AN INVESTIGATION OF THE ASSOCIATION BETWEEN SEXUAL MATURATION AND PHYSICAL GROWTH AND MOTOR PROFICIENCY IN MALES

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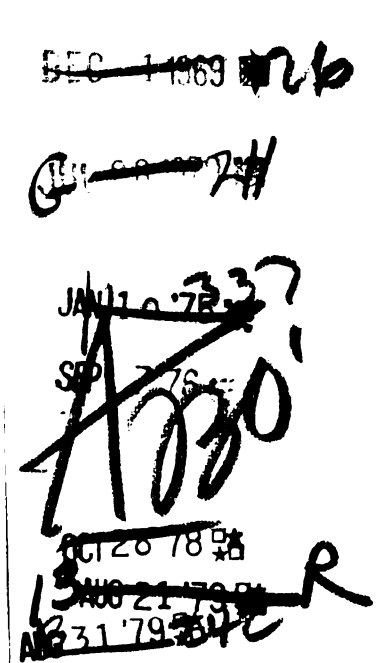

ABSTRACT

AN INVESTIGATION OF THE ASSOCIATION BETWEEN SEXUAL MATURATION AND PHYSICAL GROWTH AND MOTOR PROFICIENCY IN MALES

By Michael G. Marshall

This study was undertaken in an effort to correct the apparent inequality of the classification system of Chronological Age currently in use for evaluating motor proficiency of junior high school boys and to investigate the association between sexual maturation and physical growth and motor proficiency.

This investigation was designed to provide solutions to the following problems: (1) to develop reliable and objective scales for the assessments of primary and secondary sex characteristics in circumpubertal males; (a) to arrive at a descriptive value of sexual maturation based on a formula which utilizes the scales of primary and second ry sex characteristics, (2) to compare the summary data of physical growth and motor performance of individuals grouped according to a sexual maturation indicator value with similar data on boys grouped according to a value from assessment of Pubic Hair and Chronological Age, respectively, (3) to study the association between subcategories grouped by sexual maturation indicator values (independent variable) and the dependent variables of chronological age, height, weight, situps, shuttle run, pullups,

standing broad jump and vertical jump by comparing significance within and between subcategory differences.

Conclusions of this cross-sectional study of 671 white males of East Lansing Junior High School and Mason Junior High School can be stated as follows:

(1) The primary and secondary sex characteristics scales are reliable and objective with the exception of secondary sex characteristic facial hair.

(2) When grouping circumpubertal males for physical growth and motor performance the classification systems SMIV and Pubic Hair are superior to a classification by Chronological Age when the criteria of maximum range within a classification system and greatest homogeneity within subcategories is applied.

(3) The conclusions of this investigation of the association between sexual maturation as determined by SMIV subcategories and physical growth and motor proficiency in males is as follows:

(a) when classified according to SMIV, indications are that growth in stature increases significantly between subcategories throughout the scale with the possible exception of from D to E. This insignificant difference is attributed to the small sample size in E.

(b) the dependent variable, weight, does not vary significantly from SMIV group A to B and D to E, indicating that weight increases significantly as the boys pass through the other SMIV groupings of B to C and C to D.

(c) the ability to do situps does not increase significantly between any SMIV categories. This may be a result of the imposed

upper limit of 99.

(d) shuttle run scores indicate that progress in agility is not enhanced once the SMIV grouping of C is reached, but until this point of sexual maturation, agility improves between successive subcategories.

(e) as tested by pullups, the strength of the upper arms is distinctly different between subgroups C and D.

(f) the standing broad jump indicates that leg power increases significantly throughout the SMIV scale with the possible exception of groups D to E.

(g) vertical jump, another indicator of leg power, shows no significant increase between SMIV groups A and B. However, there is a significant increase in the group mean between each successive group with the exception of insignificant mean differences between groups C and E and D and E.

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By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

Figure Page

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

The apparent inequity of the classification system of chronological age currently in use for evaluating motor performances of junior high school boys and the association between sexual maturation and height, weight and motor performances prompted the author to investigate the possibility of constructing a classification system in which sexual maturity was taken into account in the appraisal of motor proficiency.

STATEMENT OF THE PROBLEM

This investigation was designed to provide solutions to the following problems:

(1) To develop reliable and objective scales for the assessments of primary and secondary sex characteristics in circumpubertal males.

(a) To arrive at a descriptive value of sexual maturation based on a formula which utilizes the scales of primary and secondary sex characteristics.

(2) To compare the summary data of physical growth and motor performance of individuals grouped according to a sexual maturation indicator value with similar data on boys grouped according to a value from assessment of Pubic Hair and Chronological Age, respectively.

(3) To study the association between subcategories grouped by sexual maturation indicator values (independent variable) and the

dependent variables of chronological age, height, weight, situps, shuttle run, pullups, standing broad jump and vertical jump by comparing significance within and between subcategory differences.

SIGNIFICANCE OF THE STUDY

The criterion most commonly used for grouping junior high school boys for competition in physical activity is that of chronological age. However, the circumpubertal male has varying rates, velocities and durations of sexual maturation. The positive association between sexual maturation and the components of motor skills provides the possibility for placing individuals into groups where physical abilities are more nearly homogeneous.

SCOPE OF THE STUDY

The subjects selected were the majority of the male students attending East Lansing Junior High School, East Lansing, Michigan and Mason Junior High School, Mason, Michigan during the school years 1965-66 and 1966-67. The mean age of the cross-sectional sample was 159.52 months ranging from 143 to 182 months. The sample included 671 white males of upper middle class backgrounds in East Lansing and of lower middle and middle class backgrounds in Mason.

LIMITATION OF THE STUDY

The data collection was conducted within the school systems. Therefore, the chance of observer error was greater than which one might expect in a laboratory situation. Two reasons accounted for this possibility. (1) Data were collected by the classroom instructors. These individuals were educated in the rating technique without any previous knowledge about their abilities to carry out the instructions.

(2) No inducement, outside of the gratitude of the investigator and the possible education which the experience provided was given to those who collected the data. Therefore, accuracy of the assessments depended upon the professional interest of the raters. While one might argue that the limitation of having volunteer personnel perform the ratings might unduly influence the outcome of the study, it seemed essential that school personnel without special competences in this area be able to conduct the assessments of sexual maturity.

CHAPTER II

RELATED LITERATURE

Assessment of Sexual Maturity

Reports of early attempts to study the process of sexual maturation were concerned with the sequence of development in the secondary sex characteristics of body hair and genitalia.

VanDyke[1] stated that generally the onset of puberty in females was announced by pigmented pubic hair and terminated with the appearance of axillary hair. Similarly, Richey[2] developed a classification system founded upon chronological age at appearance of axillary hair. Richey's Maturity Group I contained boys with appearance of axillary hair by their fourteenth birthday while Maturity Group II had evidence of axillary hair by their fifteenth birthday. Maturity Group III contained the individuals who had no axillary hair at fifteen years of age.

Greulich[3] proposed a method of classifying sexual maturation utilizing genitalia development and body hair development of pubic

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[1] VanDyke, G.E., The effects of the advent of puberty on the growth in height and weight in girls. School Review, 38: 211-12, March, 1930.

[2] Richey, H.G., The relation of accelerated, normal and retarded puberty to height and weight of school children. Monog. Soc. Res. Child Dev., 2(1): 6-7, 1937.

[3] Greulich, W.W., R.I. Dorfman, H.R. Catchpole, E.I. Soloman, and C.S. Culotta, Somatic and endocrine studies of pubertal and adolescent boys. Monog. Soc. Res. Child Dev., 7(3): 15-17, 1942.

facial, throat, circumanal and axillary regions. Five stages of progress toward maturity, with detailed descriptions of the characteristics at each stage, were provided.

Another technique by which boys could be categorized on the basis of secondary sex characteristics was proposed by Ellis,[1] and was composed of classification groups very similar to those of Greulich, with the exception that boys were placed into three classes. On the basis of secondary sex characteristic development scales, the boys were graded as prepubescent, pubescent or adolescent. A rating of prepubescent required no evidence of development in any region, whereas a rating of pubescent required the presence of pubic hair and/or pubescent genitalia development. An adolescent rating required marked increases in total size of the penis and testicles in addition to profuse pubic hair.

Methods of Classifying Boys for Physical Activity

One of the first to express the need for homogeneous grouping for athletic activities was Reilly,[2] who based his classification groups upon age, height and weight. This system was acclaimed as a great advancement in equating uncontrollable structural and develop-

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[1]Ellis, R.W.B., Height and weight in relation to onset of puberty in boys. Arch. Dis. Child., 21: p.182, 1946.

[2]Espenschade, A.S., Restudy of relationships between physical performances of school children and age, height and weight. Res. Quart. 34: p.144, 1963 from F.J. Reilly, New rational athletics for boys and girls. Boston: D.C. Health and Co., 1917.

mental factors. Numerous other reports[1] [2] have used similar techniques. Espenschade[3] investigated the changes in performance which accompanied growth and maturity and concluded that any separation of chronological age, physiological and skeletal maturity was artificial because of the inseparability of these variables in the development in the circumpubertal male. In a later article, Espenschade recognized the importance of sexual maturation in the relationship between physical performance and age, height and weight. However, due to an inability to obtain reliable ratings, the assessment of secondary sex characteristics was not included in her study.

Physical Maturation and Motor Performance

In a report dealing with the relationship between physical maturation and motor performance, Dimock[5] stated that acceleration in strength lagged behind the spurt in height and weight. The post-pubescent male at thirteen was found stronger than the pre-pubescent male at fifteen, the difference in strength was especially marked in the first year after the post-pubescent stage.

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[1] Cozens, F.W. and Neilson, N.O., Age, height and weight as factors in the classification of elementary school children. J. Health and Phys. Ed., 3(10): p.21, 1932.

[2] McCloy, C.H. and N.C. Young, Test and measurements in health and physical education. New York: Appleton-Century-Crofts, 1954.

[3] Espenschade, A.S., Motor performance in adolescence. Monog. Soc. Res. Child Dev., 5(1): p.73, 1940.

[4] Espenschade, A.S., Restudy of relationships between physical performances of school children and age, height and weight. Res. Quart., 34: p.144, 1963.

[5] Dimock, H., A research in adolescence. I. Pubescence and physical growth. Child Dev., 6: 176-195, 1935.

Clarke and Degatis[1] assessed skeletal age of hand-wrist X-rays on 81 twelve-year-old boys to study the relationships between standing broad jump and various maturational, anthropometric and strength tests. They concluded that leg power of 12-year-old boys as measured by the standing broad jump was dependent partially upon body size and muscular strength.

Rarick and Oyster[2] reported that in pre-puberty boys skeletal age by itself was of little consequence in explaining differences in strength and motor proficiency due to the inseparability of height, weight, chronological age and skeletal age at this early phase of growth and development.

Rate of Physical Maturation

It appears that the age at onset of the circumpubertal growth spurt determines the velocity of bone growth during this period. It is hypothesized that if the onset of this growth phase is early, the longer will be the duration of circumpubertal growth. On the other hand, should the onset be late, the duration is believed not to be as long and the resultant growth opportunity is lowered.[3]

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[1]Clarke, H.H. and E.W. Degatis, Relationships between standing broad jump and various maturational, anthropometric and strength tests of 12-year-old boys. Res. Quart., 35: 253-264, 1964.

[2]Rarick, G.L. and N. Cyster, Physical maturity, muscular strength and motor performances of young school-age boys. Res. Quart. 35: 523-531, 1964.

[3]Broverman, D.M., I.K. Broverman, W. Vogel, R.D. Palmer and E.L. Klaiber, Physique and growth in adolescence. Child Dev., 35: p.384, 1964.

Physique and Sexual Maturation

Investigations of the interrelationship between physique and sexual maturation have resulted in conflicting reports. However, the important point of the following review is that the differences in the timing of onset and of velocity in sexual maturation between ectomorphs, endomorphs and mesomorphs are thought to be of insignificant consequence.

Reynolds[1] studied the association between sexual maturation and physical growth and concluded, using primary and secondary sex characteristic development as the guide, that early-maturing boys were on the average both heavier and taller than late-maturing boys.

Hunt[2] demonstrated that the timing of onset of sexual maturation was consistently early in physiques with mesomorph dominance whereas the velocity of sexual maturation was smallest in the fattest boys and greatest in the leanest sample. The average endomorph was found to initiate sexual maturation early, but to move through the stages at a slow rate. The ectomorph, though his onset was late, had a rapid velocity and caught up to the earlier maturing endomorph. Hunt concluded that the amount of body fat may influence the timing and velocity of sexual maturation.

Barton,[3] an associate of Hunt, found that adult body type as estimated by somatotype was fairly unpredictable from adolescence

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[1]Reynolds, E.L. and J.V. Wines, Physical changes associated with adolescence in boys. Amer. J. Dis. Child., 82: p.545, 1951.

[2]Hunt, E.E. Jr., G. Cocke and J.R. Gallagher, Somatotype and sexual maturation in boys: a method of developmental analysis. Human Biol., 30: p.90, 1958.

[3]Barton, W.H. and E.E. Hunt, Jr., Somatotype and adolescence in boys: a longitudinal study. Human Biol., 34: p.269, 1962.

because boys from age 11½ years tended to regress toward the mean in somatotype. The extreme prepubertal endomorph was shown to have an early onset of sexual maturation with a rapid velocity, while the extreme prepubertal mesomorph and ectomorph exhibited a slightly delayed onset of sexual maturation with average velocities.

On the basis of the available information, it is apparent the following questions remain to be studied. (1) Are there reliable and objective scales for the assessment of primary and secondary sex characteristics of circumpubertal males? (2) Is it feasible to incorporate the scale ratings of the primary and secondary sex characteristics into a component descriptive value of sexual maturation? (3) Do individuals grouped on the basis of a component value of sexual maturation exhibit greater homogeneity in selected traits of physical growth and motor performance than those grouped by either Pubic Hair or Chronological Age? (4) What are the associations between sexual maturation and of physical growth and motor proficiency?

In an attempt to provide answers to the questions above it is the purpose of this investigation to:

(1) develop reliable and objective scales for the assessments of primary and secondary sex characteristics in the circumpubertal male.

(a) arrive at a descriptive value of sexual maturation based on a formula which utilizes the scales of primary and secondary sex characteristics.

(2) compare the summary data of physical growth and motor performance of individuals grouped according to a sexual maturation indicator value with similar data on boys grouped according to a value

from assessment of Pubic Hair and Chronological Age, respectively.

(3) study the association between subcategories grouped by sexual maturation indicator values (independent variable) and the dependent variables of chronological age, height, weight, situps, shuttle run, pullups, standing broad jump and vertical jump by comparing significance within and between subcategory differences.

CHAPTER III

METHODOLOGY

Restatement of Problems

This investigation sought information regarding the association between sexual maturation and height, weight and five motor performance scores of junior high school boys. Four major problems were considered.

The first problem was to develop reliable and objective scales for the assessments of secondary sex characteristics in circumpubertal males. Assessments of the three body hair regions and genitalia development were combined in a formula to produce a sexual maturation indicator value.(For future discussion this value will be referred to as SMIV.) SMIV was determined from a composite of scores resulting from assessments of secondary sex characteristics of five distinct body regions. The regions were facial hair, axillary hair, pubic hair, penis growth and scrotum growth. The formula used was $X + \left(\frac{Y - 4X}{10}\right) = SMIV$, where X equaled the stage of development of pubic hair and Y equaled the total of the facial, axillary, penis and scrotum stages of development. For example, suppose that pubic hair development was equivalent to stage three while the developmental total of the other four regions equaled fifteen; then $3 + \left(\frac{15 - 12}{10}\right) = 3 + \left(\frac{3}{10}\right) = 3.3 = SMIV$. It is evident that the formula was heavily weighted in favor of pubic hair development. Justification for this

weighting is based upon two factors: (1) appearance of pubic hair is generally the first indication of the sequence of changes in body structure which accompany physical maturation, (2) the assessment of pubic hair has been demonstrated to be highly reliable and objective. SMIV ranged from 1.0 to 5.0 with incremental units of .1.

