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STRENGTH AND PHYSICAL FITNESS OF RURAL VERSUS URBAN BOYS AS DETERMINED BY THE ROGERS PHYSICAL FITNESS INDEX

BY

JAMES L. WELTON

A thesis submitted
in partial fulfillment of the requirements for the degree
Master of Science, Department of Physical
Education, South Dakota State
College of Agriculture
and Mechanic Arts

June, 1960

STRENGTH AND PHYSICAL FITNESS OF RURAL VERSUS URBAN BOYS AS DETERMINED BY THE ROGERS PHYSICAL FITNESS INDEX

This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and acceptable as meeting the thesis requirements for this degree; but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Advisor

Head of the Major Department

ACKNOWLEDGEMENTS

The author wishes to express his sincere appreciation and gratitude to Dr. R. B. Frost for his guidance and assistance during the course of this research.

Expressions of appreciation are also extended to the many students whose aid cooperation made this study possible.

J. L. W.

To

Marilyn,

Marsha,

and

Nancy.

Roger

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CHAPTER I

INTRODUCTION

The farm family has been recognized by many as a hardy lot who could endure a hard life and strenuous labor. On the other hand, city people have been thought of as being weaker because of a life less demanding.

In the past it has been accepted generally that the rural boy was superior to the urban boy in over-all physical strength. The rural boy has been stereotyped as a big, muscular individual with a strong back and a weak mind. The town boy, on the other hand, has seldom been considered as an exceptionally strong individual.

Throughout the years the farm and city families have led different types of lives. The farmer has been more dependent upon himself while the city man has been more dependent upon others.

The machine age has greatly changed the type and amount of work a man has to perform on the farm. The great influx of machinery since the turn of the century has tended to create less work for the farmer. This, in turn, meant less work for his children. Such things as chopping wood, pitching hay, and mowing alfalfa, which used to be a major part of farm work, have been greatly changed due to the increased use of machinery. It is possible that the absence of such manual tasks has affected the strength of the rural youth.

This increase in mechanization and automation has considerably altered the lives of both rural and urban people. This change has

created more time-saving devices, a decline in physical labor, and an increase in leisure time. As a result over-all rural and urban living is more closely parallel than ever before.

The general consensus has been that rural people are outstanding examples of healthful living.

Rogers tells us that there is a definite correlation between health and strength.[1] This thesis, therefore, has been designed to compare one phase of health in rural and urban boys, namely that of strength.

Statement of the Problem

Many strength tests have been administered to city and farm boys but very few comparisons of the two groups have been made. Their differing physical abilities have been almost completely ignored. The problem of this thesis is to compare the strength of urban and rural boys as determined by the Rogers Physical Fitness Index.

Sub-Problems

Areas which will be considered in the comparison of strength and fitness between urban and rural youth are as follows:

1. their respective scores on the Physical Fitness Index;
2. their respective scores on the Strength Index.

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[1]Frederick R. Rogers, "The Significance of Strength Tests in Revealing Physical Conditions," Research Quarterly, vol. 5, 43-46, October, 1934.

3. their performances with respect to each item in the Strength Index;

4. height;

5. weight.

Delimitations

Certain factors existed which possibly influenced the conclusiveness of this study. It was limited to subjects taken from one geographical area and to the use of only two age groups (ages 12 and 15). The study was also limited to the comparison of growth and maturity factors, items of strength, and the Physical Fitness Index.*

The general limitations of all testing procedures and methods are well summed up by McCloy in his statement that:

> No one test can measure everything in the physical education program . . . each test has its specific uses and its definite limitations . . . so that each type of measurement will be used only for the purposes for which it is adapted.[2]

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[2]Charles H. McCloy, Tests and Measurements in Health and Physical Education, p. 2, F. S. Crofts Company: New York, 1939.

*Hereafter referred to as P.F.I.

CHAPTER II

HISTORY AND PREVIOUS RESEARCH

The precise measurement of strength has been the concern of scientists during the past 250 years. An historical account of the origin and development of instruments to measure the strength of human muscles has been provided by Hunsicker and Donley.[3] The first study of its kind was reported in 1699 by De La Hire, a French scientist. Since that time, numerous instruments have been designed and many studies have been made in an attempt to measure man's strength. Prior to the latter part of the 19th century, tests used to estimate and predict physical performance were primarily anthropometric in nature. Sargent and Martin realized the need for a test that would give a higher relationship to physical performance.[4] Thus, the first strength test was originated.

Physical educators and health officials have long recognized the need for adequate muscular strength in the human body. Rogers summarizes the opinion of many physical education people in the following paragraph:

> The positive and very high relation of muscular strength to general health, physical fitness, or capacity for activity can

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[3]Hunsicker and Donley, "Instruments to Measure Strength," Research Quarterly, vol. 26, 408-420, December, 1955.

[4]Larson and Yocom, Measurement and Evaluation in Physical Health and Recreation Education, p. 77, C. V. Mosby Co.: St. Louis, 1951.

> hardly be questioned. With no strength there can be no physical activity; moreover, when muscular strength is low, all other life functions are handicapped. One can hardly see as much, hear as much, meet as many people, or contribute as much to social life when one is continually fatigued by the most necessary activities of life--eating, digestion, attention to environment, and the physical movements incident upon travel from one group or surroundings to another. The relation of organic conditions is just beginning to be recognized; but experiences are multiplied which reveal beyond per adventure, the truth of the following rule: Practically every change in the condition or functioning of the vital organs has a corresponding change in the condition of functioning of voluntary muscle.[5]

Steinhaus says that an individual's muscles become larger and therefore stronger as a result of exercise. Only exercise which is heavy enough to tax a muscle to its limit will stimulate muscles to grow larger and correspondingly stronger.[6]

The result of poor muscular strength is explicitly explained by McCloy when he states that:

> Individuals who are twenty-five percent overweight, or individuals who have only four-fifths of the normal amount of muscle for given weights suffer certain hardships. The under-muscled individuals tire easily, and this fatigue is cumulative to complete exhaustion. The overweight individuals carry too great a load for the muscle structure of their bodies. Thus muscle efficiency is lessened, because the efficiency of the muscle contraction is related to the muscle load. A muscle with a light load operates more effectively than one that is overloaded. This overload so leads to fatigue, and constant fatigue becomes a health handicap, in that fatigued individuals are more liable to colds.[7]

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[5]Frederick R. Rogers, "The Significance of Strength Tests in Revealing Physical Condition," Research Quarterly, vol. 5, 43-46, October, 1934.

[6]Larson and Yocom, op. cit., p. 77.

[7]Charles H. McCloy, "The Apparent Importance of Arm Strength in Athletics," Research Quarterly, vol. 5, 3-10, March, 1934.

The Intercollegiate Strength Test, originated by Sargent and Martin, was highly recognized and extensively used until World War I. In 1925 Frederick Rand Rogers presented a revised strength test which changed one item and included a different method of scoring for other items.[8] Rogers also published norms for his test. A number of studies followed which supported Roger's original conclusion of the significant relationship of strength to general athletic ability.

McCloy believed that strength tests have two important uses in our program of physical education: first as indices of health or general physical condition, and second, as predictors of potential general motor ability or general athletic ability.[9]

Throughout the history of strength testing, physical educators have been concerned as to what part of the body or what muscle groups should be measured to get a realistic picture of total body strength. Wendler made an analytical study of a large battery of strength measurements to determine the muscle groups that are most valuable for predicting total strength. He concluded with the following:

1. The sum of the strength of four muscle groups--the thigh flexors, the leg extensors, the arm flexors, and the pectoralis major--gives a highly reliable prediction of total strength of men.

2. The strength of six muscle groups--the thigh extensors, the thigh flexors, the leg extensors, the deltoids, the

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[8]Frederick R. Rogers, "Physical Capacity Tests in the Administration of Physical Education," Contributions to Education No. 173, Teachers College, Columbia University: New York, 1925.

[9]C.H. McCloy, op. cit., p. 5.

pectoralis major, and the hand flexors--when properly combined will predict total strength of woman with approximately the same degree of reliability as the men's battery does for men.

3. The above batteries are almost as valuable for the prediction of total strength as the entire Intercollegiate Strength Test and have the added advantage of requiring no expensive apparatus.[10]

Strength Tests

Rogers' Strength Index and Physical Fitness Index

Rogers, in creating the P.F.I., was originally concerned with devising only a single test which was valid, reliable, and simple to compute, for the purpose of predicting general athletic ability. His study was extended so that the final score, the Strength Index,* was related to a norm based on age, weight, and sex. The S.I. was used in deriving a quotient, the P.F.I., which he considered a measure of relative strength and an essential element in general physical fitness.

The P.F.I. consisted of four muscular strength tests (Right Grip, Left Grip, Leg Lift, and Back Lift), two muscular endurance tests (Chins and Dips), and a test of Lung Capacity. The S.I. was the gross score obtained by adding the strength scores of the seven items. The P.F.I. was obtained by dividing the achieved S.I. by a norm for the individual's age, weight, and sex and multiplying by 100. The average

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[10]Arthur J. Wendler, "An Analytical Study of Strength Tests Using the Universal Dynamometer," Research Quarterly, vol. 6, 81-85, October, 1935.

*Hereafter referred to as S.I.

score was considered to be 100.

