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# A Comparison of Physical Fitness Increases as the Result of a Selected Physical Education Program

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A COMPARISON OF PHYSICAL FITNESS INCREASES AS THE

RESULT OF A SELECTED PHYSICAL EDUCATION PROGRAM

by

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This thesis, submitted by Richard M. Vinger in
partial fulfillment of the requirements for the Degree
of Master of Science in the University of North Dakota,
is hereby approved by the committee under whom the work
has been done.

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iii

# TABLE OF CONTENTS

# LIST OF TABLES

# CHAPTER I

## THE PROBLEM AND ITS SCOPE

### The Problem

The purpose of this study was to determine the effect of a selected physical education program on the fitness values of the participants as compared to the change in fitness values of a group who did not participate in any required or extra-curricular physical education activities.

The specific problems of this study were as follows:

1. To find the status of fitness of the control group and the experimental group at the beginning of the school year.

2. To determine the changes in physical fitness as the result of participating in the required physical education program.

3. To determine the changes made in fitness values of a control group who did not participate in physical education during the school year.

4. To try to determine what effect, if any, growth and maturation had upon fitness values during the experimental period.

## Need for the Study

The field of physical education embodies many theories, ideas and/or practices as to what activities constitute a satisfactory physical education program. There is also a great deal of concern, to the physical educator, in selecting criteria by which the effectiveness of the program can be determined. Through the administration of physical fitness and strength tests, it is usually possible to obtain an evaluation of the effectiveness of the required physical education program in terms of the improvement in the participant's physical fitness test scores.

By using one group of boys who participated in the required physical education program and comparing their test scores with another group who did not participate in any phase of the required physical education program it was hoped that results might be obtained which would give some indications that might help in solving this perplexing problem. But, is this method valid enough to be used as a basis for determining what activities constitute a good, sound physical education program? If the student shows an increase in his test score since his previous trials, does this mean the improvement was due to the effectiveness of the total program, or was this increase in score obtained primarily from the physical growth and development of the individual

over the period of time that had elapsed since the previous
testing period.

Youth is a time of growth and development.
Development postponed to maturity is doomed to a
reduction if not a total loss.[1] Therefore, it is the
definite responsibility of every physical educator to
provide for the maximum growth and development of each
and every individual. This will be accomplished only by
providing the kind of physical education program which
will provide for the individual needs and differences
of every person in the school. This study was designed
to provide some of the answers to this perplexing problem.

## Delimitations

This study was limited to forty-five boys in
grades ten, eleven, and twelve of Rugby Public High
School, Rugby, North Dakota. The American Association
of Health, Physical Education, and Recreation Youth
Fitness Test, with the exception of the aquatic test,
was administered to these boys. The tests were given
at the beginning of the 1963-1964 school term and again
at the end of that school year.

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[1] Ben W. Miller, Karl W. Bookwalter, and George E.
Schlafer, _Physical Fitness for Boys_, (New York: A. S.
Barnes and Company, Inc., 1943), p. 5.

## Definitions

"Physical fitness is one phase of total fitness. The components of physical fitness are resistance to disease, muscular strength and muscular endurance, cardiovascular respiratory endurance, muscular power, flexibility, speed, agility, coordination, balance and accuracy."[2]

The American Association of Health, Physical Education, and Recreation Youth Fitness Test included sit-ups, pull-ups, shuttle run, standing-broad-jump, 50-yard dash, softball throw, and the 600-yard run-walk.

The Control Group consisted of boys who did not participate in any phase of the required physical education program or the intra-mural or inter-scholastic programs.

The Experimental Group was composed of boys who participated in the required physical education three days a week for a period of one hour each time the class met. This group did not engage in any intra-mural or inter-scholastic programs. A description of the required physical education program in which they participated is presented in Appendix A.

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[2]Thomas Kirk Cureton, Physical Fitness Appraisal and Guidance, (St. Louis: The C. V. Mosby Company, 1947), p. 18.

CHAPTER II

REVIEW OF RELATED LITERATURE AND RESEARCH

A number of studies have been undertaken in the area of physical fitness and its relationship to the physical education activities program. Some of the important findings have been summarized in this chapter.

Paul Hunsicker, chairman of the AAHPER Fitness Council, made the following statement:

> The physical performances tested in the youth fitness test include running, jumping, throwing, strength, agility, and endurance. These activities should be part of physical education programs and, within limits, an improvement in test scores should accompany continuous participation in physical education. If pupils are enrolled in physical education classes and fail to improve throughout the school year in all probability the program was not sufficiently vigorous.[1]

Cartier[2] made a study at the University of Washington on the effects of certain physical education activities on some elements of the physical fitness of freshmen college women. Freshmen women (263) enrolled

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[1]Helen M. Starr, "How to Fit in Fitness Testing", Journal of Health, Physical Education and Recreation, Vol. 30, (March, 1958), p. 19.

[2]Elsie M. Cartier, "The Effects of Certain Physical Education Activities on Some Elements of the Physical Fitness of Freshmen College Women," Completed Research in Health, Physical Education and Recreation, Vol. 1, (1959), p. 55.

in basic activities were given pre-and-post tests with a
six item physical fitness test battery covering flexibility,
strength, endurance, and agility. Pre-test results showed
significant differences in mean fitness levels between
several classes and, with one exception, these results were
duplicated on the post-test. Comparison within classes
showed that all but one badminton and two swimming classes
showed an increase that was significant in the post test.
Comparison of mean improvement score between classes
showed that the basic activity class improved signif-
icantly. Aside from comparisons within and between
classes, the physical activities studied contributed to
improvement of all physical fitness test items except
agility.

Culver[3] made a study at the University of Washington
on the effect of a ten-minute period of body conditioning
exercise on certain elements of physical fitness and
basketball skill of high school girls. Two freshmen and
two sophomore physical education classes were tested before
and after a five-week instructional unit on basketball
with a fitness test battery covering strength, endurance,
agility, and flexibility, and with the revised Edgren Ball
Handling Test. One class received ten minutes of body

[3]Elizabeth J. Culver, "The Effects of a Ten-Minute
Period of Body Conditioning Exercises on Certain Elements
of Physical Fitness and Basketball Skill of High School
Girls," Completed Research in Health, Physical Education
and Recreation, Vol. 1, (1959), p. 54.

conditioning exercises at the beginning of each period in addition to the basketball unit. Within the experimental group, improvement in fitness was significant; within the control group, it was not. The experimental group was below the control group in mean fitness on the pre-test and above it on the post-test, but the post-test mean difference was not significant. The ten minutes of progressive conditioning exercises improved the fitness of the experimental group significantly without affecting adversely the learning of basketball skills.

Shaffer[4] conducted a study to determine variables that affected Kraus-Weber failures among junior high school girls. It was found that a program based entirely on learning and playing games did not produce sufficient strength and flexibility to reduce the Kraus-Weber test failures below the level reported for American children; but, participation in conditioning exercises, twice each week for part of one semester, brought the rate of success for all girls to that of the European children and, in two semesters, to five per cent above the European rate. The results of this research indicated that if junior high school girls who are free from mental and physical disorders participate regularly in physical activities based on physiological needs during this age period when strength is built, they will pass the Kraus-Weber test.

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[4]Gertrude L. Shaffer, "Variables Affecting Kraus-Weber Failures Among Junior High School Girls," Research Quarterly, Vol. 30, No. 10, (March, 1958), p. 36.

Keeler[5] in a study concerned with physical skill in relation to chronological age which was used on 874 cases grades 5-12 and college freshmen at Denver University found that physical skill growth is most nearly related to chronological maturity. Physical skill as measured by the Johnson Physical Skill test matures or reaches its peak at age 16 and maintains its efficiency through age 20 after which time decrease in physical skill makes itself evident.

MacKenzie[6] found in comparing the P.F.I. changes in Northeastern University students in various activities, indications that wide differences in physical fitness are effected by participation in various sports and activities. The data seemed to show that general corrective programs, exercises to improve abdominal conditions, cross country and hockey yielded the greatest dividends in physical development. Football was the least productive, but wrestling was not much better. The conditions under which this study was conducted were abnormal and probably would help to account for the poor showing made by football and wrestling.

