AN EVALUATION OF THREE GROWTH NORMS

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H. Weldon Frase

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This is to certify that the

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AN EVALUATION OF THREE GROWTH NORMS

by

H. WELDON FRASE

AN ABSTRACT OF A THESIS

Submitted to the School for Advanced Graduate Studies of
Michigan State University of Agriculture and
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the requirements for the degree of

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Introduction

In studies of child growth and development the subjects are measured in a variety of ways. Such characteristics as height, weight, bone development, ability to read, and mental ability are checked. According to the organismic point of view, each or any of the measures can serve as manifestations of the unique growing pattern of the individual child. Since the units for the different measures appear as inches, pounds, points, it is difficult to discern the underlying unity.

To bring varied measures into relationship with each other, a common denominator is necessary. In some studies all measures are translated into months and are referred to as height ages, weight ages, dental ages, reading ages, and mental ages. In other studies measures are translated into percentage of maturity. To arrive at a common unit of measure, a standard is often necessary. An acceptable standard must provide a consistent base for comparison.

The purpose of this study was to test three commonly used standards or norms. The three norms tested were the Olson-Hughes height-age and weight-age norms, the Millard-Rothney height and weight norms, and the Mid-child in the group as proposed by Stuart Courtis.

The Cases Studied

Three groups of children were selected for whom at least five years of longitudinal height and weight measures were available. All of the cases in the study were measured in schools at mid-year from the first grade through the fifth grade. Cases were taken from Holt, a small community comprised largely of skilled and unskilled workers; from East Lansing, a residential suburb comprised predominantly of professional, and managerial personnel; and from the Harvard data collected in three towns near Boston where the populations were generally workers and trades people. The Holt and East Lansing cases represented children currently in school whereas the measures in the Harvard Study were made between 1921 and 1926.

Techniques of Study

The height and weight measures of each of the children were compared to each of the norms for each yearly age level. The hypothesis of the study was that the norm which reflected the greatest consistency, or the least variation would be considered as the most realistic in terms of the growth patterns of boys and girls.

Comparisons between the cases and the norms were made in two ways. First the increments of growth between yearly measures were compared with the changes in each norm during the same yearly intervals. Variations between the

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norm increments and the child's increments were totaled for the five year period. Total variations, mean variations, and standard deviations were determined for the comparisons of the girls with each norm and for the boys as compared with each norm.

The second comparison was made in terms of parallelism of the child's individual pattern to the pattern of the norm. Perfect parallelism would occur if each measure of the child was one pound or one inch less or more than the norm for each yearly interval. Variation from the parallel was totaled for each child as compared with each of the norms. Results were totaled, means, and standard deviations computed for each group of boys and each group of girls.

Summary

The results of the study may be summarized as follows. Combining all of the comparisons of the childrens' heights with the norms, the smallest mean variation occurred for the Mid-Child in nine of the twelve comparisons. The Millard-Rothney norm showed the smallest mean variation in two comparisons. The Olson norm showed the smallest mean variation in one instance.

The difference between means was significant in five of the comparisons, four of these cases were those in which the Mid-Child reflected the smallest variation and one where the Millard-Rothney norm reflected the smallest variation.

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In the comparisons of the childrens' weights to the norms, the Olson norm reflected the smallest mean variation in six of the twelve comparisons. The Millard-Rothney norm reflected the smallest variation in five of the comparisons. The Mid-Child standard reflected the smallest variation in one comparison.

The differences between the means were significant in three of the twelve comparisons. In two of the instances of significance the Olson norm showed the smallest variation, and in one instance of significance the Millard-Rothney norm showed the smallest variation.

Conclusions

Since this study indicates that neither the Mid-Child, the Olson-Hughes growth ages, nor the Millard-Rothney norms maintained a superiority in reflecting the height and weight changes in boys and girls, and since it can be seen by inspection that the differences between the three standards at any single point can be as great as two inches or five pounds, it must be concluded that comparisons to any of the three norms are but very general estimates.

The norms tested did not meet the important criteria for an acceptable standard, that it must provide a consistent base for comparison, therefore, for precise interpretations of individual growth trends, better standards must be developed or other methods of analysis employed.

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CHAPTER I

INTRODUCTION

Competence in any line of endeavor is structured upon a thorough understanding of the materials with which the occupation deals. The mechanical engineer must know well his metals, how they react to being pulled, pushed, squeezed, or twisted. He must also be able to determine precisely the effects of the various forces acting upon the works which are fabricated. The geologist must understand the composition of the earth's surface, the meaning of its contours, and the varied combinations of rocks and soils comprising the various strata.

Understanding is equally necessary for one who is interested in the development of the human being. In order to deal adequately with the shaping of the lives of people whether in the field of medicine, social work, child care, guidance, or education, it is necessary to know about patterns of growth.[1,2] Olson states:

> The changes that occur with age have always facinated parents, teachers, and scientists. An

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[1]Cecil V. Millard, Child Growth and Development (Boston: D. C. Heath and Company, 1951), p. 10.

[2]Elizabeth B. Hurlock, Child Development (New York: McGraw-Hill Book Company, 1950), p. 133.

> understanding of these changes and of the influences that produce them has become an indispensable part of the preparation of all who work with children.[3]

The way people grow may be identified in a number of ways. By direct observation certain stages may be seen such as the progress in an infant's growth from turning, to sitting, to crawling, to walking. And likewise the pattern of change in size may be observed. Notation of observations may be recorded periodically, and from the notations general patterns discovered. Notice may be taken of sounds, movements, skills, actions, and reactions. Each or all give clues to patterns of growth merely by employing careful, periodic observation.

Sequential observations often reveal much about the patterns of growth. The physician not only recognizes the symptoms of a fever by observation but employs a thermometer for a more accurate check. The civil engineer can see a rise in the terrain but uses a transit when accuracy is needed. And so with patterns of growth, when greater accuracy is needed more accurate measures must be recorded.

Various growth of individuals can be measured. Height, weight, length and number of bones, strength of grip, and the ability to perform a number of varied tasks, all can be recorded as numerical dimensions or scores. Each growth may be expressed in somewhat different terms than the

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[3]Willard C. Olson, Child Development (Boston: D. C. Heath and Company, 1949), p. 3.

others, height in inches, grip in pounds, but each in itself reflects a single over-all design. It has been hypothesized that there exists a basic growth pattern for the total organism.[4,5,6] Each of the various measures express something of a basic underlying unity. When all measures are viewed together unity becomes evident. However, this is true only when the various dimensions are expressed in common units of measure. To deal with unlike parts, a common denominator must be discovered. Likewise, if inches, pounds, months, and grade points are to be related, a common denominator or unit must be derived.

To arrive at a common unit, a standard is necessary. Standards for the basic units of measurement are carefully guarded in the major centers of government. A world standard for measuring the passage of time is maintained at Greenwich, England. The surveyor makes his calculations from a bench mark. All measures, then, are in terms of this standard.

An acceptable standard must provide a consistent base for comparison. Many standards remain static such as the length of an inch or a meter and the weight of a pound or a

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[4] Millard, _op_. _cit_., p. 18.

[5] Olson, _op_. _cit_., pp. 40, 177.

[6] Stuart A. Courtis, "Toward a Science of Education" (unpublished mimeographed booklet, Detroit, Michigan, 1951), p. 13.

gram. Other standards such as height, mental age, achievement are continually in flux. Whether static or in flux, the best standard is that one which most consistently and most accurately serves its purpose.

In studies of human growth and development, a number of norms have been established and used. Olson and Hughes have derived norms for converting appropriate measures to growth ages. By their utilization all data may be recorded in months.[7] Height age, weight age, carpal age, mental age, reading age, or educational achievement age, all may be expressed in the same unit, the month. All may be graphed on the same scale so that a more complete picture of the total child may be seen.

"National" norms have been derived for most of the commonly used mental and achievement tests. Millard and Rothney derived norms for the physical measures of height and weight based upon measures collected in many sections of the nation.

Courtis has recently proposed a different method as a base for comparison of growth measures.[8] Since the averaging technique tends to cancel out individual variations, and mass measures conceal the uniqueness of the individual,

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[7]Willard C. Olson and Byron O. Hughes, Manual for the Description of Growth Age Units, Ann Arbor, Michigan, 1950, p. 2.

[8]Stuard A. Courtis, "The Status Index as a Measure of Individual Differences," The Twelfth Yearbook of the National Council on Measurements Used in Education, Part Two, 1955, pp. 61-67.

he proposed basing the standard upon the pattern of a single selected normal child. The individual selected is the mid-child in the group. According to his reasoning there normally are more children approximately like the mid-child than any other child in the group.[9]

That the three standards just mentioned are different from each other can be readily determined. At eighty-seven months the Millard-Rothney norm for height is 49.2 inches, the Olson norm for the same age is 48.3 inches, and the mid-boy in the selected group of the Harvard data is found to be 47.1 inches. The two inches difference between the extremes represent for many individuals two years of height growth. Since the standards differ in both the increments of increase from year to year as well as in total configuration, it can be assumed that the three are not equally realistic in terms of the way the human organism grows and develops.

To test the three norms the writer selected three groups of children from different school settings for whom at least five years of height and weight measurements were available.[10] In all instances measures were taken at mid-year from the first through the fifth grade.

Thirteen girls and thirty boys comprised the cases selected from the Holt schools. The oldest boy was born

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[9]*Ibid.*, pp. 61-67.

[10]See Chapter III for detailed description of the three groups.

May 12, 1943, the youngest boy was born December 14, 1944, which is a span of nineteen months in ages. The oldest girl was born March 12, 1943, and the youngest girl December 25, 1944, a span of twenty-one and one-half months in ages.

Holt is a small town under 10,000 residents. The population is comprised predominantly of industrial workers who are employed in a nearby larger town. Generally the homes range within the lower to the middle economic brackets.

The second group was taken from East Lansing, Michigan, a community on the higher end of the economic scale. East Lansing is the seat of a large State University and is also a residential suburb where many of the professional and managerial personnel from nearby Lansing have homes. Financially, the population ranges from the middle to upper brackets. There were twenty-five boys born between June 9, 1944 and November 29, 1945, a span of about seventeen and one-half months. There were seventeen girls born between January 1, 1945 and November 23, 1945, a span of about eleven months. The measurements for these children were recorded between the first and fifth grades in school.

The third group was selected from the Harvard cases where measurements were recorded for school children of the generation preceding the two previous groups. There were nineteen boys and twenty-one girls in the group. The boys were born between September 16, 1915, and November 15, 1915, a span of two months. The girls' birth dates fell between

September 1, 1915 and November 31, 1915, a span of three months. Here it was necessary to take a larger span of months for girls than for the boys to include a sufficient number of cases. Since the Harvard study includes a larger number of cases, it was considered desirable to select children who were as nearly as possible to the same chronological age.

The data for the Harvard study were collected in several small towns in the Boston area. Children were generally from the lower economic groups and from varied ethnic backgrounds.

These groups were selected for the study because they came from distinctly different environments. Children were chosen from low, middle and high economic families. A portion of the cases were from the densely populated New England seaboard in contrast to those from a small town and a suburban mid-western community. Two of the groups represent the recent, growing school population while the third group is from a generation born thirty years earlier. Due to the scarcity of longitudinal data, it was not possible to obtain samplings which could accurately represent the growth of children throughout the United States. However, the cases selected to meet the particular age, and sequence requirements of this study[11] were drawn from the most

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[11]Height and weight measures made yearly in January on children from their sixth to eleventh year of age.

comprehensive longitudinal data which were available. By choosing these groups from distinctly different environmental settings, it was possible to avoid the bias which might be suspected when a study is taken from a single school or community.

Comparison of the cases to the norm will be carried out in two ways. First, the yearly increments from each measurement to the next will be compared with the increases of the norms during the same periods of time. For example, the child grows in height from forty-six inches to forty-eight inches from the first grade measurement to the second grade measurement. The norm for those ages changes from forty-eight inches to fifty-one inches. The child has increased two inches while the norm has increased three inches. The child's growth was one inch less than the change in the norm.

The second comparison will be made to check the degree of parallelism of the child to the norm. In other words, how closely does the child's growth pattern follow the pattern of the norm? If the child's height (hypothetical case No. One) measures were 49, 50, 51, 53, 55, and the norms for the same time were 48, 49, 50, 52, 54, the child would be growing in exactly the same pattern as the norm. Another child (hypothetical case No. Two) whose measurements were 47, 48, 50, 53, 56, would be following a pattern of height growth which was different than that of the norm. Variations from the point of mid-difference then result in a measure of parallelism.

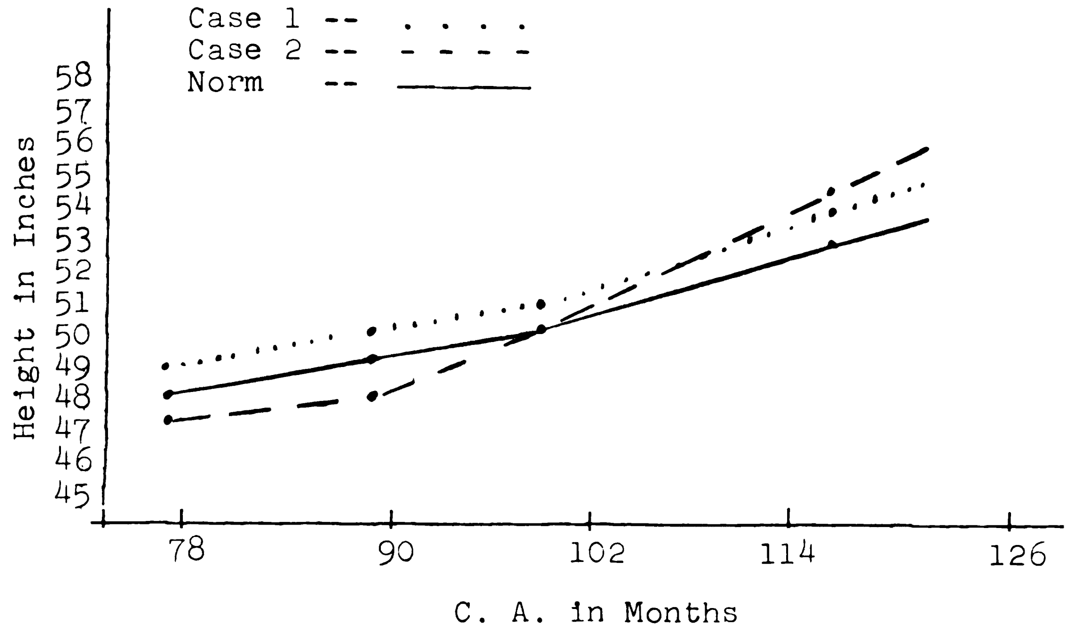

Figure 1. Hypothetical Representation of Parallelism

The study shall compare the height and weight growth patterns of the selected cases to three norms, Millard and Rothney norms as derived from data compiled by the United States Department of Health, Welfare and Education, the norms derived by Olson and Hughes, and the norm based upon the measurements of the mid-boy and mid-girl in each group. The hypothesis on which the study rests may be stated as follows: The norm which reflects the greatest consistency, or the least variation will be considered as the most realistic in terms of the growth patterns of boys and girls.

