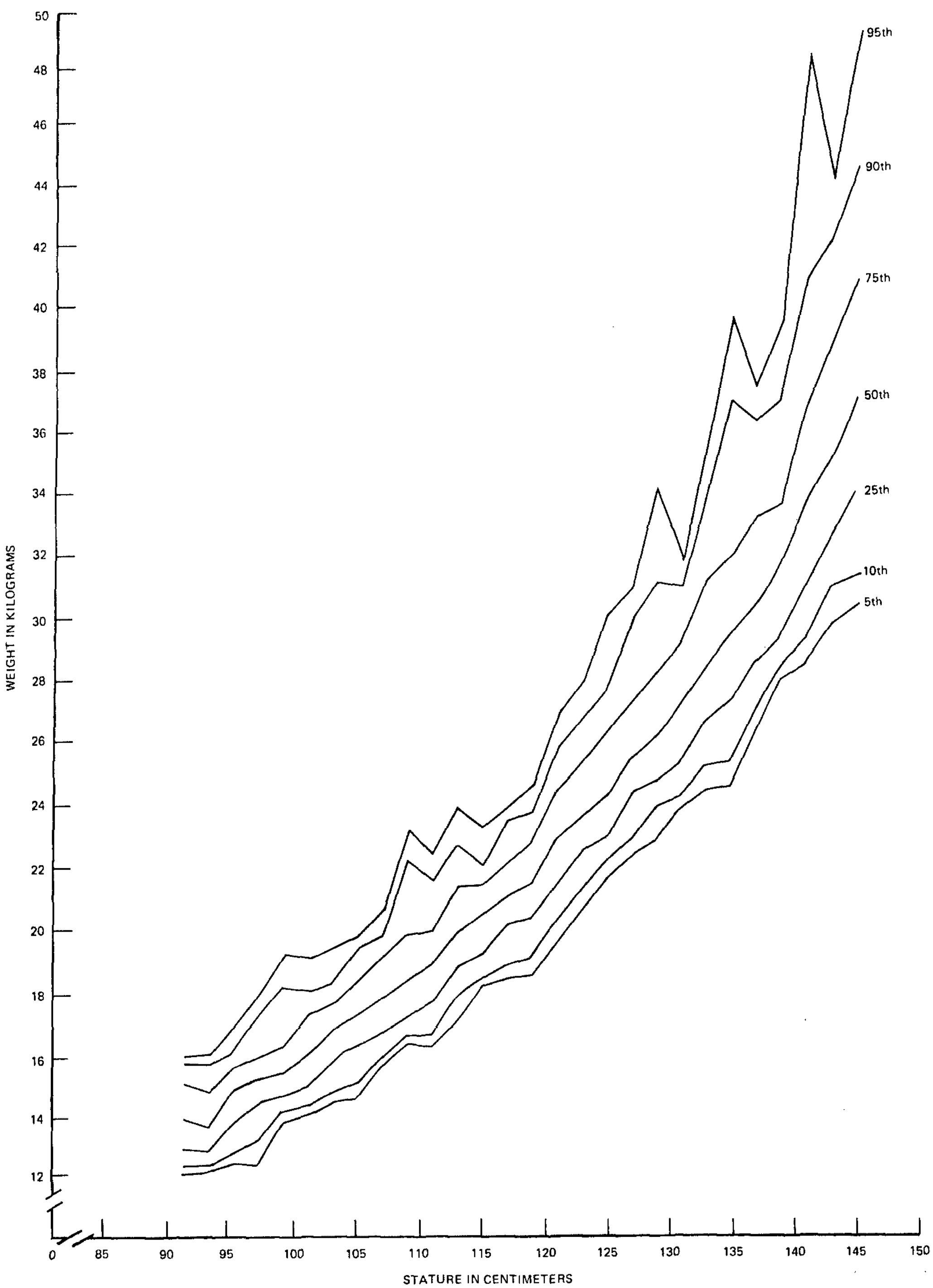


Figure XIX. Observed percentiles of weight by stature for prepubescent males 2-11.5 years: Data and statistics from National Center for Health Statistics.

