RELATION OF PRE- AND POST-PUBERTY ANTHROPOMETRIC MEASUREMENTS AND PERFORMANCE OF AMERICAN NEGRO AND CAUCASIAN FEMALES ON THE AAHPER PHYSICAL FITNESS BATTERY

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THESIS

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

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Denton, Texas

August, 1967

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CHAPTER I

INTRODUCTION

Renewed emphasis upon physical fitness has focused attention upon the need for further analysis of the components of fitness and their relationship to other variables. Increased knowledge of physical fitness and its relationship with other variables would assist in selecting activities as well as understanding the capacities of pupils.

It is generally agreed that body proportions and physical capacities of women are quite different, and that body proportions may be related to physical capacities. Moreover, some variations in body proportions among women have been attributed to race differences. Specifically, Negroes have been shown to have proportionately longer limbs than Caucasians.

Recognition of individual differences in body proportions has resulted in the development of anthropometric measures to identify body types, the establishment of standards for physical proportions, and the development of physical fitness programs that would help individuals reach these standards. However, it soon became evident that no

one set of standards would apply to individuals differing in sex, age, and race.

If there are anthropometric differences among race, the American Association for Health, Physical Education and Recreation physical fitness test norms may not be as interpretable for use in evaluating the performance of all races as might be desirable. It is possible that from this study, information might be gained that would stimulate other investigators to complete further studies whereby physical fitness norms for Negroes might be established. This study may also yield information concerning the effect that possible anthropometric advantages of Negroes have upon fitness tests.

If it can be shown from this study that there are decided differences among the races in scoring power on motor fitness tests, either in the individual items or in the physical fitness profile, then some motivational adjustment might be made in physical fitness objectives.

In order to accomplish the purpose of this study, answers to the following three questions were sought:

1. Are there differences among proportions of the body of Negroes and Caucasians which may provide either race with an advantage in physical performance?

2. Are potential differences a function of maturation or racial differences?

3. Will potential anthropometric differences effect performances on a physical fitness test?

Statement of Problem

The problem of this study is to determine the relationship that many exist among the variables of racial status, puberty status, anthropometric measurements, and physical fitness. Particularly of interest are the anthropometric differences that may exist among Negroes and Caucasians and the effect that these differences may have upon physical fitness as measured by the AAHPER Physical Fitness Battery. Differences among racial groups and puberty groups will be determined by analysis of variance technique and relations among anthropometric measures and physical fitness components will be compared and determined by correlational techniques.

Purpose

The purpose of this study is to examine the effects that anthropometric differences may have on the physical fitness performance of pre- and post-puberty American Negro and Caucasian females.

Specifically, this study will seek to determine the effect of a proportionately longer, trunk, longer legs, longer arms and hands, and wider shoulder girdle of the Negro upon

the subjects' performance on the AAHPER Physical Fitness Battery.

According to various authorities, there are certain anthropometric measurements that are significantly different in Negro college women than these same measurements in Caucasian women. This study will seek to determine if these same differences exist in younger pre- and post-puberty subjects and if existing differences affect fitness.

Hypotheses

1. There will be no significant difference between pre-puberty Negro and Caucasian groups on each of the anthropometric measures.

2. There will be no significant difference between pre-puberty Negro and Caucasian groups on each of the physical fitness items.

3. There will be no significant difference between post-puberty Negro and Caucasian groups on each of the anthropometric measures.

4. There will be no significant difference between post-puberty Negro and Caucasian groups on each of the physical fitness items.

5. There will be no significant difference between pre- and post-puberty Negro groups on each of the anthropometric measures.

6. There will be no significant difference between pre- and post-puberty Caucasian groups on each of the anthropometric measures.

7. There will be no significant difference between pre- and post-puberty Negro groups on each of the physical fitness items.

8. There will be no significant difference between pre- and post-puberty Caucasian groups on each of the physical fitness items.

9. Anthropometric measures of both Negro and Caucasian groups will not be significantly correlated with the performance of any of the seven physical fitness items.

Limitations

There were several limitations of this study. Subjects were limited to ages that ranged from eleven to sixteen. The sample was limited to a small number of one hundred subjects. The subjects were not randomly selected, but were selected from the two integrated junior high schools in Sherman, Texas. This study utilized the services of more than one test administrator.

Definition of Terms

Since there is not total agreement in various authorities' connotations of certain terms, the following definitions are to be used in this study:

Pre-puberty.--Denotes the female age range from 10.5 years to 12.5 years during which time the sexual characteristics are mostly immature (12, p. 357).

Post-puberty.--Signifies that the female has reached the age of menarche.

Sitting trunk length.--The distance from the seventh cervical vertebrae to the lower portion of the coocyx (4, p. 253).

Leg length.--The distance from the hip, where the greater trochanter enters the pelvic girdle, to the floor (4, p. 253).

Arm-and-hand length.--The distance from the clavicle and scapula joints to the distal point of the longest finger (46, p. 67).

Shoulder girdle size.--The circumference as measured around the lateral projections of the acromion processes (46, p. 57).

Foot length.--The distance from the heel of the foot to the distal point of the longest toe (46, p. 67).

Pelvic girdle width.--The bi-iliac diameter at the greatest distance between the lateral margins of the illiac crests (46, p. 69)

AAHPER.--Initials used throughout this study as an abbreviation for the American Association for Health, Physical Education, and Recreation.

Physical Fitness.--Defined generally as the nature and degree of adjustment or adaption in activities requiring muscular effort (25, p. 94). In this study, physical fitness is defined in terms of the subjects' responses to the seven items of the AAHPER Physical Fitness Battery. Degree of fitness will be assessed in terms of the norms that are provided in the AAHPER Physical Fitness Manual (21, pp. 43-49).

Review of the Related Literature

Physical anthropologists have shown that there seem to be some anthropometric differences among races and this has been a matter of considerable discussion for many years. Authorities generally agree that the Negro trunk, legs, arms and hands are significantly longer and that the shoulder girdle is significantly wider. Many studies have sought to discover the relationships that might exist among these anthropometric differences and performance.

Anthropometric Differences Among Races

Several studies in the literature of the professions of anthropology and physical education present the hypothesis that the Negro ranks among the tall races when compared to American Caucasian, Japenese, and Mexican. Many studies have sought to determine whether other anthropometric measures are significantly different among the races.

Hrdlicka (20), reporting observations on full-blood American Negroes, revealed that the American Negro had a longer and narrower hand, longer and broader foot, and higher chest. The muscular strength of the Negro was greater than that of the Caucasian with whom he was compared. However, his subjects were limited to twenty and therefore his findings may not be a representative sample of the full-blood American Negro.

Tod and Lindala (42) studied the dimensions of the body of Caucasians and Negroes of both sexes. They reported that the standing height of both male anf female Caucasians is of a rather low average. Female Negroes are of typical Caucasian height but the males are usually very tall when compared with the Caucasian. The Negro pelvis is smaller in all its dimensions and the arm is longer than the Caucasian in both sexes. There is no evidence of differences in proportions of thigh and leg with either sex or race. Foot breadth is strictly proportionate to true leg length in Caucasian males and in Negores of both sexes. The Caucasian female has a shorter foot when compared with the female Negro.

Caution must be exercised when interpreting Tod and Lindala's findings, however, since their subjects were cadavers; cadavers and their measurements were compared with those of a living population. Their findings may not

represent the true anthropometric measurements of the Caucasian and Negro.

Wolff and Steggerda (47) supported the findings of previous investigators, however. Their observations indicated that the Tuskegee Negro in both sexes had a longer lower arm and longer legs than the Caucasians.

Piscopo (34) reported skinfold and other anthropometric measurements of 647 preadolescent Italian, Jewish, and Negro children of the Massachusetts area. His findings revealed that the largest skinfold measurements were generally possessed by the Jewish subjects, followed by the Italian and Negro groups respectively. Within the Jewish and Italian groups, the largest skinfolds were found at the abdominal sites, while within the Negro group, posterior arm skinfolds measured largest. Heavier subjects were generally found within the Jewish groups. The weight measurements revealed significant differences at the eleven year age level, whereas, the height measurement revealed non-significant differences among ethnic groups.