CHAPTER II

HISTORICAL BACKGROUND

Man has been interested in the measurement and relative size of the body as far back as the early histories report man's progress. Goliath of Gath was described as having a height of six cubits and a span.[1,2] In an attempt to find the right proportions for the human figure, Indian, Egyptian, Greek, and Roman sculptors took numerous body dimensions of many individuals in order to obtain averages or typical body proportions. Over periods of time, concepts of ideal proportions varied. The Greek spear thrower, a fighter and an athlete was broad shouldered, thick set, and square chested, as the perfect man. As the arts of civilization became more gentle, however, grace more than ruggedness appealed to the Greeks; and the ideal man became slender, graceful, and skilled.[3] This interest has continued through the years up to current times. Prior to 1900, measurements were reported on the growth in size of individual children, but there was a lack of recorded data on groups of children.

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[1]Samuel 17.

[2]9 feet, 9 inches

[3]H. Harrison Clark, The Application of Measurement to Health and Physical Education (New York: Prentice-Hall, Inc., 1945), p. 4.

It was not until systematic collections of measurements were made that "normal" or "average" could be determined other than by guess. Consequently, around the turn of the century, investigators began to report measurements on groups of children.[4] From the early collections of measurements, normal or average status in height and weight was determined by statistical averaging techniques. A number of tables were presented which indicated norms of height and weight for chronological age.[5,6]

With usage of such tables, it was discovered that many apparently healthy, growing individuals did not conform to them. Either height or weight or both fell below or above the norm for the child's age, or the weight radically differed from the normative figure for height and age. Even though, in some cases, the departure from the norm indicated a disturbance in growth patterns which could be traced to some deprivation, enough healthy individuals deviated to make the norms seem highly questionable.[7]

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[4]Bird T. Baldwin, "Physical Growth of Children from Birth to Maturity," University of Iowa, Studies in Child Welfare, Vol. I, No. I (1921), p. 412.

[5]B. T. Baldwin, T. D. Wood, and R. M. Woodbury, Weight-Height-Age Tables for Boys and Girls of School Age (New York: American Child Health Assn., 1923), passim.

[6]Horace Gray, "Weight-Height-Age Tables for American Adults and Children," The Cyclopedia of Medicine, Sec. Ed., Vol. XV (1940),pp. 1052-1060.

[7]Cecil V. Millard, Child Growth and Development (Boston: D. C. Heath and Company, 1951), p. 2.

In order to account for the deviations, investigators followed a number of paths. It was readily seen that consideration had to be given to age and sex. Dearborn and Rothney reported that early measurements were taken under a great variety of conditions and that methods were completely unstandardized. They proposed more rigid methods of measurement employing several trained anthropometricians working separately. When the measures made by three people failed to agree within prescribed limits the process was repeated until closer agreement was attained.[8]

Dearborn and Rothney indicate that measurement over clothing was responsible for some variability. Clark made a study of measurements made with and without clothing and concluded that variability was only slightly greater in clothed subjects. It was clearly indicated, however, that measurements were not comparable when some measurements were upon clothed subjects and others upon nude subjects, or when one measurement was made clothed and a later measure was made with the subject nude.[9]

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[8]Walter F. Dearborn and John W. Rothney, Predicting the Child's Development (Cambridge, Massachusetts: Science and Arts Publication, 1941), p. 61.

[9]Grace Clark, "Differences in Measurement Made in the Nude and Clothed Children Between 7-9 Years of Age," Child Development, I (1930), pp. 343-345.

Another direction of study reported by McCloy[10] dealt with differences in body type. Early anthropometric standards were based upon averages of measurements taken on many types and builds. In order to allow for deviations from the norm, attempts were made to define a number of characteristic bodily categories. Classifications varied from two to four body types. Each investigator used somewhat different terminology, however, in essence they ranged from "tall thin" on one end of the scale to "short stocky" on the other end. The intermediate types were termed "normal,""athletic," or "muscular." Kretschmer, for illustration, labeled his types "asthenic," "athletic," and "pyknic."[11] Others used different names with similar meanings.

Meredith contended that the proper use of norms depended upon a knowledge of where and how the norms were derived. Such things as sex, geographic location, ancestral background, socio-economic status, diet, health care, and general condition of the subjects were important variables

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[10]Clarles H. McCloy, "Appraising Physical Status the Selection of Measurements," University of Iowa Studies, XII, No. 2 (March 15, 1936), passim.

[11]E. Kretschmer, "Physique and Character: An Investigation of the Nature of Constitution and of the Theory of Temperment," translated from the rev. and enl. ed. by W. J. H. Sprott (New York: Harcourt Brace, 1926), pp. xiv, 266, 20-34.

to be considered when norms were to be employed.[12,13]

The idea of body type or build was further pursued by Wetzel, who plotted height, weight, and age upon a grid. As the individual child's measurements were plotted, radical departures from the original channel were to indicate nutritional difficulty.[14]

The search continued for other nutritional or bodily indices for more accurate assessment of optimal bodily dimensions. Bayer and Gray plotted height against weight and against bi-iliac diameter (hip width) to indicate normal limits.[15]

Stuart and Meredith determined channels based upon five different measures: height, weight, chest circumference, hip width, and leg girth.[16]

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[12]Howard V. Meredith, "Body Size Norms for Children Four to Eight Years of Age," Journal of Pediatrics, 37 (August, 1940), pp. 183-89.

[13]Howard V. Meredith, "Anthropometric Measurements on Iowa City White Males R:nging in Age Between Birth and Eighteen Years," University of Iowa Studies, XI, No. 3 (February, 1935), passim.

[14]Norman C. Wetzel, "Physical Fitness in Terms of Physique, Development, and Basal Metabolism: With a Guide to Individual Progress from Infancy to Maturity: A New Method for Evaluation," Journal of the American Medical Association, 16 (1941), pp. 1365-1386.

[15]L. M. Bayer and Horce Gray, "Plotting of a Graphic Record of Growth for Children, Aged from One to Nineteen Years," American Journal Diseases of Children, 50 (1935), pp. 1408-1417.

[16]H. C. Stuart and H. V. Meredith, "Use of Body Measurements in the School Program," American Journal Public Health, 36 (1946), pp. 365-386.

It seems that each of the evaluative techniques had supporters and rejectors. Kallner contends that deviation from the normal channel on a grid need not imply a health disorder or permanent deviation from normal physique. He claimed that developmental deviations based upon the grid method of analysis are not at all rare and can lead to diagnostic error.[17]

Krogman believes that the grid method might serve as a useful tool in some situations. When used with understanding and care, the method provides a rapid screening device for teachers, pediatricians, or research persons. By merely recording height and weight one-in-three of the real or potential growth failures can be identified, and in these cases provides the therapist with a graphic, dynamic standard of assessing degree and extent of recovery in height weight balance.[18]

Earlier McCloy had used about the same measures to form norm tables based upon multiple regression formulae. With four variables it was necessary to read first from a table comparing height and hip width, then take the figure from the table comparing chest circumference and knee width.

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[17] A. Kallner, "Growth Curves and Growth Types," Annals Pediatrics, 177 (August, 1951), pp. 83-102.

[18] Wilton Marian Krogman, "A Handbook of the Measurement and Interpretation of Height and Weight in the Growing Child," Monographs of Society for Research in Child Development, XIII, No. 48 (1948), pp. 61-63.

The two were combined to arrive at a single normal weight figure.[19]

Massler and Suher discovered that normal weight could be quite accurately determined by using height and calf girth, measurements which could be accurately and easily made. Norms were compiled as nomograms making possible the determination of ideal weight without mathematical computations.[20]

During the search for accurate assessment and prediction of status, interest was also generated in growth trends. A number of research centers began collecting data on the same children as they grew older. Some of the notable studies were the Iowa Studies started by Baldwin and continued by Meredith, the Harvard Growth Study by Dearborn, and associates, the Brush Foundation Studies of Cleveland Children started by T. W. Todd, studies at the University of California Institute of Child Welfare by Nancy Bayley.[21] Additional longitudinal growth studies have been under way at the University of Michigan under Olson and

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[19] Charles H. McCloy, "Appraising Physical Status: Methods and Norms," University of Iowa Studies, XV, No. 2 (1938), pp. 105-114.

[20] Maury Massler and Theodore Suher, "Calculations of 'Normal' Weight in Children by Means of Nomograms Based on Selected Anthropometric Measurements," Child Development, 22 (June, 1951), pp. 75-94.

[21] Nancy Bayley and Harold Carter, Section of Physical Growth, Encyclopedia of Educational Research, edited by Walter S. Monroe, (revised edition; New York: MacMillen Co., 1950), pp. 153-156.

and Hughes, and at Michigan State University, studies on Dearborn and Lansing children under Millard and the Holt study under Millard and DeLong. These and others furnished data for investigations for growth trends.

From these studies it was noted that growth is orderly and follows well defined sequences of changing sizes and proportions and physiological functions. In the area of physical growth it was discovered that there was need to know about the average growth trends to be expected with age changes. A few years ago it was equally important to know in what ways and to what extent normal individuals might differ from these averages.[22]

The literature indicates wide divergence of opinion as to the place of norms in respect to individual growths.

In tests of achievement and intelligence, norms have been provided to make scores comparable for varied age and performance levels as well as to indicate typical performance.[23, 24, 25, 26] The assumptions in the testing manuals

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[22] Ibid.

[23] California Test of Mental Maturity, California Test Bureau, 5916 Hollywood Boulevard, Los Angeles 28, California.

[24] Pintner General Ability Test, World Book Company, Yonkers on Hudson, New York.

[25] Stanford Achievement Tests, World Book Company, Yonkers on Hudson, New York.

[26] Kuhlman-Anderson Tests, Educational Test Bureau, Minneapolis, Minnesota.

is that the norm furnishes an accurate pattern for assessing intellectual or academic growth of individual children.

In a summary regarding norms Herbert S. Conrad upholds the importance of them in making dependable interpretations of individual and group measures. However, he cautions that difficulties arise when it is assumed that the characteristic or variable considered represents a pure continuum, a continuum of quantitative differences exclusively. With this assumption, qualitative change is not considered.[27]

A number of writers flatly state that norms based upon the statistical averages taken from measurements upon a number of different organisms even though the number is large may not be considered as characteristic of any individual organism.[28,29,30]

Millard reports that norms have value in that they reveal growth tendencies within groups, races, populations, and either of the sexes. He suggests that misinterpretation

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[27] Herbert S. Conrad, Encyclopedia of Educational Research, edited by Walter S. Monroe (revised edition; New York: MacMillan Company, 1950), pp. 795-801.

[28] Ibid.

[29] Margaret Merrill, "The Relationship of Individual Growth to Average Growth," Human Biology, 3 (1931), pp. 37-70.

[30] Reuben R. Rusch, "The Cyclic Pattern of Height Growth from Birth to Maturity" (unpublished PhD thesis, Michigan State University, East Lansing, Michigan, 1956), pp. 9-12.

often results when prediction and analysis of individual growth rhythms are made based upon normative data.[31]

Olson adds:

> Investigators in child development have become wary of making statements concerning what is average or normal. Even when great care is taken in the choice and range of children measured, there are so many variables that a true cross-section of the population is unattainable. Very often the children reported upon are those who are available as subjects for study without extraordinary investments of time and money.[32]

Dearborn and Rothney conclude that there is so much overlapping of measurements for various age groups that deviation from the average in any physical measurement is unimportant for any given individual. They feel that judgment of physical status should be made in relation to a child's physical status in the past rather than to arbitrary group standards.[33]

Courtis suggests a reason why mass statistics or norms based upon cross-sectional data often point to misleading conclusions. He states that the innate differences which made individuals in the population hetrogeneous are chance and often are averaged out.[34,35]

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[31]Milard, op. cit., p. 59.

[32]Willard Olson, Child Development (Boston: D. C. Heath Company, 1949), p. 14.

[33]Dearborn and Rothney, op. cit., p. 343.

[34]Stuart A. Courtis, "Personalized Statistics in Education," School and Society, May 1955, p. 171.

[35]Cecil V. Millard, School and Child (East Lansing, Mich.: Michigan State College Press, 1954), p. 178.

In a graphic representation, Shuttleworth observed that when height measures from cross-sectional norms were charted, they resulted in smoothly rounded curves. When graphs were made based upon measures of individual children who were similar in age, sex, and background, curves followed paths quite different from the norm curves.[36]

Shuttleworth concludes: "Individual variations which might be significant when related to other measures or observations are averaged out in the formation of norms."[37]

When DeLong compared groups of children using both cross-sectional and longitudinal methods, he discovered that the mean described only a very small portion of the cross-sectional group.[38] He found that no children were precisely described by the height mean. Reasoning that this requirement was quite rigid, he expanded the measurement above and below the mean score. It was only when he included measurements one inch above the mean and one inch below the mean that up to twenty-five per cent of the group could be described. Two inches difference at third grade

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[36]Frank K. Shuttleworth, "The Physical and Mental Growth of Girls and Boys Age Six to Nineteen in Relation to Age at Maximum Growth," Monographs for Research in Child Development, IV, No. 3, Washington, D. C., 1939, passim.

[37]Ibid.

