

**NCCHS 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.

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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.

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NCHS GROWTH CURVES FOR CHILDREN BIRTH-18 YEARS

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INTRODUCTION

In 1974 the National Academy of Sciences¹ 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).

^aMore 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

(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.

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

^bAs 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.

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

^dThere 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).^c 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

^cAs 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.

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

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 report¹ 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

^fThe 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[§] 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 data¹⁰), 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.

[§]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.

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)

^hThe signs of early pubescence are breast budding; testicular enlargement; and growth, coarsening, and pigmentation 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 dramatically²¹). 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 growthⁱ 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 deviation

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

^jA 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)

ⁱGrowth 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}

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 Davila¹¹ 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

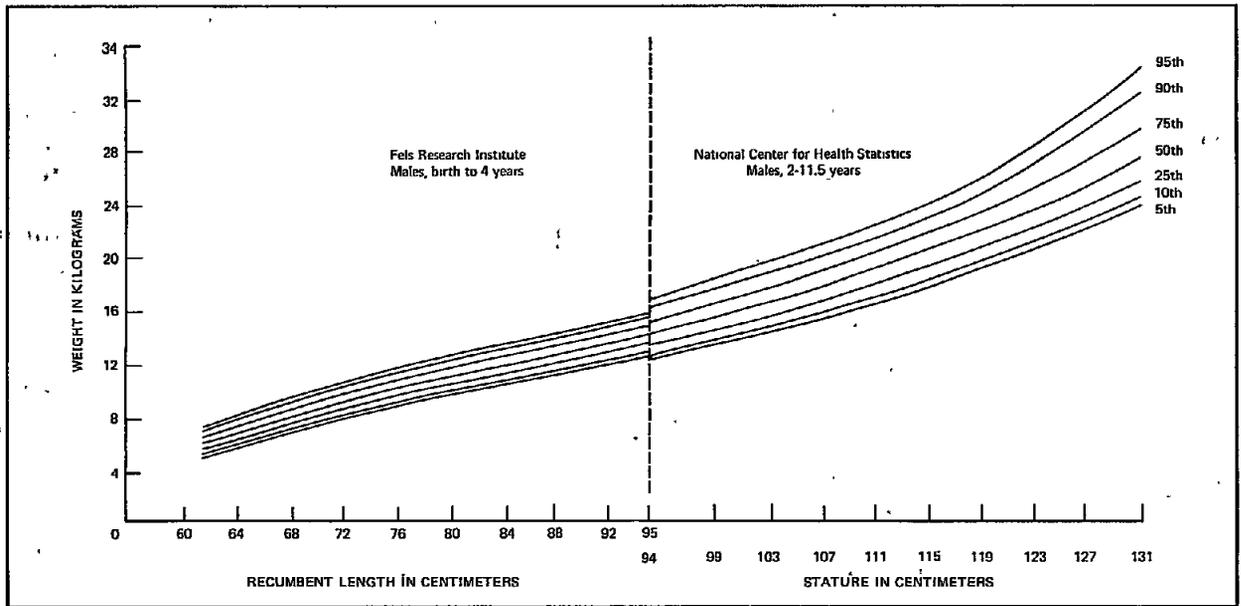


Figure 1. Comparison of selected percentiles of weight for recumbent length with weight for stature, including a 1-centimeter adjustment as a typical median difference between recumbent length and stature: Males, birth-4 years, Fels Research Institute data; males, 2-11.5 years, National Center for Health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

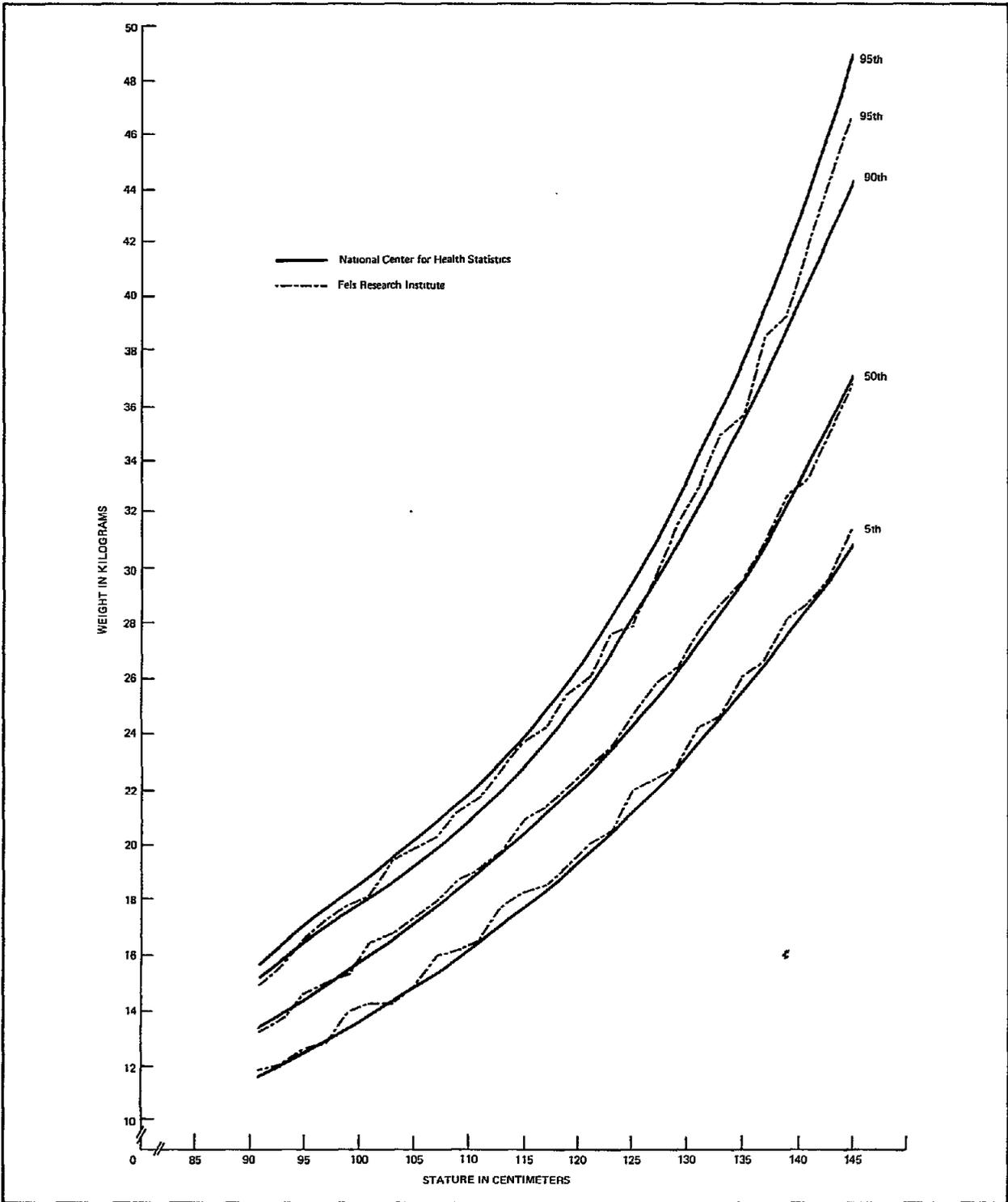


Figure 2. Selected percentiles of weight by stature for prepubescent males: Observed data, Fels Research Institute; smoothed data, National Center for Health Statistics.

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 (pre-pubescent).

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 parallelism 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 1968²⁷ 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 data²⁶ 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 com-

paring that first cycle of HES children²⁶ 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.



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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 centimeters), by sex and age: Fels Research Institute, birth-20 years—Con.

| Sex and age | n | Observed percentile | | | | | | |
|-----------------|-----|---------------------------------|-------|-------|-------|-------|-------|-------|
| | | 5th | 10th | 25th | 50th | 75th | 90th | 95th |
| <u>Female</u> | | 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 |
| <u>Male</u> | | 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 | 12.89 | 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 |
| <u>Female</u> | | 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 | 42.69 | 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 Institute, 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 | 166.8 | 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 |
| <u>Female</u> | | 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 | 13.16 |
| 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 |

¹Sample 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 |
| <u>Female</u> | | 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 |

¹Sample 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 | 866 | 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 | 1,165 | 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 |

¹Sample 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 |
| <u>Female</u> | | 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 |

¹Sample 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 | 18.98 |
| 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 | 21.08 | 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 | 26.86 |
| 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 | ... | ... | ... | ... | ... | ... | ... | ... |

¹Sample 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 |
| Male | | | | | | | |
| Recumbent length in centimeters | | | | | | | |
| 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 |

¹Smoothed 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 |
| Male | | | | | | | |
| | Weight in kilograms | | | | | | |
| 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 |

¹Smoothed 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 |
| Male | | | | | | | |
| Head circumference in centimeters | | | | | | | |
| 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 |

¹Smoothed 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 | ... | ... | ... | ... | ... | ... | ... |

¹Smoothed 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 |
| Male | | | | | | | |
| | Stature in centimeters | | | | | | |
| 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 | 170.8 | 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 | 157.9 | 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 |

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

²Because 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 | 82.46 |
| 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 | 61.81 | 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 | 14.16 |
| 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 | 16.69 | 17.77 | 18.59 |
| 4.0 years | 13.11 | 13.84 | 14.80 | 15.96 | 17.66 | 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 | 18.66 | 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 | 50.67 |
| 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 | 54.95 | 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 |

¹Smoothed 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 | ... | ... | ... | ... | ... | ... | ... |

¹Smoothed 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 | | | | | | | | | |
|-------------------------------------|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 2¼-2½ | 2½-3¼ | 3¼-3½ | 3½-4¼ | 4¼-4½ | 4½-5¼ | 5¼-5½ | 5½-6¼ | 6¼-6½ | 6½-7¼ |
| <u>Male</u> | 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 | | | | | | | | | |
|-------------------------------------|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 2½-2¾ | 2¾-3¼ | 3¼-3¾ | 3¾-4¼ | 4¼-4¾ | 4¾-5¼ | 5¼-5¾ | 5¾-6¼ | 6¼-6¾ | 6¾-7¼ |
| Cumulative frequency distribution | | | | | | | | | | |
| Female | | | | | | | | | | |
| 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 | 96.2 | 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 | Observed percentile | | | | | | |
|------------------------|-------|-----|-----------|-----|---------------------|-------|-------|-------|-------|-------|-------|
| | | | | | 5th | 10th | 25th | 50th | 75th | 90th | 95th |
| HES II | | | | | | | | | | | |
| Male | | | | | | | | | | | |
| Stature in centimeters | | | | | | | | | | | |
| 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 | \bar{X} | s | Observed percentile | | | | | | |
|-------------------------------|-------|-----|-----------|-----|---------------------|-------|-------|-------|-------|-------|-------|
| | | | | | 5th | 10th | 25th | 50th | 75th | 90th | 95th |
| HANES I | | | | | | | | | | | |
| Male | | | | | | | | | | | |
| Stature in centimeters | | | | | | | | | | | |
| 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; \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 | \bar{X} | s | Observed percentile | | | | | | |
|-------------------------------|-------|-----|-----------|-----|---------------------|-------|-------|-------|-------|-------|-------|
| | | | | | 5th | 10th | 25th | 50th | 75th | 90th | 95th |
| HANES I—Con. | | | | | | | | | | | |
| Female | | | | | | | | | | | |
| Stature in centimeters | | | | | | | | | | | |
| 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 |
| HES II | | | | | | | | | | | |
| Male | | | | | | | | | | | |
| Weight in kilograms | | | | | | | | | | | |
| 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 | 59.33 | 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 | \bar{X} | s | Percentile | | | | | | |
|-------------------------|-------|-----|-----------|-------|------------|-------|-------|-------|-------|-------|--------|
| | | | | | 5th | 10th | 25th | 50th | 75th | 90th | 95th |
| HANES I | | | | | | | | | | | |
| Male | | | | | | | | | | | |
| Weight in kilograms | | | | | | | | | | | |
| 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; \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 | \bar{X} | s | Percentile | | | | | | |
|-------------------------|-------|-----|-----------|-------|------------|-------|-------|-------|-------|-------|-------|
| | | | | | 5th | 10th | 25th | 50th | 75th | 90th | 95th |
| HANES I—Con. | | | | | | | | | | | |
| Female | | | | | | | | | | | |
| Weight in kilograms | | | | | | | | | | | |
| 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.