Anthropometric Differences Related to Chronological Age

Investigators have studied the anthropometric differences in children, college students, and adults. Some studies have sought to determine whether anthropometric differences were

factors related to performance that would advance with age.

Shuttleworth (38) studied the sexual maturation and the skeletal growth of girls age six to nineteen. Anthropometric measures studied were chronological age, height, weight, body shape and body size. His findings indicated that radical changes in the growth patterns of girls occur immediately before and during menarche.

Shuttleworth (39) studied the physical growth characteristics in relation to age of achievement of maximum growth. His findings revealed that groups classified as slow, average, or fast in achieving maximum growth showed decidedly different growth in a large variety of anthropometric measures.

Espenschade (18) studied the growth which occurs during adolescence. Relationships investigated included those of motor performance with chronological age, anatomical development, physiological maturity, height and weight. Indices of relative leg length and relative hip width were also compared to motor performance. The findings indicated that correlations between motor performance of girls and all measures of physical growth and maturity are low and in most cases not statistically significant.

Authorities generally agree that there is a tendency for all correlations with anthropometric age to decline with age,

and this must be considered when interpreting Espenschade's results. Her study recommends the investigation of the influence of certain girths and lengths of body segments on particular performances.

Clarke and Degustis (12) compared the skeletal age and various physical and motor factors with the pubescent development of ten-, thirteen-, and sixteen-year-old boys. The findings indicated that physical maturation was differentiated most effectively at thirteen years of age. At sixteen years, maturational differentation was much more limited and at ten years, little or no value can be attributed to this method. The thirteen and sixteen year old boys who were advanced in pubescent development had higher mean scores on all physical and motor tests studied. Generally the differences between the means were significant. The only significant difference of physique types was found at sixteen years of age, where a greater percentage of ectomorphs was found in the pubescent group.

Metheny (30), in a study of the differences between Negro and Caucasian male athletes, found a longer forearm and hand to be advantageous in thowing events. Narrower hips, and longer legs, of which the upper segment is shorter and the lower proportionately longer, seemed to be advantageous in running.

Relationship of Anthropometric Differences to Physical Performance

It has been hypothesized that anthropometric differences may affect physical performance. Many studies have examined various components of physical performance such as, strength, flexibility, power and neuromuscular functioning, in the event that the variations in the components are a function of anthropometric differences.

Strength.--Clarke (10) conducted a study to determine the relationship between arm strength and arm size. The upper girth was measured in a "tension flexed" position at the level of maximal circumference using a cloth tape with a Gulick Handle. A fairly high relationship was found between girth of the upper arm and the strength tests. The highest correlation was between upper arm girth and shoulder flexion strength.

Clarke (11) reported a study of the relationship of strength and anthropometric measures to physical performance that involves the trunk and legs. His findings revealed a high correlation between standing height and leg length. Moderate correlations were reported for body weight with standing height, leg length, and leg lift. Negative correlations were reported also for standing broad jump with body weight, standing height, and leg length.

Elbel, Reid, and Ormand (17) used fifty male students in studying the relationship between physical fitness and certain anthropometric measurements. Moderate correlations were reported for all weight relationship among height, vital capacity, and endurance.

Hutinger (23) reported results indicating that Negro children tend to surpass Caucasian children in a measure of speed. The 35-yard dash was administered to nine, ten, and eleven year old children of which 402 were Negroes and 390 were Caucasians. Differences in the mean scores of the 402 Negro children and the 390 Caucasian children indicated the Negro children were superior in speed. However, Hutinger was highly criticized by Henry (19), who stated that Hutinger cited references that were favorable only to his hypothesis. Henry also stated that no consideration was given to an alternative hypothesis that would ascribe the observed results to possible age differences between the racial groups at a given grade placement.

Ponthieux and Barker (36) administered the American Association of Health, Physical Education and Recreation Youth Fitness Test to 633 children enrolled in the fifth and sixth grades of thirteen public elementary schools in central Texas. The findings of this investigation revealed that the differences in physical fitness in relation to performance of racial

groups generally favored Negro pupils. The Negro schoolboys in the sample exceeded the Caucasian boys significantly in five of the components of physical fitness while there was no significant difference between their performance on the other two measures. The Negro girls surpassed the Caucasian boys significantly in five of the components of physical fitness while there was no significant difference between their performance on the other two measures. The Negro girls significantly surpassed the Caucasian girls on four measures, whereas the Caucasian girls surpassed the Negro girls on two. There was no significant difference in the girls' performance on the shuttle-run.

Buxton (7) extended the Kraus-Weber Test of Minimum Muscular Fitness in order to provide more differentiating scores at all levels of ability. A pass and fail score, which could be determined from the continuous scoring system, was also obtained. Results indicated that strength and flexibility differ with age and sex and that the standards, even though considered minimal, should also wary with the different age and sex groups.

Flexibility.--Mathews, Shaw, and Bohnen (26) reported a study of the relationship of reaching height, standing height, and leg length to hip flexibility of college women. The

Kraus-Weber, the Wells Sit and Reach Test, and flexibility measurements taken with the Leighton Flexometer were used to measure hip flexibility. Their results indicated that there was no significant relationship among the three tests of flexibility and the three anthropometric measures. The investigators did not, however, study the relationship between reaching length and leg length, nor that of weight and height.

Broer and Galles (4) reported the importance of the relationship of trunk-plus-arm length (reach), to leg length in the ability to perform the toe-touch test. Various anthropometric measurements, flexibility scores, and toe-touch scores were obtained. The findings indicated that the relationship of reaching length to leg length is not an important factor in the performance of the toe-touch test for persons with average body build, however, a longer trunk plus arm (reach) measurement in relation to shorter legs gives an advantage in the performance of this test.

Phillips (33) studied the relation of flexibility to age. The Kraus-Weber test was administered to boys and girls from six to twelve years of age. She concluded that males tend toward a rapid decrease in flexibility with increased age; the flexibility of the girls decrease more rapidly.

Hupprick and Sigerseth (22) measured the flexibility in twelve joints in girls. They concluded that flexibility tends

to increase in most joints until age twelve is reached. It then decreases gradually. However, a gradual decrease in shoulder, knee, and thigh flexion was noticed from age six to eighteen.

Power.--Clarke and Harrison (9) studied the skeletal retardation development of boys. Their findings indicated that fifteen year old boys who were retarded in skeletal age had a significantly lower jump mean than did the boys who were advanced or normal in skeletal age. Significant differences between means of maturity groups were not obtained at ages nine and twelve years.

Clarke and Degutis (13) studied the relationship between standing broad jump as a test of leg power and various maturational, anthropometric, and strength tests of twelve year old boys. The subjects were tested within two months of their birthdays. This had the effect of largely eliminating chronological age in the correlations. Seven of the sixteen correlations with the jump were significant. They concluded that leg power as evaluated in this study was dependent in part upon the body size and muscular strength.

Burley, Dobell and Farrell (6) conducted a study to determine the differences among seventh, eighth, and ninth grade girls in power, speed and flexibility, and to determine

the relation between power and flexibility, speed and flexibility, and speed and certain anthropometric measures. Their findings indicated that seventh grade girls were faster than eighth grade girls in the 50-yard dash. Ninth grade girls broad jumped farther than seventh and eighth grade girls. No significant relations were found in the other items studied.

Neuromuscular Functioning.--Some investigators have sought to study the physiological functioning of the human rather than looking at gross functioning such as strength, flexibility and power. These investigators have hypothesized that perhaps the Negro is faster because his neuromuscular functioning is better and the neuro-impulses travel faster; his reaction time might create an advantage in the short dash but not in a long one.

Browne (5) compared 4,100 patellar tendon reflex times of eighty-three Caucasian subjects and 4,050 patellar tendon reflex times of eight-one Negro subjects. The findings revealed that the mean racial difference between the patellar tendon reflex time of the Negro group suggests that their spinal responses might have a bearing on the speed of the Negro athletes.

Although the obtained difference between the patellar tendon reflex time of Caucasians and Negroes is small, yet

it is significant. The findings may not be relied on too greatly because no explanation for the difference is at hand. However, the faster patellar tendon reflex time of Negro groups suggests that their spinal responses might have a bearing on the speed of Negro athletes in the sprints.