Since it was originated, the P.F.I. has been gradually improved by Rogers and others. Possibly the greatest improvement in the testing technique was reported in 1938 by Hathaway and Everts, when they designed the "belt technique."[11] In considering the effect of this technique, Rogers estimated that it increased the validity of the S.I. as a measure of general athletic ability by ten to fifteen per cent and of the P.F.I. as a measure of general health and endurance by possibly fifteen per cent.[12]

A statistical analysis of this test by McCloy, Cureton, and Larson demonstrates that the arm strength formula accounts for about ninety per cent of the test when used as a measure of general athletic ability.[13] McCloy also states the following:

> In case the arms are well developed as to strength, the back and legs are usually also well developed. The individual develops his legs doing activities which use the other muscles. The reverse however, is not necessarily true; for individuals who engage in running or jumping programs do not necessarily develop the arms. The correlation between chinning strength alone and all the rest of the body in a study in which this comparison was made was .91.[14]

McCloy also states that lung capacity should be eliminated as

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[11]Hathaway and Everts, "The Use of the Belt to Measure Leg Strength Improves the Administration of Physical Fitness Tests," Research Quarterly, vol. 9, 62-69, October, 1938.

[12]Frederick R. Rogers, "The Evaluation of Physical Fitness Tests and Programs," Education, vol. 60, 538, April, 1940.

[13]Larson and Yocom, op. cit., p. 84.

[14]Charles H. McCloy, op. cit., p. 7.

it is not a test of strength and contributes nothing to the value of the strength tests as such.[15]

To indicate the significance of muscular strength as a measure of general physical fitness, Rogers offered the following summary:

1. Since large muscle activity improves general physical fitness, and
2. Since large muscle activity procedures increase the strength of the active muscles, therefore
3. A measure of the increase in strength is a measure of the improvement in general physical fitness, and
4. A measure of the strength status of muscle fibers is also a measure of the fitness status of the organs of respiration, circulation, digestion, and elimination.[16]

According to Clarke the reliability and objectivity of the P.F.I., when administered by a competent tester, were established in 1925 by Rogers and have since been verified by other investigations.[17] Rogers reported the reliability coefficients of various test items ranged between .86 and .97. The reliability coefficient of the S.I. ranged from .94 to .98.[18]

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[15]Charles H. McCloy, Tests and Measurements in Health and Physical Education, 2nd Ed., Appleton-Century-Crofts, Inc.: New York, 1942.

[16]Frederick R. Rogers, Tests and Measurements Programs in the Redirection of Physical Education, pp. 1-111, Teachers College, Columbia University: New York, 1927.

[17]H. Harrison Clarke, Application of Measurement to Health and Physical Education, p. 172, Prentice Hall, Inc.: New York, 1950.

[18]Frederick R. Rogers, Physical Capacity Tests in the Administration of Physical Education, p. 25, Teachers College, Columbia University: New York, 1925.

McCloy Strength Index

McCloy devised a method of scoring chinning and dipping which simplified the computation of actual strength from the number of chins or dips and body weight.

In devising this test, McCloy used well-trained subjects who did pull-ups daily. The first day five pounds of weight was attached to the subject and the number of pull-ups was recorded. On each succeeding day an additional five pounds of weight was added until he could do no pull-ups.

The total chinning strength was considered to be the individual's weight plus the amount of additional weight added that permitted but one chin or dip.[19]

Clarke Strength Test

This test was devised during World War II when it was felt that improved methods of rehabilitation were needed. This test was first used for the Orthopedic disabled servicemen.

The Clarke Strength Test, through the use of the tensionmeter, can be administered at any of the joints of the body. Measurement can vary from 5 to 300 pounds. The position of the joint for the application of pulling force is specified for each test in the strength measurement sequence. The elimination of compensating action of muscles is accomplished with this adjustment. Test reliabilities are

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[19]Charles H. McCloy, "A New Method of Scoring Chinning and Dipping," Research Quarterly, vol. 2, 132, December, 1931.

high by this method; however, there are no norms available for this test.[20]

Wendler Total Strength Test

This test was devised by measuring forty-seven different muscle groups with the universal dynamometer. The purpose was to find the muscle groups most valuable in predicting total strength. The best combination proved to be (1) thigh extensors, (2) leg extensors, (3) pectoralis major, (4) arm flexors, (5) anterior trunk extensors, (6) foot extensors.[21]

Bruckner, who employed the Navy Standard Physical Fitness Test in a comparative study of urban and rural boys, concluded that there was no significant difference in the physical fitness of urban and rural boys.[22]

During World War I fifteen states had more physical rejections of rural inhabitants than urban inhabitants.[23]

Interest in strength testing is not new. However, it has been

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[20]H. Harrison Clarke, "Objective Strength Tests of Affected Muscle Groups Involved in Orthopedic Disabilities," Research Quarterly, vol. 19, 120, May, 1948.

[21]Arthur J. Wendler, "An Analytical Study of Strength Tests Using the Universal Dynamometer," Research Quarterly, vol. 6, 81-85, October, 1935.

[22]L. R. Bruckner, Unpublished Master's Thesis, "A Comparative Study of the Physical Fitness of Eleventh and Twelfth Grade Rural and Town Boys as Measured by the Navy Standard Physical Fitness Test," University of Michigan, Ann Arbor, Michigan, June, 1946.

[23]Henry S. Curtiss, "Physical Education--Rural and City Aspects," Playground, vol. 19, 106-108, May, 1925.

only since the turn of the century that practical, valid, and reliable strength tests have been constructed. While the opinions of physical educators has differed as to the items which should constitute strength tests, they have been more in agreement concerning the value and need of adequate physical strength in the human body.

Many sociologists have compared urban and rural living. However, the comparisons have dealt primarily with the areas of material and environmental differences.

It may be seen, therefore, that not much research has been done with respect to differentiating rural and urban students as to strength. This study will seek to determine whether or not differences do actually exist or whether opinions have been based on little more than presumption.

CHAPTER III

PROCEDURE

Source of Data

To obtain the data for this investigation, an equal distribution of rural and urban boys was needed. Seven Minnesota schools and one South Dakota school were selected to participate in this study. The schools were as follows:

Clear Lake, South Dakota

Hendricks, Minnesota

Ivanhoe, Minnesota

Jasper, Minnesota

Lake Benton, Minnesota

Pipestone, Minnesota

Tracy, Minnesota

Tyler, Minnesota

A total of 403 boys were used as subjects. They were grouped as follows:

Group	Description	Number
A	12 year old rural boys	100
B	12 year old urban boys	102
C	15 year old rural boys	101
D	15 year old urban boys	100

The groups have been referred to by letter, as indicated above, throughout this study.

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The reasons for the selection of boys at these specific age levels were as follows:

1. A period of at least three years between the two age levels was desirable because it allowed for a suitable period of growth and maturation. Any changes in P.F.I. scores, between the age groupings, could be more clearly observed.

2. The testing was facilitated by using boys of these age levels who were participating in physical education.

Definitions

Rural boys were defined as those boys who have lived on a farm continuously since their third birthday.

Urban boys were defined as those boys who have lived in a town continuously since their third birthday.

Rural and urban boys were defined in this manner because it was felt that prior to this age boys would have basically the same interests and their activities would be essentially the same.

Testing Procedure

Permission to administer the test battery was obtained through a personal interview with each of the superintendents and physical education instructors. At that time class schedules were obtained and dates for the administration of the test battery were agreed upon.

During the second visit each boy was given instructions and

assistance in filling out a brief questionnaire (Appendix). Some individuals were eliminated from further consideration for reasons of age, inability to meet the residence requirements, and physical handicaps which prevented adequate or complete measurement.

All items of the test were administered during the regular physical education class. The entire test battery was administered by the author. Physical education instructors of the respective schools assisted with the recording of scores.

Each item was administered to each boy three times with the best score being recorded and used. All boys were dressed in their regular physical education costumes.

During the administration of each test item, the subject was strongly encouraged to obtain a maximum effort.

Instructions for the administration of the Rogers P.F.I., as outlined by H. Harrison Clarke, were closely followed.[25] Prior to beginning the testing program, the author was thoroughly trained in the use of the P.F.I. and many sample tests were administered.

The Rogers P.F.I. consisted of seven items plus age, height, and weight. The following order was recommended for the administration of the test battery:[26]

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[25]H. Harrison Clarke, Application of Measurement to Health and Physical Education, 3rd ed., pp. 184-197, Prentice Hall, Inc.: New York, 1959.

[26]Ibid., p. 184.

1. Age
2. Height
3. Weight
4. Lung Capacity
5. Right Grip
6. Left Grip
7. Back Lift
8. Leg Lift
9. Chins
10. Dips

Each test item was demonstrated to the group before being administered. Detailed instructions for the test battery will be found on the following pages.

Age

The age of each boy was taken in years and months. Each birthdate was rounded to the nearest full month.

Height

The subjects were measured in stocking feet with their height being recorded at the nearest half-inch.

Weight

The subjects were dressed in physical education costumes. Tennis shoes were removed and the weight was recorded at the nearest full pound.

Lung Capacity

Lung Capacity was measured in cubic centimeters with a Wet Spirometer (Figure 1).