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APPENDIX I

GROWTH CHARTS

Figure 1. Length by age percentiles for girls aged birth-36 months.

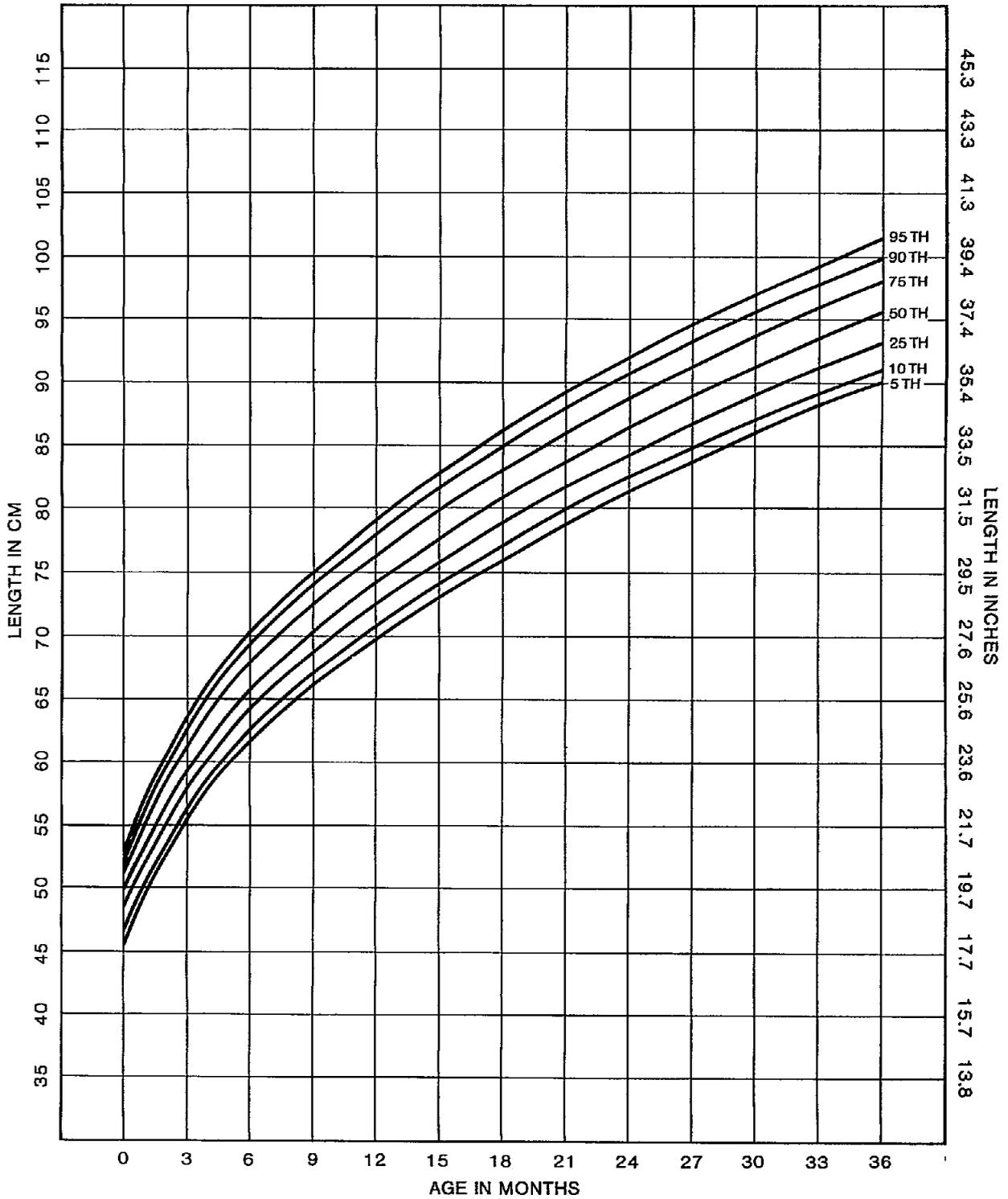
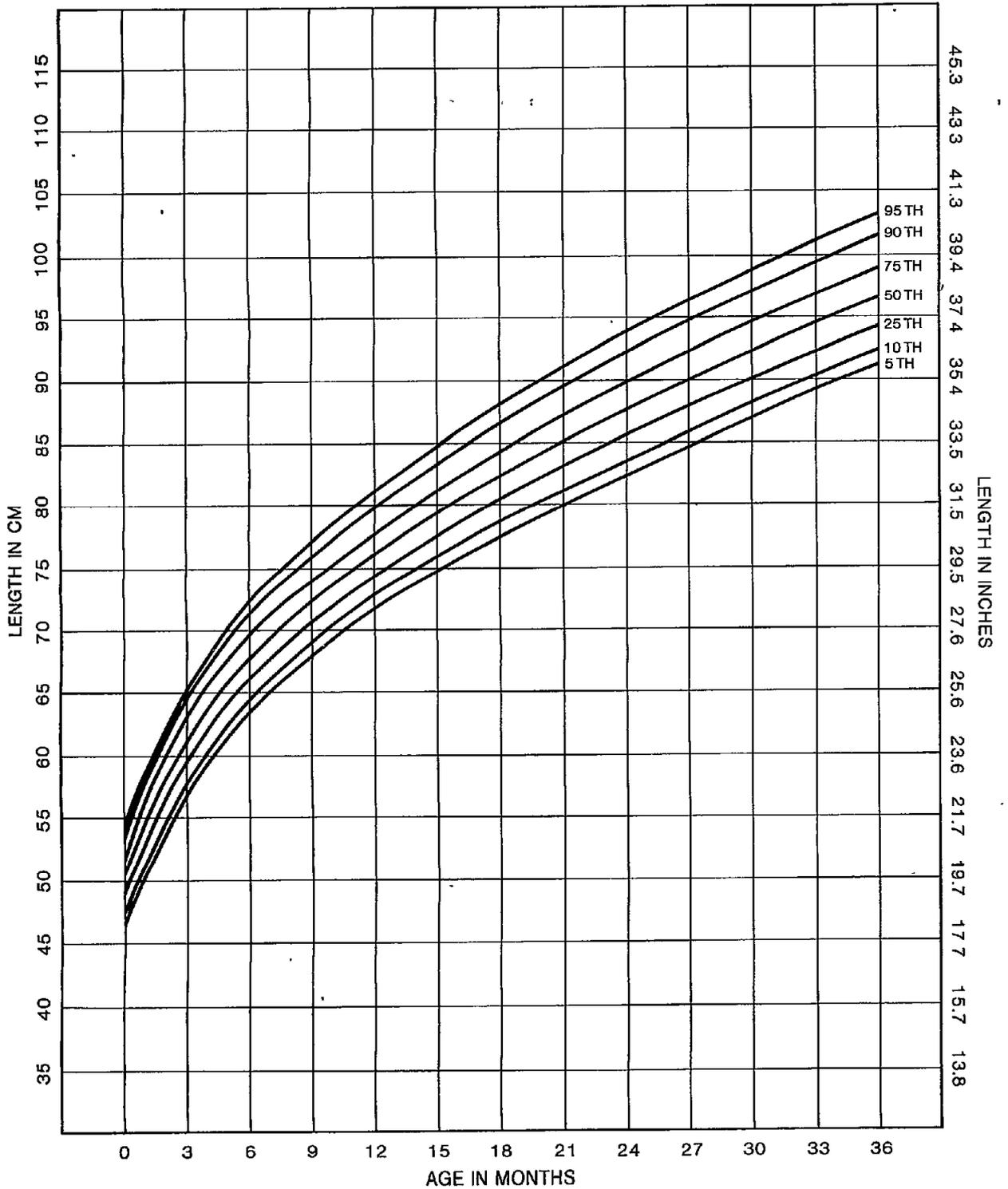


Figure II. Length by age percentiles for boys aged birth-36 months.