Slinker (40) studied the patellar tendon reflex time of 124 men and 126 women with special reference to influencing factors such as age, weight, and fatigue. Slinker concludes that the weight of an individual has nothing to do with the reflex time, but the factor of age should be considered. He concluded also that fatigue influences the length of the patellar tendon reflex time, since the afternoon readings are longer than the forenoon readings.

Tuttle and Lautenback (43) investigated the relation between reflex time and speed in sprinting. The subjects used in this study were grouped according to the type of foot-race in which each excelled. The groups included in this study were subjects who ran the short distance, middle distance, or distance race. These investigators found that there was a high correlation between speed in sprinting and reflex time.

Pubescence and Its Effect on Physical Performance

Authorities generally agree that the peak of physical skills for girls occurs around thirteen to fourteen years of age, whereas boys carry the potential motor capacity for improvement throughout high school, although it still remains to be determined whether the decrease in physical performance may be due to the fact that girls become less active and more feminine as they reach sexual maturity.

Cearley (14) studied the relationship of age, height, and weight to track and field performance. The findings indicated that performance ability of both boys and girls nine to seventeen years old in track and field events bears a non-linear relationship to age, height and weight. Age made its greatest contribution to performance in the area of 15.5 years for boys and 13.5 years for girls. Height made its greatest contribution at 71 inches for boys and 51 inches for girls, while weight made its greatest contribution in both boys and girls at 55 pounds.

Methods of Assessing Pubescence

In the profession of physical education it is generally agreed that in assessing pubescence some adjustment or classification should be made for body or constitutional type. Factors such as age, height, weight, and sexual development

are used in assessing pubescence; however, it is generally agreed also that the use of a single factor is unsatisfactory.

McCloy (27) reported a study in which he evaluated the factors of age, height, and weight in relation to their influence upon performance. He proposed the following classification indices:

High School = Classification I = (20 x age) + (6 x height) + weight
College = Classification II = (6 x height) + weight
Elementary = Classification III = (10 x age) + weight

Height was omitted from Classification III because it was found to be a negligible factor on the elementary school level. Classification II is used with college men, as it was found that after seventeen, age ceased to make further contribution. Classification I is more significant for the high school level, where height seems of greater importance.

Delaney (16) experimented with an age, height, weight classification method for girls ranging from ten to 16.5 years. She found that the classification index of 10A+W should be used for girls fourteen and under and the index of 10A+H be applied to girls fifteen and over. Delaney's findings supported McCloy's in the fact that weight is a more important factor to young subjects while height for the older student is more important.

Neilson and Cozens (31) published achievement scales in physical education activities based on the Classification

> The use of a single factor for classification purposes is not satisfactory and cannot be successfully defended. The use of grade in school alone favors the older, heavier, and stronger individuals as the variance in height, weight, and age within a grade is considerable. Little defense for grade as a factor exists because the grade status of the pupil may be suddenly changed as a result of the pupils' activity or the teacher's decision. . . . Age may be a crude indication of amount of experience and physical development, but there is much variability in height and weight within each group. Classification by weight alone does not meet the criteria for fair competition because it is not known how much of the weight is fat, bone, or muscle. Moreover, there is a wide variation in maturity at a given weight, and the temporary modification of weight by training down is sure to be resorted to. . . . Height is an important fact, and more so in some events than others because the mechanical advantage required in several events is different.

The Effect of Pubescence on the Female Somatotype

During pubescence the female somatotype changes. The female hip is wider, caused by the enlargement of the pelvic girdle. The breast is larger and the female shoulders remain relatively narrow. It is hypothesized that these observed differences in the female somatotype will affect the performance.

Sheldon, Stevens, and Tucker (37) presented methods for assessing body build. They adopted the terms endomorphy, mesomorphy and ectomorphy to indicate the three body components that were used in somatotyping. Endomorphy is characterized by roundness and softness of body, central concentration of mass, no muscle relief, and short tapering limbs.

Mesomorphy is characterized by squareness and hardness of body, large bones, heavy musculature, broad shoulders with pyramiding trapezius, and broad hips with sturdy pelvis. Ectomorphy is characterized by linearity and delicacy of body, narrow shoulders that lack muscular relief, fingers and toes that are generally slender and long, and a head that appears too large for the slender neck.

Willgoose and Rogers (45) studied the relationship of somatotype to physical fitness. The findings revealed that mesomorph-ectomorphy as a physical group scored highest on a selected physical fitness test and that endomorphs were apparently limited in physical fitness by their physiques.

Jones (24) reported his study concerning the relationship of strength to physique. The findings revealed that strength was related to both body size and to the mesomorphic component in body build. The mesomorphy gave a low correlation with weight and a negative correlation with height. The findings also revealed that the ectomorph scored lower on the Brace test than the mesomorphs.

Perbis (32) studied the relation of somatotype ratings to motor fitness of college women of eighty-three physical education majors and 100 non-majors. Correlations between test scores and somatotype components were computed. The two groups were compared and the means and standard

deviations of each component were determined. She concluded that her groups as a whole had endomorphy as their dominant component but that physical education majors tended to be more dominant in mesomorphic traits. Significant relationships were indicated between mesomorphy and strength and power.

Androgynous Effects on Performance

Numerous research efforts reflect the hypothesis that athletic ability and motor performance are influenced by factors of body size, maturity, and body build. While it is true that significant correlations have been obtained between various motor performance test scores and endomorphy, mesomorphy and ectomorphy, neither zero-order nor multiple correlation coefficients have been of sufficient magnitude to enable accurate prediction of individual performance.

Upshaw (44) studied the motor performance of college women in relation to the Trunk Index, Ponderal Index, and ratings of gynandromorphy in addition to the three primary somatotype components. Gynandromorphy refers to the extent to which an individual reflects characteristics associated with the opposite sex. His findings suggest the need to study motor performance in the light of this additional expression of body build, but provides no information concerning the effect of femininity upon motor performance.

Cress and Thorsen (15) studied masculinity and feminity ratings in relation to motor performance scores of college women. The findings indicated that arm strength, muscular explosive power, pure speed, and the Humiston Test of motor ability showed a significant positive relationship to masculine ratings and a significant negative relationship to feminine ratings. Subjects were classified as being "above," "at," or "below," the established mean of the masculine and feminine factors. Comparison of the mean scores revealed those above the masculine mean to be superior on test of speed, arm strength, and motor ability. Those below the mean of the feminine factor were found to be superior on these same tests and on explosive power. The extent to which the physical expression of masculinity exceeded that of femininity was more highly related to performance scores than were either masculinity or femininity ratings alone.

Carpenter (8) conducted a study to determine to what extent strength, power, and femininity influenced athletic performance. The test battery included the 60-yard dash, six-pound shot put, and standing broad jump. Anthropometric measurements were taken of shoulder width, thigh girth, elbow width, and chest girth. The findings revealed that power and muscular strength were the two most important factors relating to athletic performance, and of the two, the power

factor is by far the more important. A masculine type of build had relatively little influence upon athletic performance.

Bookwalter (3) studied the relationship of body size and shape to physical performance. He concluded that size and shape seemed to have an influence on physical performance; however, maximum size and shape did not produce maximum physical fitness.

Related Variables that Influence Performance

Although some studies have emphasized certain physical factors in growth that influence performance, other studies have indicated that there are other related variables, such as previous work and socio-economic differences that may also be related to performance.

Socio-economic Differences.--Investigators have indicated that differences in height, weight and sexual development exist among different socio-economic groups. If these differences do exist there might be some relationship among these groups and their performance.

Meredith (29) studied the relation between socio-economic status and body size in boys seven to ten years of age. His findings indicated that Caucasian boys of the professional

and major managerial classes are taller and heavier than those of the unskilled and semi-skilled classes.

Ponthieux and Barker (35) investigated the relationship between socioeconomic status and the seven aspects of physical fitness measured by the American Association of Health, Physical Education and Recreation Youth Fitness Test. Significant relationships were found; however, they did not favor one status group in all the components of fitness. There were indications that girls of the lower economic group were faster, better coordinated, and had more endurance than the girls of the upper economic group. There were also indications that the upper economic level girls were stronger in arm and shoulder girdle strength and in abdominal and hip flexor muscles than the lower economic girls.