[5] Lindsay D. Keeler, "The Effect of Maturation on Skill," Research Quarterly, Vol. 10, No. 3, (October, 1958), p. 54.

[6] Donald H. MacKenzie, "Effects of Various Activities on the Physical Fitness of University Men," Research Quarterly, Vol. 6, No. 1, (March, 1935), p. 137.

Esslinger[7] brought out some of the criticisms in regard to the use of a national test in physical education programs. Certain critics are opposed to a national test because some teachers make the standards their programs. In their anxiety to have their students do well on the tests, they design their entire program toward this end. In this way the national test determines the curriculum. The norms rather than the generally accepted purposes become the objectives of the program. Another objection is that in any typical group of children, half will be below the norm or average. In trying to get all the children in their class "up to the grade level" it is feared that some teachers ignore or overlook the individual differences which exist among them.

From the review of literature, there is evidence that activity from a physical education class aids in the development of physical fitness. Generally it has been shown that the activity programs that provide for definite area development will yield the more productive returns. If such is the case, then the physical education programs are justified within the schools and every individual should be encouraged to participate in a wide variety of physical activities.

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[7]Arthur A. Esslinger, "Perspective on Testing," Journal of Health, Physical Education and Recreation, Vol. 31, No. 6, (September, 1960), p. 37.

# CHAPTER III

## PROCEDURE

The tests were administered in accordance with the recommendations and instructions of the American Association for Health, Physical Education, and Recreation Youth Fitness Test Manual.[1] The method and procedure used in selecting the group, setting up, and supervision of the testing have been presented in this chapter.

## Selection of Groups

The selection of the groups was accomplished by listing the name of every boy, in grades ten, eleven, and twelve of Rugby Public High School, who was physically able to participate in the required physical education program and each individual was assigned a number. From this group, five boys from each grade were selected by random number for the control group and ten boys from each grade were selected by random number for the experimental group.

The control group was withheld from participating in any phase of the required physical education

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[1]AAHPER. "Youth Fitness Test Manual," Washington 6, D. C., The American Association for Health, Physical Education, and Recreation, (1958).

program. The experimental group participated in the required program which is described in Appendix A.

## Test Administration

An indoor gymnasium was used for the administration of the first part of the test which included the sit-ups, pull-ups, and the shuttle run. The second part was administered outdoors after a period of rest. This included the standing broad jump, fifty yard dash, softball throw, and the six hundred yard run-walk. The initial tests were given to each group at the same time after the first week of the school year. The re-tests were given to each group during the last week of the school term.

The subjects of both groups were given instructions on the execution of all phases of the test.

## Pull-Ups

**Equipment:** A metal bar approximately one and one-half inches in diameter.

**Procedure:** The bar was high enough so that each subject could hang with his arms and legs fully extended and his feet free of the floor. The overhand grip was used. After assuming the hanging position, the pupil raised his body by his arms until his chin could be placed over the bar and then lowered his body to a full hang as in the starting position. The exercise was repeated as many times as possible.

Rules: 1. One trial unless it was obvious that the subject did not have a fair chance.

2. The knees could not be raised and kicking of the legs was not permitted.

3. The body could not swing during the execution of the movement. The pull could in no way be a snap movement. If the subject started swinging he was checked by holding an extended arm across the front of his thighs.

Scoring: The number of completed pull-ups to the nearest whole number was recorded.

## Sit-Ups

Equipment: Sit-ups were done on the gym floor.

Procedure: The subject lay on his back with legs extended and feet about two feet apart. His hands were placed on the back on the neck with the fingers inter-laced. Elbows were retracted. A partner held the ankles down, the heels being in contact with the floor at all times.

The subject then sat-up, turning the trunk to the left and touching the right elbow to the left knee, returned to starting position, then sat up turning the trunk to the right and touching the left elbow to the right knee. The exercise was repeated, alternating sides.

Rules: 1. The fingers had to remain in contact behind the neck throughout the exercise.

13

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

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

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

Scoring: One point was given for each complete movement of touching elbow to knee. No score was counted if the fingertips did not maintain contact behind the head, if knees were bent when the subject lay on his back or when he began to sit up, or if the subject pushed off the floor from an elbow. The maximum limit in terms of number of sit-ups was one hundred.

## Shuttle Run

Equipment: A stopwatch and two blocks of wood, 2 inches x 2 inches x 4 inches.

Procedure: Two parallel lines were marked on the floor thirty feet apart. The blocks of wood were placed behind one of the lines. The subject started from behind the other line on the signal "Ready? Go." The subject ran to the blocks, picked one up, ran back to the starting line and placed the block which he carried back across the starting line. The procedure was repeated for the second block.

14

Rules: Two trials were allowed with some rest in between.

Scoring: The better of the two trials to the nearest tenth of a second was selected.

## 50-Yard Dash

Equipment: A stopwatch with a split-second timer was used.

Procedure: The subject took his position behind the starting line and started on the commands "Are you ready?" and "Go!" The latter was accompanied by a downward sweep of the starter's arm to give the timer a visual signal.

Rules: The score was the amount of time between the starter's signal and the instant the subject crossed the finish line.

Scoring: The seconds to the nearest tenth of a second were recorded.

## Standing Broad Jump

Equipment: Outdoor jumping pit and tape measure.

Procedure: The subject stood with the feet several inches apart and the toes just behind the take-off line. Preparatory to jumping, the subject swung the arms backward and bent the knees. The jump was accomplished by simultaneously extending the knees and swinging the arms forward.

Rules: 1. Three trials were allowed.

2. The distance of the jump was measured from the take-off line to the heel or other part of the body that touched the ground nearest the take-off line.

3. The scorer stood to the side and observed the mark to the nearest inch.

Scoring: The best of the three trials in inches to the nearest inch was recorded.

## Softball Throw

Equipment: Softball (12 inch), wooden stakes and a tape measure were used.

Procedure: A football field marked in conventional fashion was used for this test. The subject threw the ball while remaining within two parallel lines, six feet apart. The point of landing was marked with one of the wooden stakes. If the second or third throw was farther, the stake was moved accordingly so that, after three throws, the stake was at the point of the subject's best throw. It was found expedient to have the pupil jog out to his stake and stand there; and then, after five subjects had completed their throws, the measurements were taken.

Rules:
1. Only the overhand throw was permitted.
2. Three throws were allowed.
3. The distance recorded was the distance from the point of landing to the nearest point on the restraining line.

Scoring:  The best of three trials to the nearest foot was recorded.

## 600-Yard Run-Walk

Equipment:  Track marked accordingly and a stop-watch.

Procedure:  The subject started from a standing start.  At the signal "Ready? Go!," the subject started running the 600-yard distance.

Rules:  Walking was permitted, but the object was to cover the distance in the shortest possible time.

Scoring:  The time was recorded in seconds to the nearest second.

Following the collection of data, it became necessary to choose a statistical method that would test the significance of the difference between the two groups.

## Statistical Procedure

This investigator assumed the null hypothesis in analyzing the difference between the initial test and the re-test within each group.  That hypothesis[2] asserts that there is no true difference between the two mean scores, and that the difference found between the sample means is a chance difference and is accidental and unimportant. Investigation of several possible tests of the null hypothesis indicated that the "t" technique for testing the

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[2] Quinn McNemar, Psychological Statistics, (New York:  John Wiley and Sons, Inc., 1949), p. 225.

significance of the difference between means derived from correlated scores from small samples was suitable for use in this study. This test determines the ratio between the mean difference and the estimate of sampling error of the mean difference. This ratio is expressed as "t" and is checked for significance in a "t" table. The value of "t" is proportional to the degree of freedom (N-1) allowed in determining the relationship between the mean difference and the estimate of sampling error of the mean difference.

For this study it was decided to retain the null hypothesis at or beyond the .01 level of significance.