[38]Arthur R. DeLong, "The Relative Usefulness of Longitudinal and Cross-sectional Data" (from a mimeographed copy of a paper presented to the Michigan Academy of Science Arts, and Letters, March 26, 1955), 10 pages.

level represented fourteen months of height growth for boys according to the Olson-Hughes growth ages. DeLong also discovered that when longitudinal data were regrouped according to sex and age, that the mean and ranges of scores were quite different from those based upon the total group. The data clearly indicated to DeLong that: "The cross-sectional method can be used only when gross comparisons are desired. Longitudinal methods are necessary for descriptive purposes."[39]

DeLong's investigation of longitudinal and cross-sectional data can be considered only a survey or pilot study of the question, first, because the data were drawn from but a single situation and secondly, because the intent was merely to test the feasability of such a study.[40]

Hurlock refers to the question of relative usefulness of standards based upon cross-sectional as opposed to longitudinal data when she writes: "Whether norms based upon cross-sectional data are more realistic than norms based upon longitudinal data has not been subjected to scientific investigation."[41]

Courtis proposed a third type of norm or standard for use with measurements upon growing children.[42] In order to escape the danger of the individual becoming submerged in

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[39]Ibid. [40]Ibid.

[41]Elizabeth B. Hurlock, Child Development (New York: McGraw Hill Book Company, 1950), p. 27.

[42]Stuart A. Courtis, "The Status Index as a Measure of Individual Differences," The Twelfth Yearbook of the National Council on Measurement Used in Education, Part II (1955), pp. 61-67.

the mass, he suggests that a single normal child be selected as a standard.[43] The standard then is real following a real pattern not one which was mathematically derived.[44] The norm in this case always describes at least one growing child, whereas DeLong discovered that frequently a cross-sectional norm actually described no child in a group.[45]

To arrive at the norm the mid-child in a group of children similar in age, sex, and grade is picked. All other children in the group are thus compared to the scores or measurement of the mid-child.[46] Courtis claims that this procedure provides a simple, direct, and accurate method of assessing individual differences in growing children.

The literature indicates the sustained interest in the measurement of the human body and with the interest, the need for a norm or standard for examining individual status as well as progress. There seems to be considerable difference of opinion as to the type of norm which most realistically reflects the growth patterns of real boys and girls. The literature indicates no study which has been conducted to compare the growth patterns of real groups of children with several types of norms.

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[43] Ibid.

[44] Ibid.

[45] DeLong, loc. cit.

[46] Courtis, loc. cit.

CHAPTER III

A DESCRIPTION OF THE DATA AND NORMS EMPLOYED

In order to test the hypothesis presented in Chapter I, [The norm which reflects the greatest consistency, or the least variation will be considered as the most realistic in terms of the growth patterns of boys and girls.] it was necessary to use accurate measurements, and norms or standards of a type commonly chosen by those studying and working in the field of child growth and development. A careful description of the cases and norms employed in this study follows.

The Holt Cases

One of the most recent and comprehensive collections of longitudinal information was gathered in the Holt public schools. The Child Development Laboratory of Michigan State University sponsored and conducted the study.[1] The study was begun in 1950 and continued through the 1956 school year. Observations and measurements were recorded according to schedule on approximately three hundred elementary school children.

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[1]Holt Study directed by C. V. Millard and A. R. DeLong.

Aspects of the study included; physical health status, height and weight, grip, motor skill, mental growth, peer status, scholastic achievement, and general personality. Height and weight checks were made three times a year in October, January, and May. The January measures were used for this study. These data were taken under the close supervision of trained graduate assistants in child growth and development. Measures of the children at Holt were carefully recorded and maintained in files at the Michigan State University Child Development Laboratory.

All heights and weights obtained were upon children clothed in school apparel appropriate for the season. Shoes were removed and heavy objects which were not considered a part of normal attire were set aside during the weighing procedure. Height measures were read to the closest one-eighth inch and weights to the closest one-eighth pound.

Of the seventy-seven children who were enrolled in the first grade in 1950 at the beginning of the study, complete height and weight records for the five year period were available for thirteen girls and thirty boys.

The birth dates of the boys fell between May 12, 1943 and December 14, 1944, a span of approximately nineteen months. The girls' birth dates were between March 12, 1943 and December 25, 1944, a period of approximately twenty-one and one-half months.

The ethnic backgrounds of the children at Holt were much the same. All of the families in the study except two were of Northern European extraction. One of the two cases was from Southern European stock and the other of Jewish descent. There were no Negroes in the group studied.

East Lansing Cases

The data for the East Lansing cases were taken from the permanent record files of the Central Elementary School.[2] The cases selected were from the class which began first grade in the fall of 1950 and continued in the school for the five years which followed.

All measures were taken in January by classroom teachers with the help of parents from the district. Shoes were removed, otherwise the subjects were clothed in garments appropriate for the season. All measures were taken to the nearest one-fourth inch and one-fourth pound. There were complete, five year measures for sixteen girls and twenty-six boys.

The birth dates of the boys ranged from December 21, 1944 to November 29, 1945, a period of approximately eleven months. The oldest girl was born January 1, 1945, and the youngest girl was born November 23, 1945, a range of nearly eleven months.

Information about ethnic origin was not in the East Lansing school files. However, it can be safely assumed

[2]Data obtained under the guidance of Gordon Holmgren, Director of Elementary Education.

that a very high percentage of the school population was of Northern European descent. An examination of the surnames of the children indicates that all of the forty-two were names associated with Northern European countries. Needless to say it is possible that a few mothers or grandmothers could be Southern European or Jewish. There were no Negroes in the group.

Harvard Cases

The Harvard Study was based upon measurements on approximately three thousand five hundred children who entered first grade in three cities in the metropolitan Boston area during the year 1922.[3] Physical, mental, and scholastic tests were administered at regular intervals over a period of twelve years.[4] Particular care was taken to assure accuracy in the anthropometric measures. Children were clothed, but shoes and bulky sweaters or jackets were removed. The Harvard data were recorded in metric units, hence the height appeared in centimeters and the weight in grams.[5] All measures were performed three times by three

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[3]Medford, Revere, and Beverly, Massachusetts.

[4]Walter F. Dearborn, John W. Rothney, and Frank K. Shuttleworth, "Data on the Mental and Physical Growth of Public School Children," Monographs of the Society for Research in Child Development, III, No. 1 (1938), passim.

[5]It was necessary to this study to convert the Harvard data to inches and pounds in order that measures for the three groups could be in comparable units.

different persons. Where measures differed by more than 1.1 grams or centimeters, the child was sent back for remeasuring. When the three measures were within the 1.1 range, they were averaged to determine the final recorded figures.[6]

The birth dates of the nineteen boys were from September 16, 1915, to November 15, 1915, a span of two months. The birth dates of the twenty-one girls fell between September 1, 1915 and November 31, 1915, a span of three months.

The ethnic groups represented in the areas surrounding Boston were of a greater variety and number than in either of the other groups. The total, original population of the Harvard study was distributed in the following manner: North European 63.2 per cent, Italian 24.4 per cent, Negro and mixed 18 per cent, South European 4.2 per cent, and Jewish 7.4 per cent.[7] Twenty-nine of the cases selected for this study were of Northern European stock, eight were of Italian descent, two were Jewish, and one was Negro.

The three groups studied had several characteristics in common. All children were measured regularly while in the first through fifth grades. All children were in public schools. The measures selected were those taken at mid-winter time. Subjects wore clothing appropriate for the

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[6]Walter F. Dearborn and John W. Rothney, Predicting the Child's Development (Cambridge: Science Art Publishers, 1941), p. 83.

[7]Ibid., p. 76.

season, and shoes or any other unusually heavy sweaters or jackets were removed. The data were considered in separate sex groups. All measures were interpreted in units of inches and pounds to maintain over-all comparability.

Differences also are to be noted. The East Lansing and Holt groups were comprised predominantly of children of Northern European extraction while the Harvard group contained a mixture of ethnic backgrounds, although it too was predominately of the Northern European groups. The Harvard study represents the generation of children born in the year 1915, while both Holt and East Lansing cases were of the generation born in 1944 and 1945. The Harvard children were all within three months of the same chronological age while children in the other two groups differed by as much as twenty-one months in age. Children from East Lansing were from homes considered relatively high on the socio-economic scale. The Holt cases were from the middle and lower end of the socio-economic scale as were the Harvard cases. World and national economic conditions were not quite as prosperous during the early lives of the children of this preceding generation. It may be noted that all three groups were war babies even though of two different wars.

Millard-Rothney Norms

In their work with longitudinal studies of children Millard and Rothney became dissatisfied with the existing cross-sectional height and weight tables. They decided to combine the best from the available studies to derive new norms which would better reflect height and weight growth patterns.

The Millard and Rothney norms were computed from data compiled by the United States Department of Health, Education, and Welfare. Edgar Martin organized measures taken from twelve studies made between 1922 and 1942. The original studies envolved 300,198 children living in sixteen of the forty-eight states and the District of Columbia. The data were organized cross-sectionally into norms to be employed by school officials, architects, and design engineers, for the purpose of planning school buildings, furniture, and equipment.[8] Mean stature and weights were given for boys and girls at yearly intervals from age four years to sixteen years.

Millard and Rothney found it necessary to adjust the mean figures to more closely represent longitudinal growth patterns. It was likewise necessary for the authors to extrapolate mathematically to obtain norms for monthly intervals. Tables were organized into height ages for boys and for girls and weight ages for boys and for girls. The norms were first used in mimeographed form by Cecil V. Millard in his work with students in child growth and

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[8] W. Edgar Martin, Basic Body Measurement of School Age Children (Washington, D.C.: United States Office of Health, Education, and Welfare, 1953), pp. 1-12.

development at Michigan State University. Recently they were presented in printed form for wider distribution and use.[9]

Olson-Hughes Norms

A second set of norms utilized in this study were derived by Olson and Hughes. They too became dissatisfied with the existing standards, and decided to develop norms better suited to growing children. The Olson-Hughes height age and weight age tables were developed over a period of several years experimentation. At the time of the early studies of growing children, there were few available, long-term, collections of longitudinal measurements. It was, therefore, necessary to use cross-sectional data to serve as a starting place. Since cross-sectional norms did not completely satisfy the requirements of the investigators, they were revised to better represent the growth patterns observed in the studies of children in the University of Michigan Elementary School.[10]

During the year 1938, B. O. Hughes made an exhaustive study of all of the available growth studies compiled during the preceding fifty years. Means and standard deviations were compiled for the total mass of data. The resulting

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[9]Cecil V. Millard and John W. Rothney, The Elementary School Child, A Book of Cases (New York: Dryden Press 1957), appendix.

[10]Information obtained by direct communication with B. O. Hughes, August 8, 1956.

means were then used as the original Olson-Hughes growth ages. The authors immediately suspected that the selected norms were high for the general population. A gradual revision of the norms began which eventually resulted in those presently used.[11]

The most recently published Olson-Hughes height-age and weight-age tables appear in a paper-bound manual which was written by the authors to help students in the study of growth through age units.[12,13] The height-age and weight-age figures from these tables served as the Olson-Hughes norms for this study.

Mid-Child

The third type of norm employed in this study is the Courtis Mid-Child Norm. Stuart Courtis advocated the mid-child as the standard to which others in a group might be realistically compared. Courtis maintains that although statistical procedures are mathematically correct, conclusions are of no value when based upon a false assumption. Mass statistics (upon which norms are generally based) have

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[11] *Ibid*.

[12] Willard C. Olson and Byron O. Hughes, *Manual for the Description of Growth in Age Units* (Ann Arbor, Michigan: The Edwards Letter Shop, 1950), pp. 21-26.

[13] Appendix B.

been employed as if the measurements were made upon homogenious groups.[14]

> The false assumption which mass statistics always makes when dealing with measurements of living creatures is that the factors which make the individuals in the population hetrogeneous are chance and may be averaged out. The fact is that individuals, all individuals, are different.[15]

In order to escape the inherent errors of the averaging process, Courtis suggests the use of the score or measurement of the mid-child in a group made as homogeneous as possible in regard to age, grade, and sex. The measurements of this child may serve as a realistic norm for the particular group from which the child has been selected. There are no false assumptions since the standard is based upon a real child not upon a mathematical central tendency.[16,17,18]

For this study the mid-child was carefully selected for the boys of each group and for the girls of each group. The following procedure was used to make certain that the

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[14] Stuart A. Courtis, "Personalized Statistics in Education," School and Society, May 28, 1955, pp. 170-171.

[15] Ibid. [16] Ibid.

[17] Personal communication from Stuart Courtis, April 18, 1956.

[18] Stuart A. Courtis, "Marking Experiment Bulletin No. 5, The Status Index" (Mimeographed paper, November 23, 1953).

mid-child was the one who remained nearest to the middle of the group over the five year period. The mid-boy in terms of height was determined at first grade level. Then each child's measurement was recorded in points above or below the mid-measurement. For example, Harvard Case 123M was the mid-boy in the group with a height of 46.4 inches. Case 930M had a first grade height of 46.3 and was recorded as -.1 in terms of the mid-height. Case 1863M with a height of 47.1 was recorded as +.7 in terms of the mid-height at first grade. After all cases were recorded in terms of the mid-child at each grade level, the amounts of variation were totaled to determine the variation of each child from the middle of the group over the five year period. The child showing the least variation was selected as the standard or mid-child. This process was repeated for the weights and heights of each sex for each of the three groups studied.

The three norms to be tested then are: the Millard-Rothney norms based upon a wide compilation of studies and organized by the United States Department of Health, Education, and Welfare; the Olson-Hughes height and weight age norms which largely reflect the growth trends of the children enrolled in the University of Michigan Elementary School; and the mid-child in each group as proposed by Stuart A. Courtis. The next step shall be to compare the heights and weights of children from the three selected longitudinal studies with each of the three standards.

CHAPTER IV

TECHNIQUES OF COMPARISON

In order to determine which of the norms was most realistic in terms of the data, two methods of comparison were devised. First the increment of change in each child from one year's measurement to the next was compared to the increment of change in the norm from one year to the next. Secondly, the degree of parallelism of pattern between the norm and each of the cases was determined. Even though the results of the two methods might be in close agreement, it seems judicious to examine the relationship of the cases to the norms from both points of view.