The second problem involved a comparison of physical growth and motor performance scores based on the classification method of SMIV with classifications according to assessment values of Pubic Hair and Chronological Age. An attempt was made to determine which classification technique demonstrated the greatest between-group differences and within-group homogeneity. Classifications by assessment values of Pubic Hair were determined by scores assigned this particular body hair region by the raters. The group values ranged from (1) to (5). Chronological Age groups were arbitrarily chosen as 11.0 years (127 months to 138 months), 12.0 years = (139 months to 150 months), 13.0 years = (151 months to 162 months), 14.0 years = (163 months to 174 months) and 15.0 years = (175 months to 186 months).

The third problem was concerned with the association between SMIV groupings, which were arbitrarily divided into intervals of A = (1.0 to 1.5), B = (1.6 to 2.5), C = (2.6 to 3.5), D = (3.6 to 4.5) and E = (4.6 to 5.0), and the dependent variables of chronological age, height, weight, situps, shuttle run, pullups, standing broad jump and vertical jump.

Description of the Subjects

The subjects were 671 white seventh and eighth grade boys of

East Lansing and Mason Junior High Schools during the school years of 1965-66 and 1966-67. Some of the subjects were absent on days that data collection took place, therefore there was missing data in the study. The mean age was 159.52 months with an age range of 143 months to 182 months. Table I illustrates the number of boys within each Chronological Age group.

Table I The number of boys within each Chronological Age group.

Chronological Age grouping					
11.0	12.0	13.0	14.0	15.0	Total
1	98	335	215	22	671

Data Collection Schedule

The data were collected during the month of January for the years 1966 and 1967. The 1966 collection involved only East Lansing Junior High, whereas 1967 data collection took place at both East Lansing and Mason Junior High Schools.

Assessment of Primary and Secondary Sex Characteristics

Policy accepted by the raters as easiest and most functional when assessing the secondary sex characteristics was as follows: Before the commencement of class seven boys entered a well lighted room used for assessing secondary sex characteristics. Sheets for secondary sex characteristics assessment were arranged in alphabetical order by class. (A complete description of the items on the assessment form is given in Appendix A.) The boys were requested to stand nude approximately three feet from the rater. The subject raised his arms over his head and upon commands looked left-then-right. While the student continued looking to the right, the rater checked the appropriate scale point within each region. The required testing

time per student was not greater than thirty seconds. A pictorial guide for genitalia rating, (see Appendix) was provided as a reference to insure rater consistency in these ratings. Written instructions of hair development for the facial, axillary and pubic regions were provided for each rater. The same procedure was followed at the termination of the class, thus allowing the instructor to assess fourteen boys per class period.

Age

Age was recorded in years and months and later converted to months for computational purposes. If a boy was 12 years and 4 months plus 12 days old, his age was recorded as 12.4 or 148 months. If more than 14 days from the last montly anniversary date had elapsed, his age was recorded as 12.5 or 149 months.

Height

Height for subjects at East Lansing Junior High School was measured with the subject standing free, with the arms at the side. A sliding anthropometer with a horizontal arm was placed in the midsagittal plane. Height was recorded to the nearest one fourth of an inch. At Mason Junior High School the subjects were measured standing against a wall, with the heels flat on the floor in contact with the wall as were the buttocks and shoulders. In all cases the measurement was taken and recorded by the instructor.

Height was recorded in inches to the nearest one fourth of an inch.

Weight

The balance arm weight machine was used in East Lansing. In Mason a bathroom scale was used after it was checked for accuracy

and found that it needed no calibration.

1. The students wore athletic supporters only.

2. Weight was determined and recorded by the instructor.

3. Weight was recorded in pounds to the nearest one-half pound.

Situps

Description: The student was on his back with legs extended and feet abducted to shoulder width. His hands were placed on the back of his neck with the fingers interlaced. A partner held the ankles down, the heels being in contact with the mat or floor at all times.

The student sat up, turned to the left and touched the right elbow to the left knee, returned to the starting position, then sat up, turned the trunk to the right and touched the left elbow to the right knee. The exercise was repeated, alternating sides. There was no time limit, but the boys were not allowed to rest between attempts.

Scoring: One point for every properly executed movement. Maximum limit was set at 99.

Shuttle run

Description: Two parallel lines (A and B) were placed on the floor 30 feet apart. Two 2x2x4 blocks of wood were placed behind line B. The student stood behind line A. On the signal "Ready? Go!" the student ran to line B, picked up one block, ran back to line A and placed the block behind the line; he then ran back to line B and picked up the second block which he carried across line A. Practice runs were allowed without timing.

Scoring: The score to the nearest tenth of a second was recorded.

Pullups

Description: At East Lansing Junior High a ladder used for hand over hand traveling was used for the pullups. At Mason Junior High School a chinning bar was used. The pronated hand position (back of the hand toward the face) was used. After assuming the hanging position, the student elevated his body until his chin was raised above the bar. He then lowered his body to a full hang and again elevated his body as many times as he was able, always returning to the full hang.

Scoring: One point for every properly completed pullup.

Standing broad jump

Description: The student stood with his toes to the starting tape. Feet were abducted to shoulder width. Preparatory to jumping, the student extended his arms and flexed his knees. The jump was accomplished by simultaneously extending the knees and flexing the shoulder joint. Practice jumps were allowed.

Scoring: The score was recorded in feet and inches and later converted to inches.

Vertical jump

Description: The initial measurement consisted of having the student extend one arm upward with the tips of the fingers touching the measuring board or tape marked in inches. Students at East Lansing Junior High School used a board and Mason Junior High students used tape. Feet were flat on the floor and adjacent to the wall. The number nearest the extended finger tips was recorded. The boy

then lowered his arm and moistened his finger tips in preparation to jump. He bent his knees and swung his arms backward. The jump was accomplished by simultaneously extending the knees and thrusting the arms upward. The finger tips of the arm used to obtain the initial measurement touched as high as possible on the board or tape. The number at the moistened spot was recorded. The score was the difference between the initial and final values.

Reliability and Objectivity of Sexual Maturation Indicator Assessments

The second-trial assessment values of primary and secondary sex characteristics were used to demonstrate the reliability and objectivity of the raters. These data were analyzed by Hoyt's Analysis of Variance test. For the purposes of this investigation an assumption of equal intervals between the primary and secondary sex characteristics scales was made, thus meeting the requirements of Hoyt's Analysis of Variance technique.

Treatment of the Data

One-way variance analyses were applied to the data which constituted the dependent variables. F-statistics were derived from between and within subcategory mean squares of dependent variables, classified according to SMIV, Pubic Hair and Chronological Age. The Scheffe test of multiple comparisons[1] was employed to isolate subcategory differences within dependent variables when significant F-ratios were detected.

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[1]Hays, William, Statistics for Psychologists. Holt, Rinehart and Winston, Chicago, 1963.

CHAPTER IV

RESULTS AND DISCUSSION

The following results demonstrate the utility of the SMIV formula as a means of describing the sequential phases of male sexual development as a point value system. In addition they demonstrate the ability of the SMIV groupings to show significant and meaningful differences between the subcategories of eight dependent variables, including age, physical growth and motor proficiency tests.

It should be noted that subcategory A of SMIV included boys given a descriptive value of 1.0 to 1.5. Such a classification makes it possible for an infant to be assigned the value of 1.0 in this subcategory as pre-sexual maturation. By requiring a value of 1.1 as a minimum value, the mean age of this subcategory would be increased. In subcategory E (4.6 to 5.0) the reverse relationship existed. A full adult would be rated at 5.0. The age range permitted by this classification would be narrowed considerably by requiring that the maximum value for this subcategory be 4.9. For the purposes of this investigation, all 1.0 and 5.0 scores were included because the age range of the sample was narrow and the amount of misappropriation was believed to be minimal.

Reliability of the Primary and Secondary Sex Characteristics Scales

The data used to determine rater reliability were collected on the Saturday immediately preceding the week of assessment of sexual

maturation and the eight dependent variables. The three raters were introduced to the primary and secondary sex characteristics scales on the pictorial guide for genitalia rating initally one hour before rating a randomly selected sample of twenty-six East Lansing Junior High School boys. The boys were placed in random order for each of the two rating trials. Hoyt's Analysis of Variance technique was used on the second rating trial to determine the reliability between raters. The first and second rating trials were used to detect within rater reliability. For the purposes of this investigation it was assumed that there were equal intervals in the primary and secondary sex characteristics scales and SMIV as this was a requirement for use of Hoyt's Analysis of Variance test.

The coefficients for within and between rater reliability (See Table II) indicate the ability of the three raters to agree on the descriptive rating to be assigned a boy for each body region.

Table II Within and Between Rater Reliability of assessing primary and secondary sex characteristics, determined by Hoyt's Analysis of Variance.

	FACIAL	AXILLARY	PUBIC	PENIS	SCROTUM
WITHIN RATER I	.30	.95	.96	.94	.87
WITHIN RATER II	.81	.86	.93	.89	.80
WITHIN RATER III	.40	.87	.91	.96	.94
BETWEEN RATERS	.49	.95	.95	.76	.87

On the basis of the size of the reliability coefficients it is clear that raters had the greatest difficulty agreeing on the rating of facial hair (.49) while the greatest agreement between raters was noted for axillary and pubic hair (.95). The range of within rater reliability coefficients was for facial hair .30 to .81; for axillary

hair .86 to .95; for pubic hair .91 to .93; for penis development .89 to .96 and for scrotum development .21 to .94.

The size of the reliability coefficients for both the within and between raters indicates that with the exception of facial hair the primary and secondary sex characteristics scales were reliable and objective tools for obtaining a numerical value for describing the observable signs of sexual development in the male.

Comparison of Classification Systems (see Appendix C for status of data)

Table III provides a comparison of the change in sample size of the subcategories for the dependent variable height as a result of the classification systems SMIV, Pubic Hair and Chronological Age.

Table III The reclassification of the dependent variable height according to the independent variable groupings SMIV, Pubic Hair, and Chronological Age, respectively.

(SMIV)	sample	(Pubic Hair)	sample	(Chronological Age)	sample
(A)	117	(1)	105	(11.0)	1
(B)	208	(2)	150	(12.0)	98
(C)	204	(3)	164	(13.0)	335
(D)	131	(4)	237	(14.0)	215
(E)	11	(5)	15	(15.0)	22

It should be noted that a change in the method of classification also results in changes in the number of subjects and summary statistics in the subcategories within the classification system. For example, in comparative subcategories of SMIV, Pubic Hair, and Chronological Age the sample size shows (A) = 117, (1) = 105, and (11.0) = 1.

Continuation of similar comparisons between SMIV, Pubic Hair and Chronological Age throughout the remainder of the subcategories

results in the following sample sizes: (B) = 208, (2) = 150 and (12.0) = 98; (C) = 204, (3) = 164 and (13.0) = 335; (D) = 131, (4) = 237 and (14.0) = 215; and (E) = 11, (5) = 15 and (15.0) = 22. This redistribution of sample size indicates that although the SMIV was centered upon the Pubic Hair rating, the corrective factor of the remaining four regions did effect the number within the subcategories.

Tables IV, V and VI present summary data in the form of means, standard deviation and sample sizes for each subcategory of the classification systems of SMIV, Pubic Hair and Chronological Age, respectively, for the eight dependent variables. It will be noted that the F-statistic for each dependent variable reached significance, regardless of the major classification used to obtain the subcategories. As a result of these findings one must look to the size of the means and standard deviations and to the results of the Scheffe test of multiple comparisons for information regarding the advantages which one classification system might have over others.

Figures 1-8 are graphic illustrations of the summary data contained in Tables IV, V and VI. Each dependent variable is individually compared with the independent variables of SMIV, Pubic Hair and Chronological Age. For the purposes of this investigation wider range and narrower degree of one standard deviation overlap between the subcategories of the independent variables was used to indicate the superiority of one classification system over another.

Figure 1, a comparison between SMIV and Pubic Hair classifications, indicates that the range for the SMIV classification system is larger but the overlap of standard deviations shows no appreciable differences.

Table IV
Means, standard deviation and sample sizes presented in concise form for each subcategory of the classification system of SMIV for the eight dependent variables of this investigation.

SMIV	CHRONO-LOGICAL AGE (months)	HEIGHT (inches)	WEIGHT (pounds)	SITUPS (number)	SHUTTLE RUN (seconds)	PULLUPS (number)	STANDING BROAD JUMP (inches)	VERTICAL JUMP (inches)
(A)								
mean	154.17	59.57	100.85	69.39	11.08	2.34	62.16	13.17
S.D.	7.16	2.89	25.48	29.33	1.10	3.01	9.78	3.17
N	118	117	117	116	115	110	115	116
(B)								
mean	156.62	60.82	102.89	74.39	10.62	2.57	66.19	13.90
S.D.	6.66	2.96	20.04	26.80	0.89	2.82	8.85	2.71
N	208	208	207	209	204	198	206	205
(C)								
mean	161.20	63.42	114.70	77.45	10.26	3.26	72.16	16.03
S.D.	6.90	2.72	20.22	25.73	0.73	3.07	9.11	3.18
N	206	204	203	204	192	199	196	200
(D)								
mean	165.21	65.55	126.95	79.11	9.95	4.59	76.02	17.19
S.D.	7.71	2.88	19.18	25.68	0.78	3.71	10.15	3.40
N	132	131	131	128	128	131	121	129
(E)								
mean	172.09	68.18	141.27	94.54	9.76	6.73	81.27	18.64
S.D.	6.95	3.23	24.31	14.77	0.88	2.05	10.00	2.84
N	11	11	11	11	11	11	11	11
F-STAT.	62.64	101.41	40.44	3.89	31.94	9.85	47.03	42.19

(F-STAT. must be equal to or greater than 2.37 to show significant differences between subcategories at the .05 level)

Table V
Means, standard deviations and sample sizes presented in concise form for each subcategory of the classification system of Pubic Hair for the eight dependent variables of this investigation.