Physical Fitness

Physical Fitness is defined by Steinhaus (41) as a positive quality, extending on a scale from death to "abundant life." Another concept regards a person's fitness as his "distance from death." Larson and Yocom (25) define it as the nature and degree of adjustment or adaption in activities requiring muscular effort. The degree of adjustment or adaption refers to the relationship between the individual status and the requirement for life.

In a joint statement prepared by the American Medical Association and the American Association for Health, Physical Education, and Recreation (2) fitness was defined as

> Fitness rests first of all upon a solid foundation of good health. Be it in the home, on the farm, at the office, in the factory, or in military service--fitness for effective living implies freedom from disease; enough strength, agility, endurance, and skill to withstand ordinary stresses without causing harmful strain; and mental development and emotional adjustment appropriate to the maturity of the individual.

Components of Physical Fitness

According to Larson and Yocom (25) there are ten components of physical fitness. They are as follows:

Accuracy.--The ability of the individual to control voluntary movements toward an object, whether at a distance or in contact with some part of the body.

Agility.--The ability to change positions in space.

Balance.--The ability of an individual to control organic equipment neuromuscularly.

Co-ordination.--The ability of the individual to integrate movements of different kinds into simple patterns.

Endurance, (Cardio-vascular respiratory).--The ability of the individual to sustain lone continued contractions

where a number of muscle groups are used with a sufficient duration and intensity to put a demand on the function of circulation and respiration.

Flexibility.--The effectiveness of individual adjustment in many physical activities which is determined by the degree of total body or specific joint flexibility or range of movement.

Muscular Strength and Muscular Endurance.--The ability of an individual to continue successive exertion under conditions where a load is placed on the muscle group being used.

Muscular Power.--The ability to release maximum force in the shortest period of time. Power equals force times velocity.

Resistance to Disease.--The ability to resist disease which is largely determined by heredity, although environmental factors such as food, clothing, rest, relaxation, physical activities, and personal hygiene habits are all important factors in the ability to resist disease.

Speed.--The ability of the individual to make successive movements of the same kind on the shortest period of time. Speed is the number of movements per number of units of time.

Measurement of Fitness

Physiologists have become more and more aware of man's physical condition and its bearing on physical education. Melchior (28) stated that all teachers are truth seekers and to find the truth they must measure and appraise their work carefully. Strength tests, cardiovascular tests and/or motor fitness tests are among the widely used methods of measuring fitness.

Strength Tests.--Strength tests are used to reflect certain aspects of total fitness as well as to measure athletic ability. These tests consist of the subject applying a force that is measured by a dynamometer, manuometer or tensiometer. The strength of the muscle group is recorded in pounds of pull.

Cardiovascular Test.--Cardiovascular tests grew out of research by physiologists that revealed significant findings relative to changes in cardiovascular functions as a result of shifts in body positions, of varying degrees of exercise, and of athletic conditioning. The purpose of the cardiovascular test is to determine the ability of the cardiovascular system to adjust to the exercise, and it is recorded in terms of pulse rate. Some of the most widely used cardiovascular tests are The Schneider Test, McCurdy-Larson Test

of Organic Efficiency, Pulse-ratic Test, Tuttle Pulse-Ratio Test, and the Harvard Step Test.

Motor Fitness Test.--Motor fitness is a limited phase of motor ability, with emphasis placed on the underlying element of capacity for vigorous physical activity. It is a composite of factors including strength, speed, agility, endurance, balance, power, and flexibility. Motor fitness tests reflect this composite, and are typically designed to sample the elements involved. The AAHPER Youth Fitness, Indiana Motor Fitness, Youth Physical Fitness, and the Division for Girls and Women's Sports are among the widely used motor fitness tests for junior high, high school, and college levels.

The AAHPER Test battery was developed in 1957 by a special committee of the AAHPER Research Council. Its work was the direct result of a national conference called in 1956 by President Eisenhower to consider the fitness of American youth. The AAHPER Tests evaluate specific aspects of physical status, taken together, give an over-all picture of the young person's general fitness. This battery measures elements of strength, agility, and endurance, as well as proficiency in running, jumping and throwing.

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CHAPTER II

PROCEDURES

Subjects

The data for this study were obtained from fifty Caucasian and fifty Negro students enrolled at Piner and Dillingham Junior High Schools during the Second Semester, 1967. These subjects were selected on the basis of race and puberty status. From the one hundred subjects included in this study, thirty-six were selected from Dillingham Junior High and sixty-four were selected from Piner Junior High. There were fifty subjects in the seventh grade, twenty-five subjects in the eighth grade, and twenty-five subjects in the ninth grade physical education classes. The subjects ranged from eleven to sixteen years of age.

Tests and Instrumentation

The eight measures that were selected to examine the effect that anthropometric differences in pre- and post-puberty Negro and Caucasian females may have on performance were standing height, weight, sitting trunk length, leg length, arm and hand length, shoulder girdle width, foot length, and

pelvic girdle width. The instrument selected to assess physical fitness was the American Association for Health, Physical Education, and Recreation Youth Fitness Battery.

Anthropometric Assessment

Anthropometric assessment was made by the use of linear and weight measures. These measures were selected because it is believed that significant relationships may exist between performance and these measures. Also, these anthropometric measures were selected to analyze the factors which might conceivably contribute to performance.

Linear measures.--Standing height and leg length measures were obtained by means of two standard linear scales that were constructed on large cardboard poster paper. These scales were taped securely to the walls in one corner of the gymnasium so that the two scales were at right angles to each other and provided a range of measurement from zero to 102 inches high. Every half inch was drawn completely across the paper in pencil, every inch was indicated in red pencil, and every twelve inch distance was designated by a blue line. After being attached to the wall, these scales were carefully checked with a standard scale to ensure accuracy.

Sitting trunk length, pelvic width, shoulder girdle width, foot length, and arm and hand length were measured by

a sliding caliper. This instrument was constructed so that it contained a stationary arm and a sliding arm, and so that the arms of the instrument were of sufficient length so as to obviate any chances of the instrument rod contacting the subject's body.

Weight measures.--Neither of the schools selected for the study owned metric scales, and the type and condition of scales available in each of the schools differed. In order to obtain reliable and comparable results a portable English spring scale was obtained. This scale has a movable indicator which permitted ready adjustment to a test weight, and was used to weigh every subject.

Physical Fitness Assessment

The AAHPER battery does not include a composite score as a measure of total fitness; rather, each of the seven subjects is used as a measure of a component of physical fitness. The items included in the AAHPER Battery are: flexed-arm hang, sit-ups, shuttle-run, standing broad jump, 50-yard dash, soft-ball throw, and 600-yard run-walk. The AAHPER Youth Fitness Tests were selected for several reasons. First, the battery is easy to administer and is objective. Because most of the physical education teachers in the junior high schools have administered the test yearly since its inception

into the Sherman Public Schools, the scores were readily available. Furthermore, these scores were obtained from experienced test administrators who followed standardized procedures of administration of the tests. The AAHPER Youth Fitness Test Battery was further selected because the professional organization has established national norms on the basis of a very large and representative sample. Finally, this battery was sponsored by the profession of Health, Physical Education, and Recreation and is pertinent to the objectives of this study.

Administration of Tests

All anthropometric measurements were secured from all subjects before the performance test was administered. This measuring procedure was considered more feasible for administration in the schools included in the study. The AAHPER Tests were administered precisely according to the directions in the AAHPER Youth Fitness Test Manual and specific directions for the administration of the tests may be found in the appendix of this study.

Anthropometric Assessment

The anthropometric measurements of each subject were taken by the school nurse and recorded by a student assistant from each school. All measurements were taken in the mornings

from 8:00 A.M. to 9:00 A.M., and from 10:30 A.M. to 11:00 A.M. beginning March 6, 1967. The administrator was able to secure all anthropometric measures for at least seven subjects in a one hour period. Since two junior high schools were included in the study, all measurements were not taken at the same place. The measurements of the subjects enrolled at Piner Junior High were taken on Monday, Wednesday, and Friday and the measurements of the subjects enrolled at Dillingham Junior High were taken on Tuesday and Thursday.