Increment Relationship

To determine the growth increments, each yearly measure was subtracted from the measure of the following year. This was done for each case. The increments of change for the norm was determined by the same process. The difference between the actual child's yearly growth increment and the increment of change in the norm was determined at each grade level. Yearly differences were totaled for each child over the five year period. This relationship can best be comprehended by examining a single case represented in graphical form. Notice Figure 2 where case H-O-114F has

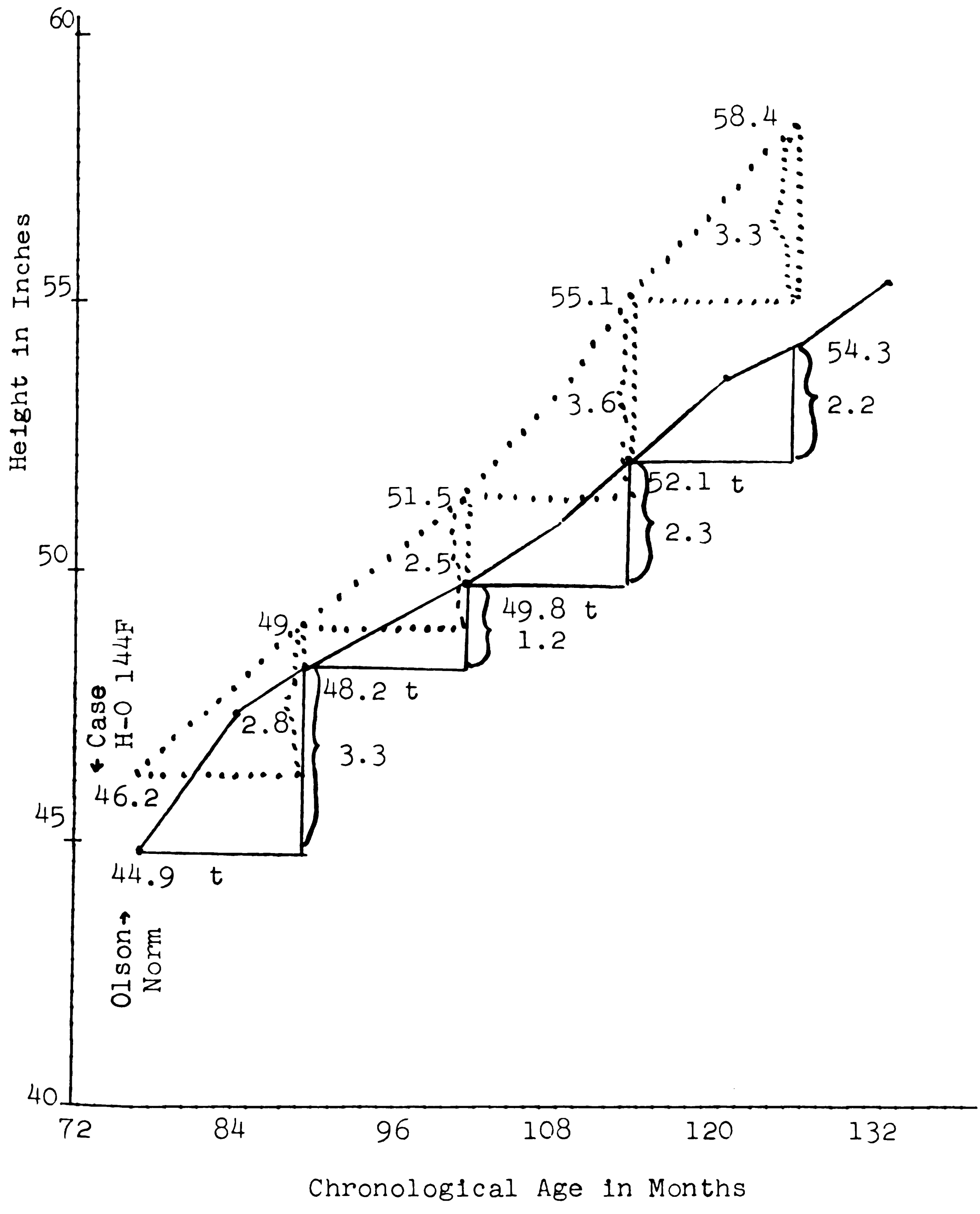

Figure 2. Increment Difference between Height Case H-O 144F and the Olson Norm.

been compared to the Olson norm. The height norm, shown as points on the solid line, for seventy-seven months of age is 44.9 and for eighty-nine months the norm is 48.2. The change for the twelve month period of time was 3.3 inches. Case H-O-144F represented by points on the dotted line was 46.2 inches at seventy-seven months and 49. inches at eighty-nine months a growth of 2.8 inches over the year. The difference between the increments of increase for the year was 3.3 - 2.8 or .5. The increase for the norm between eighty-nine and one hundred and one months was 1.2 inches and the increase for the case was 2.5 inches. The difference between the yearly increase of the norm and the case was 2.5 - 1.2 or 1.3 inches. From 101 months to 113 months the increase for the norm was 2.3 and for the case the increase was 3.6 with a difference between the two of 1.3 inches. Between 113 months and 125 months the norm increased 2.2 inches and the case increased 3.3 inches, with a difference between the two of 1.1 inches. Over the five year period, the difference between increments of increase in height was .5 + 1.3 + 1.3 + 1.1 a total of 4.2 inches. The 4.2 inches represents in numerical terms the relationship of increments of growth of the child to the Olson norms. Similar computations were made to compare each of the cases to each of the norms in respect to increments of change.

Degree of Parallelism

To determine the degree of parallelism between the norm and the cases, the difference between the norm and the case was determined for each measurement. The mid-point of difference was selected, and variation from this point served as the measure of parallelism. Notice Figure 3, the graphic representation of a single case with its variation from the Olson norm. At seventy-seven months the difference between the norm and case H-O-144F was 1.3 inches. At eighty-nine months the difference between the two was .8 inches. At 101 months the difference was 1.7 inches. At 113 months the difference was 3.0 inches, and at 125 months the difference was 4.1 inches. The mid-point was determined by counting to the third measure starting with the smallest amount of variation which was .8. The next larger amount was 1.3, and the third in line from small to large was 1.7 or the mid-point. Perfect parallelism then may be represented by a line drawn parallel to the norm passing through this mid-point. The shaded portion of the diagram (Figure 3) represents the height variation from the Olson norm for case H-O-144F. The numerical amount of variation was determined by computing the difference between 1.7, the mid-variation and 1.3, the variation at seventy-five months which was .4 inches. Next the difference was obtained between 1.7 and .8 the variation at eighty-seven months, which was .9 inches. Then the difference between 1.7 and 3.0 at 113 months was determined to be 1.3. And finally,

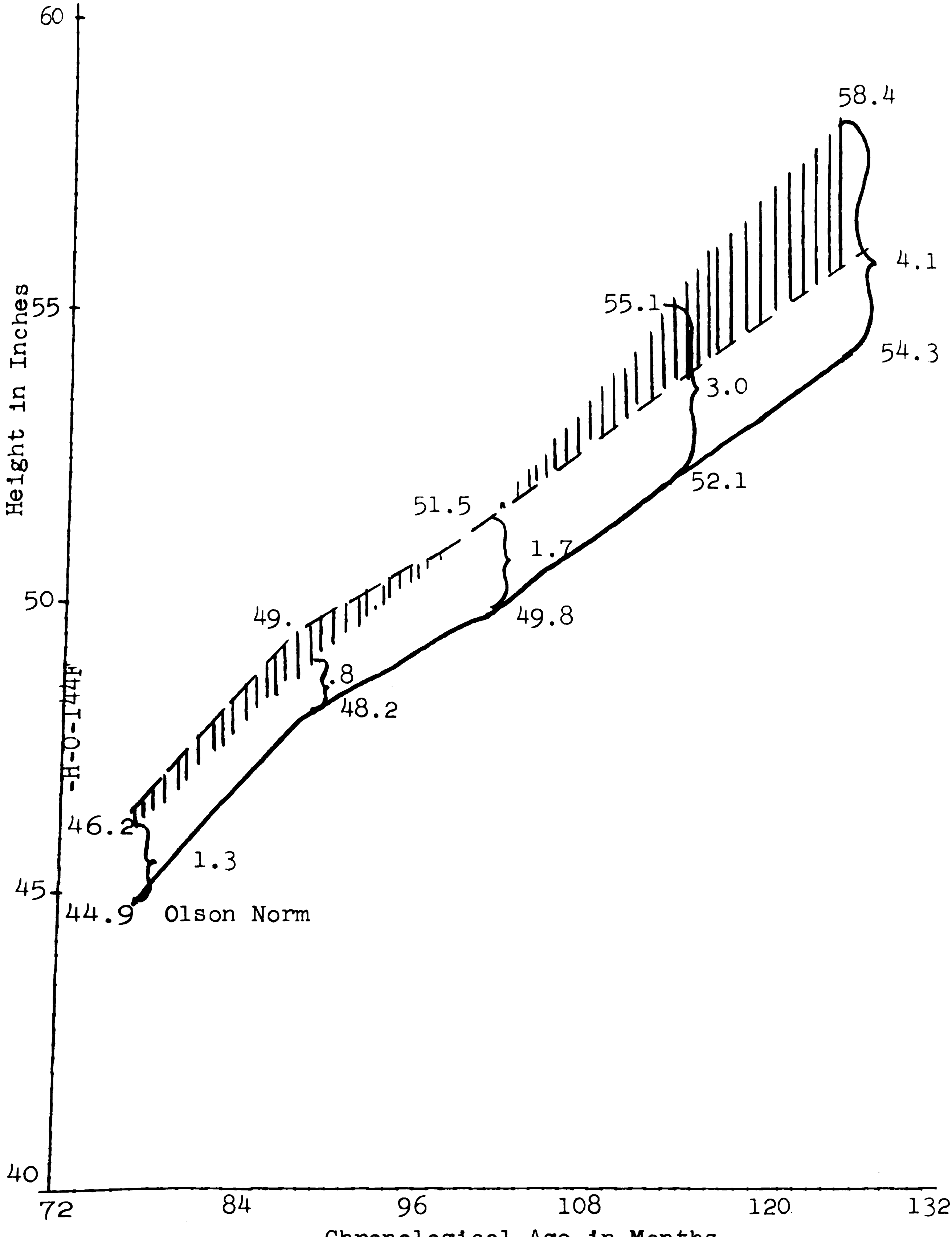

Figure 3. Variation from Perfect Parallelism between CASE H-O 144F and Olson Norm

the difference between 1.7 and 4.1 the variation at 125 months was found to be 2.4. The total variations from the point of mid-difference was .4 + .9 + 1.3 + 2.4 or 5 inches. Similar computations were made for each case in terms of each of the three norms.

The computations explained in the preceding paragraphs translate the relationships of children's growth patterns and norms into numerical quantities. These numerical quantities lend themselves to statistical interpretation which in turn should give a clear measure of the relative realism of each of the norms when compared to the heights and weights of real boys and girls.

CHAPTER V

THE RESULTS OF THE COMPARISONS

Height Variations in Increment

East Lansing girls. The height increments of the sixteen East Lansing girls were compared to the increments of increase of the three standards. When the mid-child was used as the standard the total five year difference between the girls and the standard was 50.5 inches. The mean difference was 2.66 inches with a standard deviation of 1.23 inches.

Compared to the Olson-Hughes height norms as a standard, the total difference between the increments of change in the norms and the increments of change from year to year of the East Lansing girls was 57.4 inches. The mean increment difference was 3.00 inches and the standard deviation was 1.25 inches.

When the East Lansing girls were compared to the Millard-Rothney norms in terms of height increments, the total difference between the increments over the five year period was 61.4 inches. The mean difference was 3.26 inches with a standard deviation of 1.38 inches.

The smallest total difference and mean difference as well as the smallest standard deviation occurred when

the East Lansing girls were compared to the mid-child. To ascertain the significance of the difference between the means, the "t" test was used.[1] the mean difference derived from the comparison of the cases to the mid-child was checked with the similar mean derived from the cases when compared to the Olson norm. The check revealed that the difference between the means were not significant. When the mid-child mean was compared to the Millard-Rothney mean the result also was considered not significant. The difference between the Olson and Millard means was not significant.

Harvard girls. The yearly height increments of the twenty-one girls from the Harvard study were compared to the yearly increment of increase of the three standards. The difference between the mid-child increments and the height increments of the girls totaled 29.00 inches over the five year period. The mean difference was 1.38 inches with a standard deviation of .77 inches.

When the heights of the Harvard girls were compared to the Olson-Hughes norms, the total increment difference was 38.9 inches. The mean difference was 1.85 with a standard deviation of .71 inches.

The comparison of the Harvard girls to the Millard-Rothney norms in terms of height increment resulted in a

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[1]Oliver L. Lacy, Statistical Methods in Experimentation (New York: MacMillan Company, 1953), p. 113.

total difference of 26.5 inches. The mean difference was 1.26 inches with a standard deviation of .66 inches.

The smallest total difference as well as the smallest mean difference occurred with the comparison to the Millard-Rothney norms. The largest total difference and mean difference occurred with the Olson norms, while the mid-child norm fell between the two.

The differences between the means were tested with the "t" formula.[2] The difference between the means of the Millard-Rothney and the mid-child were found to be not significant. The difference between the Millard-Rothney and the Olson means were found to be significant at the .05 level. The difference between the mid-child mean and the Olson mean were computed to be significant at the .10 level.

Holt girls. Thirteen girls from the Holt study were compared to the three norms in terms of height increments. The total difference between the girls and the mid-child was 23.9 inches with a mean difference of 1.84 inches and with a standard deviation of 1.11 inches.

When the height increments of the girls were compared to the Olson norm increments the total difference between them was 33.1 inches. The mean difference was 2.55 inches with a standard deviation of 1.46 inches.

The total difference between the Millard-Rothney norm increments and the height increments taken between

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[2]*Ibid*.

yearly measures of the Holt girls was 25.7 inches. The mean difference was 1.98 inches with a standard deviation of 1.04 inches.

Of the three comparisons the smallest total difference occurred when the Holt girls were compared to the mid-child. The Millard-Rothney comparison showed a slightly larger total difference. The Olson-Hughes showed the largest total difference. The mean differences of course reflected the same relationship as the totals.

When the significance of the means were tested by the "t" method, the differences between the means were not significant in any of the cases.[3] The difference between the mid-child mean and the Olson mean was not significant. The difference between the mid-child and Millard-Rothney means was not significant. And, the difference between the Olson and the Millard-Rothney means was not significant.

<u>Summary</u>. It could be readily seen that the mean differences between the height increments of the girls when compared to the increments of increase of the three norms, showed a slightly smaller variation when cases were contrasted to the mid-child standard. However, when the differences between the means were tested for significance, it was discovered that in the majority of the comparisons the differences were not significant.

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[3] <u>Ibid</u>.