The spirometer was equipped with a hose about 36 inches

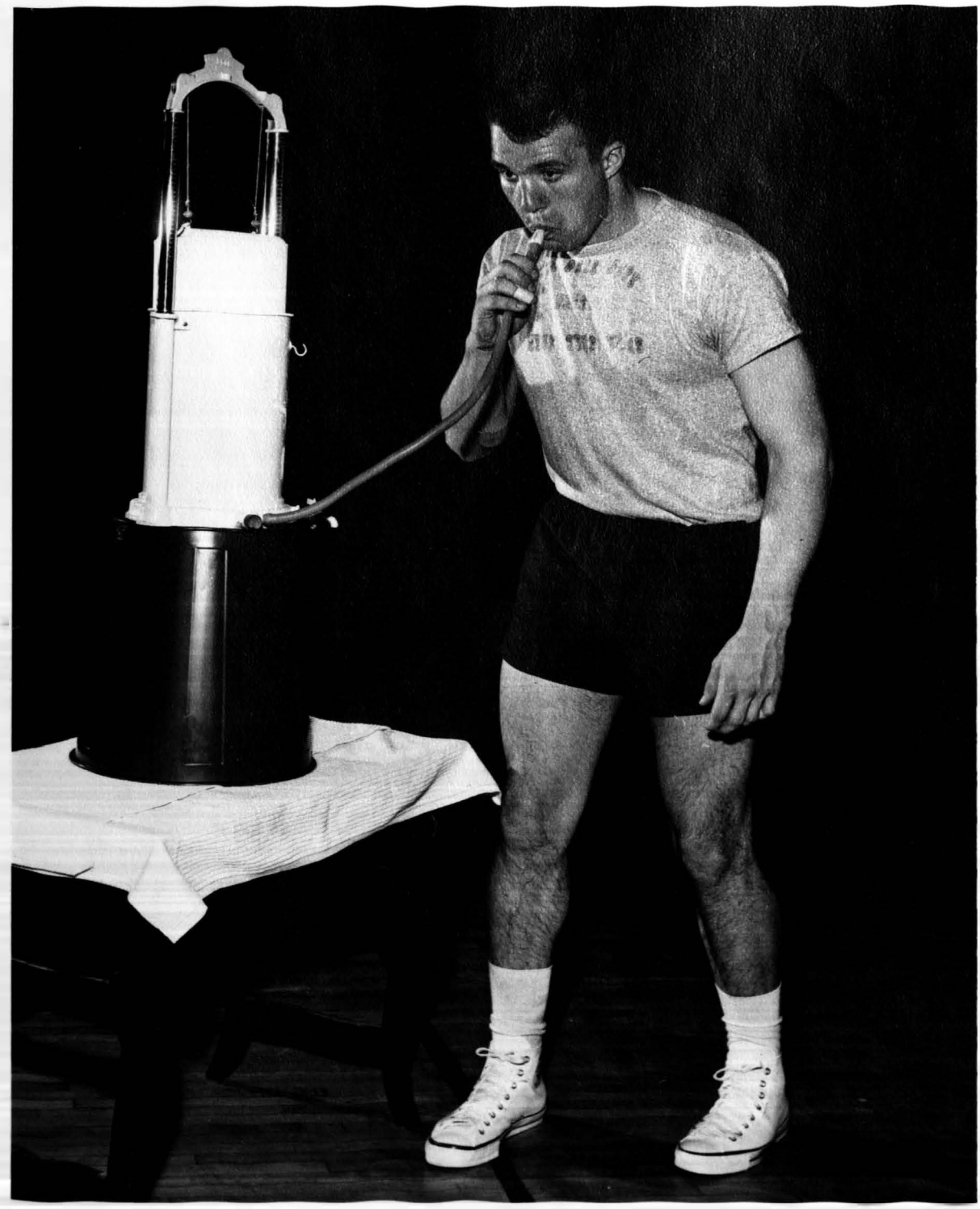

Figure 1. Test of Lung Capacity With Wet Spirometer

and filled with water to within one inch of the top. It was placed at a height of about four to four and a half feet from the floor so that all subjects could stand erect when beginning the test.

A sterilized wooden mouthpiece was made available for each subject's use. The mouthpiece was inserted, by the testee, into the rubber tube. Upon completion of the test, the subject discarded the mouthpiece.

Each subject was instructed to take one or two deep breaths of air. Then after the fullest possible inhalation, he exhaled slowly and steadily while bending forward over the hose until as much air as possible was expelled. Subjects were cautioned to avoid loss of air through the nose or around the edges of the mouthpiece, and to avoid taking a second breath until the test was completed.

The scoring pointer was watched closely to note when it reached the highest point.

Grip Strength

A hand dynamometer was used to measure the grip strength of both the right and left hands (Figure 2).

A cake of magnesium carbonate was made available for dusting the hands if they became moist and slippery.

The tester held the edge of the dynamometer between the thumb and the forefinger of his right hand and placed it in the palm of the subject's hand while holding the hand to be tested with his left hand. The dynamometer was placed in the hand in such a manner that

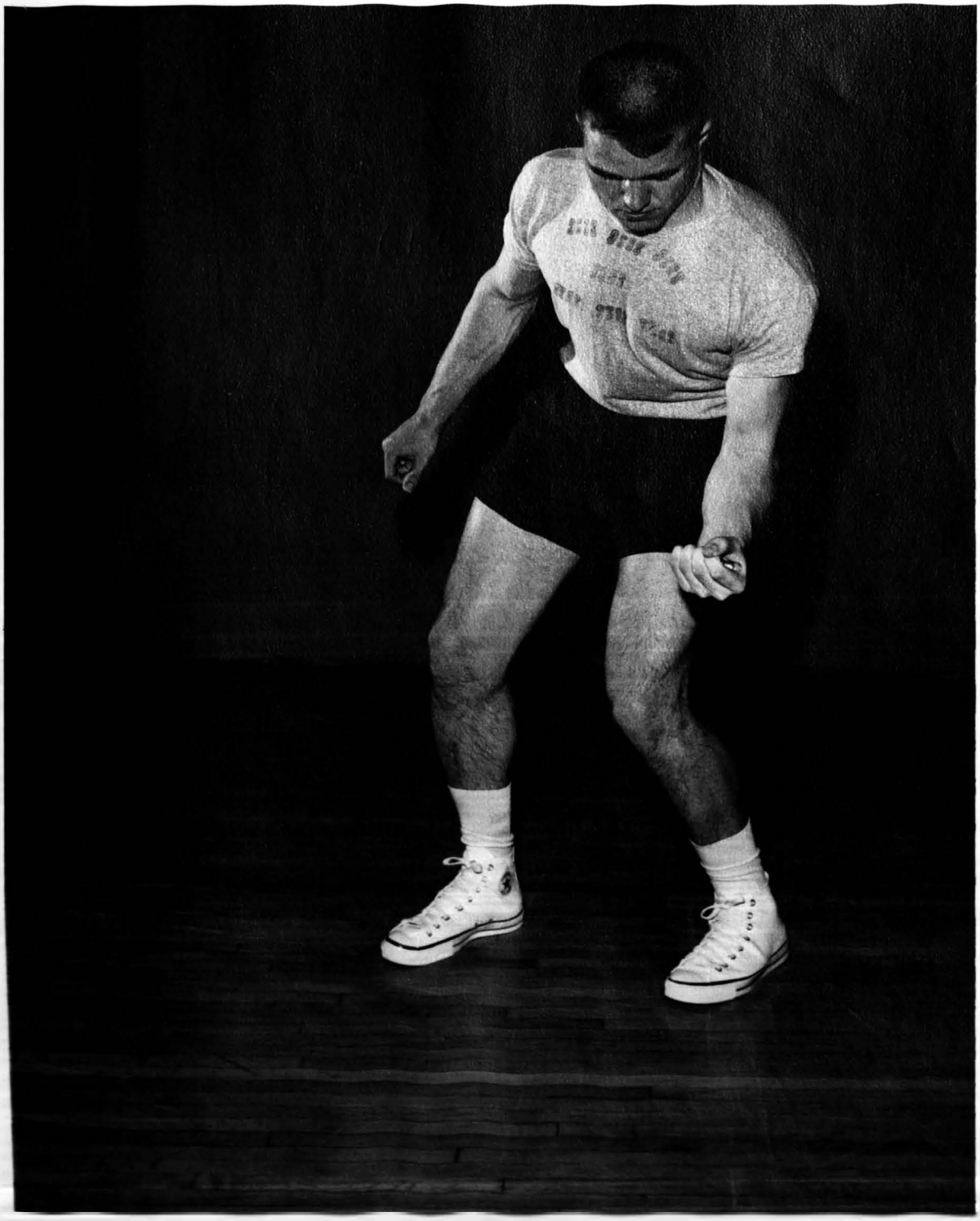

Figure 2. Test of Gripping Strength With Hand Dynamometer

the convex edge was between the first and second joints of the fingers and the rounded edge was against the base of the hand. The dial of the dynamometer was placed face down in the hand.

The subjects were instructed to bend the elbow slightly and as the dynamometer was squeezed, the arm was to move downward in a sweeping arc. The hands and arms were not allowed to touch the body or any other object while the test was being administered. If the hands did touch some object, the score was not read and a retest was given after a short rest period.

The right hand was tested first. The indicator was then returned to zero and the left hand was tested.

Leg Strength

The standard back and leg dynamometer was used in measuring the strength of both back and leg muscles (Figure 3). It was calibrated in pounds and measured a maximum lift of 2500 pounds.

A wide fiber belt, four inches wide, was fastened around the waist of the subject and to the handle to provide a more accurate measurement.

Each subject was instructed to hold the handle with both hands together in the center, palms down, and in close to the body at the waist. The loop end of the belt was then placed over one end of the handle. The free end of the belt was looped around the other end of the handle and tucked under so that it rested next to the body. In this position, the pressure of the belt against the body held the handle securely.