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

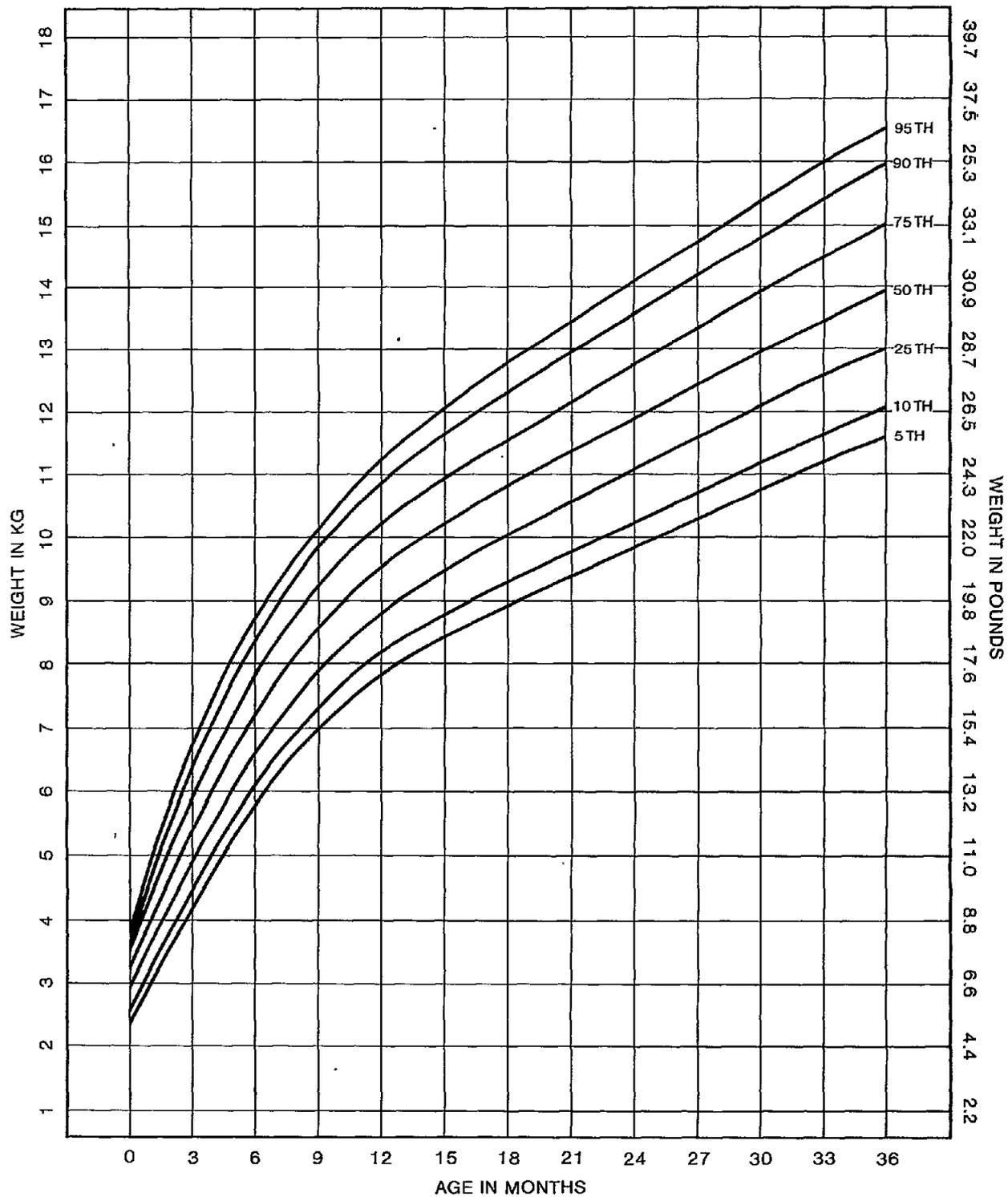
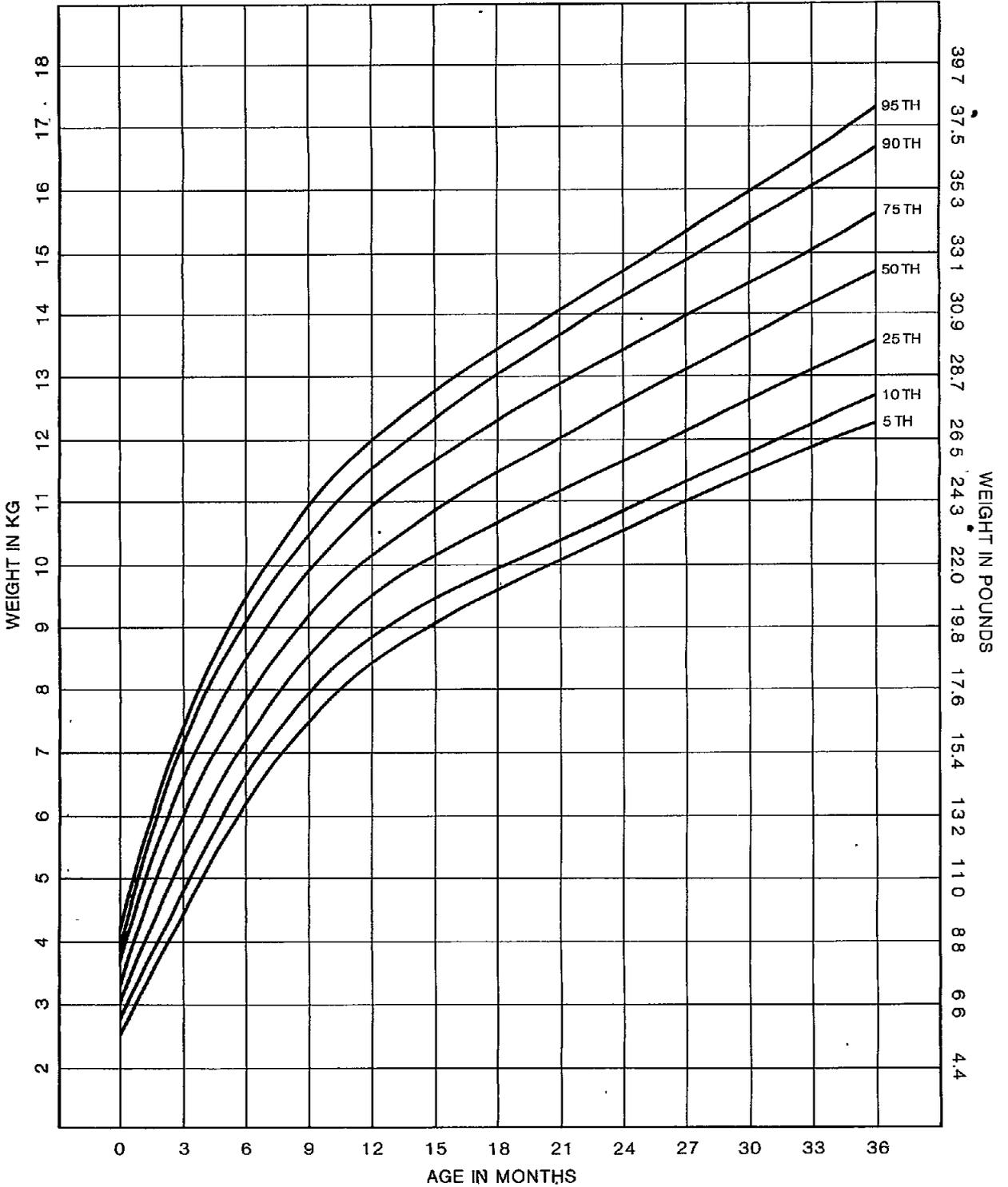


Figure IV. Weight by age percentiles for boys aged birth-36 months.



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

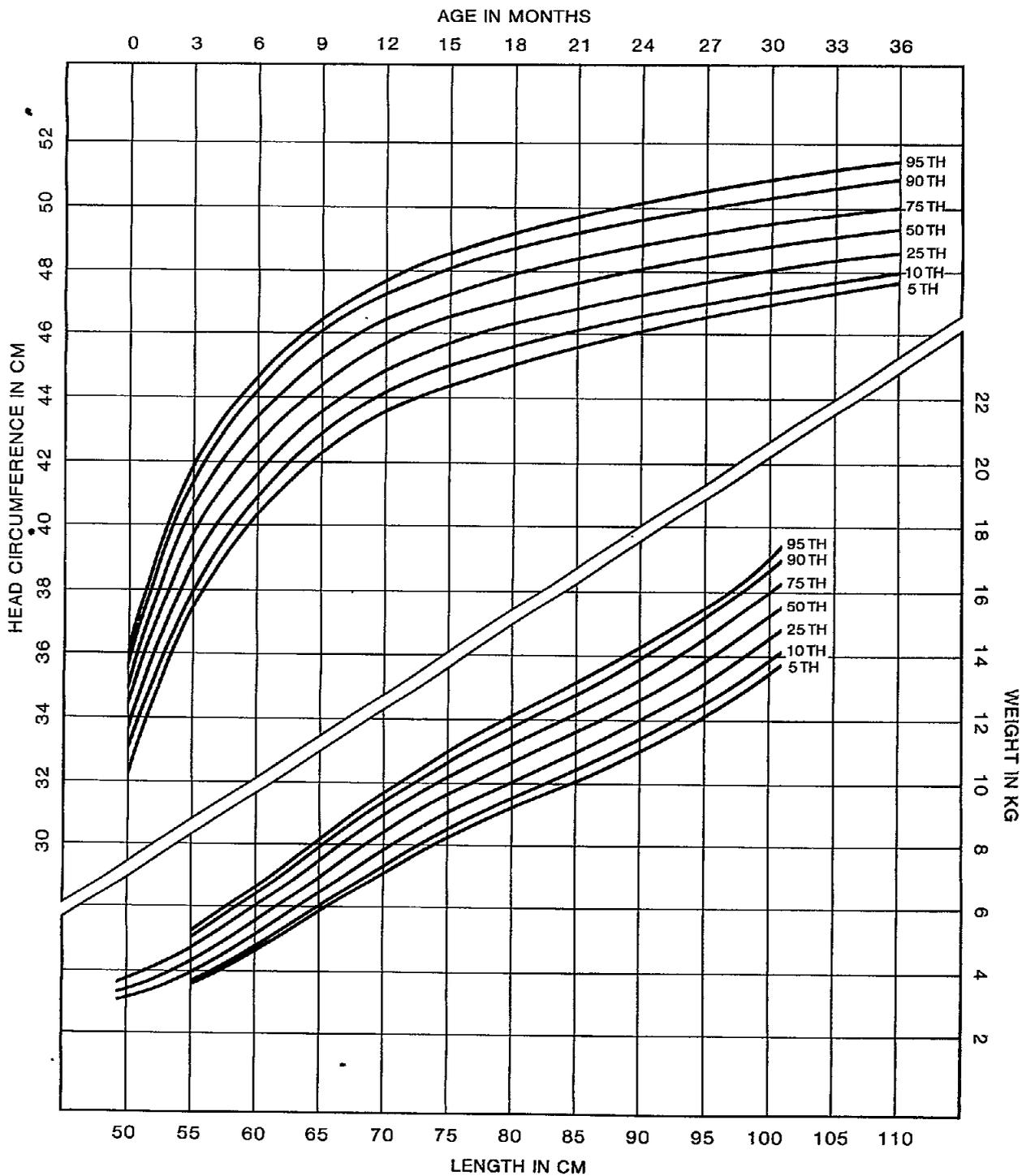


Figure VI. Weight by length percentiles for girls aged birth-36 months.