Complete data including mean differences and raw scores, together with the details of the mathematical process employed in analysis for each testing area is presented in Appendix B.

# CHAPTER IV

## ANALYSIS OF DATA

The purpose of the testing in this study was to
discover whether or not there were any significant dif-
ferences between fitness values of the experimental group
as compared to the control group. The bases of comparison
were results obtained through the use of the American
Association for Health, Physical Education and Recreation
Youth Fitness Test.

As mentioned previously no bias was present in the
random selection of the two groups. It appeared that some
uncontrolled bias was present as evidenced by the fact
that in all pre-test items the mean of the control group
was inferior to that of the experimental group except in
sit-ups. This fact appeared to favor the control group as
they had more opportunity to show improvement. As shown
by the analysis of data, this did not prove to be true, as
the experimental group exhibited significant improvement
in all items except the shuttle run at the .01 level of
confidence. In no item of the post-test did the control
group show an improvement that was statistically signif-
icant.

## Results of Comparison

### Sit-Ups

The control group had a mean score of 52.26 sit-ups in the initial test and a mean score of 49.73 sit-ups in the retest which measured abdominal strength and endurance.

The control group had a mean difference 2.53 decrease between the initial test and the retest. The estimate of sampling error of the mean difference was 7.00. The "t" value of -.36 with 14 degrees of freedom was below the criterion .01 level.

In the initial test the experimental group had a mean score of 50 sit-ups and in the retest this group had a mean score of 63.2 sit-ups.

The experimental group had a mean difference of 13.20 increase in sit-ups between the initial test and re-test. The estimate of the sampling error of mean difference was 4.49. The "t" value of 2.94 with 29 degrees of freedom indicated a significant difference at the criterion .01 level.

### Pull-Ups

In the initial test of pull-ups, the control group had a mean score 5.53 pull-ups; in the re-test this group had a mean score of 6.07 pull-ups which measured arm and shoulder-girdle strength.

A mean difference of .533 pull-ups increase between the initial test and the re-test was shown by the control group. The estimate of the sampling error of mean difference was .412. The "t" value of 1.29 with 14 degrees of freedom was below the criterion .01 level.

The experimental group had a mean score of 8.27 pull-ups in the initial test and a mean score of 12.53 pull-ups in the retest.

A mean difference of 4.26 pull-ups increase between the initial test and retest was shown by the experimental group. The estimate of sampling error of mean difference was .56. The "t" value of 7.60 with 29 degrees of freedom indicated a significant difference at the criterion .01 level.

### Shuttle Run

The control group had a mean score of 11.06 seconds on the initial test and a mean score of 11.21 seconds on the retest which measured agility and speed.

A mean difference of .15 increase between the initial and the retest was shown by the control group. The estimate of the sampling error of mean difference was .13. The "t" value of 1.18 with 14 degrees of freedom was below the criterion .01 level.

The experimental group had a mean score of 10.87 seconds in the initial test and a mean score of 10.73 seconds on the retest.

A mean difference of .14 decrease between the initial test and retest was shown by the experimental group. The estimate of sampling error of mean difference was .12. The "t" value of 1.16 with 29 degrees of freedom was below the criterion .01 level.

## 50-Yard Dash

The control group had a mean score of 8.05 seconds on the initial test and a mean score of 7.71 seconds on the retest which measured speed.

A mean difference of .34 decrease between the initial test and retest was shown by the control group. The estimate of sampling error of mean difference was .15. The "t" value of 2.27 with 14 degrees of freedom was below the criterion .01 level.

The experimental group had a mean score of 7.15 seconds in the initial test and a mean score of 6.99 seconds on the retest.

A mean difference of .16 decrease between the initial test and retest was shown by the experimental group. The estimate of sampling error of mean difference was .055. The "t" value 2.91 with 29 degrees of freedom was beyond the criterion .01 level and indicated a significant difference.

## Standing-Broad-Jump

The control group had a mean score of 72.40 inches on the initial test and a mean score of 73.13 inches on the retest which measured the explosive power of the legs.

A mean difference of .73 increase between the initial test and retest was shown by the control group. The estimate of sampling error of mean difference was 1.58. The "t" value of .46 with 14 degrees of freedom was below the criterion .01 level.

The experimental group had a mean score of 77.53 inches in the initial test and a mean score of 81.13 inches on the retest.

A mean difference of 3.60 increase between the initial test and retest was shown by the experimental group. The estimate of sampling error of mean difference was 1.07. The "t" value of 3.36 with 29 degrees of freedom indicated a significant difference at the criterion .01 level.

## Softball Throw

The control group had a mean score of 130.2 feet on the initial test and a mean score of 133.2 feet on the retest which measured the explosive power of the arm.

A mean difference of 3.00 increase between the initial test and retest was shown by the control group. The estimate of sampling error of mean difference was

3.42. The "t" value of .88 with 14 degrees of freedom was below the criterion .01 level.

The experimental group had a mean score of 153.47 feet on the initial test and a mean score of 169.97 feet in the retest.

A mean difference of 16.50 increase was shown by the experimental group between the initial test and the retest. The estimate of sampling error of mean difference was 3.09. The "t" value of 5.34 with 29 degrees of freedom indicated a significant difference at the criterion .01 level.

### 600-Yard Run-Walk

The control group had a mean score of 144.60 seconds in the initial test and a mean score of 139.13 seconds in the retest which measured muscular and cardio-respiratory endurance.

A mean difference of 5.47 decrease between the initial test and retest was shown by the control group. The estimate of sampling error of mean difference was 3.59. The "t" value of 1.52 with 14 degrees of freedom was below the criterion .01 level.

The experimental group had a mean score of 118.43 seconds in the initial test and a mean score of 107.63 seconds in the retest.

A mean difference of 10.80 decrease between the initial test and retest was shown by the experimental

group. The estimate of sampling error of mean difference was 2.06. The "t" value of 5.24 with 29 degrees of freedom indicated a significant difference at the criterion .01 level.

The experimental group showed significant changes between the initial test and the retest in all measures except the shuttle-run. All changes made by the control group were insignificant.

Since both groups made changes between the means of the initial test and the final test, it was decided to test further for possible differences between the two groups. The null hypothesis was assumed with respect to the differences between the two groups on values of mean differences found with the groups between the initial test and the retest. The null hypothesis was tested in this case by the use of the "t" technique for uncorrelated data from small samples.[1]

## Sit-Ups

The mean difference between the initial test and the retest was 13.20 sit-ups for the experimental group and 2.53 sit-ups for the control group. The difference between the mean differences of the two groups was 10.67 sit-ups. The estimate of the sampling error for the distribution of differences between the mean differences was 8.63. The "t" value resulting from the

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[1] Ibid., p. 223.

relationship of the actual difference between the mean differences of the two groups and the estimate of the sampling error for the distribution of the differences between the mean differences was 1.24. With 43 degrees of freedom, this "t" value indicated no significant difference between the mean difference found within the experimental group and the control group.

## Pull-Ups

The mean difference between the initial test and the retest was 4.26 pull-ups for the experimental group and .53 pull-ups for the control group. The difference between the mean differences of the two groups was 3.70 pull-ups. The estimate of the sampling error for the distribution of the difference between the mean differences was .69. The "t" value resulting from the relationship of the actual difference between the mean differences of the two groups and the estimate of the sampling error for the distribution of the differences between the mean differences was 5.36. With 43 degrees of freedom, this "t" value indicated a significant difference beyond the .01 criterion between the mean differences found within the experimental group and the control group.

## Shuttle Run

The mean difference between the initial test and the retest was .14 seconds for the experimental group and

.15 seconds for the control group. The difference between the mean differences of the two groups was .01 seconds. The estimate of the sampling error for the distribution of the differences between the mean differences was .18. The "t" value resulting from the relationship of the actual difference between the mean differences of the two groups and the estimate of the sampling error for the distribution of the differences between the mean differences was -.056. With 43 degrees of freedom, this "t" value indicated no significant difference between the mean differences within the experimental and the control groups.