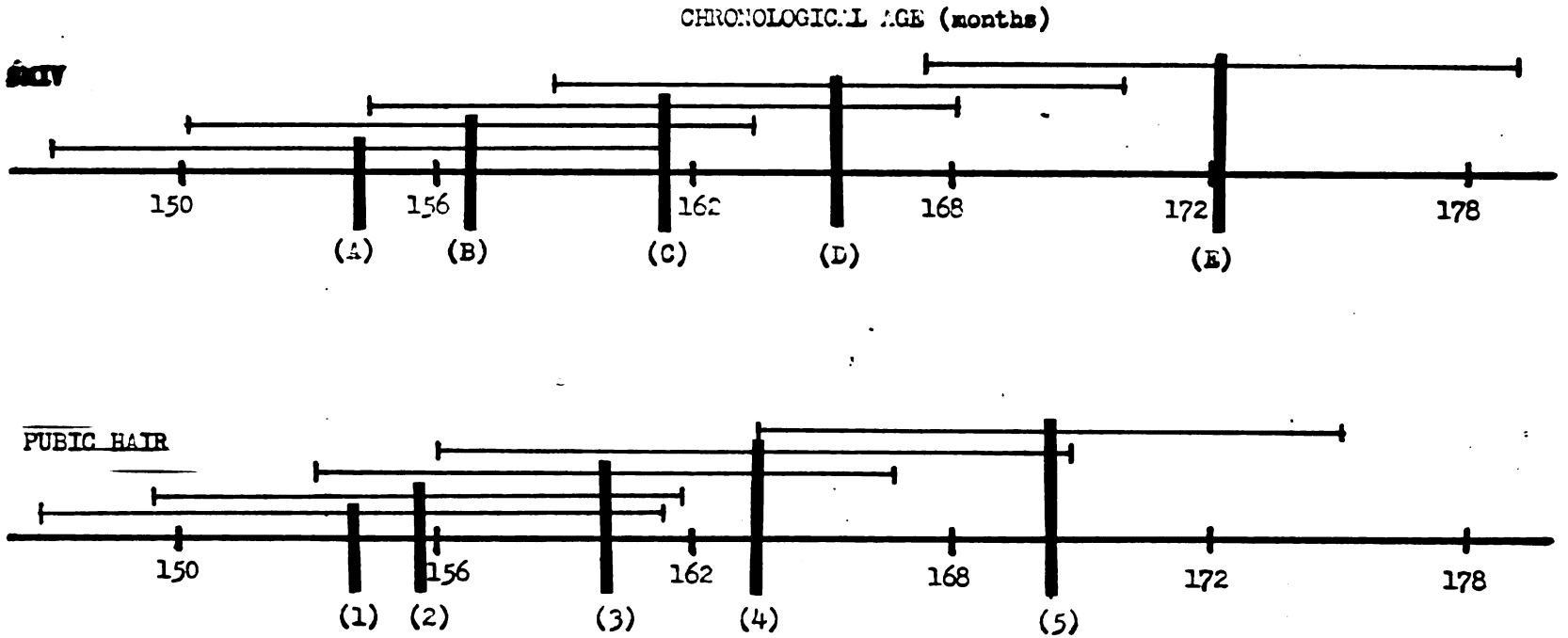
Pubic Hair	CHRONO-LOGICAL AGE (months)	HEIGHT (inches)	WEIGHT (pounds)	SITUPS (number)	SHUTTLE RUN (seconds)	PULLUPS (number)	STANDING BROAD JUMP (inches)	VERTICAL JUMP (inches)
(1)								
mean	154.07	59.52	99.12	69.14	11.16	2.45	62.32	13.02
S.D.	7.30	2.86	24.77	29.48	1.15	3.10	10.37	3.17
N	106	105	105	104	103	100	103	105
(2)								
mean	155.61	60.38	101.63	73.85	10.69	2.52	65.09	13.65
S.D.	6.15	3.01	21.55	27.39	0.86	2.81	8.05	2.44
N	150	150	149	151	147	148	148	145
(3)								
mean	159.92	62.70	110.18	75.68	10.39	2.65	69.74	15.21
S.D.	6.76	2.93	18.73	25.81	0.81	2.59	9.53	3.25
N	165	164	164	165	155	158	160	163
(4)								
mean	163.45	64.54	122.40	78.87	10.06	4.26	74.50	16.78
S.D.	7.34	3.01	20.70	25.70	0.73	3.59	9.80	3.30
N	239	237	236	233	230	225	223	223
(5)								
mean	170.27	67.12	137.27	90.27	9.80	6.40	79.67	18.13
S.D.	6.80	3.31	21.85	18.20	1.00	1.88	10.15	3.11
N	15	15	15	15	15	15	15	15
F-STAT.	56.65	82.42	38.47	3.71	34.32	7.87	42.73	40.65

(F-STAT. must be equal to or greater than 2.37 to show significant differences between subcategories at the .05 level)

Table VI
Means, standard deviations and sample sizes presented in concise form for each subcategory of the classification sustem of Chronological Age for the eight dependent variables of this investigation.

CHRONOLOGICAL AGE	HEIGHT (inches)	WEIGHT (pounds)	SITUPS (number)	SHUTTLE RUN (seconds)	PULLUPS (number)	STANDING BROAD JUMP (inches)	VERTICAL JUMP (inches)
(11.0)							
mean	58.00	90.00	45.00	10.90	2.00	63.00	11.00
S.D.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	1	1	1	1	1	1	1
(12.0)							
mean	60.20	101.69	70.14	10.89	2.45	62.62	13.04
S.D.	3.12	23.00	28.68	0.98	2.89	9.02	2.97
N	98	98	98	94	95	93	96
(13.0)							
mean	62.00	109.26	73.62	10.60	2.75	67.63	14.65
S.D.	3.47	23.46	27.53	0.97	2.70	10.12	3.28
N	335	333	330	325	323	324	331
(14.0)							
mean	63.93	118.26	80.73	10.08	4.02	74.25	16.69
S.D.	3.28	21.18	24.57	0.74	3.45	9.56	3.22
N	215	215	214	205	202	207	208
(15.0)							
mean	64.51	122.73	82.77	9.82	3.62	77.36	17.27
S.D.	4.63	23.77	21.51	0.61	4.92	9.65	2.90
N	22	22	22	22	22	22	22
F-STAT.	24.86	11.73	3.41	15.74	7.38	24.39	21.79

(F-STAT. must be equal to or greater than 2.37 to show significant differences between subcategories at the .05 level)



CHRONOLOGICAL AGE as the independent variable compared with chronological age as a dependent variable offers no useful information.

Figure 1 - Graphic illustration of the summary data contained in Tables IV, V and VI for the dependent variable chronological age as compared with independent variables SMIV, Pubic Hair and Chronological Age, respectively.

Figure 2, a comparison of the summary statistics for the dependent variable height according to the classifications of SMIV, Pubic Hair and Chronological Age, indicates that SMIV has the larger range and a smaller overlap between the standard deviation when compared to Chronological Age subcategories. However, the overlap in standard deviations of SMIV and Pubic Hair are very similar.

A comparison between the subcategories of weight for classifications according to SMIV, Pubic Hair and Chronological Age (see Figure 3) indicates a slightly larger range for the SMIV classification system, but no appreciable advantage for any classification system in the amount of standard deviation between subgroup categories.

Figure 4, a comparison of the dependent variable situps, provides no meaningful differences in the size of the range or in the amount of overlap between standard deviations of the classification systems.

Subcategory comparisons of shuttle run, classified according to SMIV, Pubic Hair and Chronological Age (see Figure 5) indicate a slightly larger range for the SMIV classification system but no system appears to have an advantage regarding degree of overlap in the size of the standard deviation.

Figure 6, a comparison of the dependent variable pullups according to SMIV, Pubic Hair and Chronological Age classifications, illustrates that the SMIV classification system has a larger range but no superiority in standard deviation overlap is evident. Similar results were detected for dependent variables standing broad jump (Figure 7) and vertical jump (Figure 8).

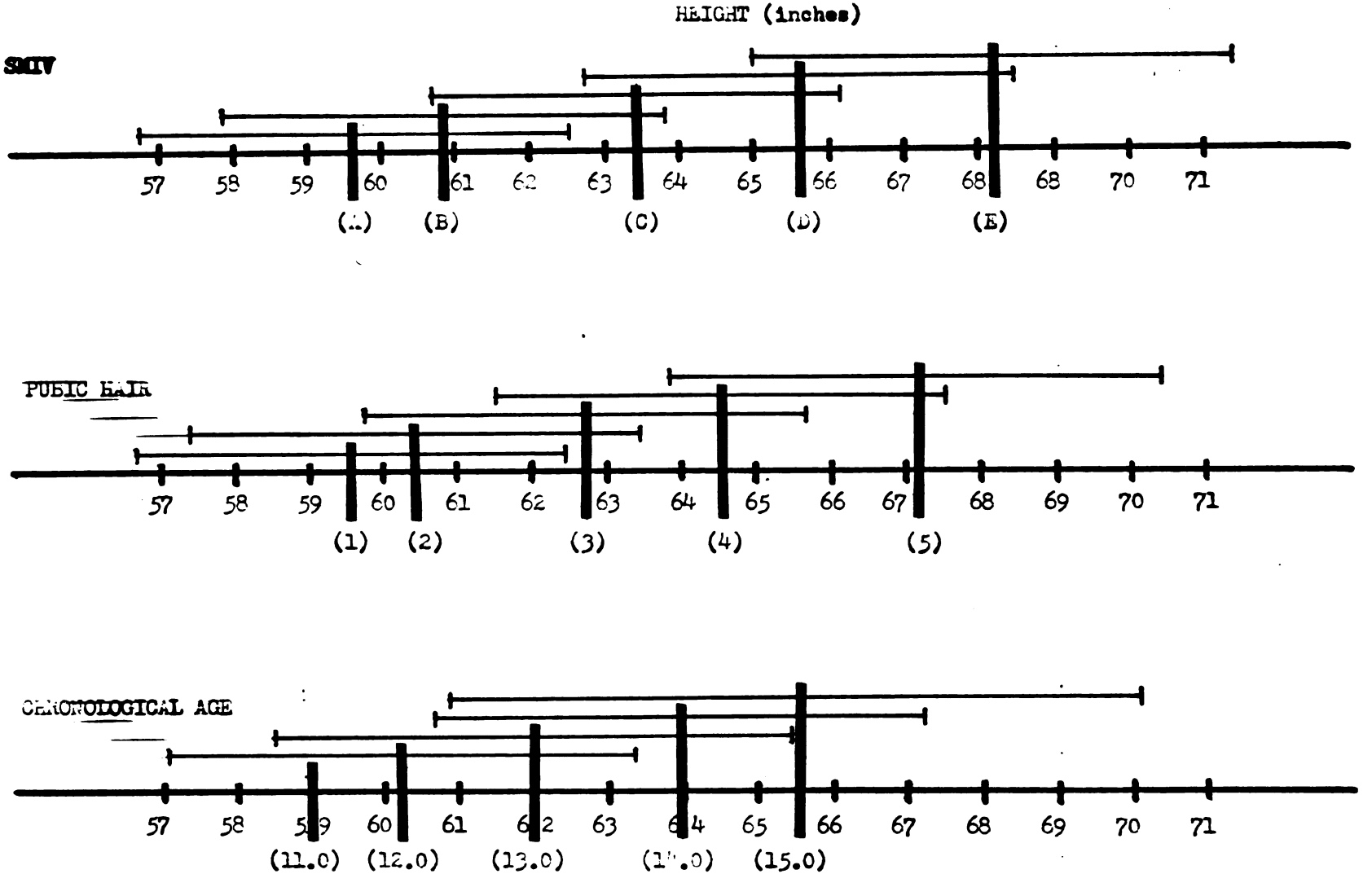


Figure 2 - Graphic illustration of the summary data contained in Tables IV,V and VI for the dependent variable height as compared with independent variables SMIV, Pubic Hair and Chronological Age, respectively.

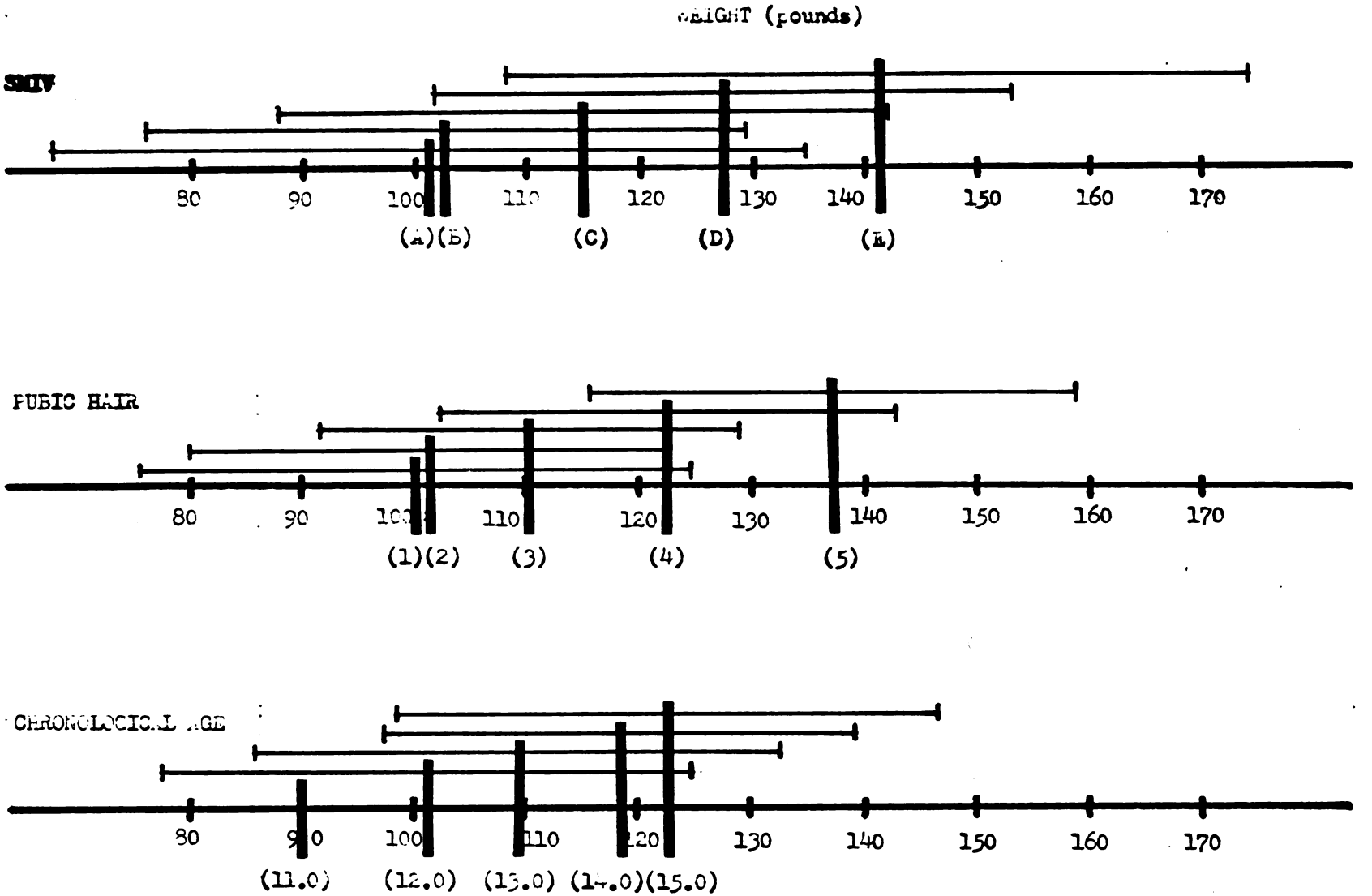


Figure 3 - Graphic illustration of the summary data contained in Tables IV, V and VI for the dependent variable weight as compared with independent variables SMIV, Pubic Hair and Chronological Age, respectively.

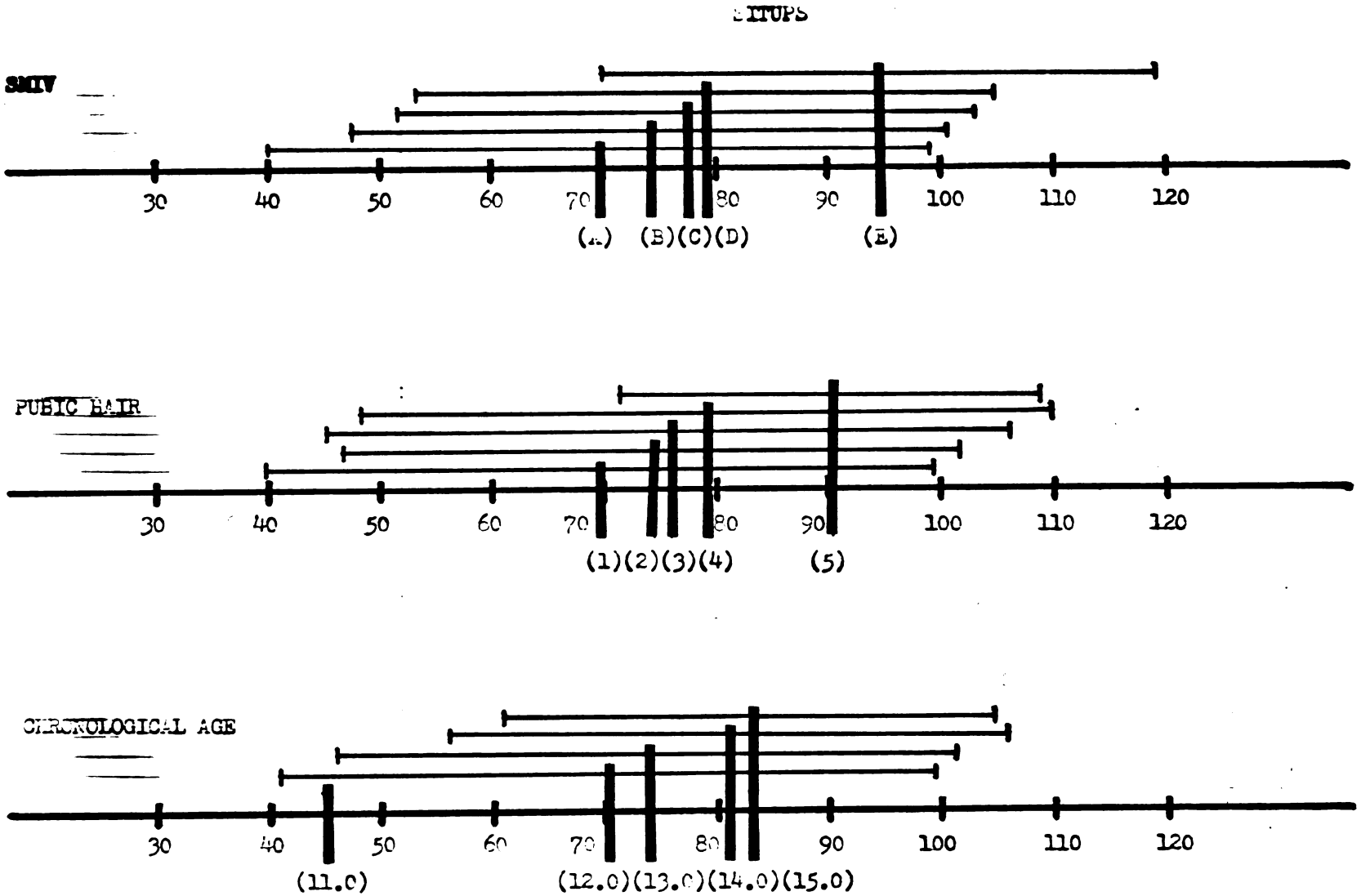


Figure 4 - Graphic illustration of the summary data contained in Tables IV,V and VI for the dependent variable situps as compared with independent variables SMIV, Pubic Hair and Chronological Age, respectively.