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

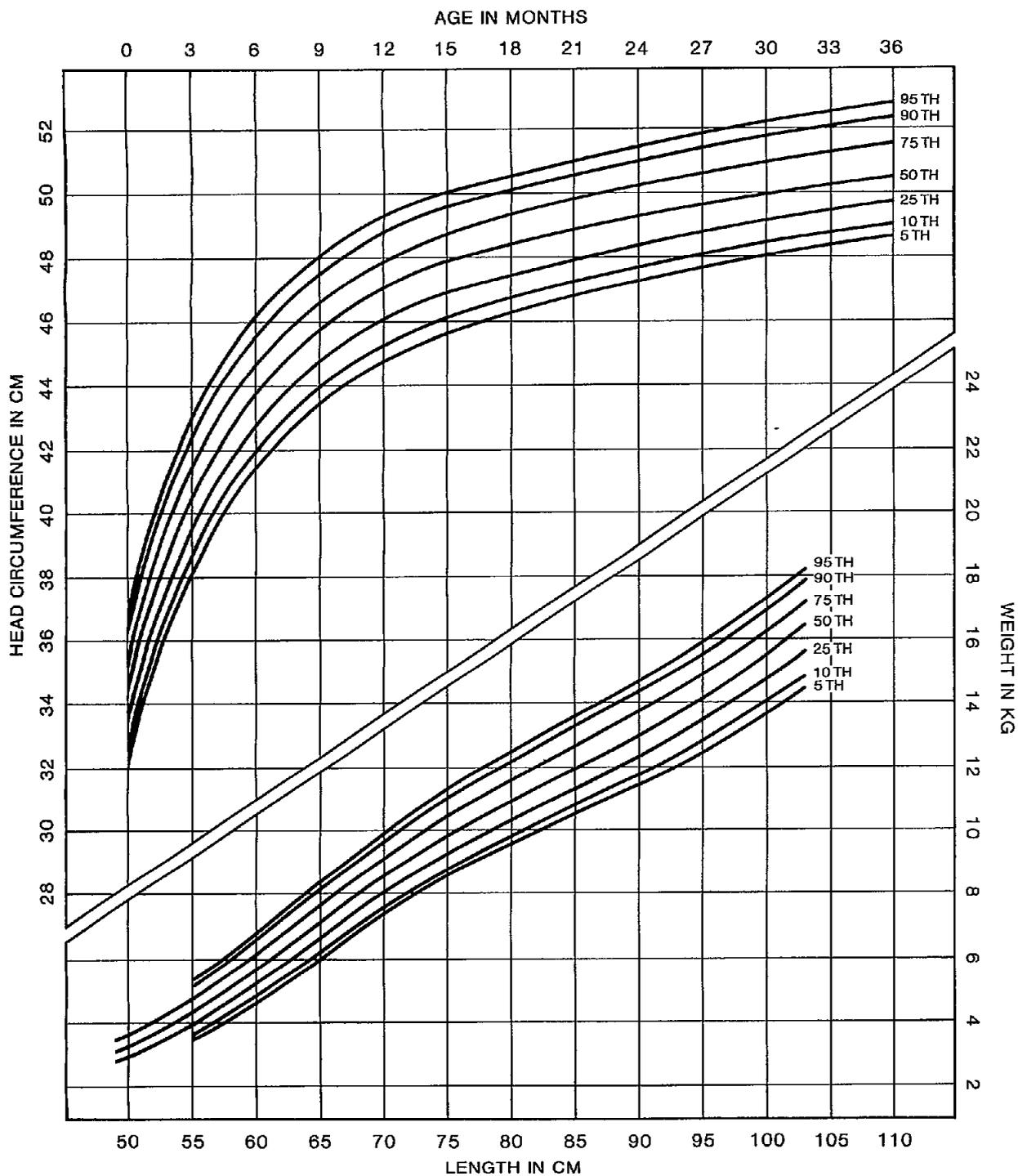


Figure VIII. Weight by length percentiles for boys aged birth-36 months.

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

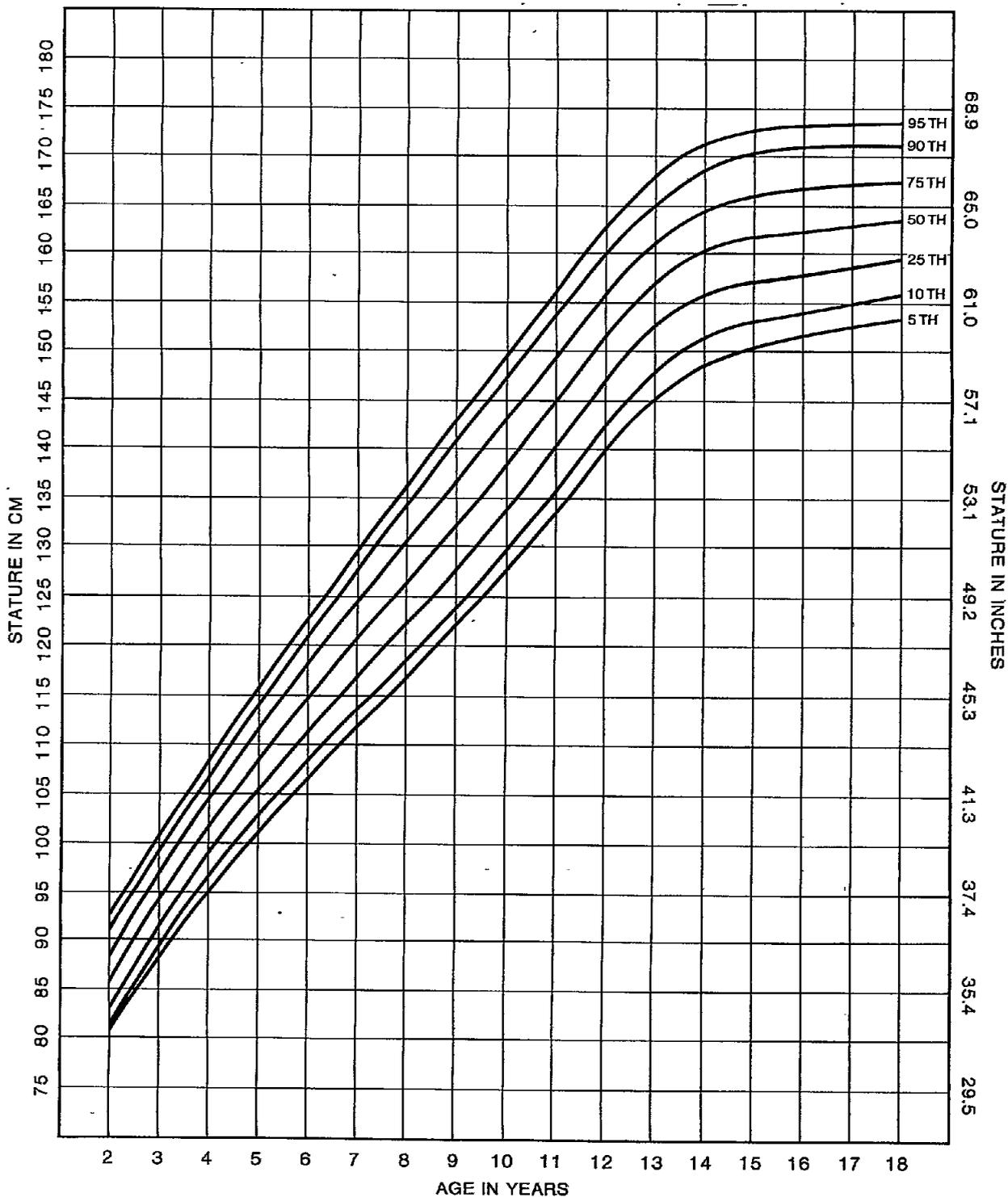


Figure X. Stature by age percentiles for boys aged 2 to 18 years.

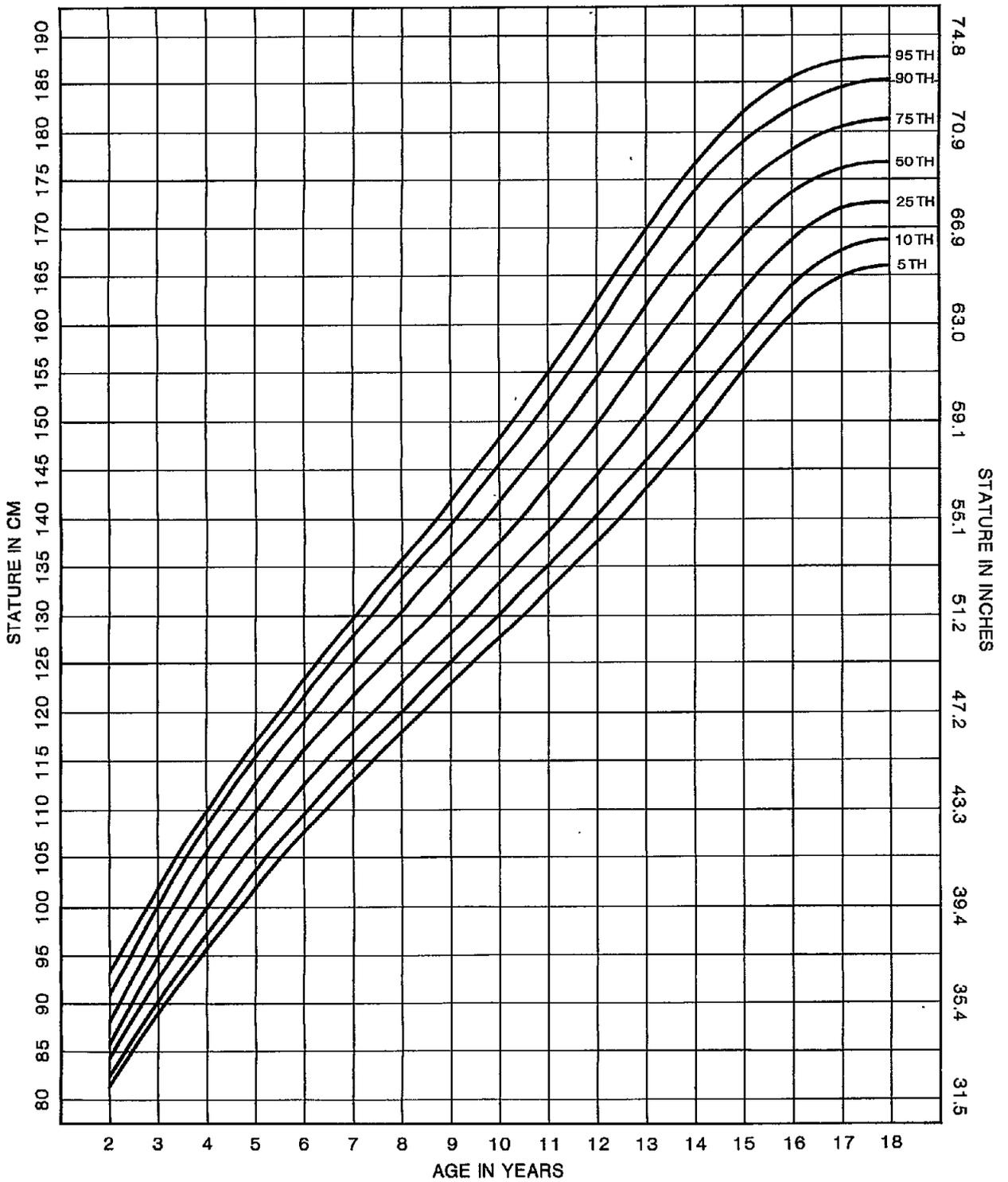


Figure XI. Weight by age percentiles for girls aged 2 to 18 years.