### 50-Yard Dash

The mean difference between the initial test and the retest was .16 seconds for the experimental group and .34 seconds for the control group. The difference between the mean differences of the two groups was .18 seconds. The estimate of the sampling error for the distribution of the differences between the mean differences was .19. The "t" value resulting from the relationship of the actual difference between the mean differences of the two groups and the estimate of the sampling error for the distribution of the differences between the mean differences was -.947. With 43 degrees of freedom, this "t" value indicated no significant

difference between the mean difference found within the experimental group and the control group.

## Standing Broad Jump

The mean difference between the initial test and the retest was 3.60 inches for the experimental group and .73 inches for the control group. The difference between the mean differences of the two groups was 2.87 inches. The estimate of the sampling error for the distribution of the differences between the mean differences was 1.91. The "t" value resulting from the relationship of the actual difference between the mean differences of the two groups and the estimate of sampling error for the distribution of the differences between the mean differences was 1.50. With 43 degrees of freedom, this "t" value indicated no significant difference between the mean difference found within the experimental and the control group.

## Softball Throw

The mean difference between the initial test and the retest was 16.50 feet for the experimental group and 3.00 feet for the control group. The difference between the mean differences of the two groups was 13.50 feet. The estimate of the sampling error for the distribution of differences between the mean differences was 4.61. The "t" value resulting from the relationship of the actual difference between the mean differences of the two groups

and the estimate of sampling error for the distribution of

the differences between the mean differences was 2.95.

With 43 degrees of freedom, this "t" value indicated a

significant difference beyond the .01 criterion between

the mean differences found within the experimental group

and the control group.

## 500-Yard Run-Walk

The mean difference between the initial test and

the retest was 10.80 seconds for the experimental group

and 5.47 seconds for the control group. The difference

between the mean differences of the two groups was 5.33

seconds. The estimate of the sampling error for the

distribution of differences between the mean differences

was 4.14. The "t" value resulting from the relationship

of the actual difference between the mean differences

of the two groups and the estimate of sampling error

for the distribution of the differences between the mean

differences was 1.29. With 43 degrees of freedom, this

"t" value indicated no significant difference between

the mean difference found within the experimental group

and the control group.

## TABLE 1

### MEAN SCORES IN TESTS OF SUBJECTS IN CONTROL GROUP

| Name of test | Number | Initial Test | Retest |
|---|---|---|---|
| Sit-ups | 15 | 52.26 | 49.73 |
| Pull-ups | 15 | 5.53 | 6.07 |
| Shuttle Run | 15 | 11.06 | 11.21 |
| 50-Yard Dash | 15 | 8.05 | 7.71 |
| Standing Broad Jump | 15 | 72.40 | 73.13 |
| Softball Throw | 15 | 130.20 | 133.20 |
| 600-Yard Run-Walk | 15 | 144.60 | 139.13 |

### MEAN SCORES IN TESTS OF SUBJECTS IN EXPERIMENTAL GROUP

| Name of test | Number | Initial Test | Retest |
|---|---|---|---|
| Sit-ups | 30 | 50.00 | 63.20 |
| Pull-ups | 30 | 8.27 | 12.53 |
| Shuttle Run | 30 | 10.87 | 10.73 |
| 50-Yard Dash | 30 | 7.15 | 6.99 |
| Standing Broad Jump | 30 | 77.53 | 81.13 |
| Softball Throw | 30 | 153.47 | 169.97 |
| 600-Yard Run-Walk | 30 | 118.43 | 107.63 |

TABLE 2

"t" AND THE SIGNIFICANCE OF DIFFERENCE

| Area of Comparison | "t" Value of Control Group | "t" Value of Experimental Group |
|---|---|---|
| Sit-ups | .36 Not Signif-icant | 2.94 Significant beyond .01 level |
| Pull-ups | 1.29 Not Signif-icant | 7.60 Significant beyond .01 level |
| Shuttle Run | 1.18 Not Signif-icant | 1.16 Not Signif-icant |
| 50-Yard Dash | 2.27 Not Signif-icant | 2.91 Significant beyond .01 level |
| Standing Broad Jump | .46 Not Signif-icant | 3.36 Significant beyond .01 level |
| Softball Throw | .88 Not Signif-icant | 5.34 Significant beyond .01 level |
| 600-Yard Run-Walk | 1.52 Not Signif-icant | 5.24 Significant beyond .01 level |

## TABLE 3

### RANK ORDER OF "t" FOR CONTROL GROUP

| Area of Comparison | "t" Value |
|---|---|
| 50-Yard Dash | 2.27 |
| 600-Yard Run-Walk | 1.52 |
| Pull-ups | 1.29 |
| Shuttle Run | 1.18 |
| Softball Throw | .88 |
| Standing Broad Jump | .46 |
| Sit-ups | .36 |

## TABLE 4

### RANK ORDER OF "t" FOR EXPERIMENTAL GROUP

| Area of Comparison | "t" Value |
|---|---|
| Pull-ups | 7.60 |
| Softball Throw | 5.34 |
| 600-Yard Run-Walk | 5.24 |
| Standing Broad Jump | 3.36 |
| Sit-ups | 2.94 |
| 50-Yard Dash | 2.91 |
| Shuttle Run | 1.16 |

# CHAPTER V

## SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

### Summary

The forty-five subjects selected for this study were Senior High School male students at Rugby Public High School, Rugby, North Dakota. The experimental group consisted of students taking the required physical education curriculum, which is described in content in Appendix 4, three times each week for a period of one hour each meeting. The control group consisted of students who did not participate in any physical education activities. Each group was tested relative to the physical fitness level in accordance with the American Association of Health, Physical Education, and Recreation Youth Fitness Test. The test was administered to both groups at the beginning of the 1963-1964 school term and again at the end of that school year. The experimental group was compared to the control group to determine whether any significant changes occurred in the selected measures of physical fitness.

Comparisons were made between the mean differences within each group as indicated by the initial and final tests. The null hypothesis was assumed with respect to

33

the differences within the groups on the initial test and the retest. This hypothesis was tested with the "t" technique for the difference between means derived from correlated scores from small samples. Comparisons were also made between the experimental group and the control group by testing the significance of the difference between the mean differences found within the groups. The between group comparison used the "t" technique for uncorrelated data from small samples.

## Conclusions

The following conclusions seem warranted on the basis of the data collected in this study between the initial test and the retest for the two groups.

1. The required physical education curriculum which the experimental group engaged in did produce significant changes in all of the selected measures of physical fitness except the shuttle run at the criterion .01 level.

2. The control group who did not participate in any phase of the physical education program made no significant changes in any of the selected measures of physical fitness. The similarity between the means of the initial test and the retest for the control group seems to indicate that the subjects, once they attain a level of physical fitness, lose very little of that

level by not participating in the physical education program. However, they do not gain very much either.

3. The control group did not change significantly in any of the measures of physical fitness levels, while the experimental group improved significantly in nearly all areas of physical fitness. This seems to indicate that the test-retest method of evaluating the effectiveness of a physical education program in meeting the objective of physical fitness is a satisfactory device. The data collected in this study for the control group indicates that growth and maturation have little effect on the physical fitness development of an individual. The physical educator who uses this method of evaluation could feel assured that any significant changes in physical fitness levels from the initial test to the retest period are due to the effectiveness of the program in attaining that objective and not to the growth and maturation of the individual.

4. The between group comparison indicates a significant difference in pull-ups and the softball throw between the groups in terms of changes occurring during the experimental period. The changes in the other measures of physical fitness between the two groups were not significant at the criterion .01 level.

## Recommendations

It is recommended that further investigations be made in determining the effect of physical education curriculums, other than the one used in this study, in attaining the objective of physical fitness. It is also suggested that this type of study be utilized in determining the effectiveness of a selected physical education curriculum in meeting some of the other specific objectives of physical fitness.