Table I. Mean and maximum residuals from seven observed percentiles of weight by stature using two alternative knot selections for boys ages 2 to 18 years

Percentile	Column 1 (81, 126, 145)[1]		Column 2 (81, 116, 145)[1]	
	Mean	Maximum	Mean	Maximum
	Residual in kilograms			
5th	0.27	0.92	0.27	0.95
10th	0.24	0.85	0.24	0.94
25th	0.21	0.73	0.21	0.68
50th	0.21	0.68	0.22	0.90
75th	0.30	1.45	0.29	1.51
90th	0.52	2.11	0.55	2.36
95th	0.91	5.16	0.92	5.22

[1]Location of three knot selections in centimeters.

this instance there were none, but the anticipated relationship between mean residuals and percentiles was observed here and for all the graphs. That is, the mean residuals were always smallest for intermediate percentiles (25th and 50th), larger for the lower percentiles (5th and 10th), and largest for the higher percentiles. This result is no more than a reflection of the variability of the respective observed percentiles.

In an attempt to improve the fit, the fitting and evaluation procedure was duplicated with the knots as indicated in column 2. The most striking result was seen in the similarity of the residual values, with only one of the seven pairs of mean residuals differing by more than 0.01 kilograms. In general, however, the second attempt was less successful than the first, and subsequent attempts were no more successful.

This procedure was repeated for each of the 14 charts. On a few occasions arbitrary decisions were made concerning at what point to terminate a chart (e.g., the endpoint of the weight-by-recumbent-length charts), and in these cases the decision was based on information concerning the relative strength of the data and on relevant physiological information (see text). Other than that, the published curves are literally copies of those generated by the computer.

Smoothing With the Pearson Distribution System

Fitting equations to data is a study in its own right.[45] For even the simplest problem, that of the two-dimensional case, care must be exercised in fulfilling assumptions and avoiding grievous oversights. For the data reported here, several considerations compounded this difficulty.

The most important of these was a desire to achieve some "commonality" or "parallelism" between the seven curves that appear on each chart. Certainly a relationship exists between any two percentile lines, and since the same phenomenon is being described over the entire range of the independent variable, this relationship might well be constant or vary in a constant fashion. It was imperative that any fitting system used either automatically incorporate this consideration or allow the researcher to incorporate it manually.

A second vitally important consideration was that of flexibility of the fitting system. Experience indicated that, for the variables to be reported, several different relationships obtained. The fitting system had to be equally effective against all alternatives. It may have been possible to find a class of equations (e.g., polynomials in age), that fit a particular relationship better that splines. However, a system involving several or many types of equations has at least three disadvantages: (1) Far more human intervention would have been necessary, thereby reducing objectivity. (2) A far greater expenditure of human and computer resources would have been necessary to ensure that the best fit was achieved for each chart. (3) The characteristics of the results would have been variable, depending on the type of equation used. For the purposes of this paper then, a fitting system involving a single type of equation was far preferable to one that used multiple types.

Finally, but less importantly, there were advantages to using a system that resulted in equations that were of a type familiar to most users. It is expected that the results reported here will be useful to persons of very different mathematical backgrounds, so simplicity is essential. It is also hoped that this simplicity will give independent researchers the maximum freedom in evaluating these results and their applicability to other populations or subpopulations.

These considerations did not singularly dictate the use of the spline method. In fact, an