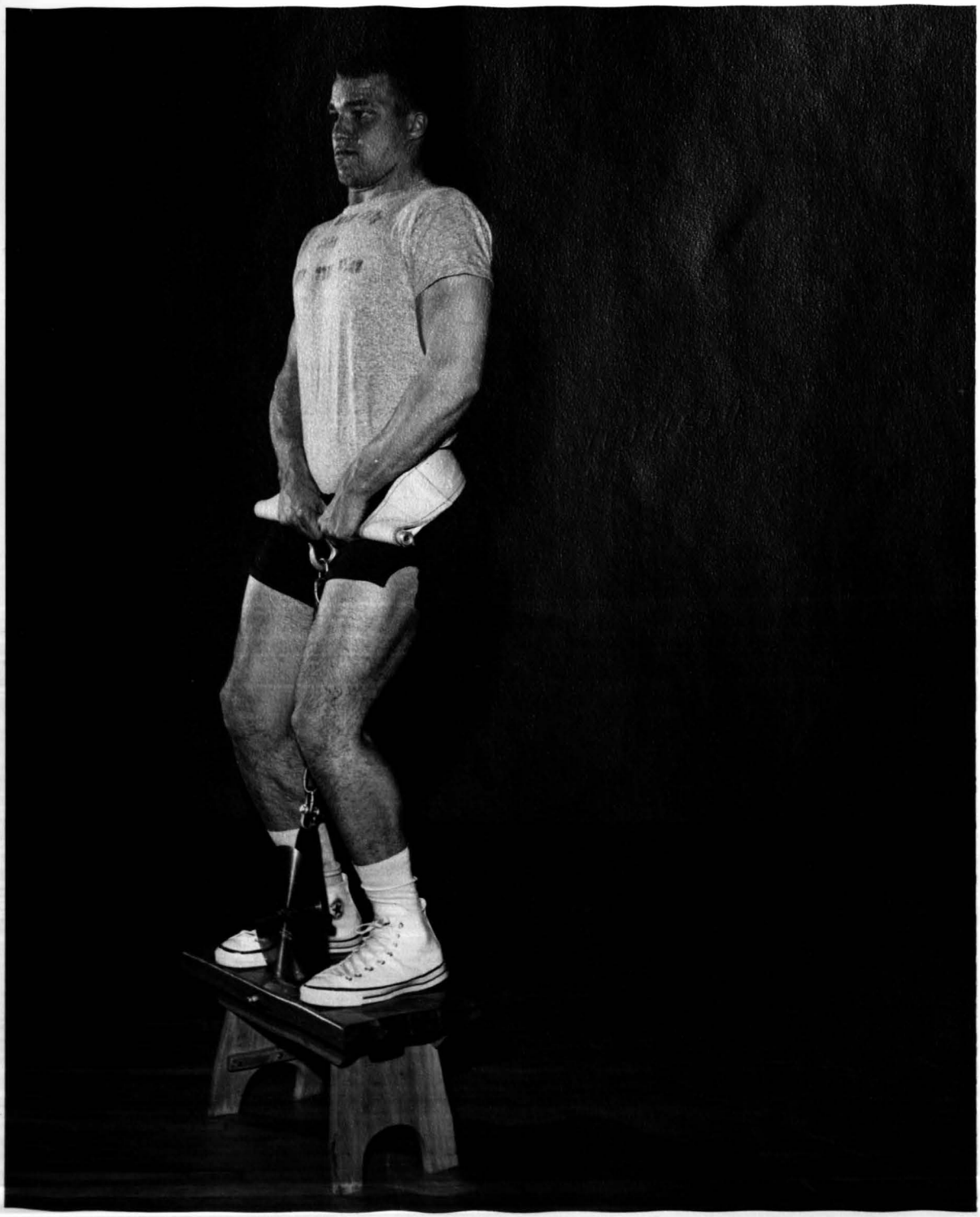

Figure 3. Leg Lift Test With Back and Leg Dynamometer

The subject then stepped on the marked areas of the bench (feet exactly six inches apart) and bent his knees slightly. The chain was then fastened in place and the subject attempted to straighten his knees by lifting. In most cases a maximum effort resulted when the legs were almost straight at the conclusion of the trial.

Three trials were given each subject with the chain being adjusted after each. The best score of the three trials was then recorded.

Back Strength

As previously mentioned, the back and leg dynamometer was used in measuring the strength of both back and leg muscles (Figure 4). In the back test, however, the belt was not used.

With the feet in the proper position on the base of the dynamometer (same as for Leg Lift), each subject was asked to stand erect with the hands on the front of the thighs, fingers extended downward. The tester then hooked the chain so that the handle level was just below the finger tips. The subject grasped the handle firmly at the ends of the bar, with one palm forward and one palm backward. The subject was then in position to lift; he was bent forward slightly at the hips, his head was up, his eyes directed straight ahead, and his legs straight. Additional instructions included emphasis upon a steady lift and upon keeping the feet flat on the bench. As the subject began to lift, the tester then firmly grasped the hands of the subject until the test was completed.

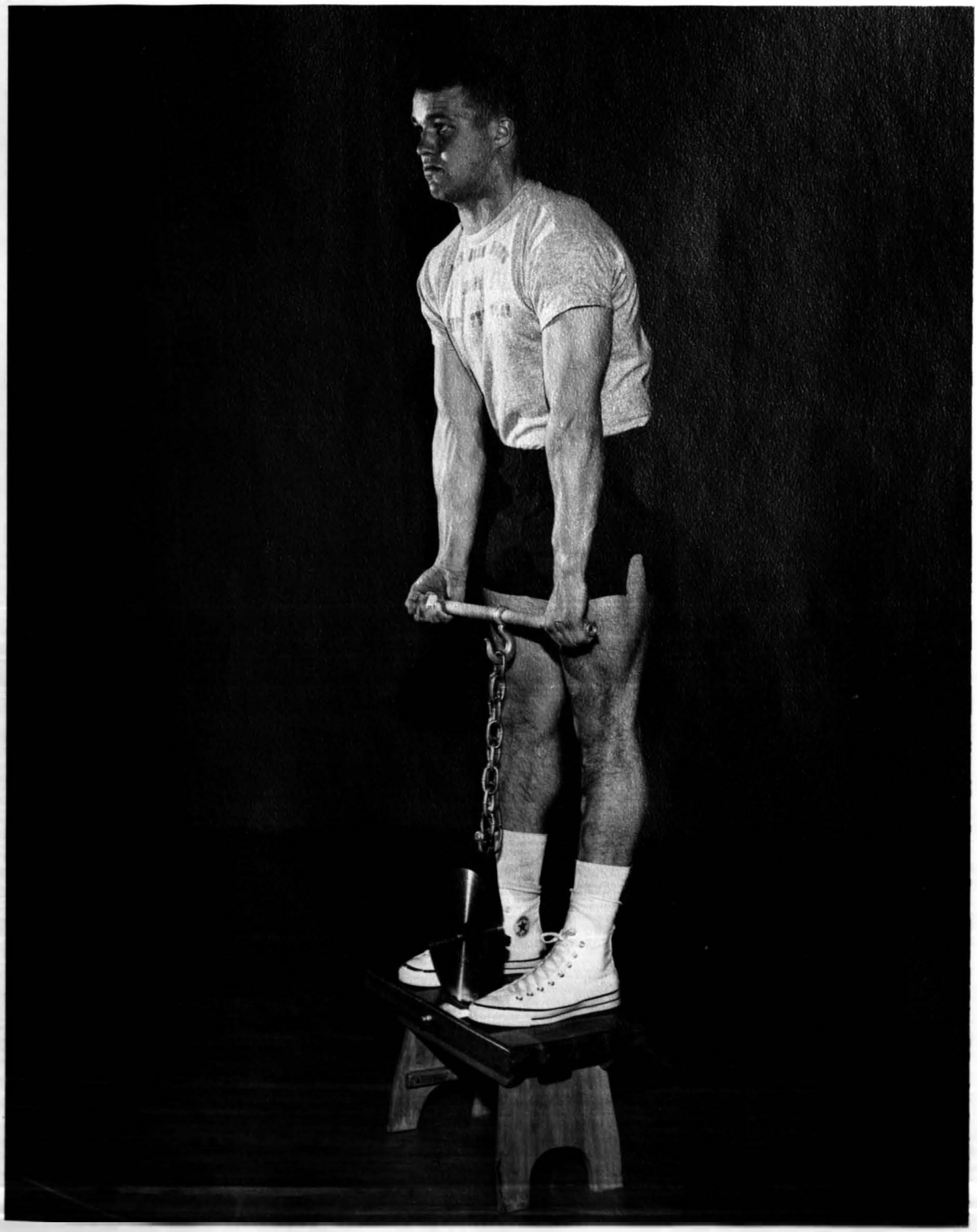

Figure 4. Back Lift Test With Back and Leg Dynamometer

A maximum effort occurred most frequently when the subject was not forced to bend forward too much. An extreme bending at the waist resulted in a loss of power.

Each subject was given three trials with the handle being re-adjusted preceding each trial. The best score was recorded and used.

Chins (Pull-Ups)

For the pull-up test a chinning bar was used which was adjusted to a height whereby the tallest boy could not touch the floor when performing the test (Figure 5).

In taking this test, each subject was to hang from the bar (palms forward) and do as many pull-ups as possible. In executing the movement, each boy was to pull upward until his chin was even with the bar, then lower himself until the arms were straight.

The subjects were cautioned to avoid jerking, kicking, and swinging movements.

A penalty was imposed by giving only half-counts for failure to pull all the way up, for failure to straighten the arms at the completion of a pull-up, and for any kicking or jerking movement in performing the test. Only four half-counts were permitted.