The measurement of the leg, arm and hand, and foot was administered only on the left side of the body since the technique used to measure the right and left limbs was identical. Each of the girth measurements was taken at the level of maximal circumference. With the exception of standing height and leg length, which were taken in the gymnasium, all measurements were taken in the nurse's office. The measurements were administered in the following order: standing height, leg length, sitting trunk length, shoulder-girdle length, pelvic girdle width, arm and hand length, foot length, and weight.

Standing height.--Height measurement was secured with the subject's feet flat on the floor and her heels, hips, and head touching the wall. Each subject was instructed to stand

erect and to hold her chin level. The height measurement was taken on the left side of the corner wall. A wooden clip-board was place on the student's head so that it touched both walls parallel to the linear scale. Readings were recorded to the nearest one-half inch.

Leg length.--This distance was measured while the subject stood in an erect position with the feet together. The examiner faced the subject, placed her hands approximately four to six inches below the subject's waist on each hip and asked the subject to swing her left leg gack and forth slowly, and then to lift it to the outside. By manipulation, the examiner was able to locate the spot where the greater trochanter entered the pelvic girdle. The height of the greater trochanter from the floor was measured to the nearest one-half inch. This procedure was followed twice with every subject and the last measure was used.

Sitting trunk length.--Measurement of the sitting trunk was made with the subject seated on a small bench in an erect position. The stationary arm of the rod was placed at the seventh cervical vertebrae and the sliding arm was placed at the lower portion of the coccyx. By finger manipulation the examiner was able to determine the location for the measurement. Readings were recorded to the nearest one-half inch.

Pelvic-girdle width.--This was measured while the subject stood in an erect position with the feet together. In this position, the crests of the iliac were located by palpation and the arms of the sliding caliper were pressed firmly against the most lateral extensions of the crests. Readings were recorded to the nearest one-half inch.

Arm and hand length.--Measurement of the arm and hand was taken while the subject stood in normal position with the arm supinated and the fingers straight and together. The stationary arm of the sliding caliper was placed at the clavicle and scapula joints and the sliding arm was placed at the end of the distal point of the longest finger. Readings were recorded to the nearest one-half inch.

Foot length.--Measurement of the foot was taken with the subject standing in a normal position, feet parallel and about six inches apart, with the weight distributed evenly through the lower limbs. In this position, the stationary arm of the sliding caliper was applied to the heel of the left foot and the sliding arm was placed to the distal point of the longest toe. Readings were recorded to the nearest one-half inch.

Weight.--All students were weighed without their socks and tennis shoes and dressed in their regulation physical

education uniform. Readings were recorded to the nearest one-half pound.

Physical Fitness Assessment

During the pre-test workshop which was scheduled for all the junior high physical education teachers in the Sherman Public Schools, precedures for administering the AAHPER Battery were outlined. Each test item was explained and demonstrated according to the specific instructions given in the AAHPER Youth Fitness Test Manual (21, pp. 16-23). This manual and the necessary forms for recording test results were issued to each teacher. These forms were familiar to most but the directions for their completion were reviewed.

The seven test items for girls were administered by the subject's physical education teacher. Two ninth grade students, who were enrolled in the first semester physical education class were used as student assistants. One student was used to record the scores and the other student was used as a spotter. The scores were recorded on forms which had been previously distributed to the teachers. These forms may be seen in the appendix of this study. The order of testing was identical to the arrangement of tests on the forms.' This test order was selected to prevent, in as much as possible, warm-up fatigue effects on specific tests. All AAHPER test

items were administered in the afternoons from 2:00 P.M. to 3:00 P.M. Monday through Friday of a two-week period beginning March 20, 1967. The test items were administered in the following order: flexed-arm hang, sit-ups, shuttle-run, standing broad jump, 50-yard dash, softball throw, and 600-yard run-walk.

One period of fifty minutes was allowed for demonstration and participation of each of the four tests. Because of the length of time necessary to administer the softball throw, standing broad jump, and the 600-yard run-walk, two periods of fifty minutes were allowed. With the exception of the sit-up test, which was completed in the gymnasium, all of the tests were administered outside. All subjects wore a regulation physical education uniform, tennes shoes, and socks during the administration of the tests.

Since plastic and cloth tapes are subject to stretching and shrinking, a flexible steel tape was used to measure the softball throw and standing broad jump distances. Two Welby Sportster stopwatches were used for recording time. These stopwatches had a start, stop, and reverse stem across the top and measured to one-tenth of a second.

Preparation of Data

The data from the school nurse and each physical education teacher were compiled. From this compilation of data,

one IBM card was prepared for each individual subject. Each IBM card contained the following data: height in inches, weight in pounds, age in months, sitting trunk length in inches, arm and hand length in inches, shoulder girdle size in inches, foot length in inches, pelvic girdle size in inches, flexed-arm hang in seconds, number of sit-ups, shuttle-run time to the nearest tenth of a second, broad jump score to the nearest inch, 50-yard dash to the nearest tenth of a second, softball throw to the nearest inch, and the 600-yard run-walk to the nearest second.

Analysis

The compilation of anthropometric measurements and fitness scores were prepared for analysis. The data were analyzed by using the techniques of descriptive statistics, a correlation matrix, and a factorial statistical design.

Descriptive statistics computed included means and standard deviations for each race on each anthropometric measure and physical fitness item. Means and standard deviations for each variable were also computed for all one hundred subjects as a group. Means and standard deviations were compared to norms.

A Pearson product moment correlation matrix of all tests and all measurements was prepared in order to determine

relationships of anthropometric measurements and physical fitness performance.

A 2 x 2 factorial statistical design was prepared to determine if significant differences existed in anthropometric measures, performance on fitness scores, and also to determine the effect of puberty status on fitness.

Subjects' scores were divided into four groups of twenty-five subjects on the basis of the two factors, race and puberty. These groups were

Pre-puberty-Caucasian

Pre-puberty-Negro

Post-puberty-Caucasian

Post-puberty-Negro

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CHAPTER III

FINDINGS AND DISCUSSION

Findings

An analysis and an interpretation of anthropometric measures and physical fitness tests are presented in this chapter. The findings were computed and analyzed in terms of descriptive statistics which included anthropometric means and standard deviations, physical fitness means and standard deviations, and the AAHPER percentile ranking of each mean. Further analysis included a Pearson product-moment correlation matrix and a 2 x 2 factorial statistical design.

Descriptive Statistics

Means and standard deviations were computed for each race on each anthropometric measure and physical fitness item. Means and standard deviations on each variable were computed for all one hundred subjects as a group. The means and standard deviations for anthropometric measures are presented in Table I. It may be noted that in the majority of variables the standard deviations tended to be smaller for the Negro groups, whereas, the standard deviations for the Caucasian groups were larger.

TABLE I

ANTHROPOMETRIC MEANS AND STANDARD DEVIATIONS OF PRE- AND POST-PUBERTY CAUCASIAN AND NEGRO GROUPS

Variable	Race	Puberty Status	Mean	Standard Deviation
Height*	Caucasian	Pre	60.90	2.57
	Negro	Pre	61.96	1.72
	Caucasian	Post	63.16	2.98
	Negro	Post	63.31	2.51
Weight (pounds)	Caucasian	Pre	105.67	18.51
	Negro	Pre	107.00	8.44
	Caucasian	Post	115.66	15.56
	Negro	Post	117.84	12.84
Age (years)	Caucasian	Pre	11.91	3.85
	Negro	Pre	12.27	2.55
	Caucasian	Post	13.99	6.14
	Negro	Post	14.02	4.80
Puberty (months post-menarche)	Caucasian	Pre	.00	.00
	Negro	Pre	.00	.00
	Caucasian	Post	21.80	6.93
	Negro	Post	17.88	5.05
Sitting Trunk Length*	Caucasian	Pre	21.78	1.26
	Negro	Pre	21.78	1.01
	Caucasian	Post	23.16	1.84
	Negro	Post	23.17	1.79
Leg Length	Caucasian	Pre	31.84	1.20
	Negro	Pre	32.74	.82
	Caucasian	Post	32.68	1.00
	Negro	Post	32.81	1.04
Arm and Hand Length*	Caucasian	Pre	31.84	1.20
	Negro	Pre	32.74	.82
	Caucasian	Post	32.68	1.00
	Negro	Post	32.81	1.04
Shoulder Girdle*	Caucasian	Pre	24.07	2.31
	Negro	Pre	25.16	.82
	Caucasian	Post	25.48	1.00
	Negro	Post	25.70	1.04

Table I--Continued

Variable	Race	Puberty Status	Mean	Standard Deviation
Foot length*	Caucasian	Pre	9.63	.41
	Negro	Pre	9.82	.28
	Caucasian	Post	9.48	.38
	Negro	Post	10.08	.44
Pelvic Girdle*	Caucasian	Pre	9.94	.33
	Negro	Pre	9.72	.25
	Caucasian	Post	10.64	1.29
	Negro	Post	10.22	.43

*unit of measure = inches to the nearest $\frac{1}{2}$ inch.