It is further recommended that studies be undertaken which would evaluate the effectiveness of each activity in the physical education curriculum in attaining the objective of physical fitness. This would probably require investigations over a shorter duration of time and would also require the use of a different physical fitness test than the one used in this study because of the AAHPER Youth Fitness Test feature of outdoor testing for some of the test measures. Studies of this type would enable the physical educator to incorporate those activities into the physical education curriculum that would contribute most toward a desirable level of physical fitness.

INDIVIDUAL RECORDING CARD

_____

NAME _____

DATE OF BIRTH _____
                          (in months)

HEIGHT _____  WEIGHT _____
              (inches)                        (pounds)

GROUP _____  GRADE _____
                                      (year in school)


FIRST TEST                        RETEST

SIT-UPS        _____        _____

PULL-UPS       _____        _____

SHUTTLE        _____        _____
RUN

50-YARD        _____        _____
DASH

STANDING       _____        _____
BROAD JUMP

SOFTBALL       _____        _____
THROW

600-YARD       _____        _____
RUN-WALK

_____

ACTIVITIES WHICH CONSTITUTED PHYSICAL EDUCATION PROGRAM

OF THE EXPERIMENTAL GROUP

First six weeks ---- Softball

During the course of this unit, drills to develop
softball skills were used for warm-up activity. As the
class became more proficient at the skills of softball,
practice games were utilized for a part of the class period.
The last part of the unit was devoted to organized com-
petition between teams within the class and records of wins
and losses were recorded. The unit was concluded with a
single elimination tournament to determine the class
champion.

Second six-weeks ---- Volleyball

No formal calisthenics were used during the course
of this unit. Drills were used to help learn the volley-
ball skills. Teams were organized from within each class.
Games between teams were held and records kept. Losers of
each game were sometimes required to perform a specified
number of push-ups after each loss. This unit was also
concluded with a single elimination tournament to de-
termine the class champion.

Third six-weeks ---- Tumbling

This unit was accompanied by the use of about ten
minutes of calisthenics at the beginning of each class
period for warm-up purposes. Exercises included: sit-ups,

39

push-ups, side straddle hops, burpees, chop wood, trunk
twisters, and neck circlers. Three stations were used and
provided equipment for individual stunts, dual stunts, and
group stunts. The class was divided into three groups and
each group spent a period at one of the three stations.
Stunts progressed from those of an elementary nature until
the class could master the most advanced stunts. As a con-
clusion to the unit, the classes devised and perfected a
tumbling demonstration which they presented at a P.T.A.
meeting.

Fourth six weeks ----- Apparatus

This unit included the high bar, low bar, trampoline,
and the balance beam. Four stations were used and the
classes were divided into four groups. Each group spent
one class period at each station and then rotated to the
next station. This progression was repeated throughout the
course of the unit. The same calisthenics were used as
those described in the previous unit with a few variations
for diversion. The unit began with the most elementary
movements and progressed to the more advanced activities.
The concluding activity in this unit was the assigning of
an area to each group and they were responsible for
devising a routine which they presented to the rest of the
class during the last class period of the unit.

Fifth six weeks --- Wrestling

This unit required the use of an vigorous warm-up activities. Additional exercises used in this unit included neck bridges and running five laps around the gym at full speed. The classes were taught the basic techniques of take-downs, escapes, reverses, and pins. The elements of scoring were also included in this unit. As the class began to master the moves that were being introduced, a gradual progression into using those techniques in a match of shortened duration was begun. This unit was concluded with a tournament within each class and within each weight classification, whenever possible, until a champion had been determined for each weight group. Wrestle-backs were also included for those who were defeated in matches prior to the championship round.

Sixth six weeks --- Track and Field

This unit included the following events: high jump, broad jump, shot put, 100 yard dash, 220 yard dash, 440 yard dash, and the half mile run. The instruction in this unit consisted primarily of demonstrating the techniques to be used and because of the amount of material to be covered and a lack of time, very little practice of the techniques involved in each event was possible. Calisthenics were used as a warm-up activity and included push-ups, sit-ups, side straddle hops, hurdle stretch, and leg raisers. This unit was concluded with a track meet.

including the afore-mentioned events. Ribbons were awarded
to the first five places in each event and for each grade
classification.

## INITIAL TEST AND RETEST OF CONTROL GROUP IN SIT-UPS

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 100 | 30 | -70 | 4900 |
| 2. | 58 | 53 | - 5 | 25 |
| 3. | 35 | 44 | 9 | 81 |
| 4. | 37 | 28 | - 9 | 81 |
| 5. | 64 | 76 | 12 | 144 |
| 6. | 35 | 96 | 61 | 3721 |
| 7. | 100 | 97 | - 3 | 9 |
| 8. | 50 | 28 | -22 | 484 |
| 9. | 79 | 100 | 21 | 441 |
| 10. | 38 | 43 | 5 | 25 |
| 11. | 48 | 31 | -17 | 289 |
| 12. | 28 | 24 | - 4 | 16 |
| 13. | 41 | 28 | -13 | 169 |
| 14. | 31 | 30 | - 1 | 1 |
| 15. | 40 | 38 | - 2 | 4 |
| | 784 | 746 | -38 | 10390 |

Mean Score of Initial Test    52.26

Mean Score of Retest    49.73

Sum of the Differences    -38

Sum of Dif. Squared    10390

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___Sit-Ups___                    GROUP ___Control___

N = ___15___

D = ___-38___

$D^2$ = ___10390___

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$)  $= \dfrac{S_D}{\sqrt{N}} =$

$$\dfrac{\sqrt{\dfrac{D^2 - \dfrac{(D)^2}{N}}{N-1}}}{\sqrt{N}} \qquad \dfrac{\sqrt{\dfrac{10390 - \dfrac{(-38)^2}{15}}{14}}}{\sqrt{15}}$$

$S_{\overline{D}}$ = ___7.00___

$\overline{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{-38}{15}$ = ___-2.53___

t = $\dfrac{\overline{D}}{S_{\overline{D}}}$ = $\dfrac{-2.53}{7.00}$ = ___-.36___

df = N - 1 = __14__

"t" at .01 level = 2.977

Not significant at .01 level

## INITIAL TEST AND RETEST OF EXPERIMENTAL GROUP IN SIT-UPS

|  | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 65 | 100 | 35 | 1225 |
| 2. | 66 | 50 | -16 | 256 |
| 3. | 50 | 100 | 50 | 2500 |
| 4. | 35 | 50 | 15 | 225 |
| 5. | 70 | 100 | 30 | 900 |
| 6. | 66 | 100 | 34 | 1156 |
| 7. | 60 | 100 | 40 | 1600 |
| 8. | 50 | 71 | 21 | 441 |
| 9. | 35 | 50 | 15 | 225 |
| 10. | 50 | 64 | 14 | 196 |
| 11. | 35 | 43 | 8 | 64 |
| 12. | 26 | 25 | - 1 | 1 |
| 13. | 50 | 100 | 50 | 2500 |
| 14. | 30 | 41 | 11 | 121 |
| 15. | 15 | 34 | 19 | 361 |
| 16. | 41 | 51 | 10 | 100 |
| 17. | 38 | 65 | 27 | 729 |
| 18. | 43 | 55 | 12 | 144 |
| 19. | 20 | 100 | 80 | 6400 |
| 20. | 52 | 34 | -18 | 324 |
| 21. | 50 | 54 | 4 | 16 |
| 22. | 32 | 39 | 7 | 49 |
| 23. | 75 | 50 | -25 | 625 |
| 24. | 35 | 40 | 5 | 25 |
| 25. | 46 | 34 | -12 | 144 |
| 26. | 100 | 55 | -45 | 2025 |
| 27. | 100 | 100 | 0 | 0 |
| 28. | 50 | 53 | 3 | 9 |
| 29. | 80 | 100 | 20 | 400 |
| 30. | 35 | 38 | 3 | 9 |
|  | 1500 | 1896 | 396 | 22770 |

Mean Score of Initial Test    50.00

Mean Score of Retest    63.20

Sum of the Differences    396

Sum of Dif. Squared    22770

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___Sit-ups___                              GROUP ___Experimental___