Dips (Push-Ups)

For the push-up test, regular gymnasium parallel bars were used (Figure 6). Since some of the smaller schools had no parallel bars, a metal portable set was devised for use in those cases. The

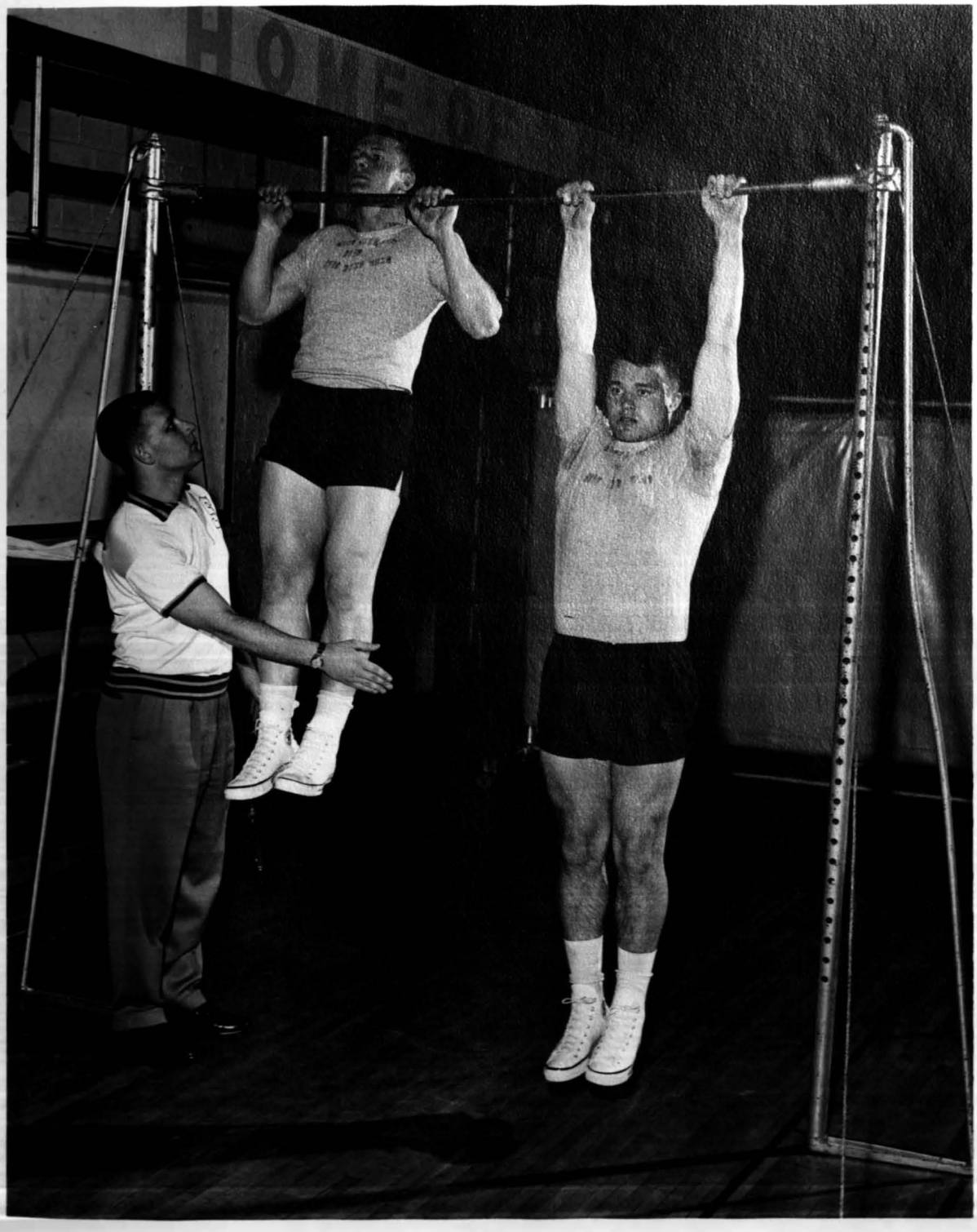

Figure 5. Pull-Up Test

parallel bars were adjusted to compensate for differences in the size of the subjects.

The subject stood at the end of the parallel bars, grasping one bar with each hand. He then jumped up to a position in which the arms were straight. He then lowered his body until the angle of the upper arm and forearm was less than a right angle. He then returned to the straight-arm position. This movement was repeated as many times as possible.

The subject was not permitted to jerk or kick when executing this test. Failure to lower himself the proper distance or to go all the way up to a straight-arm position involved the use of penalty points (a maximum of four half-count points).

During the first dip of each subject, the tester gauged the proper distance the body should be lowered by observing the elbow angle. He then placed his hand in a position so that the subject's should just touched it on repeated tests.

Method of Scoring the Strength Index and Physical Fitness Index

The Strength Index and the Physical Fitness Index were computed upon completion of the testing program. In each case, the best score obtained on each test item was used.

The Arm Strength was obtained by combining the pull-up and push-up tests in the following formula:[27]

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[27]Ibid., p. 195.

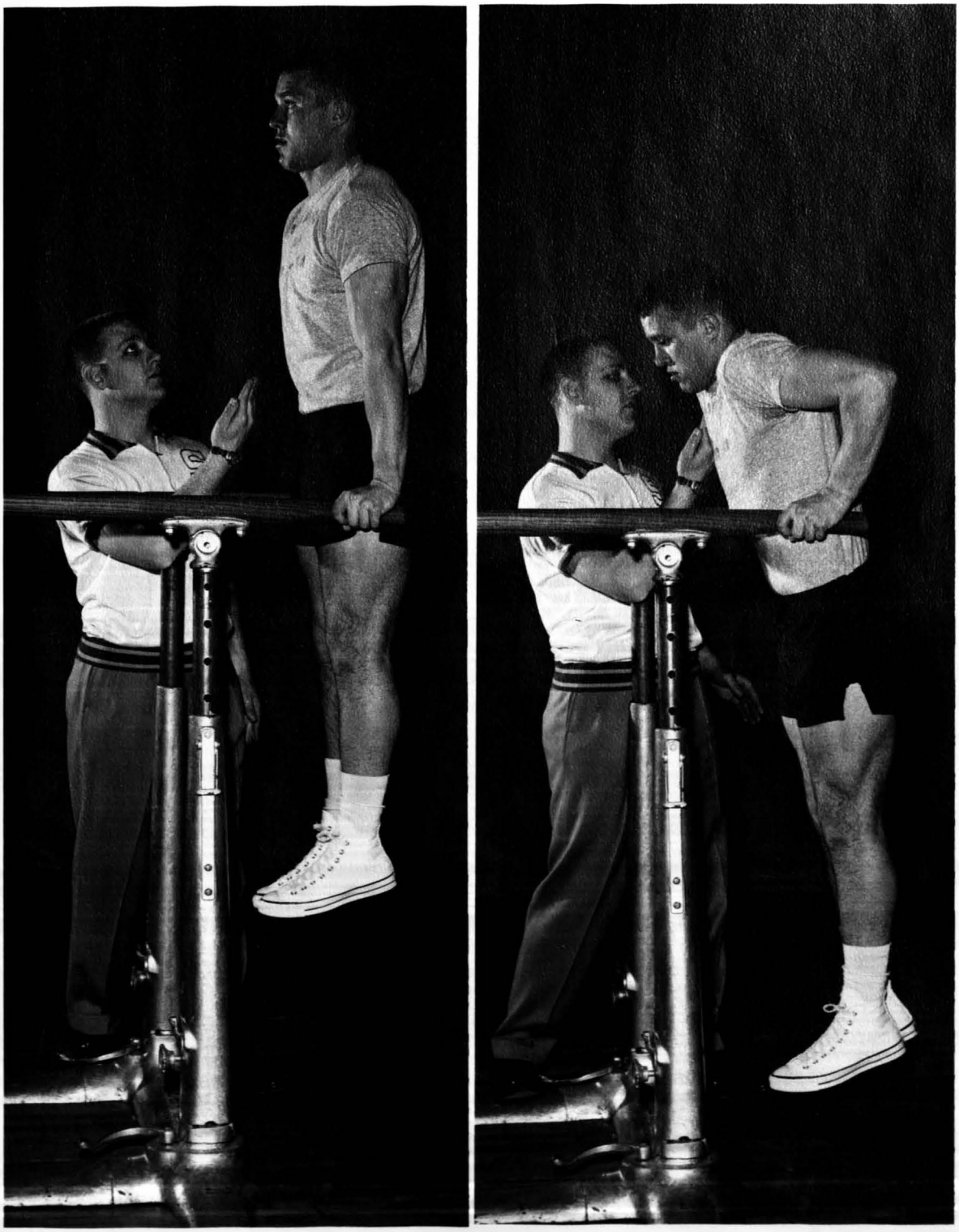

Figure 6. Push-Up Test

$$(\text{Pull-Ups} + \text{Push-Ups}) \left(\frac{\text{Weight}}{10} + \text{Height} - 60\right)$$

The S.I. was then obtained by computing the sum of the scores of Lung Capacity, Right Grip, Left Grip, Leg Lift, Back Lift, and Arm Strength.

P.F.I. scores were then determined through the use of the following formula:[28]

$$\text{P.F.I.} = \frac{\text{Achieved S.I.}}{\text{Normal S.I.}} \times 100$$

The Normal S.I. was obtained from a norm chart. When weights fell between points on the chart the next weight above and the age immediately below were used.[29]

In a limited number of cases there were boys with a weight higher than that recorded on the norm chart. For each age level a weight multiplier was provided for computing these extreme weights.

All scores were recorded and the data employed in making the desired comparisons.

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[28] Ibid., p. 195.

[29] Ibid., p. 462.

CHAPTER IV

TREATMENT AND INTERPRETATION OF THE DATA

Statistical Computations

The primary purpose of this study was to compare the strength and physical fitness of rural boys with that of urban boys. In addition, a comparison was made of their height and weight.

To determine whether or not the groups were equivalent, the Classification Index of each subject was computed, the mean and the standard deviation of these indices calculated, and a comparison of these figures made (Table I).[30] The mean and the standard deviation for Group A was compared with that of Group B and the mean and the standard deviation of Group C with that of Group D.