East Lansing boys. The twenty-five East Lansing boys were compared to the standards with the following results. The total difference between the East Lansing boys and the mid-child was 78.6 inches. The mean difference was 3.14 inches with a standard deviation of 1.54 inches.

The total increment difference between the boys and the Olson-Hughes norms was 76.9 inches with a mean difference of 2.96 inches with a standard deviation of 1.12 inches.

The difference occurring with the Olson norm as standard was the smallest. When tested by the "t" method the difference between the mid-child and the Olson means was not significant. The difference between the mid-child and the Millard-Rothney means was not significant, and the difference between the Olson and Millard-Rothney norms was also not significant.[4]

Harvard boys. The nineteen Harvard study boys when contrasted with the mid-child showed a total increment variation of 21.8 inches. The mean variation was 1.15 with a standard deviation of .58 inches.

In the comparison to the Olson-Hughes standard the total difference was 31.7 inches. The mean difference was 1.67 inches with a standard deviation of .64 inches.

The total difference between the heights of the Harvard boys and the Millard-Rothney standard was nearly the same as in the Olson comparison, 31.6 with a mean difference of 1.66 and a standard deviation of .54.

[4] Ibid.

When the significance of the differences was tested, the difference between the mid-child mean and the Olson mean was significant at the .05 level. The difference between the mid-child and the Millard-Rothney norm was also significant at the .05 level. The difference between the Olson mean and the Millard-Rothney mean was not significant[5]

Holt boys. When the comparison was made of the thirty Holt boys to the mid-child the total difference was 43.1 inches. The mean variation was 1.44 inches with a standard deviation of .72 inches.

Compared to the Olson norm the total increment difference was 50.0 inches. The mean difference was 1.67 inches with a standard deviation of .62 inches.

The difference between the Millard-Rothney norms and the Holt boys totaled 52.7 inches over the five year period. The mean difference was 1.76 inches with a standard deviation of .68 inches.

The mid-child reflected the smallest variation from the heights of the Holt boys. The "t" test of significance was again used to evaluate the difference between means.[6] The difference between the mid-child mean and the Olson mean was not significant. The difference between the mid-child mean and the Millard-Rothney mean was significant at the .10 level. The difference between the Olson mean and the Millard-Rothney mean was not significant.

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[5] Ibid. [6] Ibid.

Summary. Summarizing the boys' height increment relationship the least variation occurred between the boys and the mid-child in the Harvard and Holt comparisons. In these comparisons the differences between the mid-child and the Millard-Rothney means were significant in both cases. Although the mean of the mid-child comparison was the smaller in both comparison to the Olson mean, the difference was significant with the Harvard cases but not significant when compared to the Holt cases. In the comparison with the East Lansing boys, the Olson norm reflected the least variation and smallest mean variation. However, the differences between the Olson, mid-child, and Millard-Rothney means were not significant.

Variations in Height from Parallelism

East Lansing girls. As the heights of the sixteen East Lansing girls were compared to perfect parallelism there was a total variation of 55.2 inches when the mid-child was used as the standard. The mean variation was 2.51 inches with a standard deviation of 1.18 inches.

In the comparison of the East Lansing girls to the Olson norm the total variation was 61.7 inches. The mean variation was 2.74 inches with a standard deviation of 1.40 inches.

When the Millard-Rothney norms were used as a standard the total variation from parallelism was 62.0 inches. The mean variation was 2.75 inches with a standard deviation of 1.25 inches.

The mid-child reflected less mean variation from parallel than did the Olson norm and the Millard-Rothney, however, when the "t" test of significance was applied, the differences between the means were not significant.[7]

Harvard girls. When the twenty-one girls selected from the Harvard cases were tested for parallelism to the mid-child the resulting total difference was 31.9 inches. The mean difference was 1.52 inches with a standard deviation of 1.13 inches.

Using the Olson norm as the standard, the total deviation from parallelism was 37.6 inches. The mean variation was 1.89 inches with a standard deviation of 1.41 inches.

When compared to the Millard-Rothney norms the total difference between the girls' patterns and parallelism was 29.2 inches. The mean variation was 1.44 inches with a standard deviation of 1.10 inches.

The Millard-Rothney norm showed the smallest mean deviation from the parallel. Both the Olson norm and the mid-child showed more total variation and hence greater mean variation. When the "t" test was applied the difference between all three of the means were tested to be not significant.[8]

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[7] Ibid.

[8] Ibid.

Holt girls. The thirteen Holt girls were compared o each of the norms in terms of parallelism. Compared to he mid-child the total difference between the heights and perfect parallelism was 23.5 inches. The mean difference between the heights and parallelism was 1.73 inches with a standard deviation of 1.42 inches.

When the Holt girls were contrasted to the Olson norm the total variation was 28.2 inches. The mean variation was 2.17 inches with a standard deviation of 1.35 inches.

Compared to the Millard-Rothney norms the total variation was 24.9 inches. The mean variation was 1.92 inches with a standard deviation of 1.27 inches.

The mid-child comparison yielded the smallest mean variation, but when the test for significance was applied, there was no significant difference between the means.[9]

Summary. The mid-child standard yielded the smallest mean deviation in the East Lansing and Holt comparison. However, the differences between the means were not significant. In the Harvard comparison the Millard-Rothney norm showed the smallest mean deviation, but, again the differences between means were not significant.

East Lansing boys. The boys were next compared to the three standards in relationship to the parallelism of the height growth patterns. When the height measures of

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[9] Ibid.

the twenty-five East Lansing boys were contrasted to the measures of the mid-child the difference over five years of measurement was 66.5 inches. The mean difference was 2.56 inches with a standard deviation of 1.30 inches.

When the Olson-Hughes norms served as the standard there was a total difference of 86.2 inches over the five years. The mean difference was 3.04 inches with a standard deviation of 1.21.

Compared to the Millard-Rothney norms the total difference was 77.6 inches. The mean difference was 2.98 inches with a standard deviation of 1.17 inches.

The mid-child standard yielded the smallest total and mean difference of the three comparisons. When the "t" test of significance was used the differences between the means proved to be not significant.[10]

Harvard boys. When the nineteen boys of the Harvard study were related to the mid-child in terms of parallelism of height growth patterns the total difference between them over five years was 23.8 inches. The mean difference was 1.25 inches with a standard deviation of .74 inches.

Compared to the Olson norm the total difference in parallelism between the boys and the norms was 33.0 inches. The mean difference was 1.74 inches with a standard deviation of .91 inches.

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[10] Ibid.

The Millard-Rothney norms reflected a total difference of 32.8 inches. The mean difference was 1.73 inches with a standard deviation of .80 inches.

Again the mid-child yielded the smallest mean variation from parallelism. When the "t" test was applied the difference between the mid-child mean and the Olson mean was significant at the .10 level. The difference between the mid-child mean and the Millard-Rothney mean also proved to be significant at the .10 level. The difference between the Olson mean and the Millard-Rothney mean showed no significance.[11]

Holt boys. When the thirty Holt males were checked against the mid-child in terms of parallelism the total five year difference was 40.2 inches. The mean difference was 1.34 inches with a standard deviation of .65 inches.

Compared to the Olson norms in terms of parallelism the difference between the boys and the norms totaled 59.0 inches. The mean difference was 1.97 inches with a standard deviation of .86 inches.

When the Millard-Rothney norms served as the standard, the difference in parallelism was 53.0 inches. The mean difference was 1.77 inches and the standard deviation was .63 inches.

The "t" test of significance indicated that the difference between the mid-child mean and the Olson mean was

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[11] Ibid.

significant at the .01 level. The difference between the mid-child and the Millard-Rothney means was significant at the .05 level. The difference between the Olson and Millard-Rothney means was not significant.[12]

Summary. Summarizing the relationship between the three groups of boys as compared to three standards in terms of parallelism we find the most consistent pattern of the study. With each of the three groups the Mid-Child reflected the least deviation, the Millard-Rothney the next smallest deviation and the Olson-Hughes the largest deviation. The differences between means were significant in two of the three comparisons.

Summary of Height Comparisons

Combining all of the comparisons of the children's heights with the norms, the smallest mean variation occurred for the Mid-Child in nine of the twelve comparisons. The Millard-Rothney norm showed the smallest mean variation in two places. The Olson norm showed the smallest mean variation in one instance.

The difference between means was significant in five of the comparisons, four of these cases were where the Mid-Child reflected the smallest variation and one where the Millard-Rothney norm reflected the smallest variation.[13]

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[12] Ibid.

[13] See Chapter VI for tables.

Weight Variations in Increment

East Lansing girls. The sixteen East Lansing girls' weight increments of increase between the yearly measures were compared to the increments of increase of the standards from year to year. When the East Lansing girls were compared to the mid-child standard the total difference between the cases and the standard was 36.5 pounds over the five year period. The mean difference was 22.59 pounds with a standard deviation of 7.07 pounds.

When the East Lansing girls were compared to the Olson norms the total difference was 270.4 pounds. The mean difference was 16.90 pounds with a standard deviation of 8.24 pounds.

In the comparison to the Millard-Rothney standard the variation between the weight increments of the girls and of the standard totaled 256.1 pounds. The mean difference was 16.01 pounds with a standard deviation of 8.10 pounds.

The Millard-Rothney norm reflected the smallest mean variation and the mid-child reflected the largest variation with the Olson mean falling between the two. When the "t" test of significance was computed, the difference between the mid-child mean and the Olson mean was significant at the .10 level. The difference between the mid-child mean and the Millard-Rothney mean was significant at the 0.5 level. The difference between the Olson mean and the Millard-Rothney mean was not significant.

Harvard girls. When the twenty-one girls from the Harvard study were compared to the weights of the mid-child the total increment variation was 247.9 pounds. The mean variation was 11.80 pounds with a standard deviation of 12.94 pounds.

Compared to the Olson norms in terms of increment variation, the total variation was 227.2 pounds. The mean variation was 10.82 pounds with a standard deviation of 8.65 pounds.

When the Millard-Rothney norm was used as the standard the total variation in increment between the standard and the girls was 237.5 pounds. The mean variation was 11.31 pounds with a standard deviation of 5.64 pounds.

The Olson norm reflected a slightly smaller mean deviation than the other two norms. When the significance of the difference between the means was checked by the "t" method, there was no significant difference between the means.[14]

Holt girls. The weights of the thirteen Holt girls were compared to the three standards in terms of the yearly increments. When compared to the mid-child standard the total difference between the girls' weight increments and the standard was 179.7 pounds. The mean difference was 13.82 pounds with a standard deviation of 5.52 pounds.

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[14] Lacey, *loc. cit.*

When compared to the Olson norm the total difference between the girls' weight increments and the increments of increase in the standard was 178.7 pounds. The mean difference was 13.75 pounds with a standard deviation of 6.17 pounds.

Compared to the Millard-Rothney norm the total difference was 158.0 pounds. The mean difference was 12.15 pounds with a standard deviation of 6.13 pounds.

The Millard-Rothney norm reflected the smallest total and mean difference. The Olson and mid-child means were slightly larger. When the "t" test was used the differences between the means proved to be not significant.[15]

Summary. The Millard-Rothney mean showed the smallest mean difference when compared to the East Lansing girls and to the Holt girls. The difference between the Millard-Rothney and the mid-child mean was significant in the East Lansing comparison. In the relationship to the Olson check as well as in the comparisons with the Holt cases the differences between means were not significant.

East Lansing boys. The increments of weight between the yearly measures of the boys were compared to the increments of weight between the yearly weight figures of the standards. When the twenty-five East Lansing boys' weights were compared in this manner to the mid-child as the

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[15]Ibid.

standard, the total difference was 399.5 pounds. The mean difference was 15.37 pounds with a standard deviation of of 8.90 pounds.

When the Olson norms were used as the standard the total difference between the Olson increments and the boys' increments was 444.8 pounds. The mean difference was 17.11 pounds with a standard deviation of 9.80 pounds.

Compared to the increments of the Millard-Rothney norms the total difference was 402.7 pounds. The mean difference was 15.49 pounds with a standard deviation of 9.01 pounds.

The smallest total and mean difference occurred with the mid-child as the standard, however, when checked for significance by the "t" method, none of the differences between means were judged to be significant.[16]

Harvard boys. When the Harvard boys were compared to the mid-child in terms of the weight increments, the total difference between the mid-child and the cases was 242.4 pounds. The mean difference was 12.76 pounds with a standard deviation of 4.27 pounds.

When the Olson norms were used as the standard the total difference between the cases and the standard was 107.3 pounds. The mean difference was 5.65 pounds with a standard deviation of 2.77 pounds.

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[16] Ibid.

When the Harvard boys were compared to the Millard-Rothney norms the total difference between the increments was 129.2 pounds. The mean difference was 6.80 pounds with a standard deviation of 3.20 pounds.

The Olson norm reflected the smallest total and mean variation from the cases with the Millard-Rothney norm showing a slightly greater total and mean variation. The mid-child comparison reflected a distinctly larger difference. When the means were subjected to the "t" test the difference between the mid-child mean and the Olson mean was significant at the .01 level. The difference between the mid-child mean and the Millard-Rothney mean was significant at the .01 level. The difference between the Olson mean and the Millard-Rothney mean was not significant.[17]

Holt boys. The thirty Holt boys were compared to the standards in terms of weight increments. When the mid-child was used as the standard the resulting total difference between the increments of the standards and the increments of the boys was 455.5 pounds. The mean difference was 15.18 pounds with a standard deviation of 6.95 pounds.

When the Holt males were compared to the Olson norms the increment difference over the five year period was 395.6 pounds. The mean difference was 13.19 pounds with a standard deviation of 9.47 pounds.

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[17]Ibid.

Compared to the Millard-Rothney norms the total difference was 398.7 pounds. The mean difference was 13.29 pounds with a standard deviation of 9.03 pounds.

In the comparisons between the Holt cases and the standards, the Olson norms reflected the smallest total and mean difference. The Millard-Rothney norm showed but a slightly larger difference while the mid-child reflected a considerably larger total and mean difference. When the "t" test of significance was applied, the differences between the three means proved to be not significant.

Summary. The Olson norms and the Millard-Rothney norms appeared to better reflect the weight patterns of the boys in the Harvard and Holt comparisons. In the East Lansing comparison the mid-child showed a slightly smaller variation. The differences between means were significant only in the Harvard comparison where the Olson norm and the Millard-Rothney norm both reflected smaller variations than did the mid-child, however, the difference between the Millard-Rothney and Olson means was not significant.