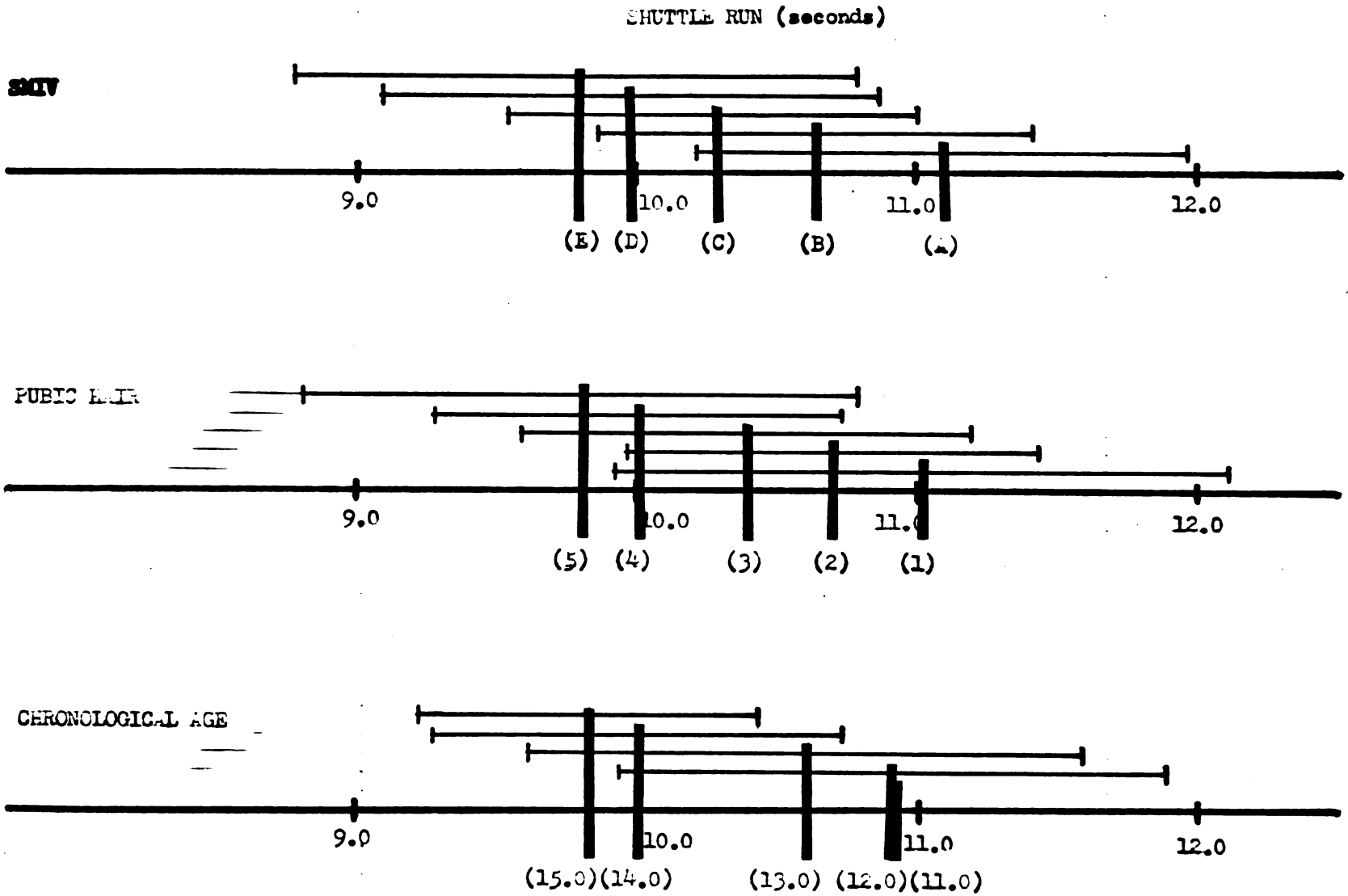


Figure 5 - Graphic illustration of the summary data contained in Tables IV, V and VI for the dependent variable shuttle run as compared with independent variables SMIV, Pubic Hair and Chronological Age, respectively.

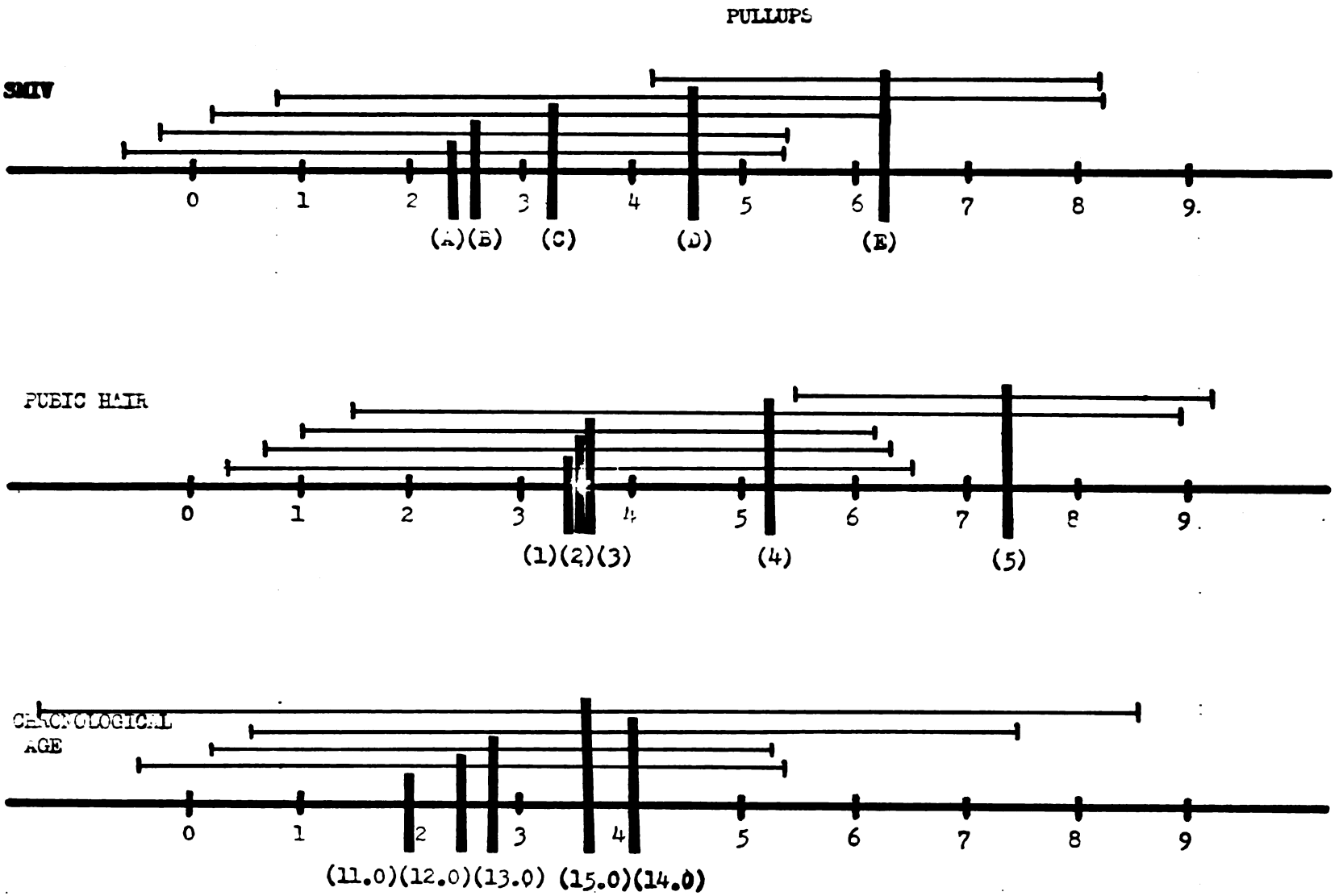


Figure 6 - Graphic illustration of the summary data contained in Tables IV, V and VI for the dependent variable pullups as compared with independent variables SMIV, Pubic Hair and Chronological Age, respectively.

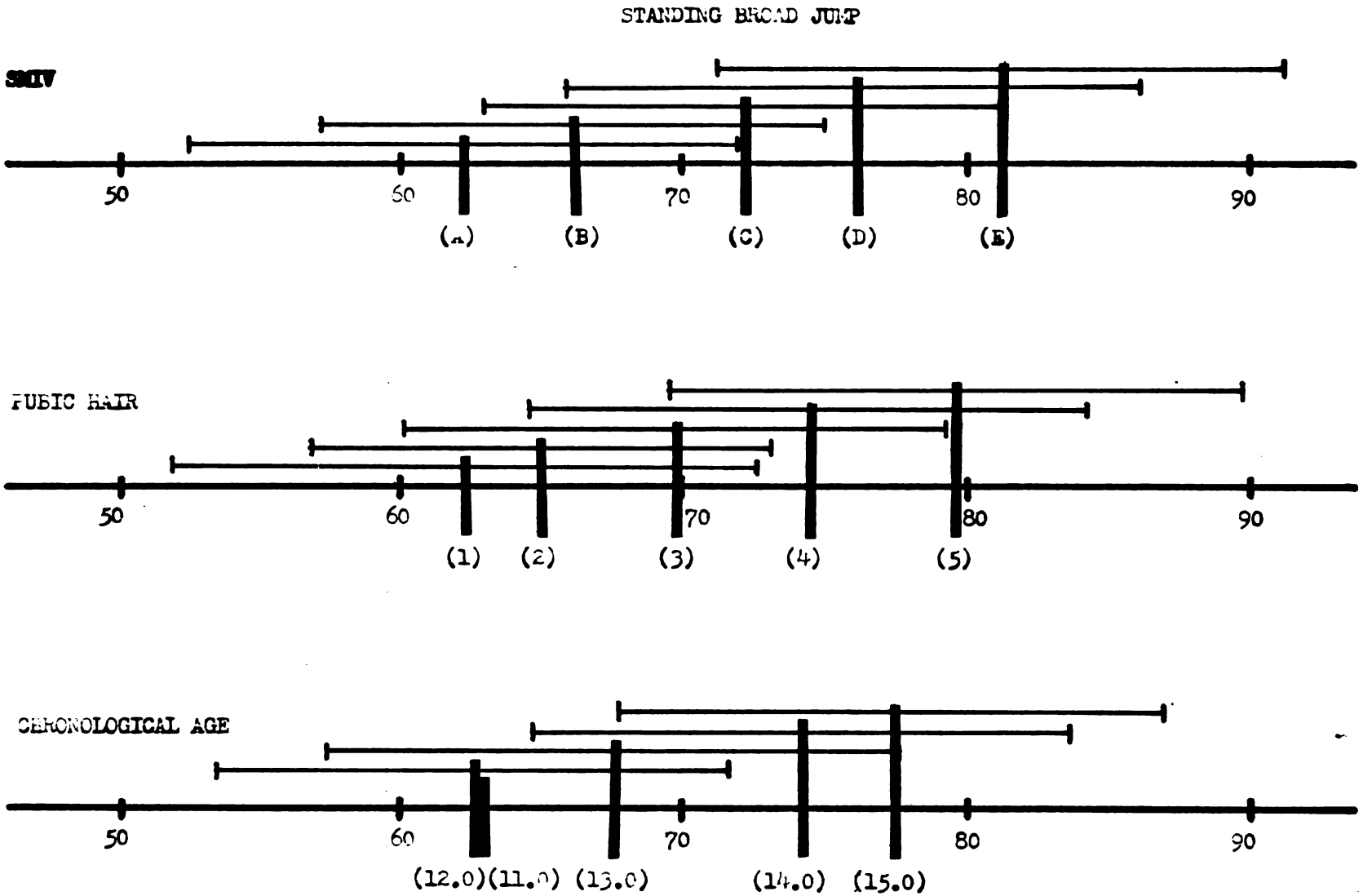


Figure 7 - Graphic illustration of the summary data contained in Tables IV, V and VI for the dependent variable standing broad jump as compared with independent variables SMIV, Pubic Hair and Chronological Age, respectively.

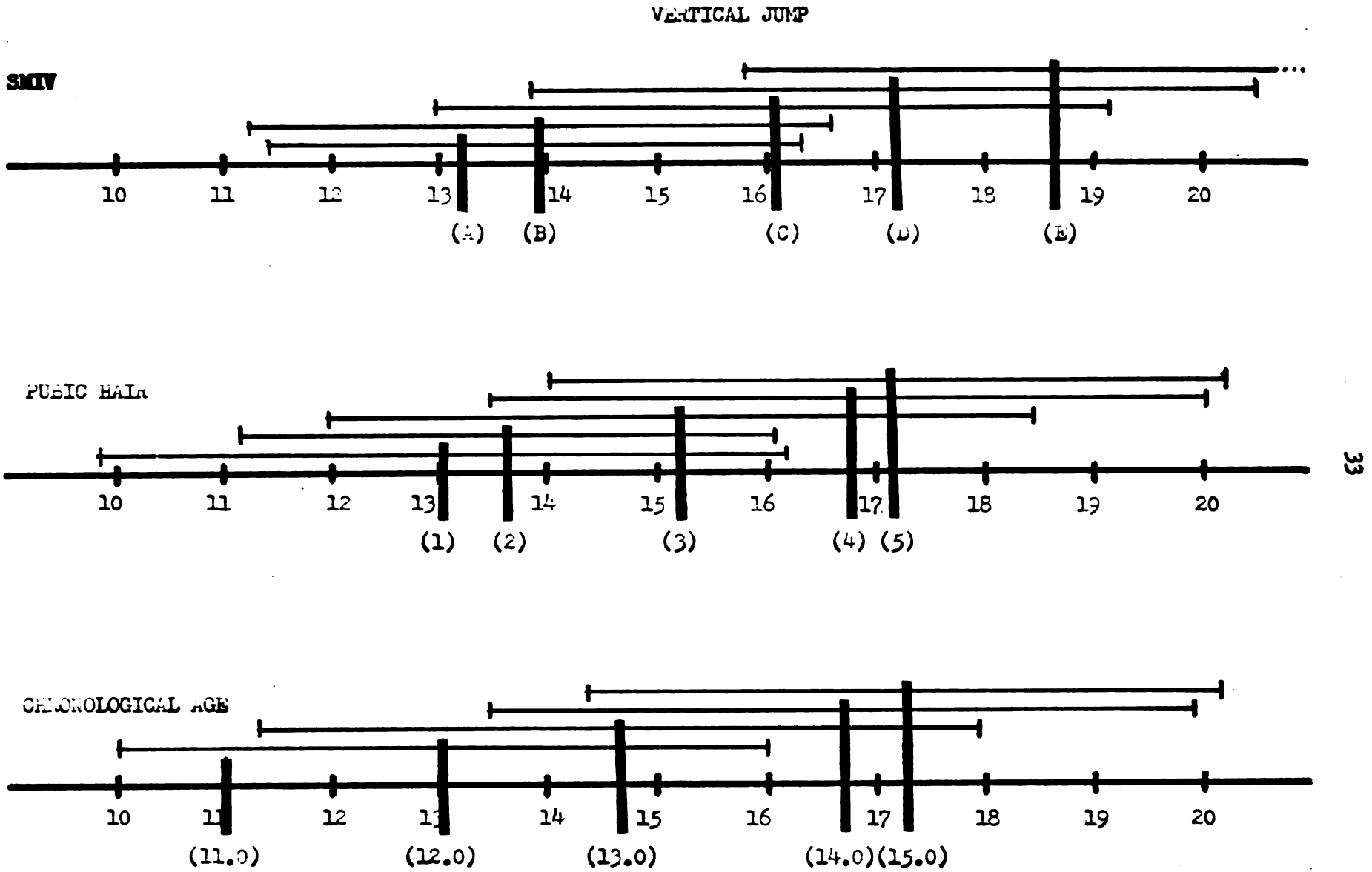


Figure 8 - Graphic illustration of the summary data contained in Tables IV, V and VI for the dependent variable vertical jump as compared with independent variables SMIV, Pubic Hair and Chronological Age, respectively.