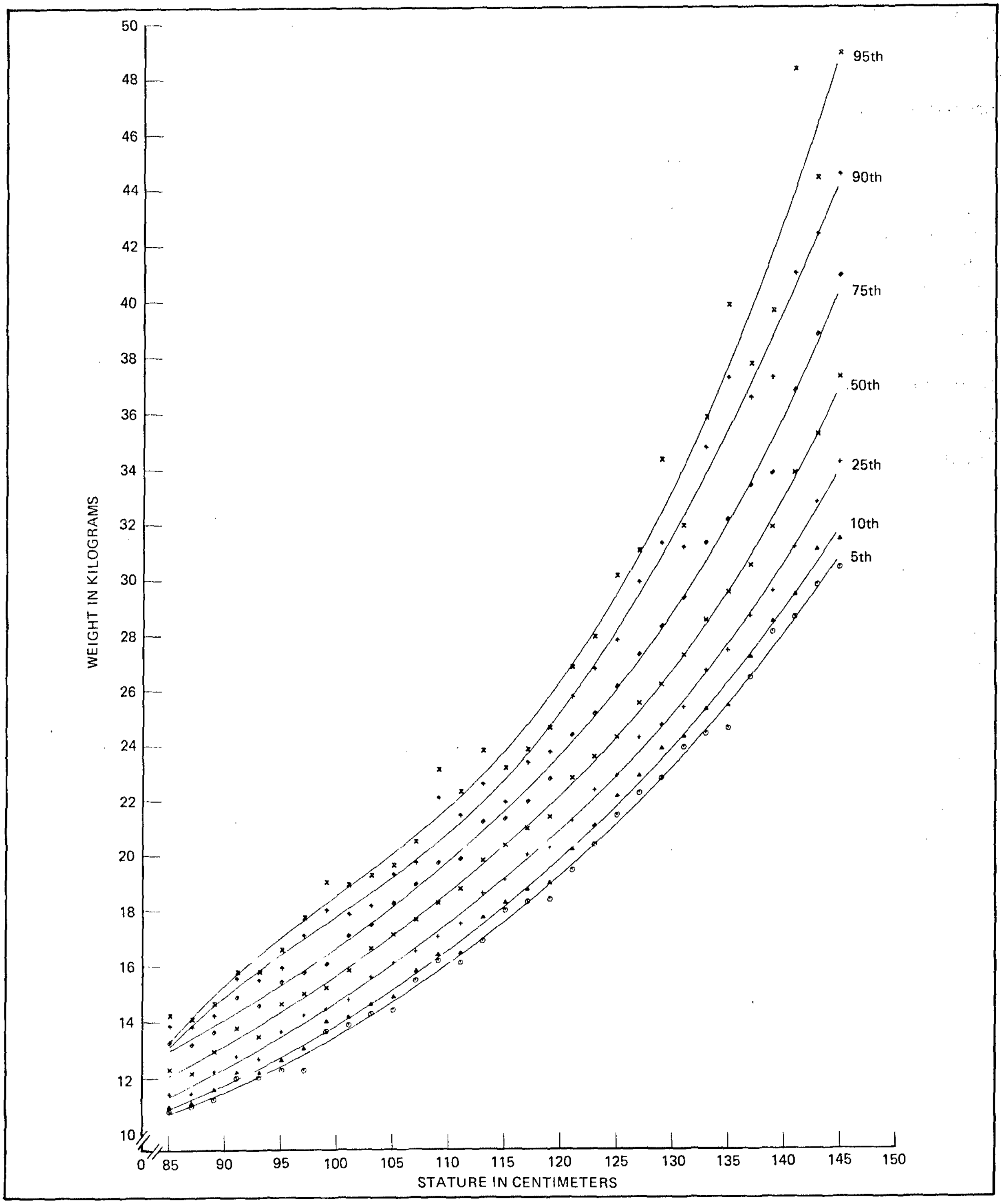


Figure XX. Smoothed percentiles of weight by stature for prepubescent males 2-11.5 years: Data and statistics from National Center for Health Statistics.

entirely different approach was investigated before the spline method was accepted. This method combined multiple regression with the Pearson distribution system to predict the desired percentiles.

The Pearson distribution system, first published in the 1890's, is a system of z values adjusted to reflect the degree of skewness and kurtosis of any given distribution. Thus, for any distribution for which the first four moments can be calculated or estimated, it is possible to estimate percentiles.

The relationship used to evaluate this method was that of stature for age. Polynomials in age were calculated by multiple stepwise regression, and from these equations statures (here noted as s_i, i representing the age interval) were estimated separately for boys and girls. The equation may be compactly written as:

$$s_i = \sum_{j=0}^{k_1} b_{1j} A^j$$

where the subscript 1 indicates that this is the equation for the mean, or first moment.

Residuals (s-$\hat{s}_i$, here noted Δ_i^1) for each individual were then calculated, as were Δ_i^2's, Δ_i^3's, and Δ_i^4's. Polynomials in age were then fitted to these data, again using multiple stepwise regression, and the resulting equations are written as:

$$\hat{\Delta}_i^2 = \sum_{j=0}^{k_2} b_{2j} A_j$$

$$\hat{\Delta}_i^3 = \sum_{j=0}^{k_3} b_{3j} A^j$$

$$\hat{\Delta}_i^4 = \sum_{j=0}^{k_4} b_{4j} A^j$$

These equations express the second, third, and fourth moments as functions of age.