$N$ = ___30___

$D$ = ___396___

$D^2$ = ___22770___

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$  $= \dfrac{S_D}{\sqrt{N}} =$

$$\dfrac{\sqrt{\dfrac{D^2 - \dfrac{(D)^2}{N}}{N-1}}}{\sqrt{N}} \qquad \dfrac{\sqrt{\dfrac{22770 - \dfrac{(396)^2}{30}}{29}}}{\sqrt{30}}$$

$S_{\overline{D}}$ = ___4.49___

$\overline{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{396}{30}$ = ___13.20___

$t = \dfrac{\overline{D}}{S_{\overline{D}}} = \dfrac{13.20}{4.49} =$ ___2.94___

$df = N - 1 = $ ___29___

"t" at .01 level = 2.756

Significance of Difference is ___beyond the .01 level___

## INITIAL TEST AND RETEST OF CONTROL GROUP IN PULL-UPS

|  | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 5 | 4 | -1 | 1 |
| 2. | 3 | 4 | 1 | 1 |
| 3. | 4 | 5 | 1 | 1 |
| 4. | 10 | 9 | -1 | 1 |
| 5. | 7 | 7 | 0 | 0 |
| 6. | 0 | 3 | 3 | 9 |
| 7. | 8 | 9 | 1 | 1 |
| 8. | 10 | 8 | -2 | 4 |
| 9. | 12 | 14 | 2 | 4 |
| 10. | 3 | 3 | 0 | 0 |
| 11. | 6 | 10 | 4 | 16 |
| 12. | 3 | 3 | 0 | 0 |
| 13. | 4 | 4 | 0 | 0 |
| 14. | 6 | 5 | -1 | 1 |
| 15. | 2 | 3 | 1 | 1 |
|  | 83 | 91 | 8 | 40 |

Mean Score of Initial Test     5.53

Mean Score of Retest     6.07

Sum of the Differences     8

Sum of Df. Squared     40

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST  Pull-Ups                                    GROUP  Control

$N$ = 15

$D$ = 8

$D^2$ = 40

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$)  $= \dfrac{S_D}{\sqrt{N}} =$

$$\frac{\sqrt{\dfrac{D^2 - \dfrac{(\ D)^2}{N}}{N-1}}}{\sqrt{N}} \qquad \frac{\sqrt{\dfrac{40 - \dfrac{(8)^2}{15}}{14}}}{\sqrt{15}}$$

$S_{\overline{D}}$ = .412

$\overline{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{8}{15}$ = .533

$t = \dfrac{\overline{D}}{S_{\overline{D}}}$ = $\dfrac{.533}{.412}$ = 1.29

df = N - 1 = 14

"t" at .01 level = 2.977

Not significant at .01 level

## INITIAL TEST AND RETEST OF EXPERIMENTAL GROUP IN PULL-UPS

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 12 | 15 | 3 | 9 |
| 2. | 14 | 18 | 4 | 16 |
| 3. | 11 | 21 | 10 | 100 |
| 4. | 11 | 16 | 5 | 25 |
| 5. | 12 | 17 | 5 | 25 |
| 6. | 11 | 22 | 11 | 121 |
| 7. | 9 | 18 | 9 | 81 |
| 8. | 14 | 15 | 1 | 1 |
| 9. | 4 | 5 | 1 | 1 |
| 10. | 4 | 8 | 4 | 16 |
| 11. | 5 | 10 | 5 | 25 |
| 12. | 4 | 8 | 4 | 16 |
| 13. | 10 | 13 | 3 | 9 |
| 14. | 9 | 15 | 6 | 36 |
| 15. | 0 | 2 | 2 | 4 |
| 16. | 4 | 12 | 8 | 64 |
| 17. | 9 | 18 | 9 | 81 |
| 18. | 8 | 12 | 4 | 16 |
| 19. | 15 | 21 | 6 | 36 |
| 20. | 4 | 7 | 3 | 9 |
| 21. | 11 | 20 | 9 | 81 |
| 22. | 8 | 9 | 1 | 1 |
| 23. | 5 | 9 | 4 | 16 |
| 24. | 6 | 8 | 2 | 4 |
| 25. | 8 | 9 | 1 | 1 |
| 26. | 11 | 12 | 1 | 1 |
| 27. | 14 | 15 | 1 | 1 |
| 28. | 5 | 6 | 1 | 1 |
| 29. | 4 | 5 | 1 | 1 |
| 30. | 6 | 10 | 4 | 16 |
| | 248 | 376 | 128 | 814 |

Mean Score of Initial Test       8.27

Mean Score of Retest       12.53

Sum of the Differences       128

Sum of Dif. Squared       814

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___Pull-ups___                    GROUP ___Experimental___

$N = $ ___30___

$D = $ ___128___

$D^2 = $ ___814___

$S_D$ (estimate of sampling error of $\overline{D}$) $= \dfrac{S_D}{\sqrt{N}} =$

$$\frac{\sqrt{\dfrac{D^2 - \dfrac{(\ D)^2}{N}}{N-1}}}{\sqrt{N}} \qquad \frac{\sqrt{\dfrac{814 - \dfrac{(128)^2}{30}}{29}}}{\sqrt{30}}$$

$S_D = $ ___.56___

$\overline{D}$ (Mean Difference) $= \dfrac{D}{N} = \dfrac{128}{30} = $ ___4.26___

$t = \dfrac{\overline{D}}{S_D} = \dfrac{4.26}{.56} = $ ___7.60___

$df = N - 1 = $ __29__

"t" at .01 level = 2.756

Significance of Difference is __beyond the .01 level__

# INITIAL TEST AND RETEST OF CONTROL GROUP IN SHUTTLE RUN

|  | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 10.1 | 10.0 | - .1 | .01 |
| 2. | 12.3 | 11.7 | - .6 | .36 |
| 3. | 11.7 | 11.9 | .2 | .04 |
| 4. | 10.4 | 10.4 | .0 | .00 |
| 5. | 11.3 | 11.2 | - .1 | .01 |
| 6. | 12.2 | 11.9 | - .3 | .09 |
| 7. | 11.5 | 11.6 | .1 | .01 |
| 8. | 10.4 | 10.3 | - .1 | .01 |
| 9. | 9.9 | 10.3 | .4 | .16 |
| 10. | 10.4 | 10.5 | .1 | .01 |
| 11. | 10.4 | 10.6 | .2 | .04 |
| 12. | 12.1 | 12.5 | .4 | .16 |
| 13. | 11.6 | 12.1 | .5 | .25 |
| 14. | 10.4 | 12.0 | 1.6 | 2.56 |
| 15. | 11.2 | 11.1 | - .1 | .01 |
|  | 165.9 | 168.1 | 2.2 | 3.72 |

Mean Score of Initial Test    11.06

Mean Score of Retest          11.21

Sum of the Differences        2.2

Sum of Dif. Squared           3.72

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST   Shuttle Run                    GROUP   Control

$N$ =   15

$D$ =   2.2

$D^2$ =   3.72

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$)

$$= \frac{S_D}{\sqrt{N}} =$$

$$\sqrt{\frac{D^2 - \frac{(D)^2}{N}}{N-1}} \qquad \sqrt{\frac{3.72 - \frac{(2.2)^2}{15}}{14}}$$

$$\frac{}{\sqrt{N}} \qquad \frac{}{\sqrt{15}}$$

$S_{\overline{D}}$ =   .13

$\overline{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{2.2}{15}$ =   .15