On the basis of comparisons between classification systems regarding the total range within a dependent variable, the SMIV system appears more discriminatory. When comparing the size of standard deviations with subcategories of a dependent variable with those of another classification system it appears that no one classification system has an advantage over the others.

Tables VII-XIV show the mean values of the eight dependent variables, taken independently as classified by the systems of SMIV, Pubic Hair and Chronological Age, tested for significant differences within subcategories by the Scheffe test for multiple comparisons.[1] The classification system of Chronological Age has only one subject in the subcategory of (1.0). Although this subcategory was included for the sake of similarity between tables a discussion of results is meaningless.

Table VII, a comparison of between subcategory differences for the dependent variable Chronological Age, shows no significant differences between subcategories (1) and (2) of Pubic Hair while all other comparisons between subcategories are significantly different. Significant differences between all subcategories were detected in the classification system SMIV.

Table VIII, showing between-subcategory comparisons for the dependent variable height, indicates that classification systems of SMIV, Pubic Hair and Chronological Age are equal in significant differences between means.

Table IX (dependent variable weight) shows that a greater number of between-subcategory differences were detected in the SMIV

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[1] Hays, William, Statistics for Psychologists, Holt, Rinehart and Winston, Chicago, 1963.

Table VII - CHRONOLOGICAL AGE

Mean values of the dependent variable chronological age, classified by the systems SMIV, Pubic Hair and Chronological Age, tested for significant differences between subcategories by the Scheffe test for multiple comparisons.

SMIV		B	C	D	E
	MEAN	156.62	161.20	165.21	172.09
SAMPLE	118	208	206	132	11
A	154.17	(2.43) 2.45*	(2.43) 7.03*	(2.68) 11.04*	(6.65) 17.92*
B	156.62		(2.06) 4.58*	(2.34) 8.59*	(6.53) 15.47*
C	161.20			(2.34) 4.01*	(6.53) 10.89*
D	165.21				(6.62) 6.88*

* indicates significant differences between subcategories at the .05 level

Pubic Hair		2	3	4	5
	MEAN	155.61	159.92	163.45	170.27
SAMPLE	106	150	165	239	15
1	154.07	(2.68) 1.54	(2.65) 5.85*	(2.49) 9.38*	(5.88) 16.20*
2	155.61		(2.40) 4.31*	(2.21) 7.84*	(5.79) 14.66*
3	159.92			(2.16) 3.53*	(5.76) 10.35*
4	163.45				(5.70) 6.82*

* indicates significant differences between subcategories at the .05 level

Chronological Age as the independent variable compared with chronological age as the dependent variable offers no useful information.

Table VIII - HEIGHT (inches)
Mean values of the dependent variable height, classified by the systems SMIV, Pubic Hair and Chronological Age, tested for significant differences between subcategories by the Scheffe test for multiple comparisons.

SMIV		B	C	D	E
	MEAN	60.81	63.41	65.54	68.18
SAMPLE	117	208	204	131	11
A	59.57	(0.99) 1.24*	(0.99) 3.84*	(1.91) 5.97*	(2.77) 8.61*
B	60.81		(0.86) 2.60*	(3.08) 4.73*	(2.77) 7.37*
C	63.41			(0.98) 2.13*	(1.23) 4.77*
D	65.54				(2.77) 2.64

*indicates significant differences between subcategories at the .05 level

Pubic Hair		2	3	4	5
	MEAN	60.38	62.70	64.54	67.12
SAMPLE	105	150	164	237	15
1	59.52	(1.14) 0.86	(1.14) 3.18*	(1.08) 5.02*	(2.52) 7.60*
2	60.38		(1.02) 2.32*	(0.98) 4.16*	(2.49) 6.74*
3	62.70			(0.92) 1.84*	(2.46) 4.42*
4	64.54				(2.43) 2.58*

* indicates significant differences between subcategories at the .05 level

Chronological Age		12.0	13.0	14.0	15.0
	MEAN	60.20	62.00	63.95	64.51
SAMPLE	1	98	335	215	22
11.0	58.00	(10.50) 2.20	(10.47) 4.00	(10.44) 5.95	(10.69) 6.51
12.0	60.20		(1.20) 1.80*	(1.26) 3.75*	(2.46) 4.31*
13.0	62.00			(0.92) 1.95*	(2.31) 2.51*
14.0	63.95				(2.34) 0.56

* indicates significant differences between subcategories at the .05 level

and Pubic Hair classification systems than by the classification system according to Chronological Age. For example, weight subcategory differences were detected in all groups of SMIV and Pubic Hair classifications except A and B and D and E, and 1 and 2 and 4 and 5, respectively. However, in Chronological Age only the subcategories of 12.0 and 14.0, 12.0 and 15.0 and 13.0 and 14.0 showed significant differences.

Subgroup differences in situps (see Table X) were not detectable at the .05 level in any of the classification systems. This is believed to be due to the conservative nature of the Scheffe test. Comparisons between subgroups at the .10 level resulted in significant differences in SMIV, Pubic Hair and Chronological Age, respectively, between A and D, A and E, 1 and 4, and 12.0 and 14.0.

Table XI, shuttle run, provides no apparent superiority in any classification system as determined by the number of significant differences found between subcategories.

Similar results were detected when subcategory differences were determined for the dependent variable pullups, based on classifications according to SMIV, Pubic Hair and Chronological Age (see Table XII). Between subcategory comparisons for SMIV and Pubic Hair classifications resulted in significant differences between identical subcategories (SMIV = A and D, A and E, B and D, B and E, C and D and C and E; Pubic Hair = 1 and 4, 1 and 5, 2 and 4, 2 and 5, 3 and 4 and 3 and 5). According to classification by Chronological Age, significant differences were detected only between ages 12.0 and 14.0 and 13.0 and 14.0.

Table IX - WEIGHT (pounds)

Mean values of the dependent variable weight, classified by the systems SMIV, Pubic Hair and Chronological Age, tested for significant differences between subcategories by the Scheffe test for multiple comparisons.

SMIV		B	C	D	E
	MEAN	102.89	114.70	126.95	141.27
SAMPLE	117	207	203	131	11
A	100.85	(7.48) 2.04	(7.48) 13.95*	(8.25) 26.10*	(20.45) 40.42*
B	102.89		(6.41) 11.81*	(7.24) 25.06*	(19.56) 38.38*
C	114.70			(7.27) 12.25*	(20.08) 26.57*
D	126.95				(20.36) 14.32

* indicates significant differences between subcategories at the .05 level

Pubic Hair		2	3	4	5
	MEAN	101.63	110.18	122.40	137.27
SAMPLE	105	149	164	236	15
1	99.12	(8.32) 2.51	(8.13) 11.06*	(7.64) 23.28*	(17.99) 38.15*
2	101.63		(7.36) 8.55*	(6.81) 20.77*	(17.65) 35.64*
3	110.18			(6.62) 12.22*	(17.59) 27.09*
4	122.40				(20.51) 14.87

* indicates significant differences between subcategories at the .05 level

Chronological Age		12.0	13.0	14.0	15.0
	MEAN	101.69	109.26	118.26	122.73
SAMPLE	1	98	333	215	22
11.0	90.00	(70.53) 11.69	(70.22) 19.26	(70.22) 28.26	(71.76) 32.73
12.0	101.69		(8.04) 7.57	(7.05) 16.57*	(16.48) 21.04*
13.0	109.26			(6.10) 9.00*	(18.54) 13.47
14.0	118.26				(15.65) 4.47

* indicates significant differences between subcategories at the .05 level

Table X - SITUPS
Mean values of the dependent variable situps, classified by the systems SMIV, Pubic Hair and Chronological Age, tested for significant differences between subcategories by the Scheffe test for multiple comparisons.

SMIV		B	C	D	E
	MEAN	74.39	77.45	79.11	94.54
SAMPLE	116	209	204	128	11
A	69.39	(9.61) 5.00	(9.52) 8.06	(10.52) * 9.72	(25.84) * 25.15
B	74.39		(8.07) 3.06	(9.18) 4.72	(24.41) 20.15
C	77.45			(9.18) 1.66	(24.35) 17.09
D	79.11				(19.56) 15.43

*** indicates significant differences between subcategories at the .10 level**

Pubic Hair		2	3	4	5
	MEAN	73.85	75.68	78.87	90.27
SAMPLE	104	151	165	233	15
1	69.14	(10.44) 4.71	(10.44) 6.54	(9.67)* 9.73**	(22.64) * 21.13
2	73.85		(9.21) 1.83	(8.56) 5.02	(22.18) 16.42
3	75.68			(8.35) 3.19	(22.18) 14.42
4	78.87				(21.84) 11.40

*** and ** indicate significant differences between subcategories at the .10 and .05 level, respective**

Chronological Age		12.0	13.0	14.0	15.0
	MEAN	70.14	73.62	80.73	82.77
SAMPLE	1	98	330	214	22
11.0	45.00	(82.50) 25.14	(82.24) 28.62	(82.24) 35.73	(83.78) 37.77
12.0	70.14		(9.42) 3.48	(9.98) * 10.59**	(19.31) 12.63
13.0	73.62			(7.18) * 7.11	(18,02) 9.15
14.0	80.73				(18.33) 2.04

*** and ** indicate significant differences between subcategories at the .10 and .05 level, respectively**

Table XI - SHUTTLE RUN (seconds)
Mean values of the dependent variable shuttle run, classified by the systems SMIV, Pubic Hair and Chronological Age, tested for significant differences between subcategories by the Scheffe test - for multiple comparisons.

SMIV		B	C	D	E
	MEAN	10.62	10.26	9.95	9.76
SAMPLE	115	204	192	128	11
A	11.08	(0.31) -0.46*	(0.31) -0.82*	(0.31) -1.13*	(0.80) -1.32*
B	10.62		(0.27) -0.36*	(0.28) -0.67*	(0.80) -0.86*
C	10.26			(0.31) -0.31*	(0.80) -0.50
D	9.95				(0.80) -0.19

*** indicates significant differences between subcategories at the .05 level**

Pubic Hair		2	3	4	5
	MEAN	10.69	10.39	10.06	9.80
SAMPLE	103	147	155	230	15
1	11.16	(0.31) -0.47*	(0.31) -0.77*	(0.31) -1.10*	(0.74) -1.36*
2	10.69		(0.31) -0.30	(0.31) -0.63*	(0.68) -0.89*
3	10.39			(0.31) -0.33*	(0.68) -0.59
4	10.06				(0,68) -0.26

*** indicates significant differences between subcategories at the .05 level**

Chronological Age		12.0	13.0	14.0	15.0
	MEAN	10.89	10.60	10.08	9.82
SAMPLE	1	94	325	205	22
11.0	10.90	(2.77) -0.01	(2.74) -0.30	(2.74) -0.82	(2.83) -1.08
12.0	10.89		(0.31) -0.29	(0.31) -0.81*	(0.62) -1.07*
13.0	10.60			(0.31) -0.52*	(0.62) -0.78*
14.0	10.08				(0.62) -0.26

*** indicates signifcant differences between subcategories at the .05 level**

Table XII - PULLUPS
Mean values of the dependent variable pullups, classified by the systems SMIV, Pubic Hair and Chronological Age, tested for significant differences between subcategories by the Scheffe test for multiple comparisons.

SMIV		B	C	D	E
	MEAN	2.57	3.26	4.59	6.72
SAMPLE	110	198	199	131	11
A	2.34	(1.08) 0.23	(1.08) 0.92	(1.14) 2.25*	(2.86) 4.48*
B	2.57		(0.92) 0.69	(1.02) 2.02*	(2.77) 4.15*
C	3.26			(1.02) 1.33*	(2.83) 3.46*
D	4.59				(2.83) 2.13

* indicates significant differences between subcategories at the .05 level

Pubic Hair		2	3	4	5
	MEAN	2.52	2.65	4.26	6.40
SAMPLE	100	148	158	225	15
1	2.45	(1.20) 0.07	(1.14) 0.20	(1.11) 1.81*	(2.52) 3.95*
2	2.52		(1.02) 0.13	(0.98) 1.74*	(2.46) 3.88*
3	2.65			(0.92) 1.61*	(2.46) 3.75*
4	4.26				(2.43) 2.14

*** indicates significant differences between subcategories at the .05 level**

Chronological Age		12.0	13.0	14.0	15.0
	MEAN	2.45	2.75	4.02	3.62
SAMPLE	1	95	323	202	22
11.0	2.00	(9.12) 0.45	(9.09) 9.75	(9.09) 2.02	(9.27) 1.62
12.0	2.45		(1.08) 0.30	(1.11) 1.57*	(2.12) 1.17
13.0	2.75			(0.80) 1.27*	(2.00) 0.87
14.0	4.02				(2.03) -0.40

* indicates significant differences between subcategories at the .05 level

Table XIII (standing broad jump as the dependent variable) indicates that classification according to SMIV, Pubic Hair and Chronological Age classification systems discriminate equally well between subcategories; namely, differences were detected at every meaningful subcategory comparison for all classifications.

Table XIV (vertical jump) shows that Pubic Hair and Chronological Age classification systems result in one more significant subcategory difference than the SMIV classification system. This discrepancy between classification systems occured when the Scheffe test failed to detect significant differences between C and E subcategories of SMIV.

From the comparisons of the significant differences between subcategory means for the classification systems of SMIV, Pubic Hair and Chronological Age as tested by the Scheffe test for multiple comparisons, it is not possible to recommend any one system as superior to the other two. However, it may be stated that classifications according to SMIV and Pubic Hair generally resulted in a greater number of subcategory differences than a similar classification according to Chronological Age.

Tables XVa. and XVb. show the mean values of the eight dependent variables classified according to SMIV, as tested for significant differences within subcategories by the Scheffe test for multiple comparisons. These values provide the basis upon which the associations between SMIV subcategories and the dependent variables of chronological age, height, weight, situps, shuttle run, pullups, standing broad jump and vertical jump were studied. As demonstrated in Tables IV, V and VI (summary data) the application of one-way

Table XIII - STANDING BROAD JUMP

Mean values of the dependent variable standing broad jump, classified by the systems SMIV, Pubic Hair and Chronological Age, tested for significant differences between subcategories by the Scheffe test for multiple comparisons.