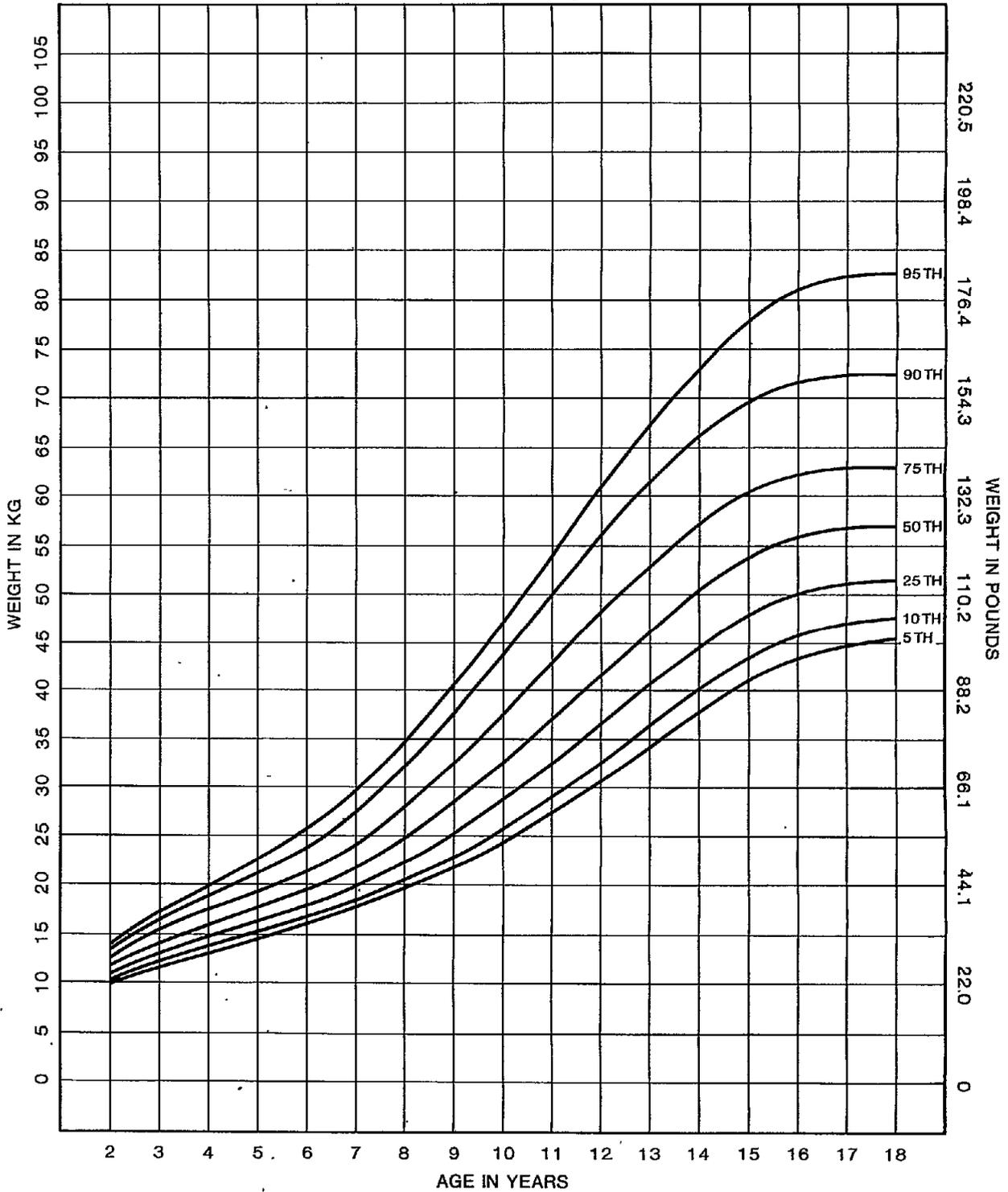
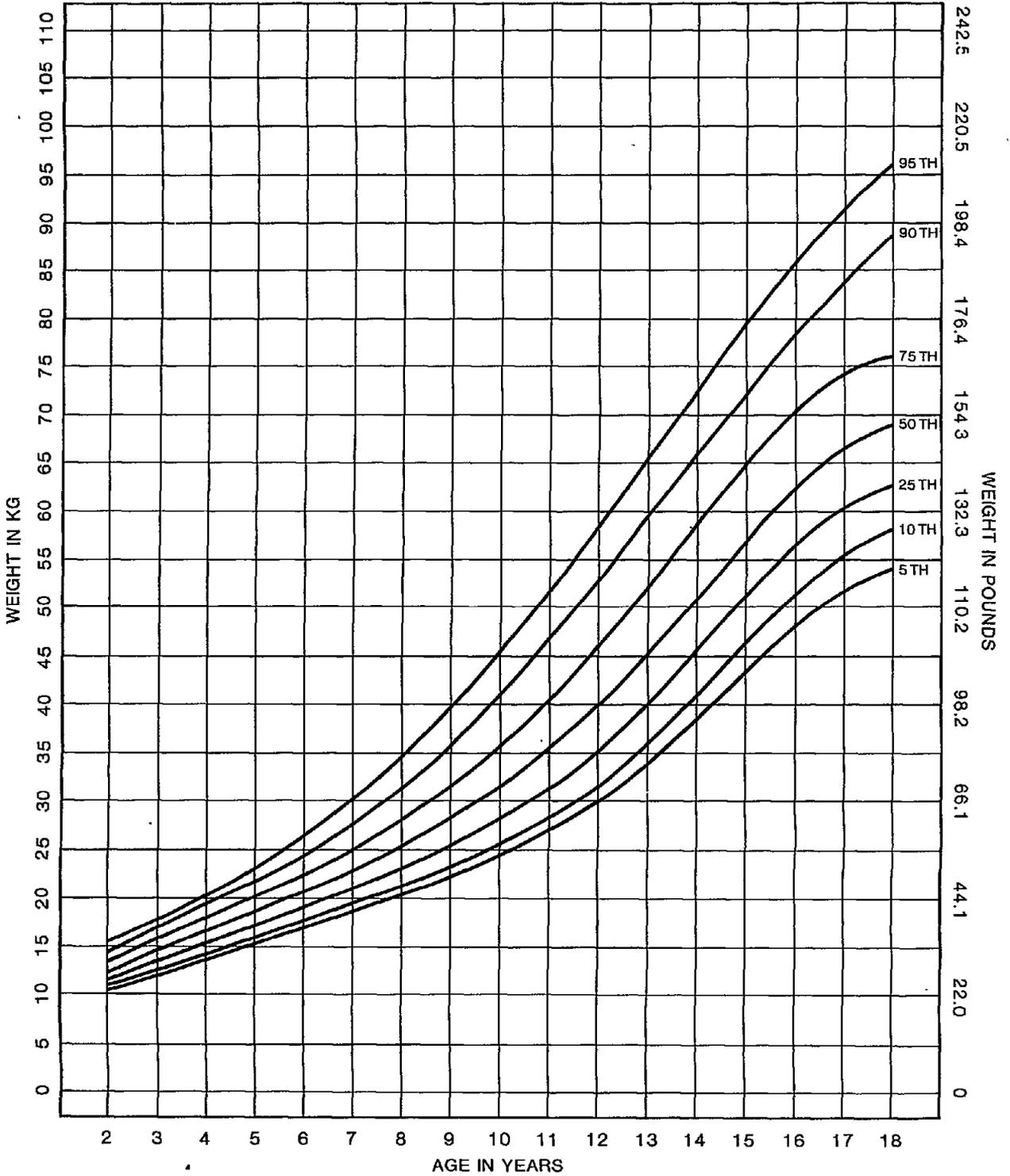


Figure XII. Weight by age percentiles for boys aged 2 to 18 years.



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Figure XIII. Weight by stature percentiles for prepubescent girls.
 STATURE IN INCHES