$t$ = $\dfrac{\overline{D}}{S_{\overline{D}}}$ = $\dfrac{.15}{.13}$ =   1.18

df = N - 1 = 14

"t" at .01 level = 2.977

Not significant at .01 level

INITIAL TEST AND RETEST OF EXPERIMENTAL GROUP IN SHUTTLE RUN

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 10.5 | 11.2 | .7 | .49 |
| 2. | 10.3 | 10.4 | .1 | .01 |
| 3. | 10.7 | 10.6 | - .1 | .01 |
| 4. | 10.1 | 10.6 | .5 | .25 |
| 5. | 10.0 | 10.5 | .5 | .25 |
| 6. | 9.8 | 10.2 | .4 | .16 |
| 7. | 11.7 | 11.1 | - .6 | .36 |
| 8. | 10.2 | 10.0 | - .2 | .04 |
| 9. | 11.0 | 11.1 | .1 | .01 |
| 10. | 10.3 | 10.1 | - .2 | .04 |
| 11. | 11.4 | 10.4 | -1.0 | 1.00 |
| 12. | 11.4 | 11.5 | .1 | .01 |
| 13. | 10.3 | 10.8 | .5 | .25 |
| 14. | 10.2 | 10.9 | .7 | .49 |
| 15. | 14.1 | 12.3 | -1.8 | 3.24 |
| 16. | 10.9 | 10.2 | - .7 | .49 |
| 17. | 10.5 | 10.0 | - .5 | .25 |
| 18. | 11.1 | 11.0 | - .1 | .01 |
| 19. | 11.3 | 11.0 | - .3 | .09 |
| 20. | 11.1 | 10.9 | - .2 | .04 |
| 21. | 11.3 | 11.0 | - .3 | .09 |
| 22. | 11.5 | 11.1 | - .4 | .16 |
| 23. | 11.2 | 11.1 | - .1 | .01 |
| 24. | 11.3 | 11.1 | - .2 | .04 |
| 25. | 11.1 | 12.7 | 1.6 | 2.56 |
| 26. | 11.1 | 10.2 | - .9 | .81 |
| 27. | 10.2 | 10.1 | - .1 | .01 |
| 28. | 10.4 | 10.0 | - .4 | .16 |
| 29. | 10.5 | 10.1 | - .4 | .16 |
| 30. | 10.8 | 9.8 | -1.0 | 1.00 |
| | 326.3 | 322.0 | -4.3 | 12.49 |

Mean Score of Initial Test        10.87

Mean Score of Retest              10.73

Sum of the Differences            - 4.3

Sum of Dif. Squared               12.49

### THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
### DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___Shuttle Run___          GROUP ___Experimental___

$N$ = ___30___

$D$ = ___- 4.3___

$D^2$ = ___12.49___

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$) $= \dfrac{S_D}{\sqrt{N}} =$

$$\frac{\sqrt{\dfrac{D^2 - \dfrac{(\ D)^2}{N}}{N - 1}}}{\sqrt{N}} \qquad \frac{\sqrt{\dfrac{12.49 - \dfrac{(-4.3)^2}{30}}{29}}}{\sqrt{30}}$$

$S_{\overline{D}}$ = ___.12___

$\overline{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{-4.3}{30}$ = ___.14___

$t$ = $\dfrac{\overline{D}}{S_{\overline{D}}}$ = $\dfrac{.14}{.12}$ = ___1.16___

$df = N - 1 =$ ___29___

"t" at .01 level = 2.756

Not significant at .01 level

INITIAL TEST AND RETEST OF CONTROL GROUP IN 50-YARD DASH

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 7.6 | 7.9 | .3 | .09 |
| 2. | 8.9 | 8.1 | - .8 | .64 |
| 3. | 7.5 | 8.3 | .8 | .64 |
| 4. | 7.0 | 7.1 | .1 | .01 |
| 5. | 8.4 | 7.3 | -1.1 | 1.21 |
| 6. | 9.4 | 8.2 | -1.2 | 1.44 |
| 7. | 8.6 | 7.7 | - .9 | .81 |
| 8. | 7.3 | 7.3 | .0 | .00 |
| 9. | 7.6 | 7.0 | - .6 | .36 |
| 10. | 8.0 | 8.0 | .0 | .00 |
| 11. | 7.2 | 7.2 | .0 | .00 |
| 12. | 8.4 | 8.5 | .1 | .01 |
| 13. | 8.1 | 7.5 | - .6 | .36 |
| 14. | 7.9 | 7.4 | - .5 | .25 |
| 15. | 8.8 | 8.1 | - .7 | .49 |
| | 120.7 | 115.6 | -5.1 | 6.31 |

Mean Score of Initial Test    8.05

Mean Score of Retest    7.71

Sum of the Differences    -5.10

Sum of Dif. Squared    6.31

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___50-Yard Dash___ GROUP ___Control___

$N$ = ___15___

$D$ = ___- 5.1___

$D^2$ = ___6.31___

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$) $= \dfrac{S_D}{\sqrt{N}} =$

$$\frac{\sqrt{\dfrac{D^2 - \dfrac{(\ D)^2}{N}}{N - 1}}}{\sqrt{N}} \qquad \frac{\sqrt{\dfrac{6.31 - \dfrac{(-5.1)^2}{15}}{14}}}{\sqrt{15}}$$

$S_{\overline{D}}$ = ___.15___

$\overline{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{-5.1}{15}$ = ___.34___

$t = \dfrac{\overline{D}}{S_{\overline{D}}}$ = $\dfrac{.34}{.15}$ = ___2.27___

df = $N$ - 1 = <u>14</u>

"t" at .01 level = 2.977

Not significant at .01 level

# INITIAL TEST AND RETEST OF EXPERIMENTAL GROUP IN 50-YARD DASH

|  | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 7.0 | 6.2 | - .8 | .64 |
| 2. | 7.3 | 6.5 | - .8 | .64 |
| 3. | 7.1 | 6.9 | - .2 | .04 |
| 4. | 6.7 | 6.2 | - .5 | .25 |
| 5. | 6.1 | 6.4 | .3 | .09 |
| 6. | 6.7 | 6.6 | - .1 | .01 |
| 7. | 7.5 | 7.1 | - .4 | .16 |
| 8. | 6.9 | 6.7 | - .2 | .04 |
| 9. | 7.0 | 7.0 | .0 | .00 |
| 10. | 6.9 | 7.0 | .1 | .01 |
| 11. | 7.6 | 7.9 | .3 | .09 |
| 12. | 6.9 | 6.6 | - .3 | .09 |
| 13. | 7.0 | 6.9 | - .1 | .01 |
| 14. | 7.6 | 7.1 | - .5 | .25 |
| 15. | 9.9 | 9.5 | - .4 | .16 |
| 16. | 7.2 | 7.0 | - .2 | .04 |
| 17. | 7.0 | 7.0 | .0 | .00 |
| 18. | 7.5 | 7.4 | - .1 | .01 |
| 19. | 7.5 | 6.8 | - .7 | .49 |
| 20. | 7.9 | 7.8 | - .1 | .01 |
| 21. | 6.6 | 6.5 | - .1 | .01 |
| 22. | 7.6 | 7.5 | - .1 | .01 |
| 23. | 7.0 | 6.9 | - .1 | .01 |
| 24. | 6.8 | 7.2 | .4 | .16 |
| 25. | 7.4 | 7.1 | - .3 | .09 |
| 26. | 6.9 | 6.9 | .0 | .00 |
| 27. | 6.1 | 6.0 | - .1 | .01 |
| 28. | 6.8 | 6.6 | - .2 | .04 |
| 29. | 7.5 | 7.8 | .3 | .09 |
| 30. | 6.5 | 6.5 | .0 | .00 |
|  | 214.5 | 209.6 | -4.9 | 3.45 |

Mean Score of Initial Test    7.15

Mean Score of Retest    6.99

Sum of the Differences    -4.9

Sum of Dif. Squared    3.45

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___50 Yard Dash___       GROUP ___Experimental___

$N$ = ___30___

$D$ = ___- 4.9___

$D^2$ = ___3.45___

$S_D$ (estimate of sampling error of $\overline{D}$)      $= \dfrac{S_D}{\sqrt{N}} =$

$$\frac{\sqrt{\dfrac{D^2 - \dfrac{(D)^2}{N}}{N-1}}}{\sqrt{N}} \qquad \frac{\sqrt{\dfrac{3.45 - \dfrac{(-4.9)^2}{30}}{29}}}{\sqrt{30}}$$