SMIV		B	C	D	E
	MEAN	66.19	72.16	76.02	81.27
SAMPLE	115	206	196	121	11
A	62.16	(3.39) 4.03*	(3.39) 10.00*	(3.76) 13.86*	(9.12) 19.11*
B	66.19		(2.86) 5.97*	(3.29) 9.83*	(10.78) 15.08*
C	72.16			(3.39) 3.86*	(8.93) 9.11*
D	76,02				(9,09) 5.25

*** indicates significant differences between subcategories at the .05 level**

Pubic Hair		2	3	4	5
	MEAN	65.09	69.74	74.50	79.67
SAMPLE	103	148	160	223	15
1	62.32	(3.73) 4.77*	(3.66) 7.42*	(3.48) 12.18*	(8.04) 17.45*
2	65.09		(3.33) 4.65*	(3.08) 9.41*	(7.88) 14.58*
3	69.74			(3.02) 4.76*	(7.85) 9.93*
4	74.50				(7.76) 5.17

*** indicates significant differences between subcategories at the .05 level**

Chronological Age		12.0	13.0	14.0	15.0
	MEAN	62.62	67.63	74.25	77.36
SAMPLE	1	93	324	207	22
11.0	63.00	(30.28) -0.38	(30.15) 4.63	(30.18) 11.25	(30.77) 14.36
12.0	62.62		(3.54) 5.01*	(3.76) 11.63*	(7.14) 14.74*
13.0	67.63			(2.68) 6.62*	(6.62) 9.73*
14.0	74.25				(6.74) 3.11

*** indicates significant differences between subcategories at the .05 level**

Table XIV - VERTICAL JUMP
Mean values of the dependent variable vertical jump, classified by the systems SMIV, Pubic Hair and Chronological Age, tested for significant differences between subcategories by the Scheffe test for multiple comparisons.

SMIV		B	C	D	E
	MEAN	13.90	16.03	17.19	18.64
SAMPLE	116	205	200	129	11
A	13.17	(0.91) 0.73	(1.14) 2.86*	(1.23) 4.02*	(2.99) 5.47*
B	13.90		(0.92) 2.13*	(1.08) 3.29*	(2.92) 4.74*
C	16.03			(1.08) 1.16*	(2.92) 2.61
D	17.19				(2.99) 1.45

* indicates significant differences between subcategories at the .05 level

Pubic Hair		2	3	4	5
	MEAN	13.65	15.21	16.78	18.13
SAMPLE	105	145	163	223	15
1	13.02	(1.23) 0.63	(1.20) 2.18*	(1.11) 3.76*	(2.67) 5.11*
2	13.65		(1.08) 1.65*	(1.02) 3.13*	(2.59) 4.48*
3	15.21			(0.98) 1.57*	(2.59) 2.92*
4	16.78				(2.52) 1.35

* indicates significant differences between subcategories at the .05 level

Chronological Age		12.0	13.0	14.0	15.0
	MEAN	13.04	14.65	16.69	17.27
SAMPLE	1	96	331	208	22
11.0	11.0	(9.95) 2.04	(9.89) 3.65	(9.89) 5.69	(10.10) 6.27
12.0	13.04		(1.14) 1.61*	(1.23) 3.65*	(2.31) 4.23*
13.0	14.65			(0.86) 2.04*	(2.19) 2.65*
14.0	16.69				(2.19) 0.58*

* indicates significant differences between subcategories at the .05 level

variance analysis for determination of differences between subcategories within the SMIV classification system resulted in significant differences between these subcategories for each dependent variable. Results of the Scheffe test of multiple comparisons were as follows:

Chronological Age - significant differences were detected at every comparison between SMIV subcategories.

Height - significant mean differences were detected between all pairs with the exception of D and E, indicating that growth in height increases significantly throughout the scale with the possible exception of from D to E. However, the small sample size of E (11) makes this a questionable comparison.

Weight - all comparisons except those between A and B and between D and E were significantly different, indicating that between the subcategories of B to C and C to D the boys gain a significant amount of weight.

Situps - no significant differences were detected between any comparisons at the .05 level of significance. However, because the Scheffe test is conservative,[1] placing the significance level at .10 demonstrated significant differences between SMIV subcategories of A and D and A and E.

Shuttle run - significant differences were detected in all but three comparisons; namely C and D, C and E, and D and E. This finding indicates that development in agility did not increase significantly

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[1] Edwards, Allen L., Experimental Design in Psychological Research. p.154, Holt, Rinehart and Winston, New York, 1960.

Table XVa
Mean values of four dependent variables classified according to SMIV, tested for significant differences within subcategories by the Scheffe test for multiple comparisons.

CHRONOLOGICAL AGE (months)

		B	C	D	E
	MEAN	156.62	161.20	165.21	172.09
SAMPLE	118.	208	206	132	11
A	154.17	(2.43)2.45*	(2.43)7.03*	(2.68)11.04*	(6.65)17.92*
B	156.62		(2.06)4.58*	(2.34) 8.59*	(6.53)15.47*
C	161.20			(2.34) 4.01*	(6.53)10.89*
D	165.21				(6.62) 6.88*

HEIGHT (inches)

		B	C	D	E
	MEAN	60.81	63.41	65.54	68.18
SAMPLE	117	208	204	131	11
A	59.57	(0.99)1.24*	(0.99)3.84*	(1.91)5.97*	(2.77)8.61*
B	60.81		(0.86)2.60*	(0.98)4.73*	(2.77)7.37*
C	63.41			(0.98)2.13*	(2.71)4.77*
D	65.54				(2.77)2.64

WEIGHT (pounds)

		B	C	D	E
	MEAN	102.89	114.70	126.95	141.27
SAMPLE	117	207	203	131	11
A	100.85	(7.48)2.04	(7.48)13.95*	(8.25)26.10*	(20.45)40.42*
B	102.89		(6.41)11.81*	(7.24)24.06*	(19.56)38.38*
C	114.70			(7.27)12.25*	(20.08)26.57*
D	126.95				(20.36)14.32

SITUPS

		B	C	D	E
	MEAN	74.39	77.45	79.11	94.54
SAMPLE	116	209	204	128	11
A	69.39	(9.61)5.00	(9.52)8.06	(10.52)9.72	(25.84)25.15
B	74.39		(8.07)3.06	(9.18) 4.72	(26.18)20.15
C	77.45			(9.18) 1.66	(25.34)17.09
D	79.11				(19.56)15.43

* indicates significant differences between subcategories at the .05 level

once the SMIV subcategory of C was reached. This is a possible result of the center of gravity stabilization at this point in development, thus enabling better control in stop-and-go movements.

Pullups - significant differences were detected only between subcategories C and D indicating that strength in the upper body does not significantly increase until subcategory C of SMIV. The sample size (11) of E prohibits discussion of increase in strength from D to E.

Standing broad jump - significant differences were found between all comparisons except D and E indicating that leg power does increase significantly throughout most of the SMIV scale. Because execution of the standing broad jump requires agility as well as leg power, it is not surprising that the results of shuttle run agree with those of the standing broad jump.

Vertical jump - significant differences between comparisons in all but A and B, C and E and D and E were detected. In this respect the vertical jump differed from the standing broad jump. As mentioned earlier, it is believed that the additional component of agility in the standing broad jump resulted in significant differences in the earlier ages.

Since significant differences in chronological age were demonstrated at every comparison between SMIV subcategories, a logical extension of this investigation was undertaken. Height, weight, age and SMIV grids were developed using the information of the mean age for the SMIV groups combined with the height and age and weight and age Grids of Meredith.[1] Meredith's Grids provide a longitudinal

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[1]Copies may be secured through the order departments of the American Medical Association, 535 N. Dearborn St., Chicago, Illinois, 60610, or of the National Education Association, 1201 Sixteenth St., N.W., Washington, D.C. 20036

Table XVb
Mean values of four dependent variables classified according to SMIV, tested for significant differences within subcategories by the Scheffe test for multiple comparisons.

SHUTTLE RUN (seconds)		B	C	D	E
	MEAN	10.62	10.26	9.95	9.76
SAMPLE	115	204	192	128	11
A	11.08	(0.31)-0.46*	(0.31)-0.82*	(0.31)-1.13*	(0.80)-1.32*
B	10.62		(0.27)-0.36*	(0.28)-0.67*	(0.80)-0.86*
C	10.26			(0.32)-0.31	(0.83)-0.50
D	9.95				(0.83)-0.19

PULLUPS		B	C	D	E
	MEAN	2.57	3.26	4.59	6.72
SAMPLE	110	198	199	131	11
A	2.34	(1.08)0.23	(1.08)0.92	(1.14)2.25*	(2.86)4.48*
B	2.57		(0.92)0.69	(1.02)2.02*	(2.77)4.15*
C	3.26			(1.02)1.33*	(2.83)3.46*
D	4.59				(2.83)2.13

STANDING BROAD JUMP		B	C	D	E
	MEAN	66.19	72.16	76.02	81.27
SAMPLE	115	206	196	121	11
A	62.16	(3.39)4.03*	(3.39)10.00*	(3.76)13.86*	(9.12)19.11*
B	66.19		(2.86) 5.97*	(3.29) 9.83*	(10.78)15.08*
C	72.16			(3.39) 3.86*	(8.93) 9.11*
D	76.02				(9.09) 5.25

VERTICAL JUMP		B	C	D	E
	MEAN	13.90	16.03	17.19	18.64
SAMPLE	116	205	200	129	11
A	13.17	(0.91)0.73	(1.14)2.86*	(1.23)4.02*	(2.99)5.47*
B	13.90		(0.92)2.13*	(1.08)3.29*	(2.92)4.74*
C	16.03			(1.08)1.16*	(2.92)2.61
D	17.19				(2.99)1.45

* indicates significant differences between subcategories at the .05 level

record of physical growth of boys beginning at age four and terminating at age eighteen. There are five channels for height and weight, respectively. Channels for height are divided into tall, moderately tall, average, moderately short and short, respectively. Channels for weight include heavy, moderately heavy, average, moderately light and light. For the purposes of this study, the Meredith Grids were modified to include only the ages of 11.6 to 17.0 years. Each channel was divided into three equal sub-channels which were labeled #1, #2, #3 reading from top to bottom. The height and age grid has height on the ordinate and age in six month increments on the abscissa. A similar pattern is followed for the grid depicting weight and age. Meredith's Grids were utilized because in the author's opinion they represent the most complete and simply illustrated growth curves available on boys.

In order to clarify the function of the SMIV grids that were developed as a result of this investigation, the following sample is given. Suppose that two boys, Alpha and Beta have the following characteristics. Alpha is 14 years and 0 months old with a SMIV rating of 2.0 while Beta is 13 years and 0 months old with a SMIV rating of 4.0. Both are 58 inches tall and weigh 90 pounds. By comparing the height, weight and age grids of Meredith, which are the same as the ordinates and upper abscissa of the height, weight, age and SMIV grids, the following classifications result. (See Figures 9 and 10)

By entering the height, age and SMIV grid at the upper abscissa value of 14.0 years and moving downward to the height in inches of 58, Alpha's height and age subchannel is Short #1 designated by A_1

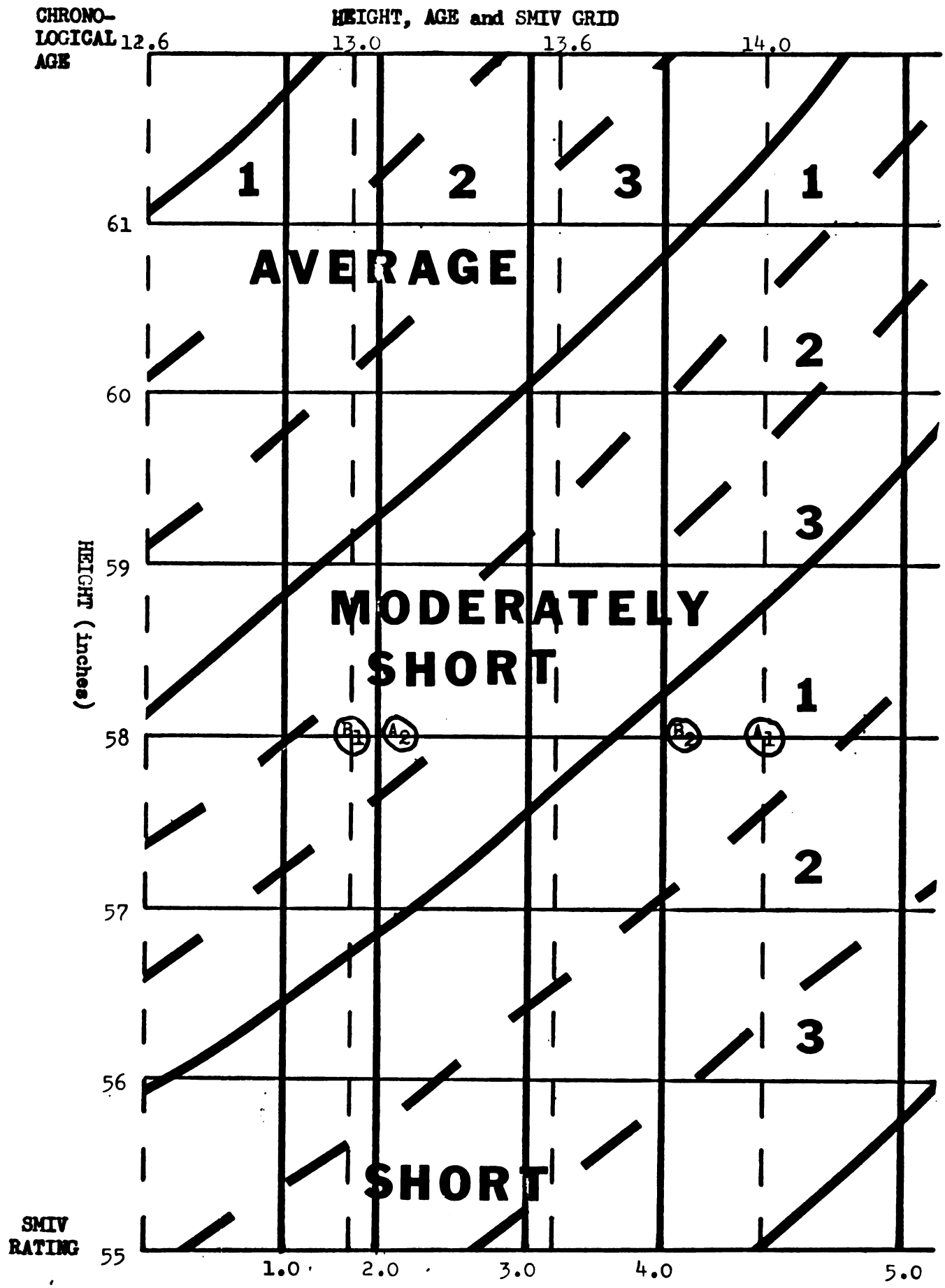
HEIGHT, AGE and SMIV GRID
CHRONO-
LOGICAL
AGE
12.6
13.0
13.6
14.0
1
2
3
1
AVERAGE
2
3
MODERATELY
SHORT
1
2
3
SHORT
61
60
59
58
57
56
55
HEIGHT (inches)
SMIV
RATING
1.0
2.0
3.0
4.0
5.0