Table II presents the physical fitness means, standard deviations, and AAHPER percentile ranking of means of pre- and post-puberty Caucasians and Negroes. The age ranged from eleven to twelve years for the pre-puberty groups and from thirteen to fourteen years of age for the post-puberty groups. It may be noted from Table II that the physical fitness test scores, with the exception of the standing broad jump and the 600-yard run-walk, appeared high for all groups when compared to the norms listed in the AAHPER Youth Fitness Test Manual (5, pp. 27-30). For example, all but these two exceptions were at or above the fiftieth percentile. It is interesting to note that the percentile ranking of the means of the

TABLE II

PHYSICAL FITNESS MEANS, STANDARD DEVIATIONS, AND PERCENTILE RANKING OF MEANS OF PRE- AND POST-PUBERTY CAUCASIAN AND NEGRO GROUPS

Physical Fitness Item	Race	Puberty Status	Mean	Standard Deviation	Percentile Ranking
Flexed-arm hang[a]	Caucasian	Pre	23.36	7.04	90
	Negro	Pre	23.28	6.49	90
	Caucasian	Post	27.80	9.12	95
	Negro	Post	26.44	8.65	95
Sit-ups[b]	Caucasian	Pre	34.56	11.41	55
	Negro	Pre	32.12	8.46	50
	Caucasian	Post	39.80	12.99	65
	Negro	Post	39.28	9.54	65
Shuttle-run[a]	Caucasian	Pre	11.18	.83	65
	Negro	Pre	11.46	.83	55
	Caucasian	Post	10.98	.69	65
	Negro	Post	10.76	.76	70
Standing broad jump[c]	Caucasian	Pre	59.08	7.03	45
	Negro	Pre	58.80	5.85	45
	Caucasian	Post	62.96	9.94	55
	Negro	Post	64.48	7.48	65
50-yard dash[a]	Caucasian	Pre	8.22	.70	50
	Negro	Pre	8.04	.66	60
	Caucasian	Post	7.88	.67	70
	Negro	Post	7.43	.57	85
Softball throw[d]	Caucasian	Pre	77.72	16.73	70
	Negro	Pre	91.93	18.75	85
	Caucasian	Post	89.14	21.99	80
	Negro	Post	98.83	19.44	90
600-yard run-walk[a]	Caucasian	Pre	172.24	24.06	15
	Negro	Pre	167.56	19.81	15
	Caucasian	Post	163.64	19.39	5
	Negro	Post	162.36	21.58	5

[a]unit of measure = time to .10/sec.
[b]unit of measure = 1 point per complete sit-up.
[c]unit of measure = distance to the nearest $\frac{1}{2}$ inch.
[d]unit of measure = distance to the nearest foot.

flexed-arm hang, 50-yard dash, and softball throw were exceptionally high for all groups. The scores ranked far above the fiftieth percentile when compared to AAHPER physical fitness test norms.

Relationships of Anthropometric Measurements and Physical Fitness

The relationships were determined by a Pearson product-moment correlation coefficient. These correlations are presented in a matrix in Table III. Almost all of the anthropometric measures correlated with each other. Few of the anthropometric measures were significantly correlated with physical fitness, and those coefficients that were significant, were very low. Four physical fitness tests correlated with each other. Those tests intercorrelating were the flexed arm-hang with sit-ups ($r = .58$), shuttle-run with 50-yard dash and 600-yard run-walk ($r = .57$). These were only moderate, however, which is to be expected since the test battery was designed to measure different aspects of physical fitness.

TABLE III

INTERCORRELATIONS OF ANTHROPOMETRIC AND PHYSICAL FITNESS VARIABLES

		2	3	4	5	6	7
1	Height	.42	.38	.34	.92	.87	.40
2	Weight		.33	.32	.40	.38	.24
3	Age			.93	.43	.29	.34
4	Puberty				.43	.22	.31
5	Sitting trunk					.68	.38
6	Leg length						.36
7	Arm and hand						
8	Shoulder girdle						
9	Foot length						
10	Pelvic girdle						
11	Flexed-arm hang						
12	Sit-ups						
13	Shuttle-run						
14	Standing broad jump						
15	50-yard dash						
16	Softball throw						
17	600-yard run-walk						

r .19 = $p < .05$
r .27 = $p < .01$

TABLE III-Continued

8	9	10	11	12	13	14	15	16	17
.46	.47	.26	.05	-.01	.04	-.01	-.06	.11	-.02
.82	.68	.72	-.10	-.04	.16	.13	.14	.23	.11
.44	.29	.37	.19	.25	-.25	.35	-.29	.26	-.14
.38	.19	.42	.22	.25	-.19	.32	-.23	.20	-.08
.47	.41	.29	.05	.05	-.04	.03	-.09	.10	-.04
.40	.45	.17	.04	-.08	.14	-.05	-.03	.11	-.00
.32	.22	.16	-.04	-.06	-.02	.06	-.00	-.04	-.02
	.70	.51	-.03	.06	.02	.11	-.02	.18	.04
		.34	-.05	.04	.15	.17	-.04	.41	.03
			-.03	.03	.06	.22	.08	.13	.01
				.58	-.19	.03	-.36	.16	-.28
					-.26	.15	-.32	.12	-.26
						-.48	.67	-.15	.51
							-.42	.16	-.35
								-.29	.57
									.17

Anthropometric and Physical Fitness Differences Attributable to Race and/or Puberty

The data were subjected to an analysis of variance and the results are presented in Table IV. Since all interactions are nonsignificant, it is possible to discuss the main effects of race and puberty as pure factors concerning either anthropometric differences or physical fitness differences.

Differences in anthropometric measures.--Race appeared to be a significant factor in anthropometric differences. The Negroes were found to have a significantly longer leg, longer arm and hand, longer foot, wider shoulder girdle, and a narrower pelvic girdle than the Caucasians with whom they were compared. The only anthropometric measure in which the Caucasians exceeded the Negroes was in pelvic girdle width. All anthropometric differences between pre- and post-puberty groups were significant. As was expected, the post-puberty groups were taller, heavier, older, had a longer arm and hand, wider shoulder girdle, longer foot, and a wider pelvic girdle than the pre-puberty groups.