These estimates were, in turn, entered in the following equations to calculate $\sqrt{\beta_1}$ and β_2, the table entries for the Pearson system:

$$\text{Skewness} = \sqrt{\beta_{1i}} = \sqrt{\frac{\mu_{3i}^2}{\mu_{2i}^3}} = \sqrt{\frac{(\hat{\Delta}_i^3)^2}{(\hat{\Delta}_i^2)^3}}$$

$$\text{Kurtosis} = \beta_{2i} = \frac{\mu_{4i}}{\mu_{2i}^2} = \frac{\hat{\Delta}_i^4}{(\hat{\Delta}_i^2)^2}$$

Since the values for $\sqrt{\beta_1}$ and β_2 do not correspond to the table entries exactly, a two-way linear interpolation was used to find the exact z values. These z values were in turn applied to the $\hat{\Delta}_i^2$ to estimate the percentiles. An example with intermediate results can be found in table 17.

As is shown in figure XXI, the results were less than ideal. In particular, there is evidence of the sustained local over- and underestimation that were mentioned earlier. It seems that this method is too "stiff"; it is not sufficiently sensitive to changes in the derivatives. Another disadvantage is that this method is highly sensitive to outliers, and the authors were loathe to adjust any raw data. Finally, the method was rejected as not suitable for this project.