Figure 9

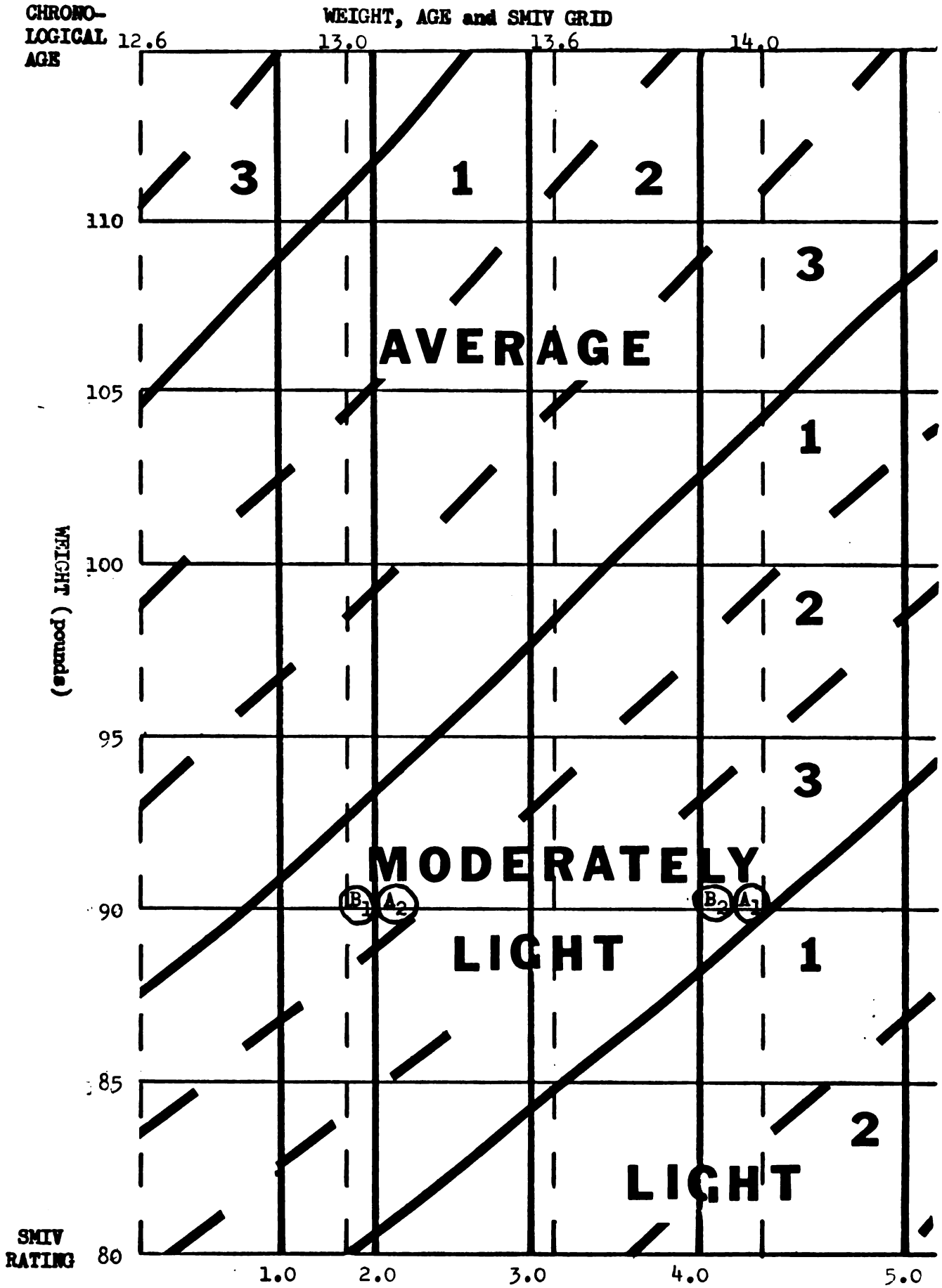
WEIGHT, AGE and SMIV GRID
CHRONO-LOGICAL AGE
12.6
13.0
13.6
14.0
3
1
2
110
3
AVERAGE
105
1
100
2
95
3
MODERATELY
90
LIGHT
1
85
2
LIGHT
SMIV RATING
80
1.0
2.0
3.0
4.0
5.0
WEIGHT (pounds)
B1
A2
B2
A1

Figure 10

on the grid. By following the same procedure for the upper abscissa value of 13.0 years and height of 58 inches, Beta's subchannel is Moderately Short #2, shown as B_1 on Figure 9 for height and age. By entering the weight, age and SMIV grid on the upper abscissa for 14.0 years and moving downward to the ordinate value of 90 pounds, Alpha's subchannel of weight and age is Moderately Light #3, designated by A_1. Following similar procedures for the upper abscissa value of 13.0 years and ordinate value of 90 pounds, Beta's subchannel for weight and age is Moderately Light #1 indicated by B_1. The Meredith height, weight and age body type, a combination of the subchannel values for height and weight, for Alpha is (Short #1, Moderately Light #1) and for Beta is (Moderately Short #2, Moderately Light #1).

To obtain the SMIV body type, a similar procedure is followed in the height, weight, age and SMIV grids, utilizing only the lower abscissa and the ordinate. Alpha's SMIV body type, represented by A_2 on Figures 9 and 10 for a height of 58 inches, weight of 90 pounds and a SMIV of 2.0 becomes (Moderately Short #2 Moderately Light #1) whereas Beta's SMIV body type for the same height and weight, but a SMIV of 4.0 becomes (Short #1 Moderately Light #3) illustrated by B_2 on Figures 9 and 10. It is apparent that the SMIV body type considers the sexual maturation of the early-and-late-maturing boy and adjusts the height and weight subchannel accordingly. The classification of Alpha, the late-maturing boy, was modified from a height, weight and age rating of (Short #1 Moderately Light #3) to a SMIV body type of (Moderately Short #2 Moderately Light #1) moving up two subchannels on each grid. The early-maturing boy, Beta, changed from (Moderately

Short #2 Moderately Light #1) to (Short #1 Moderately Light #3) moving down two subchannels on each grid.

The logical step after determing a SMIV body type (for complete Height, Weight, Age and SMIV Grids see Appendix D) is to develop a set of standards in the form of tables for age, height, weight, situps, shuttle run, pullups, standing broad jump and vertical jump based upon this body type and SMIV subcategory. An example of the proposed standards is shown on Table XVI. The utility of the proposed standards is shown by the following example. If a boy with a SMIV classification of Moderately Tall #2 and Moderately Heavy #3 wished to determine his physical growth and motor performance status in comparison to peers of similar maturity and body size, he would enter the table at his appropriate SMIV body type and SMIV classification and determine the mean score and standard deviation for any of the variables listed. Due to the small sample size in a vast majority of the standards presently developed, only a representative example showing two SMIV body type categories is given. Although these tables represent the most complete data, they fall far short of the necessary sample size to test for significant and meaningful differences between and within categories.

Table XVI - Proposed Table of standards for SMIV body types.

SMIV BODY TYPE	HEIGHT= MOD TALL 2	WEIGHT= MOD HEAVY 3

	AGE	HEIGHT	WEIGHT	SITUP	SHUTRUN	PULLUP	STBRJUMP	VERJUMP
(A) mean	154.0	63.0	115.0	99.0	11.0	2.0	60.0	10.0
s.d.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	1	1	1	1	1	1	1	1
(B) mean	162.0	64.7	121.0	49.0	9.9	1.0	63.0	13.0
s.d.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	1	1	1	1	1	1	1	1
(C) mean	163.0	65.08	121.4	93.2	9.8	2.60	74.0	18.2
s.d.	6.40	.51	2.70	12.97	.3	2.42	10.58	2.59
N	5	5	5	5	5	5	5	5
(D) mean	167.33	66.23	124.44	85.0	9.42	5.12	80.55	18.33
s.d.	5.24	1.24	3.04	22.25	.43	3.40	6.16	1.58
N	9	9	9	9	9	9	9	9
(E) mean								
s.d.		(no sample available in this cross-sectional data)						
N								

SMIV BODY TYPE	HEIGHT= MOD TALL 2	WEIGHT= AVERAGE 1

(A) mean	146.0	61.5	100.0	76.0	11.8	2.0	56.0	11.0
s.d.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	1	1	1	1	1	1	1	1
(B) mean	161.0	64.85	111.5	80.5	9.85	1.5	77.0	15.5
s.d.	9.90	.21	.71	26.16	.49	2.15	8.48	2.12
N	2	2	2	2	2	2	2	2
(C) mean	162.5	65.75	114.5	94.5	9.6	2.5	87.0	19.5
s.d.	9.19	..35	.71	6.36	.42	2.12	1.41	.71
N	2	2	2	2	2	2	2	2
(D) mean	158.33	65.66	118.33	65.33	10.53	3.66	70.66	15.0
s.d.	8.39	.29	1.53	29.19	.15	1.15	14.64	1.73
N	3	3	3	3	3	3	3	3
(E) mean								
s.d.		(no sample available in this cross-sectional data)						
N								

Future plans call for continued collection of data to insure adequate sample sizes within each of the S'MIV subcategories.

CHAPTER V

SUMMARY, CONCLUSIONS, and RECOMMENDATIONS

SUMMARY

This investigation was initiated in the winter of 1966 as a study of the association between sexual maturation and chronological age, height, weight, situps, shuttle run, pullups, standing broad jump and vertical jump. Cross-sectional data were secured during two testing periods, the first being in January of 1966 and the second one year later. The sample consisted of white males ranging in age from 143 to 182 months of upper middle class background in the public Junior High School in East Lansing, Michigan and of middle to lower middle class backgrounds in the public Junior High School in Mason, Michigan.

In order to study the association between sexual maturation and physical growth and motor performance, it was necessary to assess the sexual maturation level of various individuals. Scales of primary and secondary sex characteristics were developed and tested for within and between rater reliability. Three classification systems, SMIV, Pubic Hair and Chronological Age were used to group the dependent variables. An attempt to determine the superiority of one classification was investigated by: (1) comparing the change in sample size within the subcategories of a dependent variable for each classification system, (2) comparing the ranges of the various subcategories within each classification system with those of other classification

systems, (3) comparing the degree of overlap in standard deviation between subcategories of the three classification systems and (4) comparing the significant differences between subcategories of the three classification systems as determined by the Scheffe test for multiple comparisons. The association between sexual maturation and the physical growth measures and motor performance scores was discussed on the basis of the significant differences detected between SMIV subcategories by the Scheffe test for multiple comparisons.

The purposes of the investigation were as follows:

(1) To develop reliable and objective scales for the assessments of primary and secondary sex characteristics in circumpubertal males.

(a) to arrive at a descriptive value of sexual maturation based on a formula which utilizes the scales of primary and secondary sex characteristics.

(2) To compare the summary data of physical growth and motor performance of individuals grouped according to a sexual maturation indicator value with similar data on boys grouped according to a value from assessment of Pubic Hair and Chronological Age, respectively.

(3) To study the association between subcategories grouped by sexual maturation indicator values (independent variable) and the dependent variables of chronological age, height, weight, situps, shuttle run, pullups, standing broad jump and vertical jump by comparing significance within and between subcategory differences.

The results of this investigation based upon the cross-sectional data collection of circumpubertal males are as follows:

(1) Scales of the primary and secondary sex characteristics were demonstrated as reliable and objective with the exception of the secondary sex characteristic of facial hair.

(2) A comparison of methods (SMIV, Pubic Hair and Chronological Age) for classifying individuals demonstrates that:

(a) the total range of the dependent variable values is greater when based on the SMIV classification system than for the classification systems of Pubic Hair or Chronological Age.

(b) a comparison of the standard deviation size, used as a basis for determining homogeneity within subcategories does not demonstrate the superiority of any classification system.

(c) the Scheffe test of multiple comparisons between subcategories within the SMIV, Pubic Hair and Chronological Age systems generally results in more between-subgroup differences in the SMIV and Pubic Hair classifications than in subcategories classified by Chronological Age. No differences in number of between-subcategory differences are detected when SMIV is compared with Pubic Hair classification.

(3) When classified according to SMIV there are significant differences between the subcategories of each dependent variable of chronological age, height, weight, shuttle run, pullups, standing broad jump and vertical jump. No significant between-subcategory differences are detected for the dependent variable situps. The results of the multiple comparisons are as follows:

(a) SMIV groupings differ significantly in chronological age in every comparison within groupings.

(b) Height(inches) as classified by SMIV is significantly

different in all comparisons except D and E which may be a result of the small sample size in E.

(c) Weight(pounds) is not significantly different between A and B and D and E, but is significantly different between all other subcategory comparisons.

(d) Situps do not differ significantly between any subcategory comparison.

(e) Shuttle run is significantly different between all subcategories except C and D, C and E, and D and E.

(f) The only significant difference in pullups is between subcategories C and D.

(g) Significant differences in standing broad jump are found in all comparisons but D and E.

(h) Vertical jump failed to show significant differences between subcategories A and B, C and E and D and E but do show significant differences in all other subcategory comparisons.

CONCLUSIONS

(1) On the basis of the findings reported herein, it may be concluded that the primary and secondary sex characteristics scales are reliable and objective with the exception of secondary sex characteristic facial hair.

(2) When grouping circumpubertal males for physical growth and motor performance the classification systems SMIV and Pubic Hair are superior to a classification by Chronological Age when the criteria of maximum range within a classification system and greatest homogeneity within subcategories is applied.

(3) The conclusions of this investigation of the association between sexual maturation as determined by SMIV subcategories, and physical growth and motor proficiency in males is as follows:

(a) when classified according to SMIV, indications are that growth in stature increases significantly between subcategories throughout the scale with the possible exception of from D to E. This insignificant difference is attributed to the small sample size in E.

(b) the dependent variable, weight, does not vary significantly from SMIV group A to B and D to E, indicating that weight increases significantly as the boys pass through the other SMIV groupings of B to C and C to D.

(c) the ability to do situps does not increase significantly between any SMIV categories. This may be a result of the imposed upper limit of 99.

(d) shuttle run scores indicate that progress in agility is not enhanced once the SMIV grouping of C is reached, but until this point of sexual maturation, agility improves between successive subcategories.

(e) as tested by pullups, the strength of the upper arms is distinctly different between subgroups C and D.

(f) the standing broad jump indicates that leg power increases significantly throughout the SMIV scale with the possible exception of groups D to E.

(g) vertical jump, another indicator of leg power, shows no significant increase between SMIV groups A and B. However, there is a significant increase in the group mean between each successive

group with the exception of insignificant mean differences between groups C and E and D and E.

RECOMMENDATIONS

(1) The usefulness of the secondary sex characteristic facial hair needs to be re-examined by conducting another test of rater reliability.

(2) A longitudinal follow-up of the present sample should be undertaken in order to determine the length of time spent in any of the phases of sexual development. A longitudinal study of the association between sexual maturation indicators and physical growth and motor proficiency may ascertain information which is masked by cross-sectional analysis.

(3) The SMIV body type tables need to be completed by collecting additional cross-sectional data to insure appropriate sample sizes within each SMIV body type and SMIV subcategory.