Differences in physical fitness items.--It may be seen in Table IV that with the exception of the 50-yard dash and softball throw, race was a nonsignificant factor in physical fitness differences. However, in both the 50-yard dash and

TABLE IV

ANALYSIS OF VARIANCE: EFFECT OF RACIAL AND PUBERTY STATUS ON ANTHROPOMETRIC MEASURES AND PHYSICAL FITNESS

Variables	Source	SS	df	MS	F
Height	Race	57.50	1	57.50	1.39
	Puberty	521.10	1	521.10	12.63**
	R X P	31.10	1	31.10	
	Within	3960.30	96	41.25	
	Total	4569.90	99	158.34	
Weight	Race	14.79	1	14.79	
	Puberty	555.94	1	555.94	12.84*
	R X P	.83	1	.83	
	Within	4155.75	96	43.28	
	Total	4727.31	99	50.20	
Age	Race	116.60	1	116.60	3.78
	Puberty	12276.60	1	11276.60	398.72**
	R X P	36.00	1	36.00	1.17
	Within	2956.60	96	30.79	
	Total	15385.80	99	156.68	
Sitting trunk	Race	.23	1	.23	
	Puberty	324.89	1	324.89	21.56**
	R X P	.35	1	.35	
	Within	1482.37	96	15.44	
	Total	1807.84	99	57.12	
Leg Length	Race	43.60	1	43.60	6.22*
	Puberty	34.12	1	34.12	4.86*
	R X P	18.65	1	18.65	2.66
	Within	673.31	96	7.01	
	Total	769.68	99	82.65	
Arm and hand length	Race	64.02	1	64.02	5.73*
	Puberty	145.56	1	145.56	13.03**
	R X P	27.11	1	27.11	2.43
	Within	1072.46	96	11.17	
	Total	1309.15	99	63.79	
Shoulder Girdle	Race	22.67	1	22.67	13.82**
	Puberty	48.13	1	48.13	29.35**
	R X P	5.78	1	5.78	3.52
	Within	157.68	96	1.64	
	Total	234.26	99	33.88	

TABLE IV--Continued

Variables	Source	SS	df	MS	F
Foot Length	Race	56.14	1	56.14	53.46**
	Puberty	10.08	1	10.08	9.50**
	R X P	.02	1	.02	
	Within	100.50	96	1.05	
	Total	166.74	99	24.52	
Pelvic Girdle	Race	18.65	1	18.65	5.53*
	Puberty	61.70	1	61.70	18.40
	R X P	2.32	1	2.37	
	Within	323.73	96	3.37	
	Total	406.69	99	25.76	
Flexed-arm hang	Race	12.96	1	12.96	
	Puberty	361.00	1	361.00	5.56*
	R X P	10.24	1	10.24	
	Within	6232.96	96	64.93	
	Total	6617.16	99	25.22	
Sit-ups	Race	54.76	1	54.76	
	Puberty	961.00	1	961.00	7.84**
	R X P	23.04	1	23.04	
	Within	11753.84	96	123.44	
	Total	12792.64	99	36.44	
Shuttle-run	Race	.02	1	.02	
	Puberty	5.15	1	5.15	8.17**
	R X P	1.56	1	1.56	2.48
	Within	60.33	96	.63	
	Total	67.07	99	11.09	
Standing broad jump	Race	9.61	1	9.61	
	Puberty	571.21	1	571.21	9.20
	R X P	20.25	1	20.25	
	Within	5959.04	96	60.07	
	Total	6560.11	99	61.33	
50-yard dash	Race	2.53	1	2.53	5.75*
	Puberty	5.71	1	5.71	12.75**
	R X P	.45	1	.45	
	Within	42.66	96	.44	
	Total	53.35	99	7.89	

TABLE IV--Continued

Variable	Source	SS	df	MS	F
Softball throw	Race	357126.00	1	357126.00	9.19**
	Puberty	209582.00	1	209582.00	5.37*
	R X P	12721.00	1	12721.00	
	Within	3732309.00	96	38878.22	
	Total	4311738.00	99	894.06	
600-yard run-walk	Race	221.80	1	221.80	
	Puberty	1190.20	1	1190.20	2.52
	R X P	72.20	1	72.30	
	Within	45320.40	96	472.09	
	Total	46804.70	99	166.45	

*$F_{1,96}$ 3.95 = P < .05.
**$F_{1,96}$ 6.92 = P < .01.

the softball throw, the Negro groups were superior to the Caucasian groups. This difference was significant at the .05 level of confidence for the 50-yard dahs, and at the .01 level of confidence for the softball throw. Interestingly, the pre-puberty Negro group mean of 91.93 even exceeded the post-puberty Caucasian group mean of 89.14.

Puberty was a significant factor in responses on six of the seven physical fitness items. The post-puberty groups were superior in the flexed-arm hang, sit-ups, shuttle-run, standing broad jump, 50-yard dash, and softball throw. Neither race nor puberty was a significant factor in the subject's performance on the 600-yard run-walk item.

Discussion

The findings of this study indicate that anthropometric differences do exist between the races and that Negroes are superior in the softball throw and the 50-yard dash.

Descriptive Statistics

The Caucasian group standard deviations almost without exception, were larger than the Negro standard deviations, but there is no explanation in the literature that might clarify the meaning of this finding. Age, weight, and height are not significantly different for Negroes and Caucasians, and moderate correlations exist between all anthropometric measures. Height correlates highly with those anthropometric measures that were significantly different between races. It would seem then, that neither the relationship among variables nor the apparent racial differences account for the relatively small spread of the Negro groups around their means. Ponthieux and Barker (8) and Hutinger (6) did not report standard deviations, so these cannot be compared.

The percentile rankings of group means, when compared with the AAHPER physical fitness norms, were relatively high for all items except the 600-yard run-walk and in the standing broad jump. In all the physical fitness items except the standing broad jump and 600-yard run-walk the post-

puberty group means ranked a higher percentile rating than the pre-puberty groups. There seems to be no logical explanation for this finding. In all the physical fitness test items included in this study the post-puberty Negro group had the same or a higher percentile ranking than the post-puberty Caucasian group. These findings support the findings of Ponthieux and Barker (8, pp. 468-472) that the Negro girls surpassed the Caucasian girls significantly on four physical fitness items as measured by the AAHPER Youth Fitness Test.

Relationships of Anthropometric Measurement and Physical Fitness

It seemed reasonable at the onset of this study to predict that the anthropometric measures would correlate with each other, physical fitness variables would correlate with each other, and the anthropometric measures would correlate with physical fitness. It seemed logical to assume that a longer leg length, longer arm and hand, and a wider shoulder girdle would enable a subject to develop more power and speed in the limbs. This would result in a superior performance on fitness items for those with longer limbs. The results of this study, however, fail to show that such a relationship is found in the age group studied. With the exception

of foot length with softball throw (r = .41), the findings of this study reveal low but insignificant correlations.

Anthropometric and Physical Fitness Differences Attributable to Race and/or Puberty

There has been some discussion concerning race and puberty as being potentially significant factors influencing anthropometric and physical fitness differences. The findings indicate that there are factors that seem to influence physical performance, but the low correlations between anthropometric measures and physical fitness items indicate that anthropometric differences is not one of these factors.

Race and puberty both were significant factors in anthropometric differences. The findings reveal that the Negroes have a longer leg, longer foot, and a narrower pelvic girdle, which would appear to be an aid in running. The Negroes were also found to have a longer arm and hand and a wider shoulder girdle, which would seem to be an influence on the performance of the softball throw. These findings substantiate other investigators (4, 7, 9, 10) who have found anthropometric differences. Metheny (7) also found a greater foot length, but her conclusions agreed with the findings of this study that the anthropometric difference of a longer Negro foot does not appear to offer an advantage in jumping or running. The low correlations between the anthropometric measures and

physical fitness items force the hypothesis that differences in limb length are advantageous in motor performance to be rejected. Hutinger (6) suggested that a faster reaction time might be the cause of Negro superiority in sprint races; however Henry (3) pointed out that other evidence clearly shows that there is no significant difference in Negro and Caucasian reaction time. A yet unidentified variable or variables, other than anthropometric measurements, must be the cause of Negro superiority in short races and throwing events.

Puberty must be considered the primary factor in physical fitness differences, moreover, these findings indicate that post-puberty groups were superior in physical performance on all measures except the softball throw and the 600-yard run-walk item. These findings support Clearey's conclusions (1) that for girls, age made its greatest contribution to physical performance at the age of thirteen and one half.

Race, as well as puberty, seems to be a significant factor in only the softball throw and the 50-yard dash. Ponthieux and Barker (8) and Hutinger (6) also found that Negroes surpassed the Caucasians on the 35-yard dash.

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CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This chapter presents a summary of the problem, conclusions based on the results of the study, and recommendations. Considerable discussion has been reported in the literature concerning anthropometric differences among races. These discussions have led some investigators to believe that anthropometric differences are related to physical performance and may have some effect on test items that are used to assess fitness. This study was designed to determine the relationship that may exist among anthropometric measurements and physical fitness when racial and puberty status are considered.