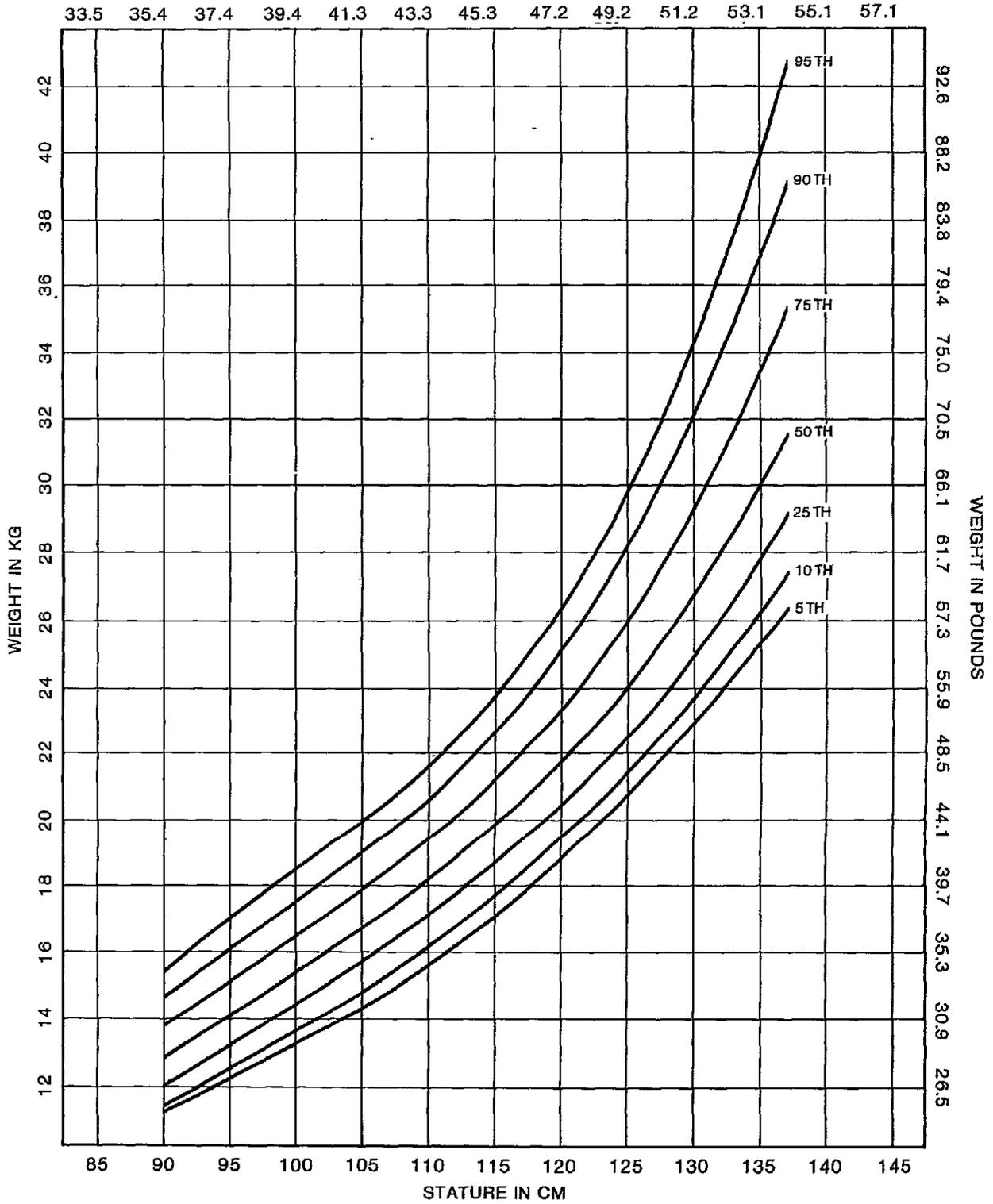
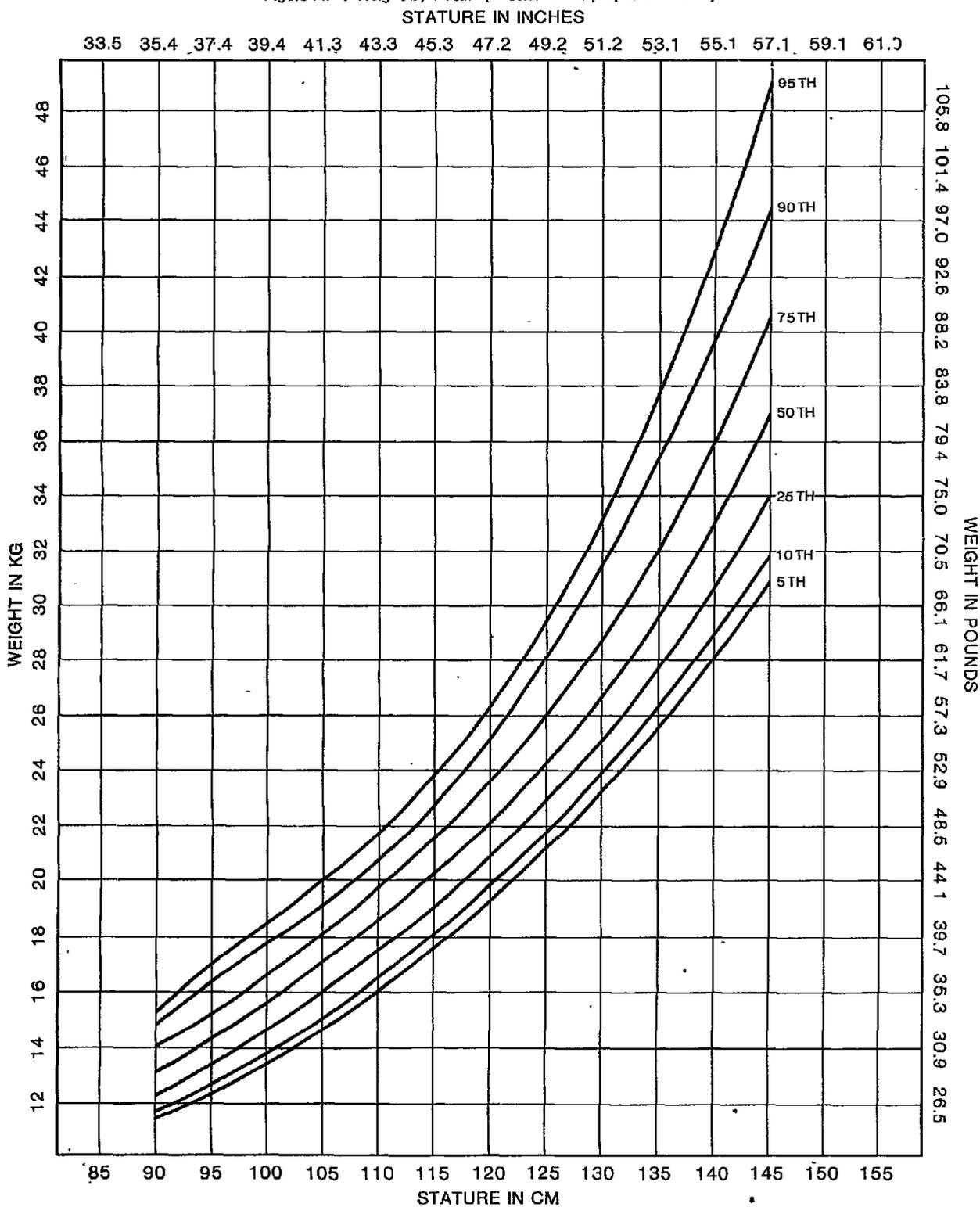


Figure XIV. Weight by stature percentiles for prepubescent boys.



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.

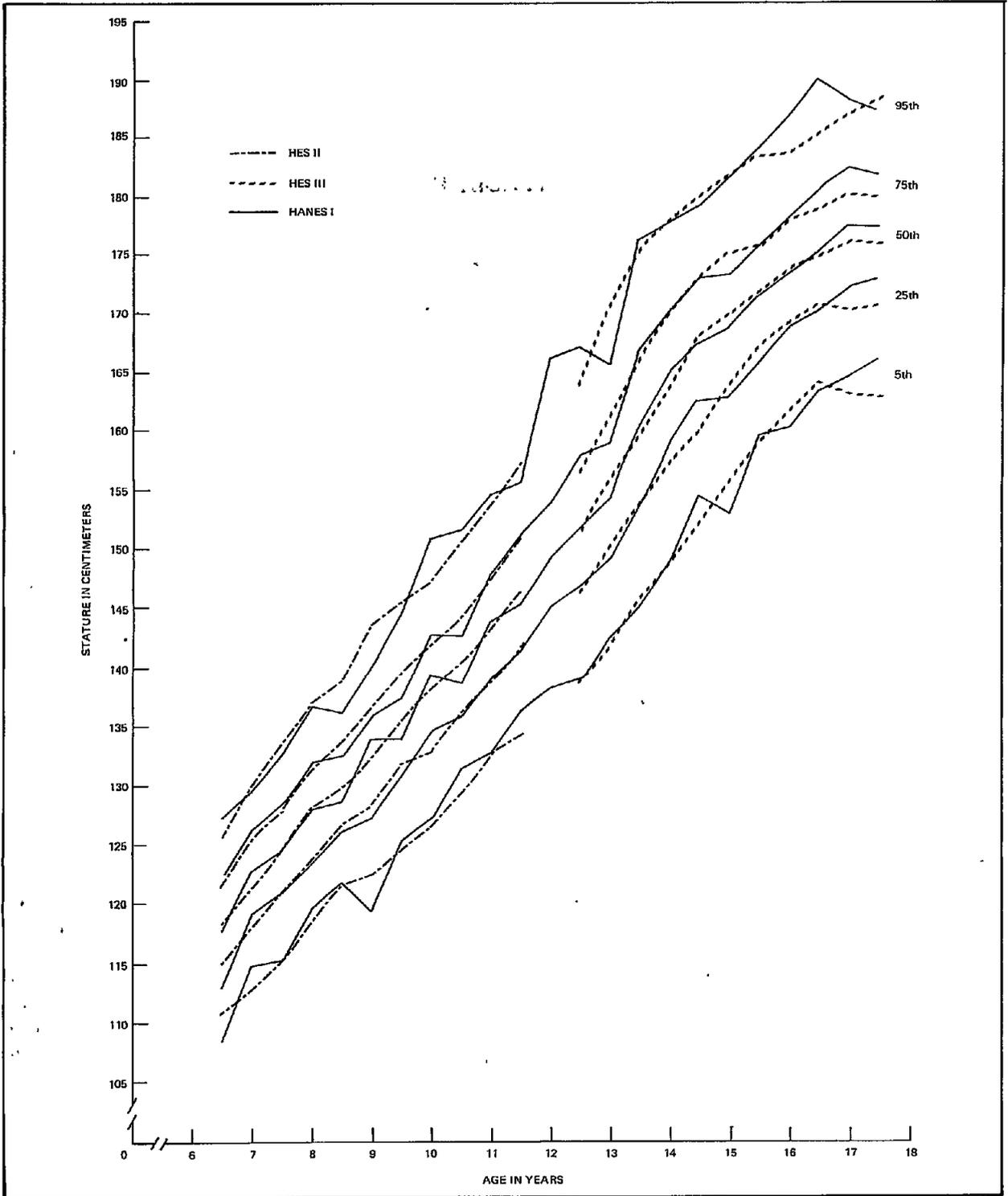


Figure XV. Observed percentiles of stature by age for males of HES II (6-11 years), HES III (12-17 years), and HANES I (6-17 years): United States.

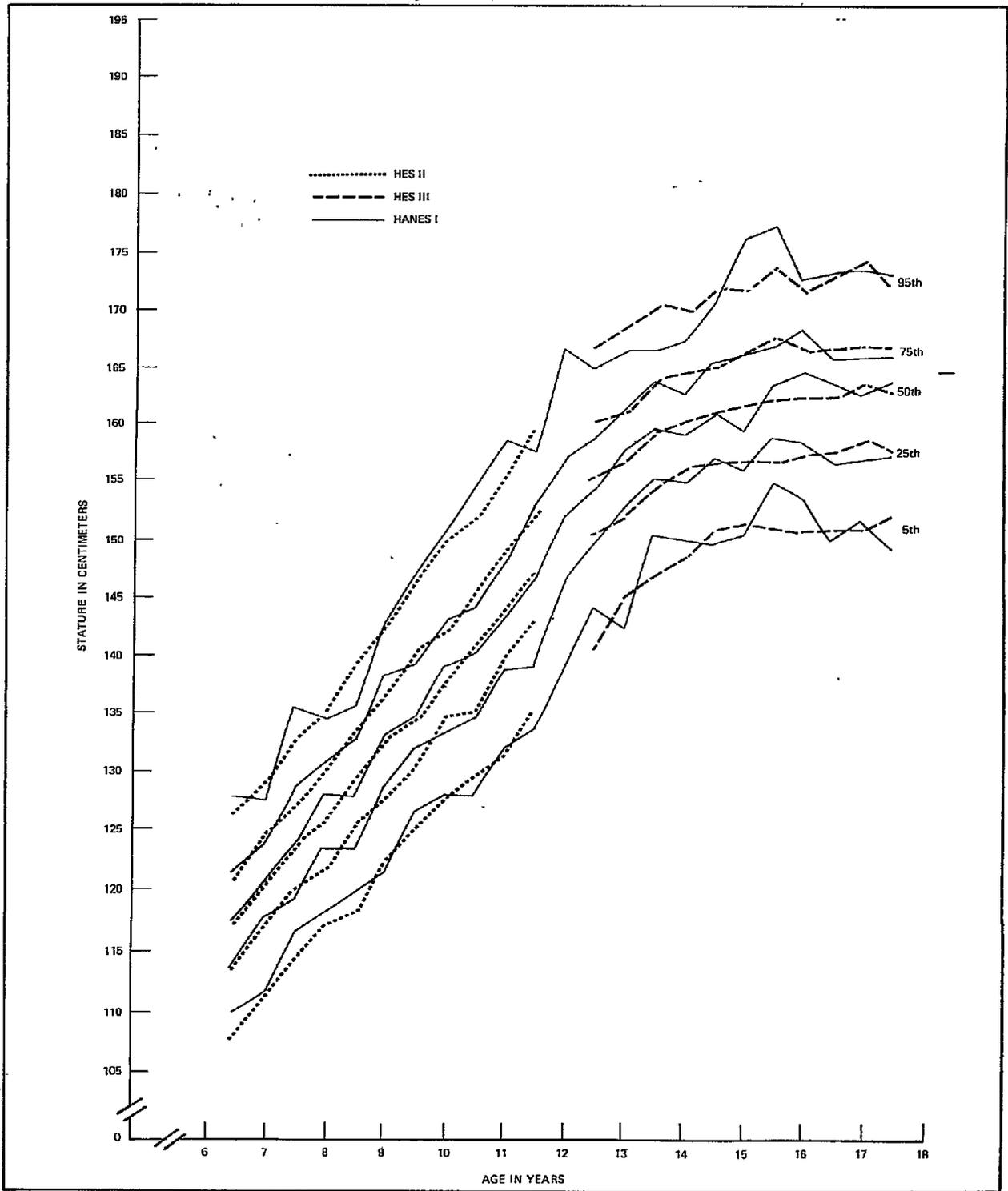


Figure XVI. Observed percentiles of stature by age for females of HES II (6-11 years), HES III (12-17 years), and HANES I (6-17 years): United States.