Weight Variation from the Parallel

East Lansing girls. The East Lansing girls were compared to the three standards in respect to their deviation from parallelism. When compared to the mid-child as standard the total difference over the five year period was 367.7 pounds. The mean difference was 22.98 pounds with a standard deviation of 11.79 pounds.

When the Olson norm was used as the standard the total difference was 294.4 pounds. The mean difference was 18.4 pounds with a standard deviation of 10.4 pounds.

Compared to the Millard-Rothney norm the total difference was 294.4 pounds. The mean difference was 18.4 pounds with a standard deviation of 10.4 pounds.

Compared to the Millard-Rothney norm the total difference between the girls' weights and perfect parallelism was 283.0 pounds. The mean difference was 17.69 pounds with a standard deviation of 10.53 pounds.

The Millard-Rothney norm reflected the smallest total and mean deviation in the comparisons, however, when the three means were subject to the "t" test of significance the differences between them were not considered significant.

Harvard girls. When the comparison was made between the weights of the twenty-one Harvard girls and the mid-child in terms of parallelism, the total difference over the five years was 308.3 pounds. The mean difference was 14.7 pounds with a standard deviation of 13.12 pounds.

Compared to the Olson norm the total difference was 267.3 pounds. The mean difference was 12.73 pounds with a standard deviation of 8.06 pounds.

When the Millard-Rothney norms served as the standard the total variation from parallelism was 270.4 pounds. The mean variation or difference was 12.88 pounds with a standard deviation of 9.40.

The Olson norms showed the smallest variation by a very small margin. When the "t" test of significance was applied the differences between the means proved to be not significant.

Holt girls. In the weight comparison of the Holt girls to the mid-child in terms of parallelism the total difference over the five year period was 230.8 pounds. The mean difference was 17.75 with a standard deviation of 11.05 pounds.

When the Olson norms served as the standard, the total difference over the five years was 193.0 pounds. The mean difference was 14.85 pounds with a standard deviation of 9.88.

Compared to the Millard-Rothney norm the total difference was 210.0 pounds. The mean difference was 16.15 pounds with a standard deviation of 12.03 pounds.

The Olson norms reflected the smallest total and mean variation from parallelism, however, when the "t" test was applied the differences between the means were found to be not significant.

Summary. When the three groups of girls were compared to the three norms in terms of parallelism, the Millard-Rothney reflected the smallest variation in the East Lansing comparison while the Olson norm reflected the smallest variation in the Harvard and Holt comparisons.

In the comparisons the differences between the means were not considered significant in any instance.

East Lansing boys. The weights of the East Lansing boys were compared to the standards in terms of parallelism. The total five year difference between parallelism and the cases when the mid-child served as the standard was 469.6 pounds. The mean difference was 18.06 pounds with a standard deviation of 14.17 pounds.

Compared to the Olson norm the total difference over the five years was 513.2 pounds. The mean difference was 19.24 pounds with a standard deviation of 16.21 pounds.

When compared to the Millard-Rothney norm the total variation was 457.1 pounds. The mean variation was 17.58 pounds with a standard deviation of 13.96 pounds.

The Millard-Rothney norm showed the smallest mean and total variation, however, when the three means were subjected to the "t" test of significance the differences were determined to be not significant.

Harvard boys. The weights of the Harvard boys were compared to the mid-child standard in terms of parallelism. The resulting total variation from parallelism was 179.0 pounds. The mean variation was 9.42 pounds with a standard deviation of 3.39 pounds.

When the Harvard boys were compared to the Olson norm in terms of parallelism the total variation was 114.5 pounds.

The mean variation was 6.03 pounds with a standard deviation of 3.36 pounds.

When the Millard-Rothney norm served as the standard the variation over the five years totaled 162.8 pounds. The mean variation was 8.57 pounds with a standard deviation of 4.49 pounds.

The Olson norm reflected the smallest total and mean variation. The Millard-Rothney norm reflected a somewhat greater variation and the mid-child reflected the largest variation. When the "t" test was used to determine the significance of the difference between the means, the difference between the mid-child and Olson means proved to be significant at the .01 level. The difference between the Olson mean and the Millard-Rothney mean was significant at the .10 level. The difference between the mid-child mean and the Millard-Rothney mean was not significant.

Holt boys. When the Holt boys' weights were compared to the mid-child in terms of variation from parallelism the total variation was 485.6 pounds. The mean variation was 16.19 pounds and the standard deviation 7.81 pounds.

Compared to the Olson norm the total variation for the five years was 472.1 pounds. The mean variation was 15.74 pounds with a standard deviation of 11.62 pounds.

When the Millard-Rothney norm was used as the standard, the total variation was 436.5 pounds. The mean variation was 14.55 pounds with a standard deviation of 11.57 pounds.

The Millard-Rothney norm reflected the smallest total and mean variation. When the "t" test of significance was used, the differences between the three means were not significant.

Summary. The Millard-Rothney norm reflected the smallest variation in the comparisons of the East Lansing boys and Holt boys. In these comparisons, however, the differences between the means were not found to be significant. In the Harvard comparison the Olson norm reflected the smallest variation and the difference between the Olson and mid-child proved to be significant at the .01 level. The difference between the Olson and Millard-Rothney means also proved to be significant at the .10 level in the Harvard comparison.

Summary of Weight Comparisons

In the comparisons of the children's weights to the norms the Olson norms reflected the smallest mean variation in six of the twelve comparisons. The Millard-Rothney norm reflected the smallest variation in five of the comparisons. And the Mid-Child standard reflected the smallest variation in one comparison.

The differences between the means were significant in three of the twelve comparisons. In two of the instances of significance the Olson norm showed the smallest variation, and in one instance of significance, the Millard-Rothney norm showed the smallest variation.[18]

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[18]See Chapter VI for tables.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The heights and weights of three groups of children, East Lansing, Holt, and Harvard, have been compared to three standards, the Mid-Child, the Olson-Hughes growth ages, and the Millard-Rothney norms. The hypothesis to be tested was that the norm which reflected the greatest consistency, or the least variation would be considered as the most realistic in terms of the growth patterns of boys and girls. A clear cut superiority would be indicated by a significantly lower mean variation in terms of one of the selected standards when compared to the three groups of children.

Girls' Height

Table I shows the relationship between the girls' height measures and the three norms. Total variation represents differences between the measures and the norm over a five year period. The mean variation from the parallel was slightly less for the mid-child standard in both the East Lansing and the Holt cases. The Millard-Rothney variation appeared smaller than the Mid-Child or Olson norm when compared to the Harvard cases. Using the

TABLE I

GIRLS' HEIGHT

	East Lansing			Harvard			Holt		
	Mid-Child	Olson	Millard-Rothney	Mid-Child	Olson	Millard-Rothney	Mid-Child	Olson	Millard-Rothney
Number of Cases	16	16	16	21	21	21	13	13	13
Total variation from parallel	40.2	44.1	43.8	31.9	39.7	30.2	23.5	28.2	24.9
Mean variation	2.51	2.76	2.73	1.52	1.89	1.44	1.81	2.17	1.92
Standard deviation	1.18	1.40	1.25	1.13	1.41	1.10	1.42	1.35	1.27
Total increment variation	42.5	48.0	52.2	29	38.9	26.5	23.9	33.1	25.7
Mean variation	2.66	3.00	3.26	1.38*	1.85x*	1.26x	1.84	2.55	1.98
Standard deviation	1.23	1.25	1.38	.77	.71	.66	1.11	1.46	1.04

* Mean significant between Mid-child and Olson
ø Mean significant between Mid-child and Millard
x Mean significant between Olson and Millard

"t" test of significance,[1] the differences between the means were not significant in any of the comparisons of the girls height measures to the three norms in terms of variation from the parallel.

In the comparison of height increments to the norms, the relationship was similar to that in the preceding paragraph. The variation was smallest for the Mid-Child when comparison were made to the East Lansing and to the Holt groups. When the data was compared to the Harvard cases, the Millard-Rothney norm showed the least variation, with the Mid-Child showing only a slightly greater variation than the Millard-Rothney norm. The differences between means were not significant in the East Lansing and Holt comparisons.[2] However, the Millard-Rothney mean variation was significantly different than the Olson mean variation at the .05 level. The difference between the Mid-Child and Olson was significant at the .10 level.[3]

Girls' Weight

Table II shows the relationships between the girls' weight measures and the three selected standards. The test for variation from parallelism to the norm indicated in the Harvard and Holt comparisons that the least variation

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[1]Oliver L. Lacey, Statistical Methods in Experimentation (New York: MacMillan Company, 1953), p. 113.

[2]Ibid.

[3]Ibid.

TABLE II

GIRLS' WEIGHT

	East Lansing			Harvard			Holt		
	Mid-Child	Olson	Millard-Rothney	Mid-Child	Olson	Millard-Rothney	Mid-Child	Olson	Millard-Rothney
Total variation from parallel	367.7	294.4	283	308.3	267.3	270.4	230.8	193.	210.
Mean variation	22.98	18.4	17.69	14.7	12.73	12.88	17.75	14.85	16.1
Standard deviation	11.79	10.4	10.53	13.12	8.06	9.40	11.05	9.88	12.03
Total increment variation	361.5	270.4	256.1	247.9	227.2	237.5	179.7	178.7	158.0
Mean variation	22.59*ø	16.90*	16.01ø	11.80	10.82	11.31	13.82	13.75	12.15
Standard deviation	7.07	8.24	8.10	12.94	8.65	5.64	5.52	6.17	6.13

* Mean significant between Mid-child and Olson
ø Mean significant between Mid-child and Millard
x Mean significant between Olson and Millard

occurred with the Olson norm. With the East Lansing data, the Millard-Rothney norm showed the smallest variation figure, however, the differences between the means were not significant in any of the comparisons. The "t" test of significance was used.[4]

When comparisons were made by weight increments, the Millard-Rothney norm reflected the least variation with the East Lansing and Holt cases. The Olson norm showed the smallest increment variation with the Harvard cases. The "t" test showed significance in the relationships between the means in the East Lansing comparisons, while the Harvard and Holt relationships were not significant. With the East Lansing cases the difference between the Millard-Rothney mean deviation and the Mid-Child mean deviation was significant at the .05 level. The relationship of the Olson norm to the Mid-Child was significant at the .10 level.[5]

Boys' Height

Table III represents the summary of the relationships between the heights of the boys in the three studies and the three selected standards. In the test for variation from the parallel the Mid-Child showed the least variation with all three groups. The difference between the means

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[4] Ibid. [5] Ibid.

TABLE III

BOYS' HEIGHT

	East Lansing			Harvard			Holt		
	Mid-Child	Olson	Millard-Rothney	Mid-Child	Olson	Millard-Rothney	Mid-Child	Olson	Millard-Rothney
Number of cases	26	26	26	19	19	19	30	30	30
Total variation from parallel	66.5	79.2	77.2	23.8	33.	32.8	40.2	59.0	53.0
Mean variation	2.56	3.04	2.97	1.25*ø	1.74*	1.73ø	1.34*ø	1.97*	1.77ø
Standard deviation	1.30	1.21	1.17	.74	.91	.80	.65	.86	.63
Total increment variation	78.5	76.9	78.1	21.8	31.7	31.2	43.1	50.0	52.7
Mean variation	3.14	2.96	3.10	1.15*ø	1.67*	1.64ø	1.44ø	1.67	1.76ø
Standard deviation	1.54	1.04	1.12	.58	.64	.535	.72	.62	.68

* Mean significant between Mid-child and Olson
ø Mean significant between Mid-child and Millard
x Mean significant between Olson and Millard

for the East Lansing comparisons were not significant. The difference in the Harvard cases between the Mid-Child and Millard-Rothney norms was significant at the .10 level, and between the Mid-Child and the Olson norms the difference was significant at the .10 level. For the Holt cases the difference between the Mid-Child and the Olson mean variation was significant at the .01 level. The differences between the Mid-Child and Millard-Rothney was significant at the .05 level.

The height increment test gave a similar picture. The differences between means in the East Lansing comparisons were not significant. The Mid-Child showed the least increment variations in the Harvard and Holt comparison. In the Harvard test the relationship between the Mid-Child and the Olson means was judged significant at the .05 level. The relationship between the Mid-Child and the Millard-Rothney means was also significant at the .05 level.[6]

Boys' Weight

Table IV represents the summary of the relationships between the boys' weight measures and the three norms. In terms of variation from parallelism, the Millard-Rothney norm showed the least variation when compared to the East Lansing and Holt cases. However, the differences were not significant. With the Harvard cases the Olson norm showed the least variation. The difference between the Olson and

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[6] Ibid.

TABLE IV

BOYS' WEIGHT

	East Lansing			Harvard			Holt		
	Mid-Child	Olson	Millard-Rothney	Mid-Child	Olson	Millard-Rothney	Mid-Child	Olson	Millard-Rothney
Total variation from parallel	469.6	513.2	457.1	179.0	114.5	162.8	485.6	472.1	436.5
Mean variation	18.06	19.74	17.58	9.42*	6.03*x	8.57x	16.19	15.74	14.55
Standard deviation	14.17	16.21	13.96	3.39	3.36	4.49	7.81	11.62	11.57
Total increment variation	399.5	444.9	402.7	242.4	107.3	129.2	455.5	395.6	398.7
Mean variation	15.37	17.10	15.49	12.76*ø	5.65*	6.80ø	15.18	13.19	13.29
Standard deviation	8.90	9.80	9.01	4.27	2.77	3.20	6.95	9.47	9.03

* Mean significant between Mid-child and Olson
ø Mean significant between Mid-child and Millard
x Mean significant between Olson and Millard

Mid-Child norms was significant at the .01 level, and the difference between the Olson and Millard-Rothney norms was significant at the .10 level.

When comparisons were made in terms of the weight increments the differences between the means were not significant in the East Lansing or Holt comparisons. In respect to the Harvard cases the difference between the Olson norms and the Mid-Child were significant at the .01 level and the difference between the Millard-Rothney norms and the Mid-Child was also significant at the .01 level. The difference between the Olson and Millard-Rothney norms was not significant.[7]

Conclusion for Height

The evidence indicates that the Mid-Child reflects best the height characteristics of the boys. With both the Harvard and Holt data where there were significant differences, the Mid-Child technique had the least variation. The East Lansing data also showed the Mid-Child to be slightly superior although the differences between means were not deemed significant.[8]

The relationship of the girls' heights to the norms also indicated that somewhat less variation occurred when the Mid-Child was used as the standard. In no case,

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[7] Ibid.