Data for determining relationships consisted of anthropometric measurements and physical fitness scores of fifty pre- and post-puberty Caucasian and fifty pre- and post puberty Negro females enrolled in the physical education classes at Piner and Dillingham Junior High Schools, Sherman, Texas. The subjects ranged in age from eleven to sixteen years of age and were selected from the seventh, eighth, and ninth grades. Anthropometric measures of interest were height,

weight, sitting trunk length, leg length, arm and hand length, shoulder girdle, foot length, and pelvic girdle. Physical fitness scores were obtained from the administration of the AAHPER Youth Fitness Test Battery, which is composed of the items of flexed-arm hang, sit-ups, shuttle-run, standing broad jump, 50-yard dash, softball throw, and 600-yard run-walk.

The data were computed and analyzed by descriptive analysis, the Pearson product-moment correlation technique, and a 2 x 2 factorial statistical design. Subjects' scores were divided into four groups of twenty-five subjects on the basis of the two factors, race and puberty. The four groups were pre-puberty Caucasian, pre-puberty Negro, post-puberty Caucasian, and post-puberty Negro.

Conclusions

Of the hypotheses presented on pages four and five, hypotheses one, three, five six, seven, and eight were rejected. Hypotheses two and four were not rejected for any physical fitness item except the softball throw and the 50-yard dash. Hypothesis nine was not rejected except for the relationship of puberty and age with the fitness items. These findings justify the following conclusions within the limits of this study:

1. Almost all anthropometric measures intercorrelated significantly.

2. There was no relationship between anthropometric measures and physical fitness.

3. The performance of Negroes was significantly superior to that of Caucasians on the 50-yard dash and the softball throw.

4. Negroes have a significantly longer leg, longer arm and hand, longer foot, a wider shoulder girdle, and a narrower pelvic girdle than Caucasians.

5. The superiority of Negroes in two items of the physical fitness test does not appear to be due to racial anthropometric differences.

Recommendations

As a result of this study, the following recommendations are presented.

1. Norms for the 50-yard dash and the softball throw should be re-evaluated in terms of their suitability for children the same age but of different races.

2. Pre- and post-puberty girls should not compete against each other in activities that involve any of the motor fitness items included in the AAHPER Physical Fitness Battery.

3. The significant difference in Negro and Caucasian performance on the softball throw and the 50-yard dash should be considered before planning competitive events that involve primarily running and throwing.

4. A similar study should be conducted utilizing pre- and post-puberty boys of both races as subjects.

5. Further study should be initiated that would clarify the causes of an apparent Negro superiority in short running and throwing activities.

6. In preparing a physical fitness program, the puberty status of individuals should be considered a major factor rather than race.

7. Physical educators should consider anthropometric differences in comparing the physical performance of Negroes and Caucasians in physical education classes.

APPENDIX

PROCEDURE OF THE PHYSICAL FITNESS TEST ADMINISTRATION

I. Flexed-arm hang for girls

A. Equipment: A horizontal bar approximately 1½ inches in deameter, fixed to prevent rotation and preferably adjustable to various heights. A stop watch is needed.

B. Description: The height of the bar should be adjusted so it is approximately equal to the pupil's standing height. The pupil should use the overhand grasp. With the assistance of two spotters, one in front and one in back of pupils, the pupil raises her body off the floor to a position where the chin is above the bar, the elbows are flexed, and the chest is close to the bar. The pupil holds this position as long as possible.

C. Administration:

1. The stop watch is started as soon as the subject takes the hanging position.

2. The watch is stopped when:

a. Pupil's chin touches the bar

b. Pupil's head tilts backwards to keep chin above the bar

c. Pupil's chin falls below the level of the bar

D. Scoring: Record in seconds to the nearest second the length of time the subject holds the hanging position.

II. Sit-ups for girls

A. Equipment: Mat or floor

B. Description: The pupil lies on her back, either on the floor or on a mat, with legs extended and feet about two feet apart. Her hands are placed on the back of the neck with the fingers interlaced. Elbows are retracted. A partner holds the ankles down, the heels being in contact with the mat or floor at all times. The pupil sits up, turning trunk to the left and touching the right elbow to the right knee, returns to starting position, then sits up turning trunk to the right touching the left elbow to the right knee. The exercise is repeated, alternating sides.

C. Administration:

1. The fingers must remain in contact behind the neck throughout the exercise.

2. The knees must be on the floor during the sit-up but may be slightly bent when touching elbow to knee.

3. The back should be rounded and the head and elbows brought forward when sitting up as a "curl" up.

4. When returning to starting position, elbows must be flat on the mat before sitting up again.

D. Scoring: One point is given for each complete movement of touching elbow to knee. No score should be counted if the fingertips do not maintain contact behind the head, if knees are bent when the pupil lies on her back or when she begins to sit up, or if the pupil pushed up off the floor from an elbow.

III. Shuttle-run for girls

A. Equipment: Two blocks of wood, 2 inches x 2 x 4 inches, and stop-watch.

B. Description: Two parallel lines are marked on the floor or ground 30 feet apart. Place the blocks of wood behind one of the lines. The pupil starts from behind the other line. On the signal "Ready? Go" the pupil runs to the blocks, picks one up, runs back to the starting line, and places the block behind the line; she then runs back and picks up the second block, which she carries back across the starting line.

C. Administration: Two pupils may run at the same time if stop-watches are available.

D. Scoring: Record the time from the word, "Go," until the pupil crosses the finish line on the second trip. The time is recorded to the nearest tenth of a second.

IV. Standing Broad Jump for girls

A. Equipment: Mat, floor, or outdoor jumping pit, and tape measure.

B. Description: Pupil stands with the feet several inches apart and the toes just behind the take-off line. From this position, the pupil bends her knees, swings her arms downward and backward and then jumps forward from both feet as far as possible. The jump is accomplished by a simultaneous extension of the knees and vigorous forward and upward swing of the arms. The landing is made on both feet.

C. Administration:
1. Three trials are allowed.

2. The distance of the jump is measured from the take-off, starting line, to the heel or other part of the body that touches the floor nearest the take-off line.

D. Scoring: Record the best distance of the three trial jumps. The distance jumped is recorded in feet and inches to the nearest inch.

V. 50-yard dash for girls

A. Equipment: Stop-watches, designated starting and finish lines.

B. Description: This test item should be administered out of doors. The runner takes a starting position behind the starting line. The starter uses the commands, "Take your mark, Get set, Go." On the command, "Go," the pupil runs the distance at top speed.

C. Administration:

1. Pupils are allowed a reasonable warm-up.

2. Regular tennis shoes should be worn.

3. Two or more pupils may run at the same time depending on the availability of stop-watches.

4. The timer starts his stop-watch on the starter's signal and stops it the instant the runner crosses the finish line.

D. Scoring: Record the time required to run the distance in seconds to the nearest tenth of a second.

VI. Softball throw for distance for girls

A. Equipment: Softball, small metal or wooden stakes, and tape measure.

B. Description: Lines should be drawn parallel to the restraining line, five yards apart. The pupil throws the ball while remaining within two parallel lines, six feet apart. Mark the point of landing with one of the stakes. If her second or third throw is farther, move the stake accordingly so that, after the throws, the stake is at the point of the pupil's best throw.

C. Administration:

1. Only an overhand throw may be used.

2. Three throws are allowed.

3. The distance recorded is the distance measured at right angles from the point of landing to the restraining line.

D. Scoring: Record the best of the three trials to the nearest foot.

VII. 600-yard run-walk for girls

A. Equipment: Stop-watch, starting play.

B. Description: The pupil uses a standing start and assumes a starting position behind the starting line. The starter uses the command, "Take your mark, Get set, Go." At the command, "Go," the starter lowers the flag and the pupil runs or, if necessary runs and walks the distance in the shortest possible time.

C. Administration:

1. The timer starts his stop-watch at the word, "Go," and times the crossing of the finish line to the nearest second.

2. The pupil may run the entire distance or she may stop running, walk for awhile, and begin running again.

3. The pupil should set her pace so that she will cover the total distance and cross the finish line in the possible shortest time.

D. Scoring: Record the time for the distance in minutes and seconds to the nearest second.

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