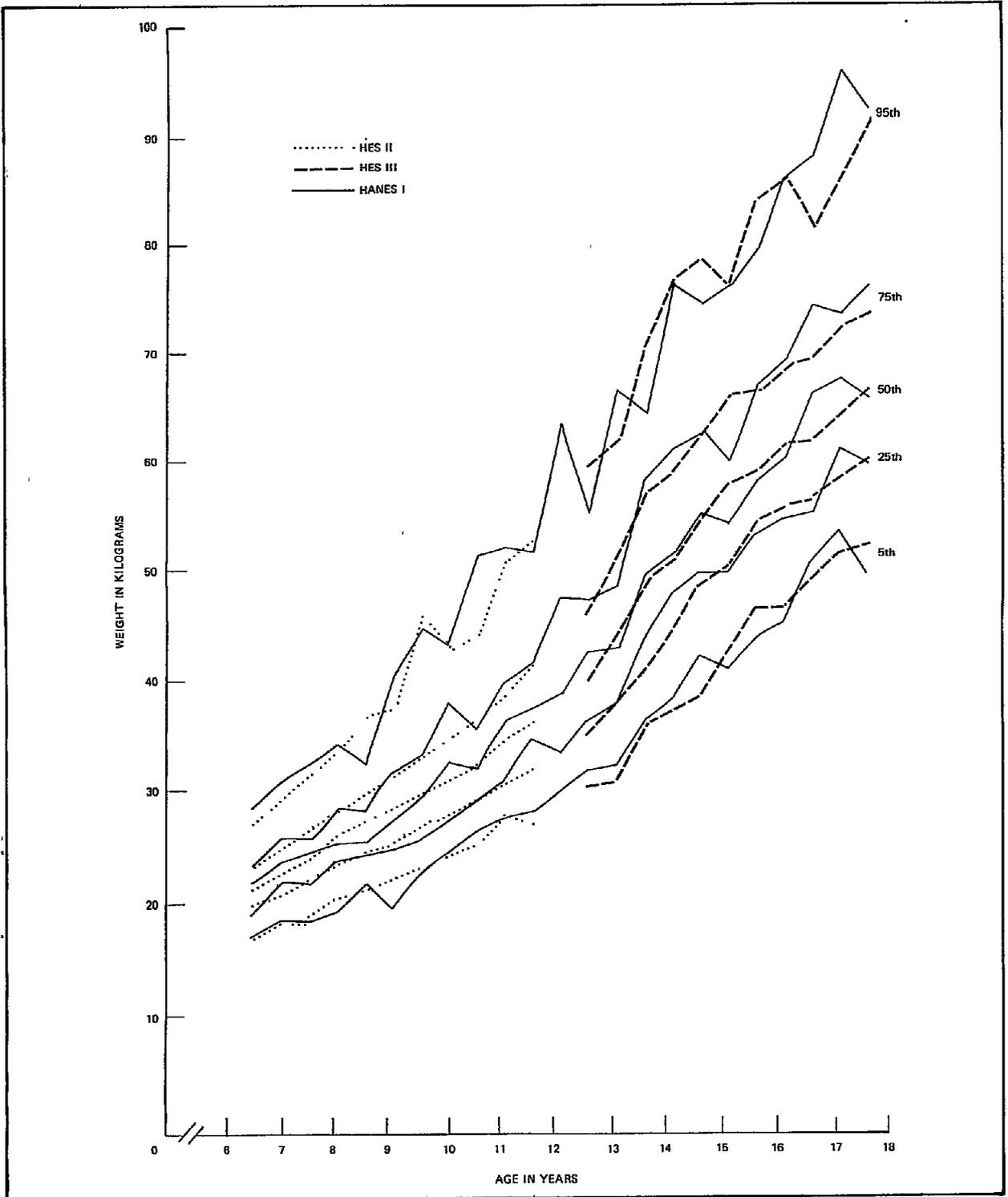


Figure XVII. Observed percentiles of weight by age for males of HES II (6-11 years), HES III (12-17 years), and HANES I (6-17 years): United States.

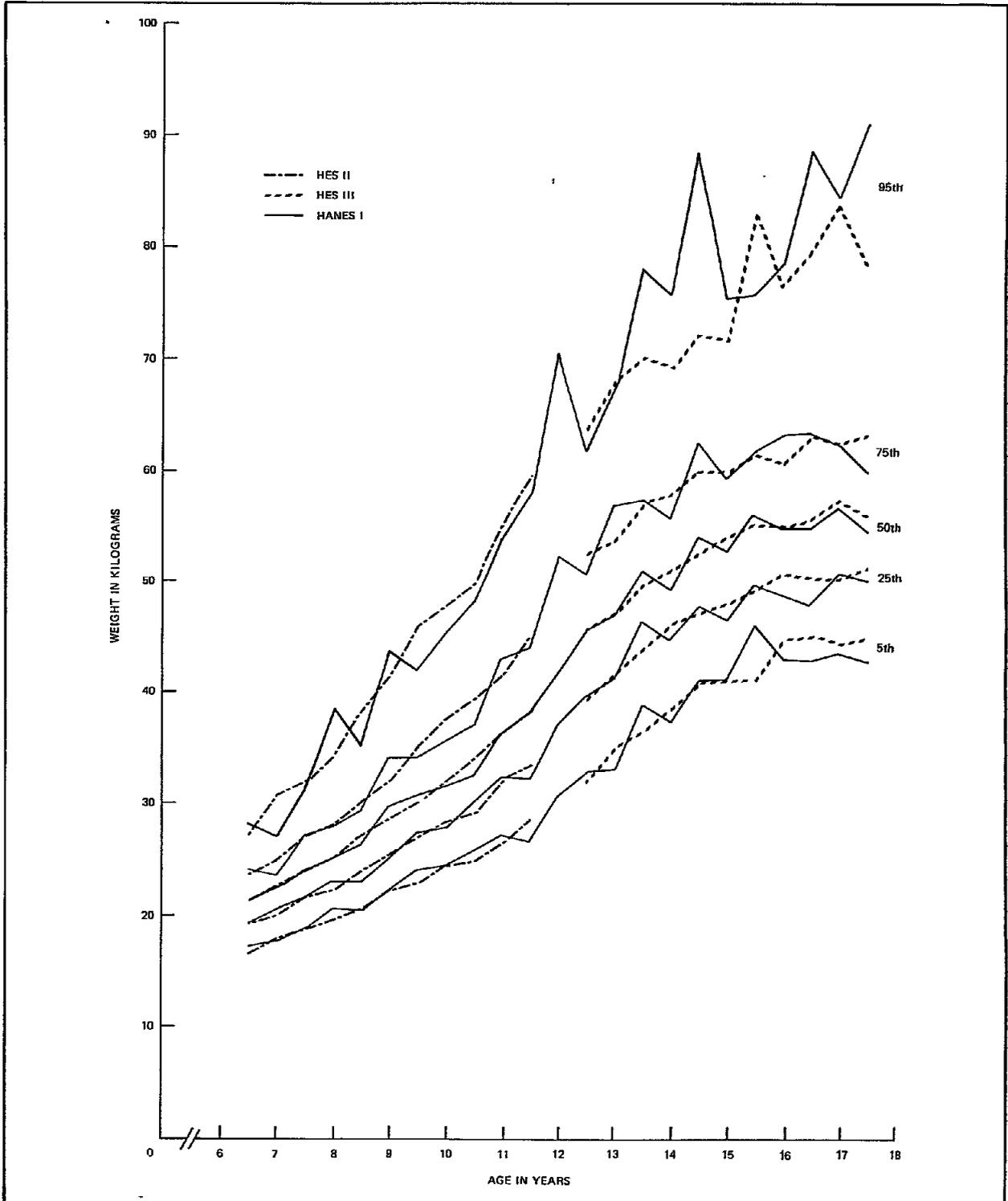


Figure XVIII. Observed percentiles of weight by age for females of HES II (6-11 years), HES III (12-17 years), and HANES I (6-17 years): United States.