TABLE I. MEANS AND STANDARD DEVIATIONS OF GROUPS A, B, C, AND D AS COMPUTED FROM THE McCLOY CLASSIFICATION INDEX

Group	Mean	Standard Deviation
A	702.70	32.55
B	702.75	32.85
C	842.39	35.55
D	846.39	32.70

[30] H. Harrison Clarke, Application of Measurement to Health and Physical Education, p. 305, Prentice Hall, Inc.: New York, 1959.

Groups A and B and Groups C and D were accepted as equivalent for the purposes of this study.

The experimental design employed was the "correlated group" method, in which the rural and urban subjects were given the same test. The results were then compared statistically.

It was therefore necessary to compute the means ($M = \frac{\Sigma X}{N}$), the difference between the means ($M_1 - M_2$), and the significance of the difference. The standard error of the means was determined through the use of the following formula:[31]

$$\sigma_D = \sqrt{(\sigma^2_{M_{x_1}} + \sigma^2_{M_{x_2}})(1 - r^2_{xy})} \quad *$$

The device used for determining the significance of the difference was the "t" value, which was computed by dividing the difference between the means by the standard error of this difference ("t" = $\frac{M_{Difference}}{D}$).

The null hypothesis was then applied in each case.[32]

With 199 degrees of freedom for Groups A and B $\Big((N-1) + (M-1)\Big) - 1$, a "t" value of 1.97 was needed for significance at the five per cent level, and 2.50 for significance at the one per cent level.

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* x represents the variable under study.

y represents the variable by which the groups have been equated as to mean and standard deviation (Classification Index).

[31] Henry E. Garrett, Statistics in Psychology and Education, pp. 230-231, Longmans, Green and Co.: New York, 1958.

[32] Ibid., p. 213.

With 198 degrees of freedom for Groups C and D, the "t" value needed for significance was the same.[33]

Interpretation of the Data

Groups A and B (Individual items of the Strength Test)

The "t" values, computed from the results of the various items of the Rogers Strength Test, may be found in Table II. From observation of this table, it may be seen that "t" values for all

TABLE II. DIFFERENCES (GROUPS A AND B) BETWEEN THE MEANS, STANDARD ERROR OF THE DIFFERENCES, "t" VALUES, AND LEVEL OF SIGNIFICANCE COMPUTED FROM EACH ITEM OF THE ROGERS STRENGTH TEST

Test Items	M_1 (Group A)	M_2 (Group B)	Difference ($M_1 - M_2$)	σ Diff	"t"	Level
Lung Capacity	173.20	170.20	3.00	3.91	.77	*
Right Grip	51.10	49.21	1.89	2.97	.64	*
Left Grip	46.00	43.03	2.97	2.62	1.13	*
Leg Lift	550.50	523.60	26.90	20.61	1.30	*
Back Lift	230.00	217.15	12.85	8.64	1.49	*
Chins	2.95	2.05	.90	.88	1.03	*
Dips	4.92	3.75	1.17	.66	1.76	*
Arm Strength	83.00	68.65	14.35	10.85	1.32	*

*Not Significant.

[33] Ibid., p. 449.

items are too small for significance at the five per cent level. The null hypothesis must therefore be accepted and the assumption made that there is no real difference.

Groups C and D (Individual items of the Strength Test)

From Table III it may be observed that the "t" value of 1.51 for Lung Capacity and the "t" value of 1.09 for the Right Grip are both too small for significance at the five per cent level. This is also true for the Leg Lift with a "t" value of .08 and of the Back Lift with a "t" value of 1.80. In these cases the null hypothesis was accepted. No real differences between these groups existed with respect to these items.

TABLE III. DIFFERENCES (GROUPS C AND D) BETWEEN THE MEANS, STANDARD ERROR OF THE DIFFERENCES, "t" VALUES, AND LEVEL OF SIGNIFICANCE COMPUTED FROM EACH ITEM OF THE ROGERS STRENGTH TEST

Test Items	M_1 (Group C)	M_2 (Group D)	Difference ($M_1 - M_2$)	σ Diff.	"t"	Level
Lung Capacity	253.20	261.00	-7.80	5.16	1.51	*
Right Grip	92.12	96.10	-3.98	3.65	1.09	*
Left Grip	87.96	81.40	6.56	3.29	1.99	.05
Leg Lift	857.40	855.50	1.90	23.57	.08	*
Back Lift	351.50	334.50	17.00	9.43	1.80	*
Chins	6.25	4.58	1.67	.56	2.95	.01
Dips	8.82	7.25	1.57	.73	2.14	.05
Arm Strength	302.50	256.50	46.00	20.81	2.21	.05

*Not Significant.

The difference in the Left Grip ("t" value 1.99) was significant at the five per cent level. The null hypothesis, in this case, was rejected and the difference assumed to be real. Group C scored better in Chins than did Group D. A "t" value of 2.95 was obtained. The null hypothesis, in this case, was rejected at the one per cent level and a real difference believed to be present. Through observation of the "t" value of 2.15 in the Dips and the "t" value of 2.21 in Arm Strength, it may be seen that both items were significant at the five per cent level. Thus, the null hypothesis was rejected and a true difference assumed.

Group A and B (Height and Weight)

The rural and urban 12 year old boys were very closely related as to height and weight. It may be seen in Table IV that there was practically no difference between the two groups. The "t" value,

TABLE IV. DIFFERENCES (GROUPS A AND B) BETWEEN THE MEANS, STANDARD ERROR OF THE DIFFERENCES, "t" VALUES, AND LEVEL OF SIGNIFICANCE COMPUTED FROM HEIGHT AND WEIGHT

Items	M_1 (Group A)	M_2 (Group B)	Difference ($M_1 - M_2$)	$\sigma_{Diff.}$	"t"	Level
Height	60.80	60.85	-.05	.49	.10	*
Weight	100.00	99.30	.70	2.68	.26	*

*Not Significant.

in this instance, was not large enough to be considered significant at the five per cent level. The null hypothesis was therefore accepted.

Group C and D (Height and Weight)

In height and weight, Group C showed a slight advantage over Group D (Table V). However, the "t" values of 1.81 for height, and .83 for weight were considerably below the "t" value of 1.98 needed for acceptance at the five per cent level of significance. In both situations, the null hypothesis was accepted.

TABLE V. DIFFERENCES (GROUPS C AND D) BETWEEN THE MEANS, STANDARD ERROR OF THE DIFFERENCES, "t" VALUES, AND LEVEL OF SIGNIFICANCE COMPUTED FROM HEIGHT AND WEIGHT.

Items	M_1 (Group C)	M_2 Group D)	Difference ($M_1 - M_2$)	σ Diff.	"t"	Level
Height	67.65	68.50	-.85	.47	1.81	*
Weight	137.17	139.60	-2.43	2.94	.83	*

*Not Significant.

Group A and B (Strength Index)

The "t" value of the S.I. (1.69) was not large enough to indicate significance at the five per cent level. Therefore, the null hypothesis was accepted and no real difference assumed.

TABLE VI. DIFFERENCE (GROUPS A AND B) BETWEEN THE MEANS, STANDARD ERROR OF THE DIFFERENCE, "t" VALUE, AND LEVEL OF SIGNIFICANCE COMPUTED FROM THE STRENGTH INDEX

Item	M_1 (Group A)	M_2 (Group B)	Difference ($M_1 - M_2$)	σ Diff.	"t"	Level
Strength Index	1118.50	1063.20	55.30	32.78	1.69	*

*Not Significant.