[8] Ibid.

however, were the differences between mean variations significant.

Although there is some indication that the Mid-Child standard serves better to reflect the height growth of boys and girls, in nine out of the twelve height comparisons the smallest variation occurred when the Mid-Child was used as the standard. In four of these nine comparisons the differences between the means was considered significant. The evidence, however, is by no means clear-cut.

Failure to show significant differences between the mean deviations for the girls in all three comparisons as well as the failure to show significant differences in the comparisons with the East Lansing boys indicates that none of the three norms consistently and significantly show superiority. Therefore, the conclusion must be that when the three norms were compared to three groups of children none of them maintained sufficient consistency or sufficient superiority to be considered the most realistic in terms of the height patterns of boys and girls.

Conclusion for Weight

The comparisons of the weight measures of the three groups of children to the three standards showed considerably less consistency than did the height measures. The Olson norms showed a slightly smaller deviation when the norm was compared to the Harvard and Holt girls using the test for parallelism. The Millard-Rothney norm showed slightly less variation when compared to the East Lansing girls. None of the differences between means were considered significant according to the "t" test.[10]

In the increment test for girls the Millard-Rothney norm showed the least deviation when compared to the East Lansing girls and the Holt girls. The Olson norm showed the least deviation when compared to the Harvard cases. The difference between the Millard-Rothney mean and the Mid-Child was significant at the .05 level in the East Lansing comparison. All other differences were not significant.

When the three groups of boys were compared to the weight standards, lack of consistency was again evident. In terms of parallelism, the deviations were smallest for the Millard-Rothney norm when compared to the East Lansing and Harvard cases. The Olson norm showed the least deviation when compared to the Harvard boys. The difference between means was not significant in the East Lansing and Holt tests. But in the Harvard check the difference between Olson and the Mid-Child was significant at the .01 level, and between Olson and Millard at the .10 level.[11]

Using the increment method of comparison the Mid-Child showed slightly less deviation than Olson and Millard in the East Lansing comparison but the differences were not significant. Compared to the Harvard cases both the Millard-Rothney norms and the Olson norm showed less

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[10] <u>Ibid</u>. [11] <u>Ibid</u>.

variation than the Mid-Child. The differences were significant at the .01 level. The difference between the Olson and Rothney norms was slight and not significant. In the Holt comparison the Olson norm showed slightly less variation than the other two but the difference was not significant.

The evidence from the weight comparisons indicated that the Millard-Rothney and the Olson-Hughes norms both reflected the growth patterns of boys and girls better than did the Mid-Child, however, none of the norms showed consistent and significant superiority. Under those circumstances the only possible conclusion must be that there is no significant difference between the three weight norms.

Final Conclusion

Since this study indicates that neither the Mid-Child, the Olson-Hughes growth ages, nor the Millard-Rothney norms maintained a superiority in reflecting the height and weight changes in boys and girls, and since it can be seen by inspection that the differences between the three standards at any single point can be as great as two inches or five pounds,[12] it must also be concluded that comparisons to any of the three norms are but very general estimates.

The norms tested in this study did not meet the important criteria for an acceptable standard, that it must

[12]Cf. ante, p. 5.

provide a consistent base for comparison, therefore, for precise interpretations of individual growth trends better standards must be developed or other methods of analysis employed.

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APPENDICES

APPENDIX A

MILLARD-ROTHNEY NORMS*
Child Development Laboratory--Michigan State University

GIRLS - WEIGHT AGE SCALE

Weight Pounds	Wt. Age	Weight Pounds	Wt. Age	Weight Pounds	Wt. Age
10.	1	32.6	37	46.3	73
11.5	2	33.2	38	46.6	74
13.0	3	33.7	39	47.0	75
14.2	4	34.0	40	47.6	76
15.5	5	34.3	41	48.0	77
16.3	6	34.8	42	48.4	78
17.0	7	35.2	43	48.8	79
18.0	8	35.7	44	49.5	80
19.0	9	36.0	45	50.0	81
20.0	10	36.3	46	50.3	82
20.5	11	37.0	47	50.6	83
20.8	12	37.3	48	51.0	84
22.0	13	37.8	49	51.5	85
22.4	14	38.2	50	52.0	86
23.0	15	38.5	51	52.4	87
23.8	16	38.8	52	52.8	88
24.2	17	39.0	53	53.2	89
25.0	18	39.3	54	53.8	90
25.5	19	39.8	55	54.1	91
26.0	20	39.0	56	54.3	92
26.4	21	39.3	57	54.6	93
27.0	22	40.2	58	55.3	94
27.5	23	40.7	59	55.8	95
27.6	24	41.2	60	56.0	96
28.2	25	41.8	61	56.5	97
28.4	26	42.1	62	57.0	98
28.8	27	42.3	63	58.0	99
29.2	28	42.6	64	58.3	100
29.7	29	42.9	65	58.6	101
30.2	30	43.4	66	59.0	102
30.5	31	43.8	67	59.4	103
30.9	32	44.2	68	60.0	104
31.4	33	44.6	69	60.3	105
32.0	34	45.2	70	60.6	106
32.3	35	45.7	71	61.0	107
32.4	36	46.0	72	61.5	108

*Computed with the assistance of data from the United States Department of Health, Education, and Welfare, June, 1953, Washington, D. C.

Girls - Weight Age Scale --(Continued)

Weight Pounds	Wt. Age	Weight Pounds	Wt. Age	Weight Pounds	Wt. Age
62.2	109	90.6	145	115.0	181
63.0	110	91.6	146	115.5	182
63.5	111	92.4	147	115.8	183
64.0	112	93.0	148	116.0	184
64.5	113	94.0	149	116.2	145
65.0	114	95.0	150	116.4	186
65.5	115	96.0	151	116.5	187
66.0	116	97.0	152	116.6	188
66.5	117	98.0	153	116.7	189
67.2	118	99.0	154	116.8	190
68.0	119	99.8	155	116.9	191
68.6	120	100.4	156	117.0	192
69.4	121	101.0	157	117.1	193
70.2	122	102.0	158	117.2	194
71.0	123	102.7	159	117.3	195
71.8	124	103.5	160	117.4	196
72.4	125	104.2	161	117.5	197
73.0	126	105.0	162	117.6	198
74.0	127	106.0	163	117.7	199
75.0	128	106.5	164	117.8	200
76.0	129	107.0	165	117.9	201
77.0	130	107.5	166	118.0	202
78.0	131	108.0	167	118.1	203
79.0	132	108.5	168	118.2	204
80.0	133	109.0	169	118.3	205
81.0	134	109.5	170	118.4	206
81.6	135	110.0	171	118.5	207
82.0	136	110.5	172	118.6	208
82.8	137	111.0	173	118.7	209
83.8	138	111.5	174	118.8	210
84.4	139	112.0	175	118.9	211
85.8	140	112.5	176	119.0	212
87.0	141	113.0	177	119.0	213
88.0	142	113.5	178	119.0	214
89.0	143	114.0	179	119.0	215
90.0	144	114.5	180	119.0	216

GIRLS - HEIGHT AGE SCALE*

Height Inches	Ht. Age	Height Inches	Ht. Age	Height Inches	Ht. Age
21.5	1	38.0	37	46.0	73
22.5	2	38.3	38	46.2	74
23.2	3	38.6	39	46.3	75
24.0	4	38.9	40	46.5	76
24.6	5	39.2	41	46.7	77
25.5	6	39.4	42	46.9	78
26.0	7	39.7	43	47.1	79
26.8	8	39.9	44	47.3	80
27.3	9	40.1	45	47.4	81
28.0	10	40.3	46	47.5	82
28.5	11	40.5	47	47.6	83
29.2	12	40.7	48	47.7	84
29.4	13	41.0	49	47.8	85
29.8	14	41.2	50	47.9	86
30.2	15	41.4	51	48.0	87
30.4	16	41.7	52	48.1	88
30.6	17	42.0	53	48.3	89
30.8	18	42.2	54	48.5	90
31.4	19	42.4	55	48.7	91
31.8	20	42.6	56	48.9	92
32.2	21	42.8	57	49.1	93
32.7	22	43.0	58	49.3	94
33.0	23	43.2	59	49.5	95
33.5	24	43.5	60	49.7	96
33.8	25	43.7	61	49.9	97
34.2	26	43.9	62	50.1	98
34.5	27	44.1	63	50.3	99
34.8	28	44.3	64	50.5	100
35.2	29	44.5	65	50.7	101
35.7	30	44.7	66	50.9	102
36.0	31	44.9	67	51.1	103
36.3	32	45.1	68	51.3	104
36.6	33	45.2	69	51.5	105
37.0	34	45.3	70	51.7	106
37.3	35	45.5	71	51.9	107
37.7	36	45.8	72	52.0	108

*Computed with the assistance of data from the United States Department of Health, Education, and Welfare, June 1953, Washington, D. C.

Girls - Height Age Scale (Continued)

Height Inches	Ht. Age	Height Inches	Ht. Age	Height Inches	Ht. Age
52.1	109	59.	145	63.3	181
52.2	110	59.2	146	63.3	182
52.3	111	59.4	147	63.4	183
52.5	112	59.6	148	63.4	184
52.7	113	59.8	149	63.4	185
52.9	114	60.0	150	63.5	186
53.1	115	60.2	151	63.5	187
53.3	116	60.4	152	63.6	188
53.5	117	60.6	153	63.6	189
53.7	118	60.8	154	63.6	190
53.9	119	60.9	155	63.7	191
54.1	120	61.0	156	63.7	192
54.3	121	61.1	157	63.8	193
54.5	122	61.2	158	63.8	194
54.7	123	61.3	159	63.8	195
54.9	124	61.4	160	63.8	196
55.1	125	61.5	161	63.8	197
55.2	126	61.6	162	63.8	198
55.4	127	61.7	163	63.8	199
55.6	128	61.8	164	63.8	200
55.8	129	62.0	165	63.8	201
56.0	130	62.1	166	63.8	202
56.2	131	62.3	167	63.8	203
56.4	132	62.5	168	63.9	204
56.6	133	62.6	169	63.9	205
56.8	134	62.7	170	63.9	206
57.0	135	62.8	171	63.9	207
57.2	136	62.9	172	63.9	208
57.4	137	63.0	173	63.9	209
57.6	138	63.1	174	63.9	210
57.8	139	63.1	175	63.9	211
58.0	140	63.2	176	63.9	212
58.2	141	63.2	177	63.9	213
58.4	142	63.2	178	63.9	214
58.6	143	63.3	179	63.9	215
58.8	144	63.3	180	63.9	216

BOYS - WEIGHT AGE SCALE

Weight Pounds	Wt. Age	Weight Pounds	Wt. Age	Weight Pounds	Wt. Age
13.2	1	34.2	37	47.0	73
14.2	2	34.5	38	47.4	74
15.0	3	35.0	39	48.0	75
16.1	4	35.2	40	48.4	76
17.0	5	35.6	41	48.7	77
17.9	6	35.8	42	49.2	78
19.0	7	36.0	43	49.8	79
19.2	8	36.2	44	50.2	80
20.5	9	36.5	45	50.5	81
21.4	10	36,8	46	50.8	82
22.0	11	37.2	47	51.2	83
23.0	12	37.4	48	51.7	84
23.8	13	37.8	49	52.2	85
24.2	14	38.0	50	52.5	86
25.0	15	38.2	51	52.8	87
25.5	16	38.4	52	53.2	88
26.0	17	38.8	53	53.8	89
26.3	18	39.2	54	54.4	90
27.0	19	39.5	55	54.8	91
27.5	20	39.8	56	55.2	92
28.0	21	40.2	57	55.8	93
28.4	22	40.5	58	56.4	94
29.0	23	41.0	59	57.0	95
29.4	24	41.4	60	57.8	96
30.0	25	41.8	61	58.4	97
30.2	26	42.2	62	59.0	98
30.5	27	42.4	63	59.8	99
31.0	28	42.8	64	60.4	100
31.4	29	43.2	65	61.0	101
31.8	30	43.8	66	61.8	102
32.2	31	44.2	67	62.2	103
32.5	32	44.8	68	62.5	104
33.0	33	45.2	69	62.9	105
33.4	34	45.8	70	63.2	106
33.8	35	46.2	71	64.0	107
34.0	36	46.8	72	64.4	108

Boys - Weight Age Scale (Continued)

Weight Pounds	Wt. Age	Weight Pounds	Wt. Age	Weight Pounds	Wt. Age
64.8	109	85.2	145	122.8	181
65.6	110	85.8	146	124.0	182
66.2	111	86.4	147	125.0	183
67.0	112	87.0	148	126.0	184
67.6	113	88.0	149	127.0	185
68.2	114	89.2	150	128.0	186
68.6	115	90.0	151	129.0	187
69.4	116	91.0	152	130.0	188
69.8	117	92.0	153	130.5	189
70.2	118	92.8	154	131.0	190
70.4	119	93.8	155	131.5	191
71.0	120	94.0	156	132.0	192
71.4	121	95.5	157	132.5	193
71.8	122	96.8	158	133.0	194
72.2	123	98.0	159	133.8	195
72.5	124	99.4	160	134.4	196
73.0	125	100.2	161	135.0	197
73.6	126	101.4	162	136.0	198
74.2	127	102.4	163	137.0	199
74.6	128	103.6	164	137.5	200
75.2	129	104.6	165	138.0	201
75.8	130	106.0	166	138.5	202
76.2	131	107.0	167	139.0	203
76.8	132	108.2	168	139.5	204
77.2	133	109.0	169	140.0	205
77.6	134	110.0	170	140.5	206
78.2	135	111.0	171	141.0	207
78.6	136	112.2	172	141.5	208
79.2	137	113.4	173	142.0	209
80.0	138	114.8	174	142.5	210
80.8	139	116.0	175	143.0	211
81.6	140	117.4	176	143.4	212
82.6	141	118.2	177	143.7	213
83.2	142	119.8	178	144.0	214
84.0	143	120.4	179	144.5	215
84.8	144	121.6	180	145.0	216

BOYS - HEIGHT AGE SCALE*

Height Inches	Ht. Age	Height Inches	Ht. Age	Height Inches	Ht. Age
22.5	1	38.5	37	46.2	73
23	2	38.8	38	46.4	74
24	3	39.0	39	46.7	75
24.5	4	39.2	40	46.9	76
25	5	39.4	41	47.0	77
26	6	39.6	42	47.3	78
26.5	7	39.7	43	47.5	79
27	8	39.9	44	47.7	80
27.5	9	40.1	45	48.0	81
28.2	10	40.2	46	48.2	82
29	11	40.4	47	48.4	83
29.4	12	40.6	48	48.6	84
30.	13	40.8	49	48.8	85
30.2	14	40.9	50	49.0	86
30.8	15	41.0	51	49.2	87
31.2	16	41.1	52	49.5	88
31.8	17	41.3	53	49.7	89
32.4	18	41.8	54	49.9	90
32.8	19	42.0	55	50.1	91
33	20	42.3	56	50.3	92
33.5	21	42.5	57	50.5	93
34	22	42.9	58	50.7	94
34.5	23	43.1	59	50.9	95
34.8	24	43.4	60	51.0	96
35	25	43.5	61	51.1	97
35.4	26	43.8	62	51.3	98
35.5	27	44.1	63	51.4	99
35.8	28	44.3	64	51.5	100
36.2	29	44.5	65	51.7	101
36.5	30	44.8	66	52.0	102
36.8	31	44.9	67	52.2	103
37	32	45.1	68	52.3	104
37.4	33	45.5	69	52.4	105
37.6	34	45.7	70	52.5	106
38	35	45.8	71	52.7	107
38.2	36	46.0	72	52.8	108

*Computed with the assistance of data from the United States Department of Health, Education, and Welfare, June 1953, Washington, D. C.