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

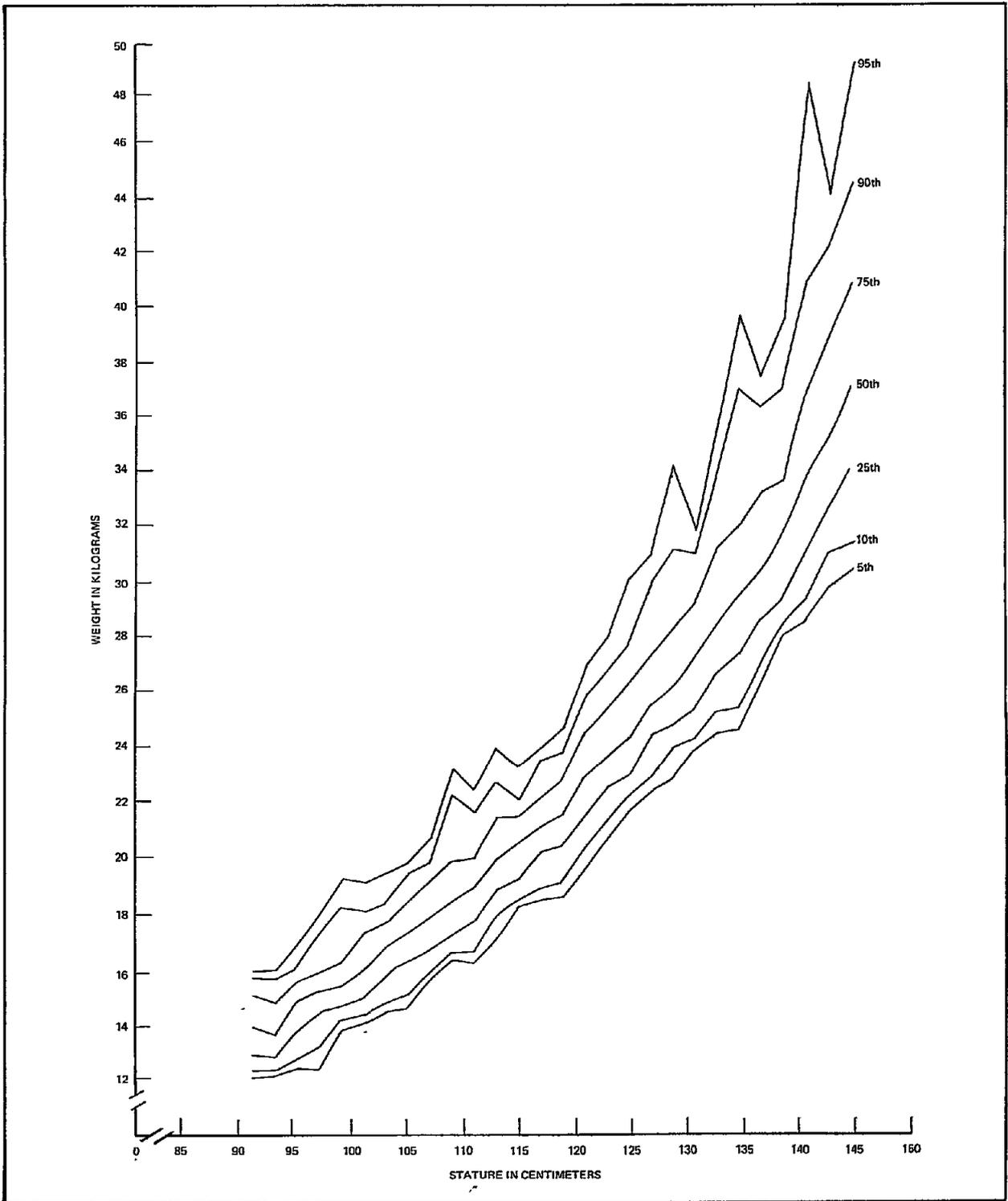


Figure XIX. Observed percentiles of weight by stature for prepubescent males 2-11.5 years: Data and statistics from National Center for Health Statistics.

Table 1. 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 |

¹Location 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 than 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

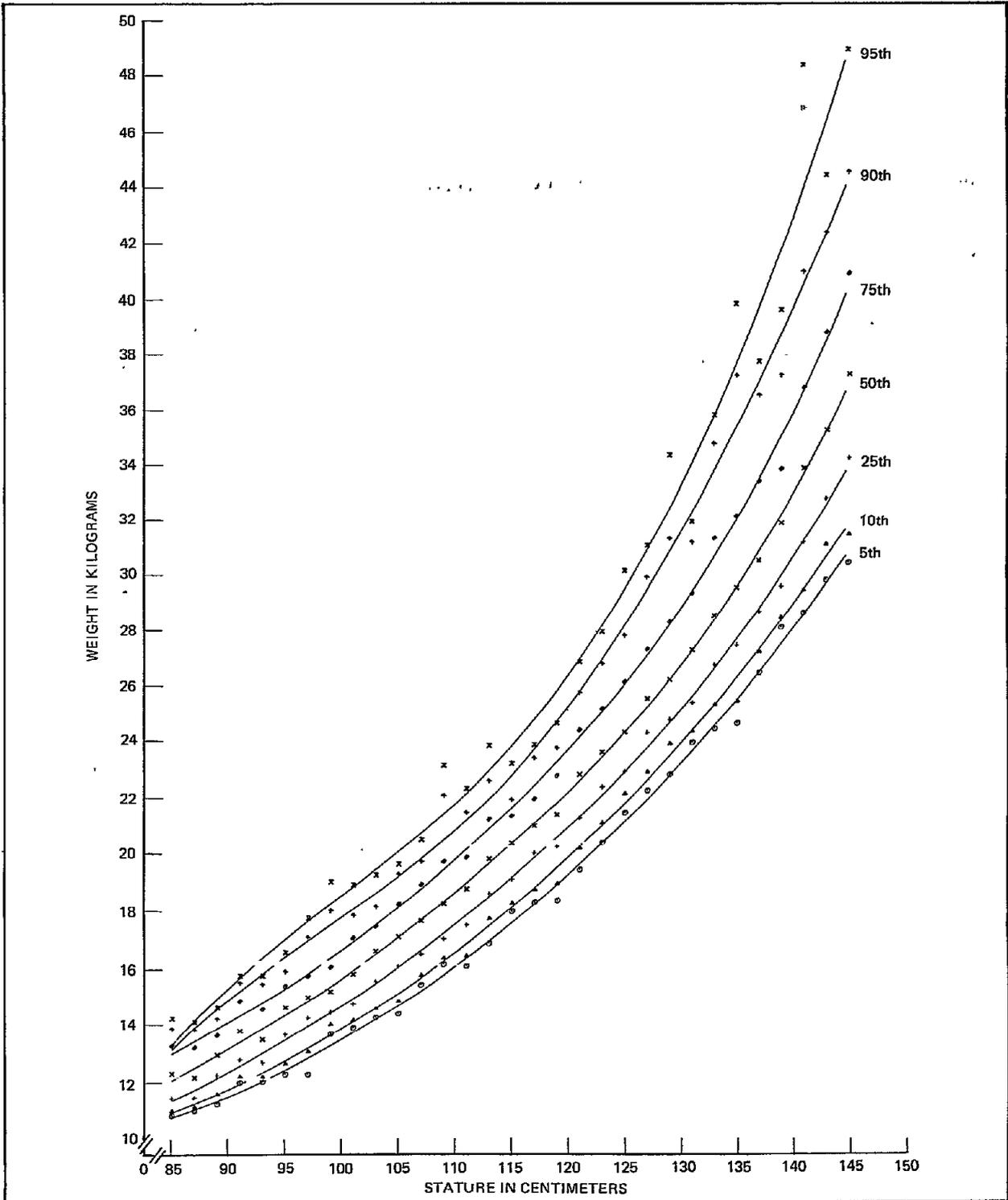


Figure XX. Smoothed percentiles of weight by stature for prepubescent males 2-11.5 years: Data and statistics from National Center for Health Statistics.

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:

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

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:

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

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

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

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:

$$\text{Skewness} = \sqrt{\beta_1} = \sqrt{\frac{\mu_{3i}^2}{\mu_{2i}^3}} = \sqrt{\frac{(\hat{\Delta}_i^3)^2}{(\hat{\Delta}_i^2)^3}}$$

$$\text{Kurtosis} = \beta_2 = \frac{\mu_{4i}}{\mu_{2i}^2} = \frac{\hat{\Delta}_i^4}{(\hat{\Delta}_i^2)^2}$$

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.

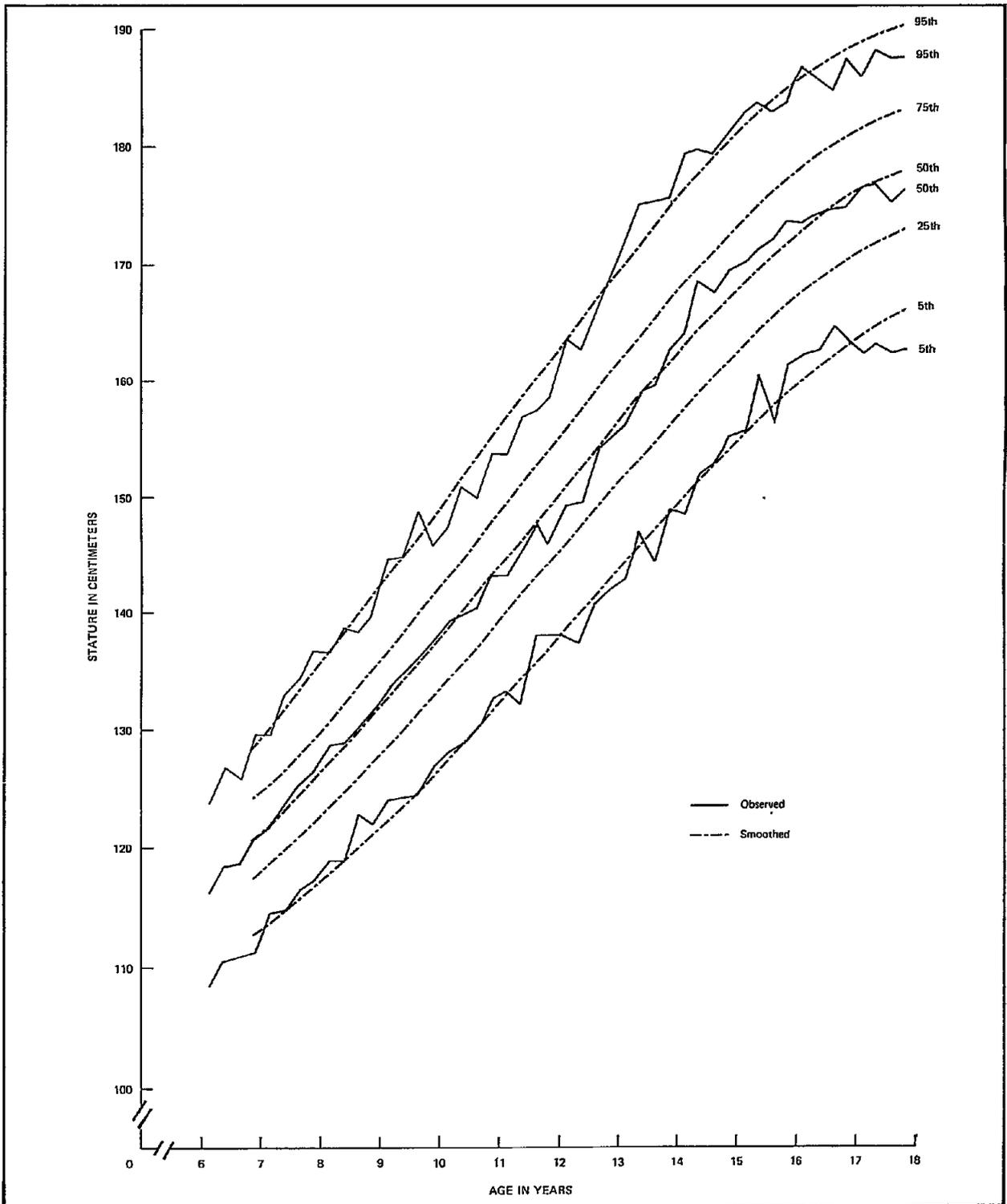


Figure XXI. Observed and smoothed percentiles (using the Pearson distribution system) of stature for males 6-18 years, by age: United States.

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