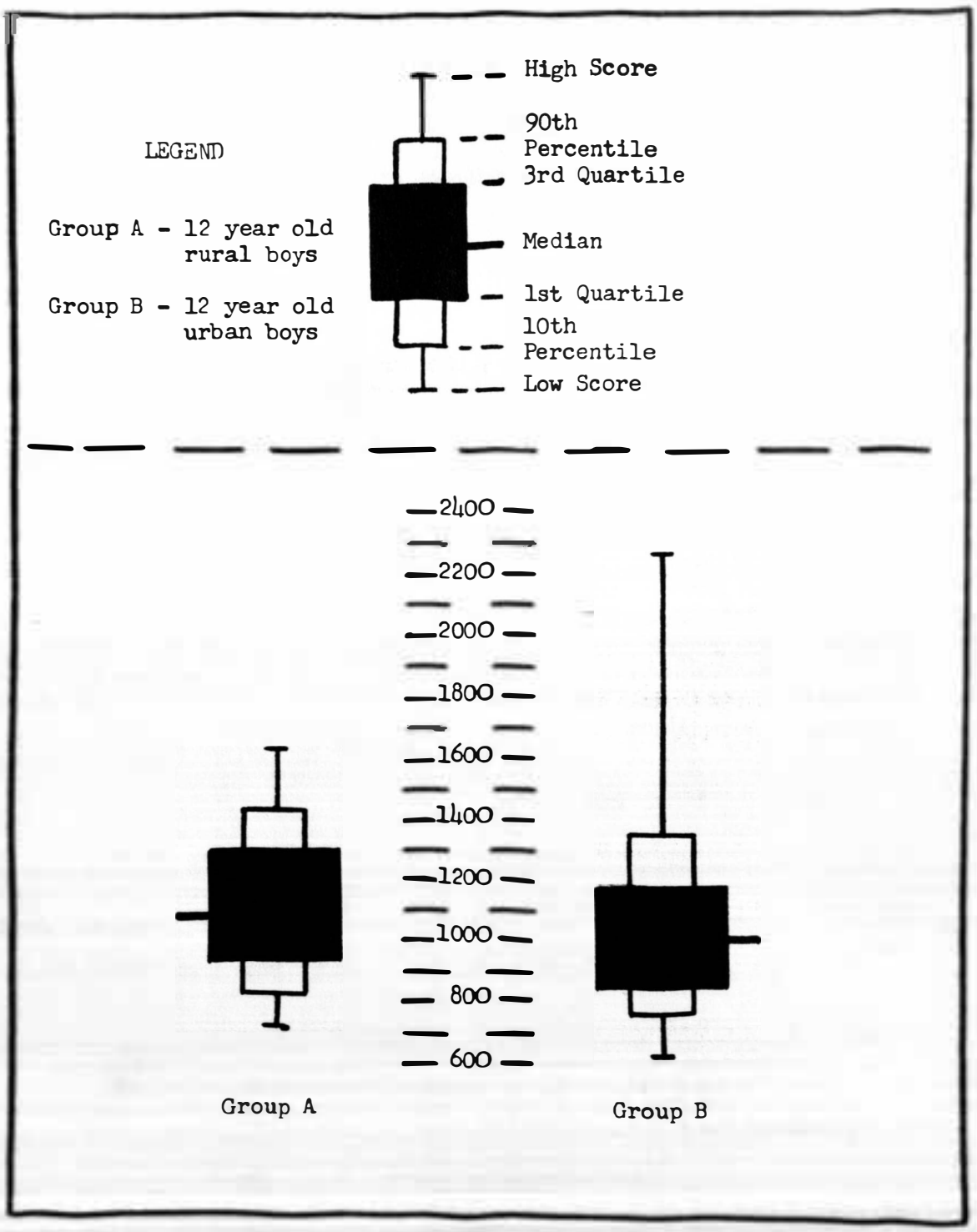

Figure 7. Comparison of the Strength Indices of Group A with those of Group B

Groups C and D (Strength Index)

By observing the comparison of over-all strength between Groups C and D (Table VII), it may be seen that the "t" value of 1.67 is considerably less than the 1.97 needed for significance at the five per cent level. Hence, the null hypothesis is again accepted.

TABLE VII. DIFFERENCE (GROUPS C AND D) BETWEEN THE MEANS, STANDARD ERROR OF THE DIFFERENCE, "t" VALUE, AND LEVEL OF SIGNIFICANCE COMPUTED FROM THE STRENGTH INDEX

Item	M_1 (Group C)	M_2 (Group D)	Difference ($M_1 - M_2$)	σ Diff.	"t"	Level
Strength Index	1946.90	1863.50	83.40	50.07	1.67	*

*Not Significant.

Groups A and B (Physical Fitness Index)

By observing Table VIII, it may be seen the Group A was significantly superior to Group B according to the Physical Fitness Indices. The "t" value of 2.07 was recognized as being significant at the five per cent level. In this case, the null hypothesis

TABLE VIII. DIFFERENCE (GROUPS A AND B) BETWEEN THE MEANS, STANDARD ERROR OF THE DIFFERENCE, "t" VALUE, AND LEVEL OF SIGNIFICANCE COMPUTED FROM PHYSICAL FITNESS INDICES

Item	M_1 (Group A)	M_2 (Group B)	Difference ($M_1 - M_2$)	σ Diff.	"t"	Level
P.F.I. Scores	98.60	93.62	4.98	2.41	2.07	.05

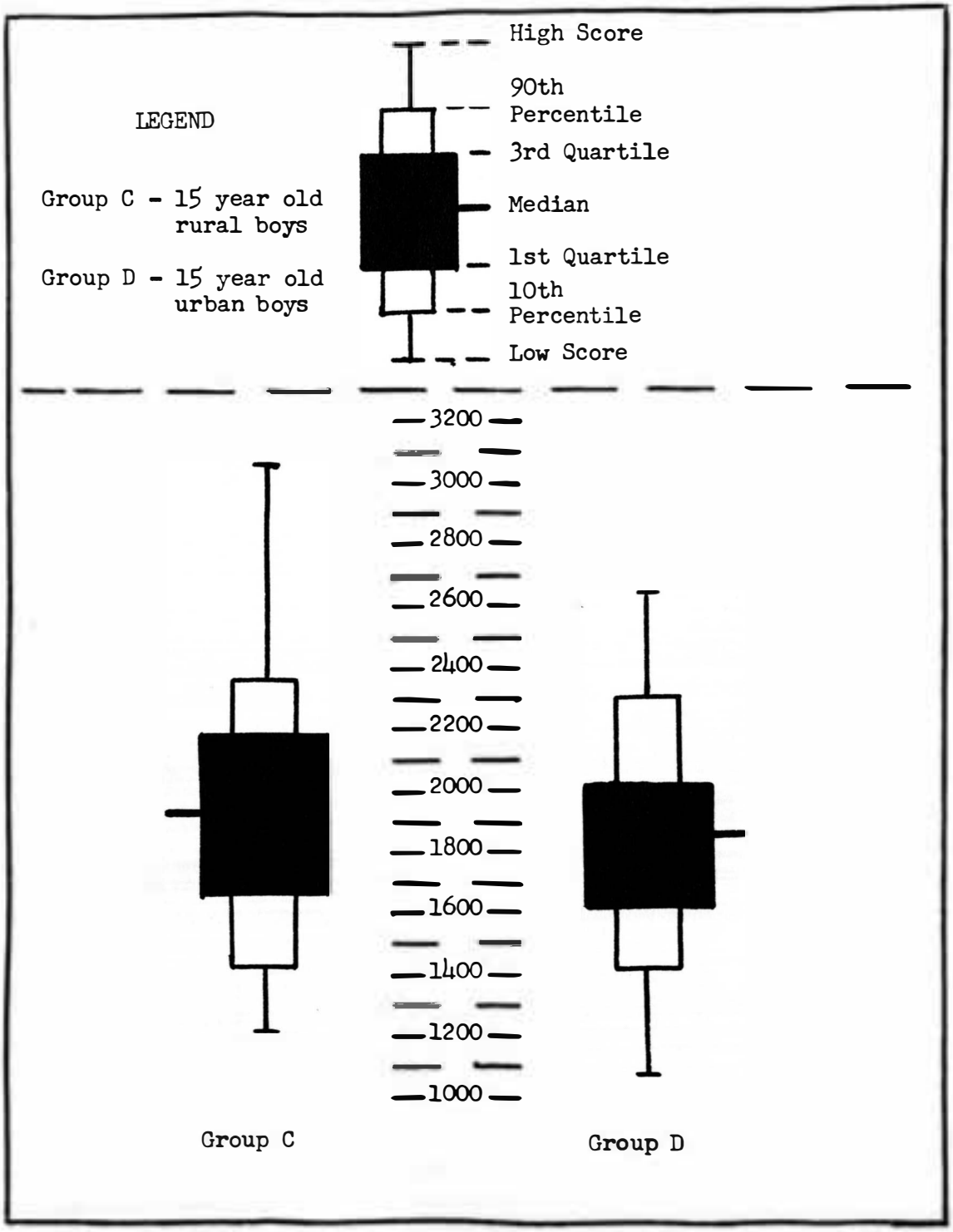

Figure 8. Comparison of the Strength Indices of Group C with those of Group D

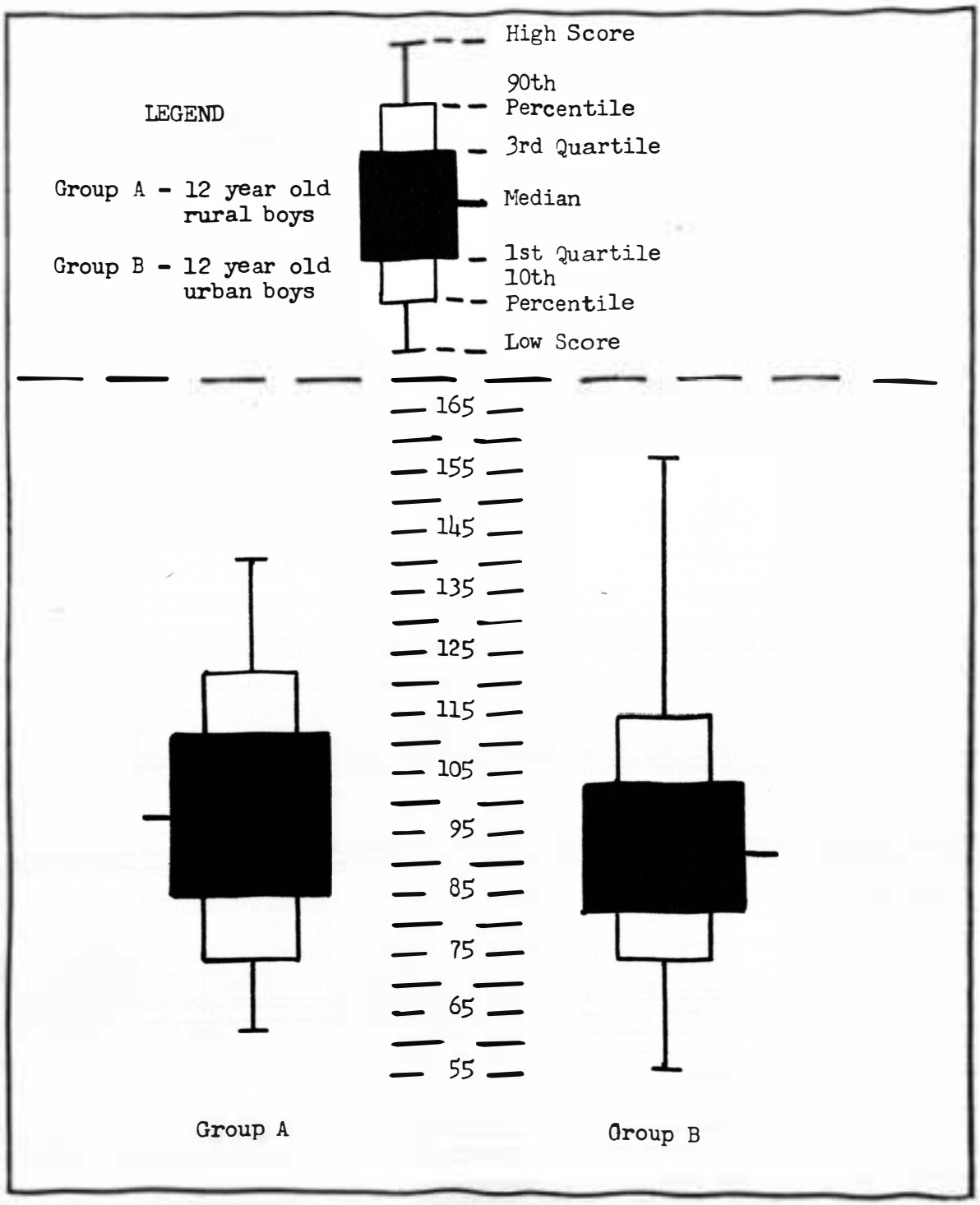

Figure 9. Comparison of the P.F.I. Scores of Group A with those of Group B

was rejected and the superiority of the rural group in Physical Fitness Indices was considered to be real.