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APPENDIX

APPENDIX A

Primary and Secondary Sex Characteristics Scales

facial

_____ no hair
_____ unpigmented hair at sideburns
_____ downy, lightly pigmented hair at corners of upper lip
_____ lightly pigmented, coarse hair visible on upper lip
_____ terminal mustache

axillary

_____ no hair
_____ slight, unpigmented hair
_____ downy, lightly pigmented hair in one or both armpits
_____ small area ½ to 1 inch of pigmented, coarse hair
_____ coarse, curly, well-developed hair

pubic

_____ no hair
_____ downy, unpigmented hair
_____ sparse pigmented hair, note it is straight
_____ curly, coarse, pigmented hair, but not extensive
_____ hair extending to medial surface of the thighs

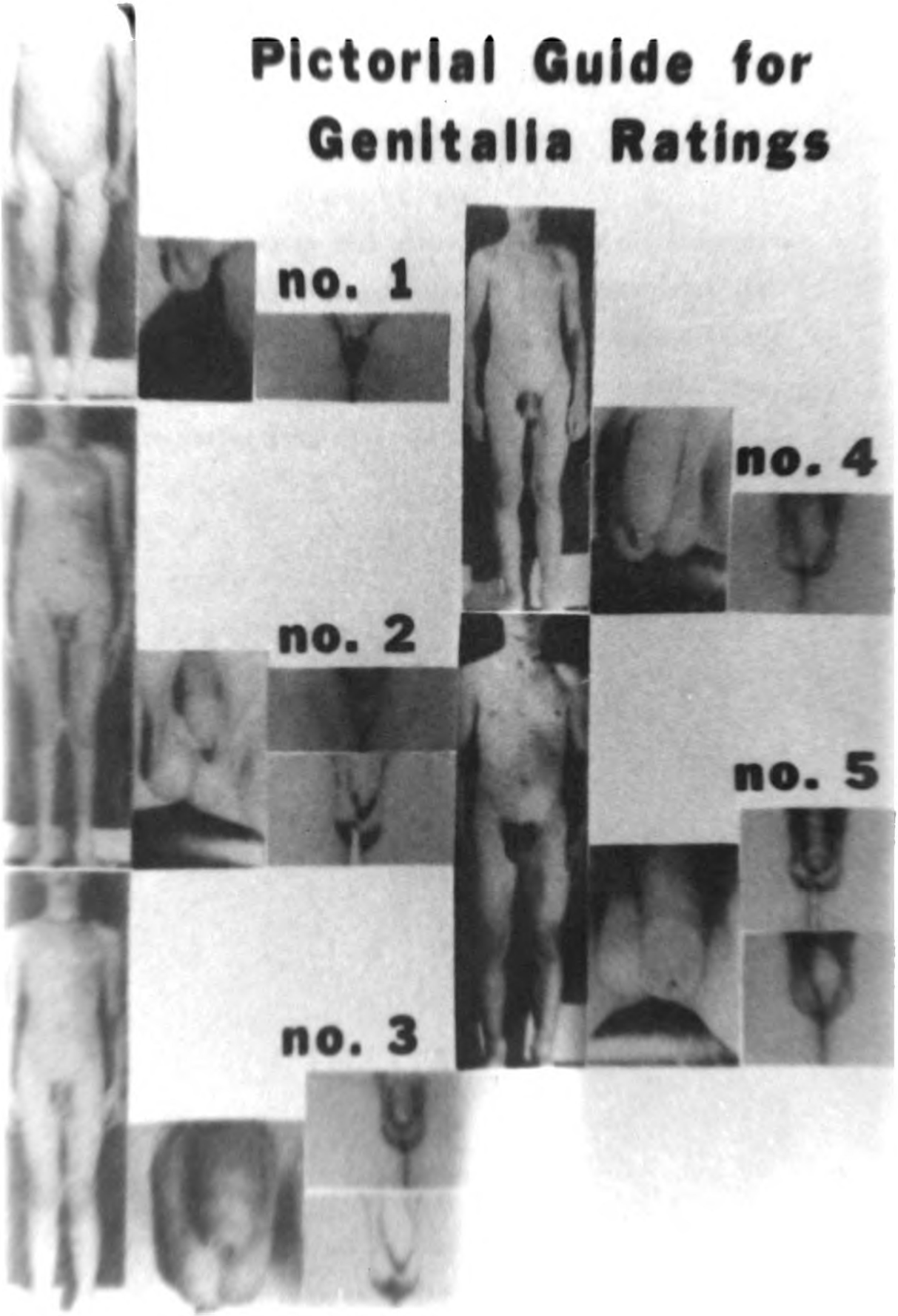
penis

_____ early childhood
_____ slight growth evident
_____ increase in shaft length, glans proportionately small
_____ total increase in length and diameter of shaft
_____ maximum size

scrotum and testes

_____ early childhood
_____ scrotum and testes visibly larger, one testes may show lower than the other
_____ one testes definitely shows lower than the other
_____ scrotum shows darkness beginning
_____ maximum size and darkness

formula: $X + \frac{Y - 4X}{10} = \quad + \frac{\quad - \quad}{10} =$

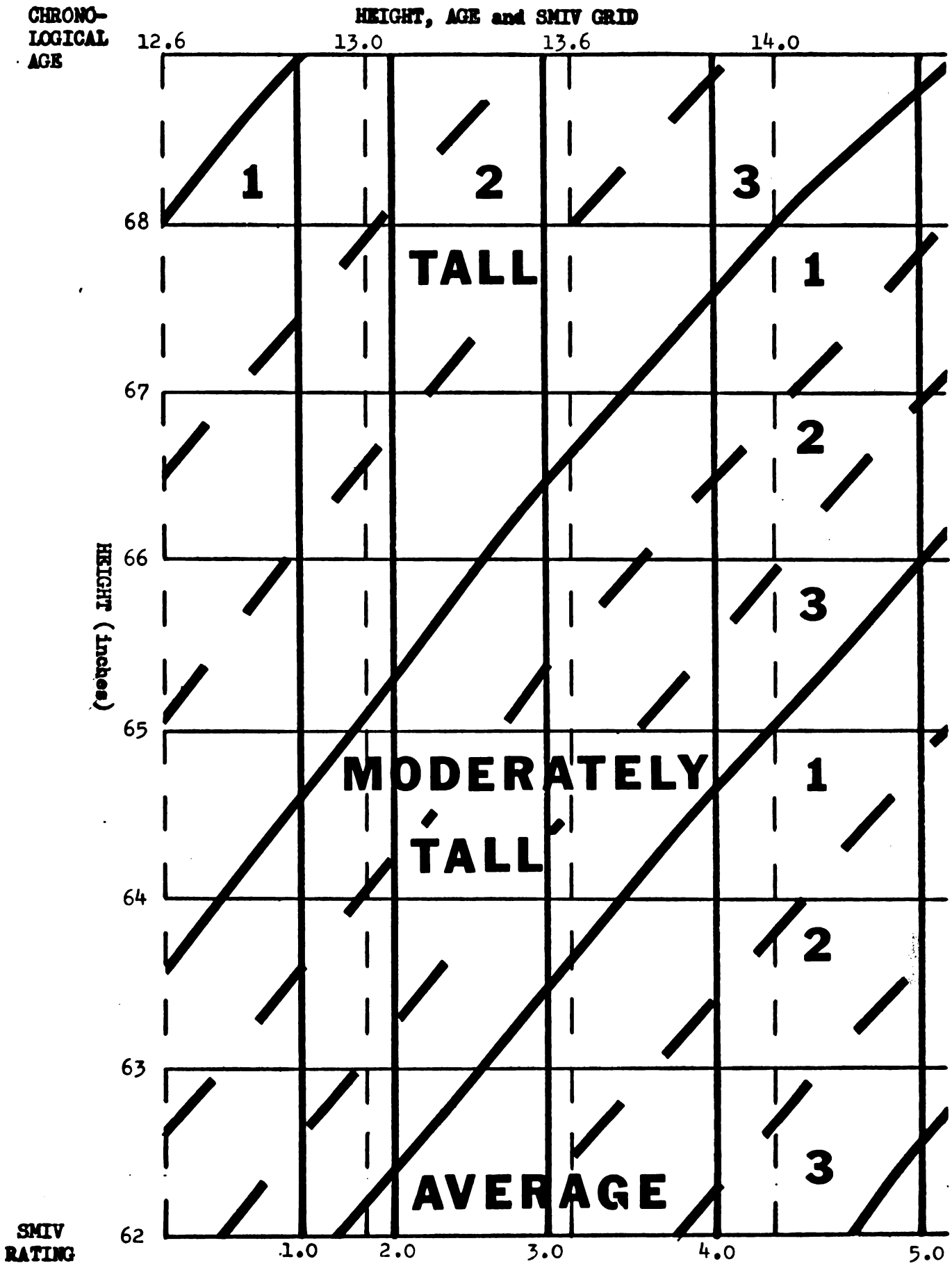


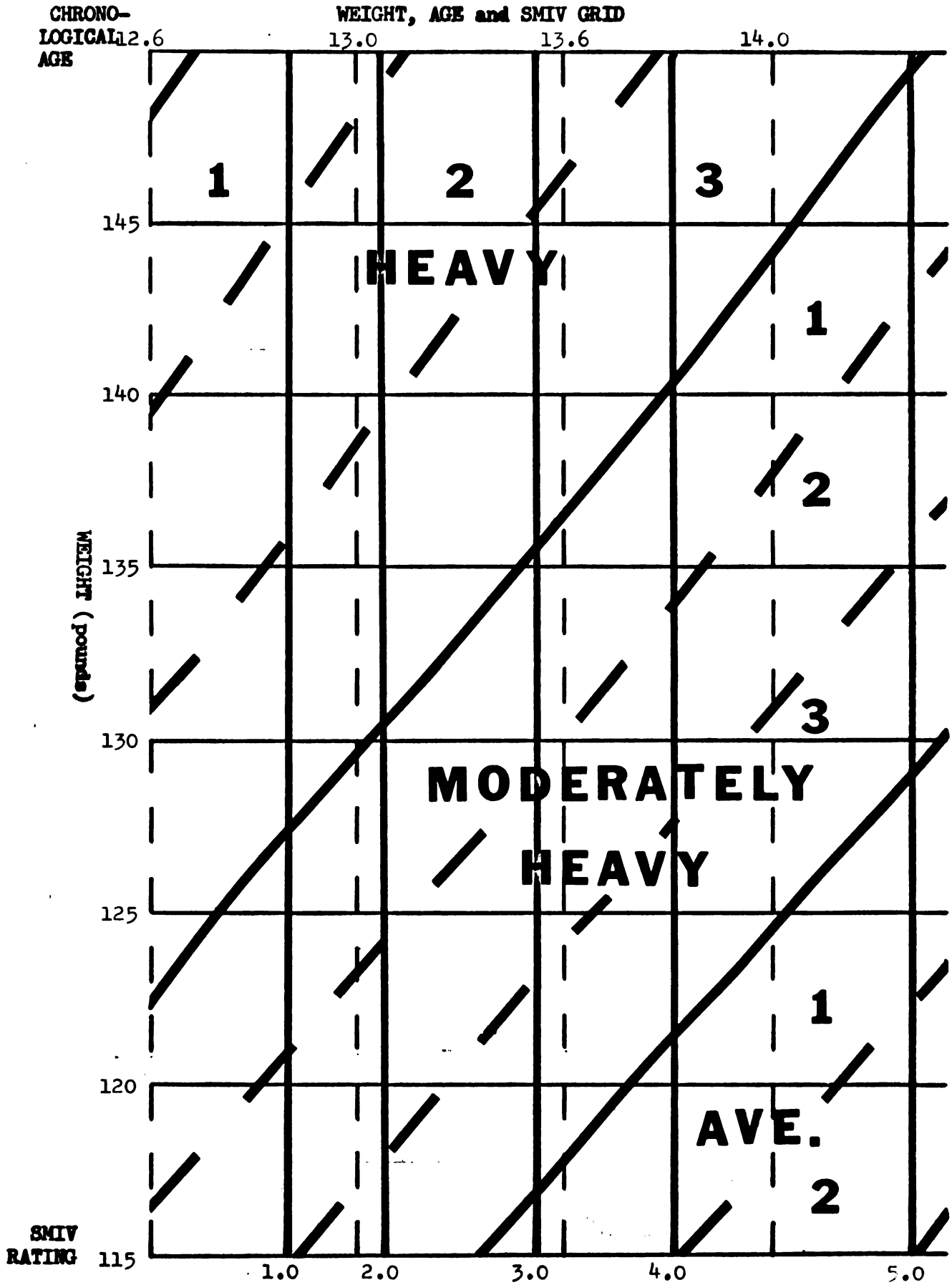
APPENDIX B

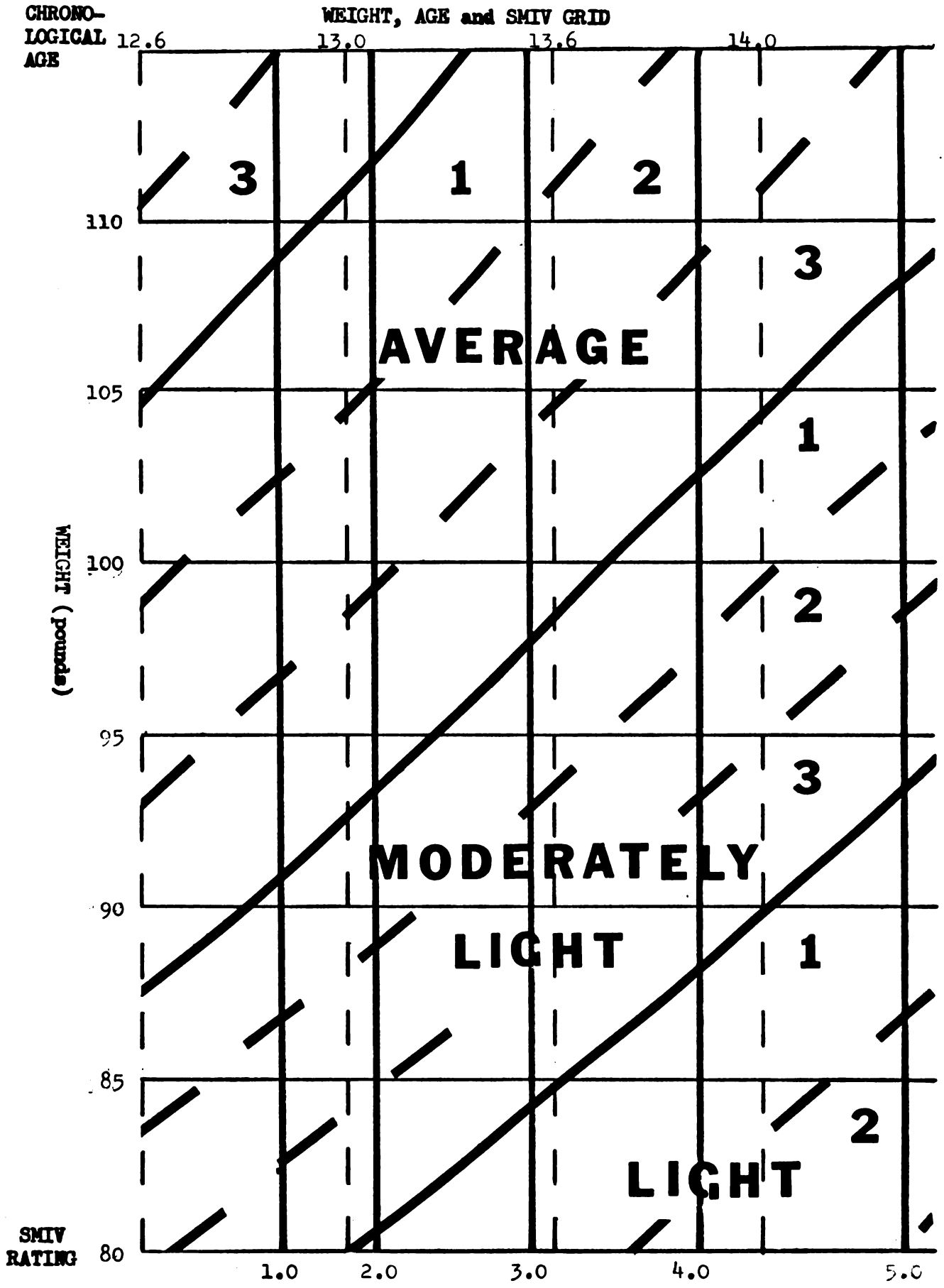
APPENDIX C

Status of Data

The data presented in this investigation is the first data of a longitudinal study. Consequently, rather than print the data at this time, the data will be kept for inspection at the Human Energy Research Laboratory, Women's Intramural Building, Michigan State University, East Lansing, Michigan.


HEIGHT, AGE and SMIV GRID
CHRONO-LOGICAL AGE
12.6
13.0
13.6
14.0
1
2
3
68
TALL
1
67
2
66
HEIGHT (inches)
3
65
MODERATELY TALL
1
64
2
63
AVERAGE
3
62
SMIV RATING
1.0
2.0
3.0
4.0
5.0


WEIGHT, AGE and SMIV GRID
CHRONO-
LOGICAL
AGE
12.6
13.0
13.6
14.0
1
2
3
HEAVY
1
2
3
MODERATELY
HEAVY
1
AVE.
2
145
140
135
130
125
120
115
WEIGHT (pounds)
SMIV
RATING
1.0
2.0
3.0
4.0
5.0


WEIGHT, AGE and SMIV GRID
CHRONO-
LOGICAL
AGE
12.6
13.0
13.6
14.0
3
1
2
110
3
AVERAGE
105
1
WEIGHT (pounds)
100
2
95
3
MODERATELY
90
LIGHT
1
85
2
LIGHT
SMIV
RATING
80
1.0
2.0
3.0
4.0
5.0