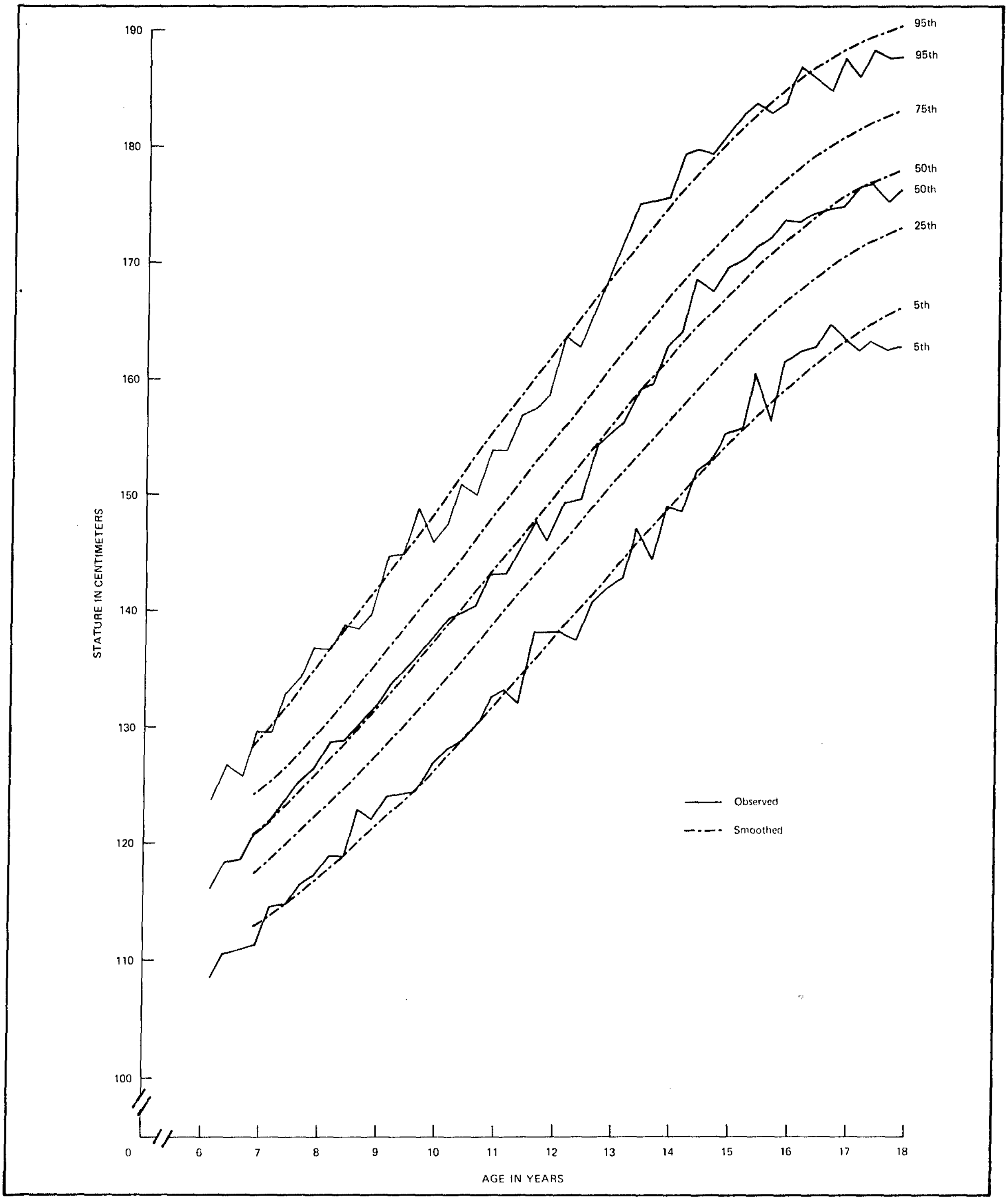


Figure XXI. Observed and smoothed percentiles (using the Pearson distribution system) of stature for males 6-18 years, by age: United States.

☆U.S. GOVERNMENT PRINTING OFFICE: 1977—260-937:37

VITAL AND HEALTH STATISTICS PUBLICATIONS SERIES

Formerly Public Health Service Publication No. 1000

Series 1. *Programs and Collection Procedures.*—Reports which describe the general programs of the National Center for Health Statistics and its offices and divisions, data collection methods used, definitions, and other material necessary for understanding the data.

Series 2. *Data Evaluation and Methods Research.*—Studies of new statistical methodology including experimental tests of new survey methods, studies of vital statistics collection methods, new analytical techniques, objective evaluations of reliability of collected data, contributions to statistical theory.

Series 3. *Analytical Studies.*—Reports presenting analytical or interpretive studies based on vital and health statistics, carrying the analysis further than the expository types of reports in the other series.

Series 4. *Documents and Committee Reports.*—Final reports of major committees concerned with vital and health statistics, and documents such as recommended model vital registration laws and revised birth and death certificates.

Series 10. *Data from the Health Interview Survey.*—Statistics on illness; accidental injuries; disability; use of hospital, medical, dental, and other services; and other health-related topics, based on data collected in a continuing national household interview survey.

Series 11. *Data from the Health Examination Survey.*—Data from direct examination, testing, and measurement of national samples of the civilian, noninstitutionalized population provide the basis for two types of reports: (1) estimates of the medically defined prevalence of specific diseases in the United States and the distributions of the population with respect to physical, physiological, and psychological characteristics; and (2) analysis of relationships among the various measurements without reference to an explicit finite universe of persons.

Series 12. *Data from the Institutionalized Population Surveys.*—Discontinued effective 1975. Future reports from these surveys will be in Series 13.

Series 13. *Data on Health Resources Utilization.*—Statistics on the utilization of health manpower and facilities providing long-term care, ambulatory care, hospital care, and family planning services.

Series 14. *Data on Health Resources: Manpower and Facilities.*—Statistics on the numbers, geographic distribution, and characteristics of health resources including physicians, dentists, nurses, other health occupations, hospitals, nursing homes, and outpatient facilities.

Series 20. *Data on Mortality.*—Various statistics on mortality other than as included in regular annual or monthly reports. Special analyses by cause of death, age, and other demographic variables; geographic and time series analyses; and statistics on characteristics of deaths not available from the vital records, based on sample surveys of those records.

Series 21. *Data on Natality, Marriage, and Divorce.*—Various statistics on natality, marriage, and divorce other than as included in regular annual or monthly reports. Special analyses by demographic variables; geographic and time series analyses; studies of fertility; and statistics on characteristics of births not available from the vital records, based on sample surveys of those records.

Series 22. *Data from the National Mortality and Natality Surveys.*—Discontinued effective 1975. Future reports from these sample surveys based on vital records will be included in Series 20 and 21, respectively.

Series 23. *Data from the National Survey of Family Growth.*—Statistics on fertility, family formation and dissolution, family planning, and related maternal and infant health topics derived from a biennial survey of a nationwide probability sample of ever-married women 15-44 years of age.

For a list of titles of reports published in these series, write to: Scientific and Technical Information Branch
National Center for Health Statistics
Public Health Service
Hyattsville, Md. 20782