Boys - Height Age Scale (Continued)

Height Inches	Ht. Age	Height Inches	Ht. Age	Height Inches	Ht. Age
52.9	109	58.2	145	65.8	181
53.0	110	58.4	146	66.0	182
53.2	111	58.6	147	66.1	183
53.4	112	59.0	148	66.3	184
53.6	113	59.1	149	66.4	185
53.8	114	59.3	150	66.6	186
54.0	115	59.6	151	66.8	187
54.1	116	59.8	152	66.9	188
54.2	117	60.0	153	67.0	189
54.3	118	60.2	154	67.1	190
54.4	119	60.4	155	67.2	191
54.5	120	60.5	156	67.4	192
54.7	121	60.7	157	67.5	193
54.9	122	60.9	158	67.6	194
55.0	123	61.0	159	67.7	195
55.1	124	61.2	160	67.8	196
55.2	125	61.4	161	67.9	197
55.3	126	61.5	162	68.0	198
55.5	127	62.0	163	68.1	199
55.6	128	62.1	164	68.2	200
55.7	129	62.2	165	68.3	201
55.8	130	62.5	166	68.4	202
55.9	131	62.8	167	68.5	203
56.0	132	63.0	168	68.6	204
56.1	133	63.5	169	68.7	205
56.2	134	63.6	170	68.8	206
56.3	135	63.8	171	68.9	207
56.4	136	64.0	172	69.0	208
56.6	137	64.2	173	69.05	209
56.8	138	64.4	174	69.1	210
57.0	139	64.6	175	69.15	211
57.2	140	64.8	176	69.2	212
57.4	141	65.0	177	69.25	213
57.6	142	65.2	178	69.50	214
57.8	143	65.5	179	69.55	215
58.0	144	65.7	180	69.6	216

APPENDIX B

OLSON-HUGHES NORMS
WEIGHT AGES FOR BOYS*

Wt. in Lbs.	Age	Wt. in Lbs.	Age	Wt. in Lbs.	Age	Wt. in Lbs.	Age
26.3	24	41.0	69	63.3	114	90.7	159
26.6	25	41.6	70	63.8	115	91.5	160
26.9	26	42.3	71	64.2	116	92.3	161
27.2	27	42.9	72	64.6	117	93.1	162
27.6	28	43.5	73	65.0	118	94.0	163
28.0	29	44.1	74	65.4	119	94.8	164
28.4	30	44.8	75	65.9	120	95.6	165
28.8	31	45.5	76	66.4	121	96.4	166
29.2	32	46.1	77	66.9	122	97.2	167
29.6	33	46.7	78	67.3	123	98.1	168
30.0	34	47.3	79	67.8	124	99.0	169
30.4	35	48.0	80	68.3	125	100.0	170
30.8	36	48.6	81	68.8	126	101.0	171
31.1	37	49.2	82	69.3	127	102.0	172
31.4	38	49.8	83	69.8	128	103.0	173
31.6	39	50.4	84	70.3	129	104.0	174
32.0	40	50.8	85	70.8	130	105.0	175
32.4	41	51.1	86	71.4	131	106.0	176
32.9	42	51.4	87	71.9	132	107.0	177
33.2	43	51.7	88	72.5	133	108.0	178
33.6	44	52.1	89	73.0	134	109.0	179
34.0	45	52.4	90	73.5	135	110.0	180
34.3	46	52.7	91	74.0	136	111.0	181
34.6	47	53.0	92	74.6	137	112.0	182
34.9	48	53.4	93	75.1	138	112.8	183
35.0	49	53.7	94	75.6	139	113.6	184
35.1	50	54.1	95	76.1	140	114.4	185
35.2	51	54.4	96	76.7	141	115.2	186
35.4	52	54.9	97	77.3	142	116.2	187
35.6	53	55.4	98	77.8	143	117.2	188
35.8	54	55.9	99	78.3	144	118.2	189
36.2	55	56.5	100	79.1	145	119.2	190
36.7	56	57.0	101	80.0	146	120.2	191
37.1	57	57.5	102	80.8	147	121.2	192
37.4	58	58.0	103	81.7	148	122.0	193
37.7	59	58.5	104	82.5	149	122.8	194
37.9	60	59.0	105	83.3	150	123.6	195
38.0	61	59.5	106	84.1	151	124.4	196
38.0	62	60.1	107	84.9	152	125.2	197
38.1	63	60.6	108	85.8	153	126.0	198
38.8	64	61.0	109	86.6	154	126.8	199
39.5	65	61.5	110	87.5	155	127.6	200
40.2	66	62.0	111	88.3	156	128.4	201
40.5	67	62.4	112	89.1	157	129.2	202
40.7	68	62.8	113	89.9	158	130.0	203
						130.5	204

*From "Manual for the Description of Growth in Age Units," Ann Arbor; University Elementary School, 1950.

WEIGHT AGES FOR GIRLS

Wt. in Lbs.	Age	Wt. in Lbs.	Age	Wt. in Lbs.	Age	Wt. in Lbs.	Age
24.6	24	37.1	64	58.8	104	83.7	144
25.0	25	37.3	65	59.4	105	84.7	145
25.4	26	37.6	66	60.0	106	85.8	146
25.8	27	38.0	67	60.6	107	86.8	147
26.1	28	38.5	68	61.2	108	87.9	148
26.5	29	38.9	69	61.8	109	88.9	149
26.9	30	39.4	70	62.5	110	90.0	150
27.2	31	39.8	71	63.1	111	91.0	151
27.6	32	40.3	72	63.8	112	92.1	152
27.9	33	41.2	73	64.4	113	93.1	153
28.2	34	42.0	74	65.1	114	94.2	154
28.5	35	42.8	75	65.7	115	95.2	155
28.8	36	43.6	76	66.4	116	96.3	156
29.3	37	44.5	77	67.1	117	97.1	157
29.7	38	45.3	78	67.8	118	97.9	158
30.2	39	46.1	79	68.5	119	98.7	159
30.5	40	46.9	80	69.2	120	99.5	160
30.8	41	47.7	81	69.7	121	100.3	161
31.0	42	48.5	82	70.3	122	101.1	162
31.2	43	49.3	83	70.8	123	101.9	163
31.3	44	50.2	84	71.4	124	102.7	164
31.5	45	50.5	85	71.9	125	103.5	165
31.7	46	50.8	86	72.5	126	104.3	166
32.0	47	51.1	87	73.0	127	105.1	167
32.2	48	51.4	88	73.6	128	106.0	168
32.6	49	51.7	89	74.1	129	107.0	169
33.1	50	52.0	90	74.7	130	108.0	170
33.6	51	52.3	91	75.2	131	109.0	171
33.7	52	52.6	92	75.8	132	110.0	172
33.9	53	52.9	93	76.5	133	111.0	173
34.0	54	53.2	94	77.1	134	112.0	174
34.5	55	53.5	95	77.8	135	113.0	175
35.0	56	53.8	96	78.4	136	114.0	176
35.4	57	54.5	97	79.0	137	115.0	177
35.6	58	55.1	98	79.6	138	116.0	178
35.8	59	55.7	99	80.3	139	117.0	179
36.1	60	56.3	100	81.0	140	118.0	180
36.3	61	56.9	101	81.7	141	119.5	183
36.6	62	57.6	102	82.4	142	121.0	186
36.8	63	58.2	103	83.0	143	122.0	189
						123.0	192
						124.0	204

HEIGHT AGES FOR BOYS

Ht. in Inches	Ht. Age	Ht. in Inches	Ht. Age	Ht. in Inches	Ht. Age	Ht. in Inches	Ht. Age
33.8	24	44.0	69	52.4	114	60.1	159
34.1	25	44.5	70	52.6	115	60.3	160
34.4	26	45.0	71	52.8	116	60.5	161
34.6	27	45.4	72	52.9	117	60.7	162
34.8	28	45.6	73	53.1	118	60.9	163
35.0	29	45.8	74	53.3	119	61.1	164
35.2	30	46.0	75	53.5	120	61.3	165
35.5	31	46.2	76	53.6	121	61.5	166
35.9	32	46.4	77	53.8	122	61.7	167
36.2	33	46.6	78	53.9	123	61.9	168
36.4	34	46.8	79	54.1	124	62.1	169
36.6	35	47.0	80	54.2	125	62.3	170
36.9	36	47.2	81	54.3	126	62.5	171
37.2	37	47.4	82	54.4	127	62.7	172
37.4	38	47.6	83	54.5	128	62.9	173
37.6	39	47.9	84	54.7	129	63.1	174
37.9	40	48.0	85	54.8	130	63.5	175
38.2	41	48.2	86	55.0	131	63.7	176
38.4	42	48.3	87	55.2	132	63.9	177
38.6	43	48.5	88	55.3	133	64.1	178
38.9	44	48.6	89	55.4	134	64.2	179
39.1	45	48.8	90	55.6	135	64.3	180
39.2	46	48.9	91	55.7	136	64.5	181
39.2	47	49.1	92	55.9	137	64.7	182
39.3	48	49.2	93	56.1	138	64.9	183
39.5	49	49.4	94	56.3	139	65.1	184
39.8	50	49.5	95	56.4	140	65.3	185
40.1	51	49.7	96	56.5	141	65.5	186
40.3	52	49.8	97	56.6	142	65.7	187
40.5	53	49.9	98	56.8	143	65.9	188
40.7	54	50.1	99	57.0	144	66.1	189
41.0	55	50.2	100	57.2	145	66.3	190
41.3	56	50.3	101	57.4	146	66.5	191
41.6	57	50.5	102	57.6	147	66.8	192
41.7	58	50.6	103	57.8	148	66.9	193
41.8	59	50.7	104	58.0	149	67.0	194
42.0	60	50.9	105	58.3	150	67.1	195
42.1	61	51.0	106	58.5	151	67.2	196
42.1	62	51.2	107	58.7	152	67.3	197
42.2	63	51.3	108	58.9	153	67.4	198
42.6	64	51.4	109	59.2	154	67.5	199
43.0	65	51.6	110	59.4	155	67.6	200
43.3	66	51.8	111	59.6	156	67.7	201
43.5	67	52.0	112	59.8	157	67.8	202
43.7	68	52.2	113	60.0	158	67.9	203
						68.0	204

HEIGHT AGES FOR GIRLS

Ht. in Inches	Ht. Age	Ht. in Inches	Ht. Age	Ht. in Inches	Ht. Age	Ht. in Inches	Ht. Age
33.0	24	42.3	64	50.3	104	57.5	144
33.3	25	42.3	65	50.5	105	57.6	145
33.7	26	42.4	66	50.6	106	57.8	146
34.1	27	42.6	67	50.8	107	58.0	147
34.4	28	42.8	68	51.0	108	58.2	148
34.6	29	42.9	69	51.3	109	58.4	149
34.9	30	43.2	70	51.5	110	58.6	150
35.2	31	43.4	71	51.7	111	58.8	151
35.5	32	43.7	72	51.9	112	59.0	152
35.7	33	43.9	73	52.1	113	59.2	153
35.9	34	44.1	74	52.3	114	59.4	154
36.2	35	44.3	75	52.5	115	59.6	155
36.4	36	44.6	76	52.7	116	59.8	156
36.7	37	44.9	77	52.9	117	60.0	157
36.9	38	45.3	78	53.1	118	60.1	158
37.1	39	45.7	79	53.3	119	60.3	159
37.3	40	46.0	80	53.6	120	60.4	160
37.5	41	46.4	81	53.8	121	60.6	161
37.8	42	46.7	82	53.9	122	60.7	162
38.0	43	47.0	83	54.1	123	60.9	163
38.3	44	47.4	84	54.2	124	61.0	164
38.5	45	47.6	85	54.3	125	61.2	165
38.7	46	47.7	86	54.5	126	61.4	166
39.0	47	47.9	87	54.7	127	61.6	167
39.3	48	48.0	88	54.9	128	61.8	168
39.5	49	48.2	89	55.0	129	61.9	169
39.6	50	48.3	90	55.2	130	62.0	170
39.8	51	48.5	91	55.3	131	62.1	171
40.0	52	48.6	92	55.5	132	62.3	172
40.2	53	48.7	93	55.6	133	62.4	173
40.4	54	48.8	94	55.8	134	62.5	174
40.7	55	49.0	95	56.0	135	62.6	175
41.0	56	49.1	96	56.1	136	62.7	176
41.2	57	49.2	97	56.3	137	62.8	177
41.3	58	49.4	98	56.4	138	62.9	178
41.5	59	49.5	99	56.6	139	63.0	179
41.7	60	49.7	100	56.8	140	63.1	180
41.9	61	49.8	101	57.0	141	63.3	183
42.0	62	50.0	102	57.2	142	63.4	186
42.2	63	50.1	103	57.3	143	63.6	189
						63.7	192
						63.8	204
						64.0	
						65	
						66	
						67	
						68	
						69	