Groups C and D (Physical Fitness Index)

It may be seen in Table IX that the "t" value of 2.90 was considerably above the "t" value of 2.60 needed for significance at the one per cent level. The null hypothesis, in this case, was rejected and Group C (rural boys) was recognized as being superior to Group D with regard to Physical Fitness Indices.

TABLE IX. DIFFERENCE (GROUPS C AND D) BETWEEN THE MEANS, STANDARD ERROR OF THE DIFFERENCE, "t" VALUE, AND LEVEL OF SIGNIFICANCE COMPUTED FROM PHYSICAL FITNESS INDICES

Item	M_1 (Group A)	M_2 (Group B)	Difference ($M_1 - M_2$)	σ Diff.	"t"	Level
P.F.I. Scores	96.30	90.20	6.10	2.10	2.90	.01

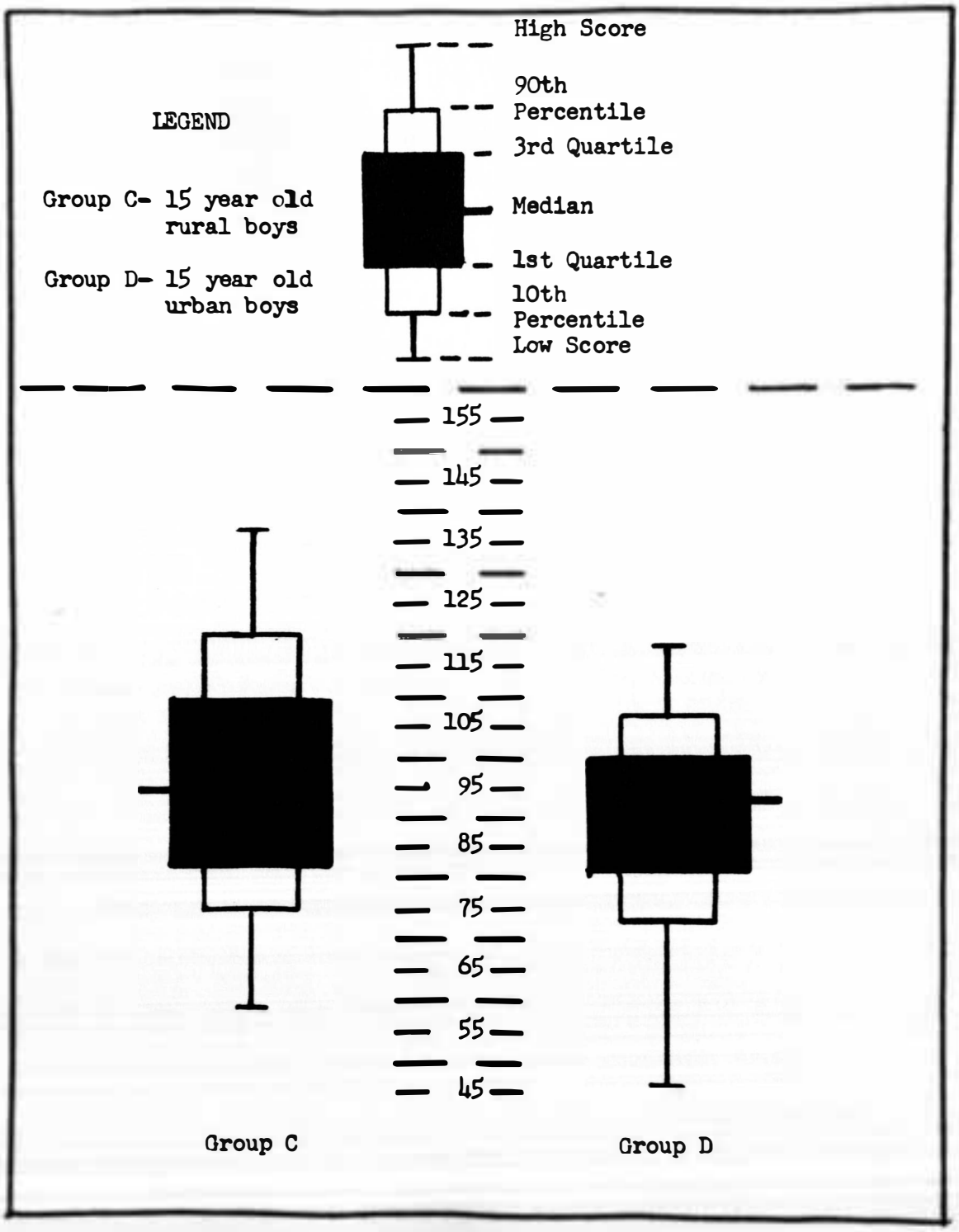

Figure 10. Comparison of the P.F.I. Scores of Group C with those of Group D

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The major purpose of this study was to compare the strength of rural 12 year old boys with that of urban 12 year old boys and the strength of rural 15 year old boys with that of urban 15 year old boys.

Related purposes were the comparison of rural and urban boys' Physical Fitness Indices, the comparison of their scores on each item of the Strength Test, and a comparison of their height and weight.

Subjects for this study consisted of boys from seven public schools in Minnesota and one in South Dakota. A total of 403 subjects were used in the study. A breakdown of this total revealed the following groupings: 100 rural 12 year old boys (Group A); 102 urban 12 year old boys (Group B); 101 rural 15 year old boys (Group C); and 100 urban 15 year old boys (Group D).

The Rogers Strength Test was administered to each subject during his regular physical education class. This test battery consisted of four items of strength, two items of muscular endurance, and a test of lung capacity. The results of each test item were used to compute the Strength Index. This Strength Index was then divided by the normal Strength Index to obtain the Physical Fitness Index.

The data was then treated statistically to determine whether or not a significant difference actually existed in the Strength Index and Physical Fitness Index between rural and urban boys.

The null hypothesis was applied in each case.

Conclusions

Conclusions resulting from the comparison of rural and urban boys with respect to each item of the Rogers Strength Test were as follows:

1. It was found that there were no significant differences between rural and urban 12 year old boys on any of the individual items of the test.

2. When the rural and urban 15 year old boys were compared, it was observed that the rural 15 year old boys were significantly stronger in gripping strength with the left hand.

3. In comparing the chinning strength of rural 15 year old boys with that of urban 15 year old boys, the rural boys were found to be significantly superior.

4. Rural 15 year old boys were significantly superior to urban 15 year old boys in dipping strength.

The results of the chinning and dipping items were combined to obtain the Arm Strength. Rural 15 year old boys proved to be significantly superior in this item also.

6. In the other items of the test (Lung Capacity, Right Grip

Back Lift, and Leg Lift), there were no significant differences between rural and urban 15 year old boys.

Conclusions resulting from the comparison of rural and urban boys to height, weight, and Strength Indices were as follows:

1. There were no significant differences in height or weight resulting from the comparison of rural 12 year old boys with urban 12 year old boys or rural 15 year old boys with urban 15 year old boys.

2. The results obtained by comparing the Strength Index of rural 12 year old boys with that of urban 12 year old boys and of rural 15 year old boys with that of urban 15 year old boys indicated no significant difference between these groups.

Conclusions based on the comparison of the Physical Fitness Indices of rural and urban boys were as follows:

1. Rural 12 year old boys were significantly superior to urban 12 year old boys.

2. Rural 15 year old boys demonstrated a highly significant superiority over urban 15 year old boys.

3. Both rural and urban boys were below the norm.

In general, it was concluded that there was no real difference between the actual strength of rural and urban boys. However, when this strength was related to norms based upon age and weight, and the Physical Fitness Index obtained, the rural boys showed a definite superiority.

Recommendations

Based on the experiences of this study the following recommendations were made:

1. a similar study should be made in a different geographical area;

2. further studies should be conducted which compare rural and urban boys in other areas of fitness such as cardiovascular fitness, emotional fitness, and sociological fitness;

3. the Rogers Physical Fitness Index should be used in the evaluation of students who are participating in physical education. This evaluation could be used for purposes of student classification and in course planning.

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APPENDIX

QUESTIONNAIRE AND SCORE SHEET

Answer the following questions either yes or no.

1. I have lived on a farm continuously since my third birthday ____.
2. I have lived in a town continuously since my third birthday ____.

Name _____, _____.
Last First

Birthdate _____ _____ _____.
Month Day Year

Weight _____.
Nearest pound

C.I. _____

Height _____.
Nearest half inch

Test Scores

1. Lung Capacity _____
2. Right Grip _____
3. Left Grip _____
4. Leg Lift _____
5. Back Lift _____
6. Pull-Ups _____
7. Push-Ups _____