$S_{\overline{D}}$ = ___.055___

$\overline{D}$ (Mean Difference) = ___$\dfrac{D}{N}$___ = ___$\dfrac{-4.9}{30}$___ = ___.16___

$t = $ ___$\dfrac{\overline{D}}{S_{\overline{D}}}$___ = ___$\dfrac{.16}{.055}$___ = ___2.91___

$df = N - 1 =$ <u>29</u>

"t" at .01 level = 2.756

Significance of Difference is <u>beyond .01 level</u>

INITIAL TEST AND RETEST OF CONTROL GROUP IN STANDING-BROAD-JUMP

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 75 | 69 | - 6 | 36 |
| 2. | 63 | 69 | 6 | 36 |
| 3. | 77 | 81 | 4 | 16 |
| 4. | 69 | 68 | - 1 | 1 |
| 5. | 70 | 72 | 2 | 4 |
| 6. | 50 | 57 | 7 | 49 |
| 7. | 68 | 71 | 3 | 9 |
| 8. | 88 | 86 | - 2 | 4 |
| 9. | 89 | 84 | - 5 | 25 |
| 10. | 79 | 86 | 7 | 49 |
| 11. | 84 | 98 | 14 | 196 |
| 12. | 63 | 62 | - 1 | 1 |
| 13. | 63 | 59 | - 4 | 16 |
| 14. | 78 | 70 | - 8 | 64 |
| 15. | 70 | 65 | - 5 | 25 |
| | 1086 | 1097 | 11 | 531 |

Mean Score of Initial Test    72.40

Mean Score of Retest    73.13

Sum of the Differences    11

Sum of Dif. Squared    531

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___Standing Broad Jump___     GROUP ___Control___

$N$ = ___15___

$D$ = ___11___

$D^2$ = ___531___

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$) = $\dfrac{S_D}{\sqrt{N}}$ =

$$\frac{\sqrt{\dfrac{D^2 - \dfrac{(D)^2}{N}}{N-1}}}{\sqrt{N}} \qquad \frac{\sqrt{\dfrac{531 - \dfrac{(11)^2}{15}}{14}}}{\sqrt{15}}$$

$S_{\overline{D}}$ = __1.58__

$\overline{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{11}{15}$ = __.73__

$t$ = $\dfrac{\overline{D}}{S_{\overline{D}}}$ = $\dfrac{.73}{1.58}$ = __.46__

$df$ = $N - 1$ = __14__

"t" at .01 level = 2.977

Not significant at .01 level

## INITIAL TEST AND RETEST OF EXPERIMENTAL GROUP

## IN STANDING BROAD JUMP

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 84 | 84 | 0 | 0 |
| 2. | 91 | 95 | 4 | 16 |
| 3. | 86 | 89 | 3 | 9 |
| 4. | 90 | 89 | - 1 | 1 |
| 5. | 89 | 82 | - 7 | 49 |
| 6. | 84 | 90 | 6 | 36 |
| 7. | 76 | 77 | 1 | 1 |
| 8. | 89 | 88 | - 1 | 1 |
| 9. | 59 | 63 | 4 | 16 |
| 10. | 84 | 78 | - 6 | 36 |
| 11. | 85 | 93 | 8 | 64 |
| 12. | 79 | 83 | 4 | 16 |
| 13. | 83 | 84 | 1 | 1 |
| 14. | 82 | 76 | - 6 | 36 |
| 15. | 33 | 42 | 9 | 81 |
| 16. | 81 | 80 | - 1 | 1 |
| 17. | 74 | 84 | 10 | 100 |
| 18. | 69 | 67 | - 2 | 4 |
| 19. | 73 | 88 | 15 | 225 |
| 20. | 75 | 75 | 0 | 0 |
| 21. | 74 | 79 | 5 | 25 |
| 22. | 71 | 77 | 6 | 36 |
| 23. | 80 | 79 | - 1 | 1 |
| 24. | 79 | 84 | 5 | 25 |
| 25. | 76 | 91 | 15 | 225 |
| 26. | 79 | 82 | 3 | 9 |
| 27. | 60 | 70 | 10 | 100 |
| 28. | 87 | 91 | 4 | 16 |
| 29. | 72 | 77 | 5 | 25 |
| 30. | 82 | 97 | 15 | 225 |
| | 2326 | 2434 | 108 | 1380 |

| | |
|---|---|
| Mean Score of Initial Test | 77.53 |
| Mean Score of Retest | 81.13 |
| Sum of the Differences | 108 |
| Sum of Dif. Squared | 1380 |

# THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
# DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST  __Standing Broad Jump__        GROUP  __Experimental__

N  = __30__

D  = __108__

D² = __1380__

$S_{\bar{D}}$ (estimate of sampling error of $\bar{D}$) = $\dfrac{S_D}{\sqrt{N}}$ =

$$S_{\bar{D}} = \sqrt{\dfrac{D^2 - \dfrac{(\sum D)^2}{N}}{N-1}} \cdot \dfrac{1}{\sqrt{N}} = \sqrt{\dfrac{1380 - \dfrac{(108)^2}{30}}{29}} \cdot \dfrac{1}{\sqrt{30}}$$

$$S_{\bar{D}} = \underline{1.07}$$

$\bar{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{108}{30}$ = 3.60

$t = \dfrac{\bar{D}}{S_{\bar{D}}} = \dfrac{3.60}{1.07} = 3.36$

df = N - 1 = __29__

"t" at .01 level = 2.756

Significance of Difference is __beyond .01 level__

INITIAL TEST AND RETEST OF CONTROL GROUP IN SOFTBALL THROW

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 140 | 138 | - 2 | 4 |
| 2. | 100 | 127 | 27 | 729 |
| 3. | 147 | 142 | - 5 | 25 |
| 4. | 137 | 123 | -14 | 196 |
| 5. | 113 | 122 | 9 | 81 |
| 6. | 97 | 105 | 8 | 64 |
| 7. | 115 | 113 | - 2 | 4 |
| 8. | 163 | 149 | -14 | 196 |
| 9. | 158 | 166 | 8 | 64 |
| 10. | 155 | 150 | - 5 | 25 |
| 11. | 162 | 144 | -18 | 324 |
| 12. | 117 | 124 | 7 | 49 |
| 13. | 106 | 113 | 7 | 49 |
| 14. | 131 | 147 | 16 | 256 |
| 15. | 112 | 135 | 23 | 529 |
| | 1953 | 1998 | 45 | 2595 |

Mean Score of Initial Test       130.20

Mean Score of Retest             133.20

Sum of the Differences            45

Sum of Diff. Squared             2595

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST __Softball Throw__          GROUP ___Control___

$N$ = ___15___

$D$ = ___45___

$D^2$ = ___2595___

$S_{\bar{D}}$ (estimate of sampling error of $\bar{D}$          $= \dfrac{S_D}{\sqrt{N}} =$

$$\dfrac{\sqrt{\dfrac{D^2 - \dfrac{(\ D)^2}{N}}{N-1}}}{\sqrt{N}} \qquad \dfrac{\sqrt{\dfrac{2595 - \dfrac{(45)^2}{15}}{14}}}{\sqrt{15}}$$

$S_{\bar{D}}$ = __3.42__

$\bar{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{45}{15}$ = __3.00__

$t = \dfrac{\bar{D}}{S_{\bar{D}}} = \dfrac{3.00}{3.42} =$ __.88__

$df = N - 1 = \underline{14}$

"t" at .01 level = 2.977

Not significant at .01 level

## INITIAL TEST AND RETEST OF EXPERIMENTAL GROUP
## IN SOFTBALL THROW

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 175 | 188 | 13 | 169 |
| 2. | 158 | 199 | 41 | 1681 |
| 3. | 167 | 214 | 47 | 2209 |
| 4. | 158 | 181 | 23 | 529 |
| 5. | 166 | 188 | 22 | 484 |
| 6. | 154 | 189 | 35 | 1225 |
| 7. | 111 | 135 | 24 | 576 |
| 8. | 153 | 162 | 9 | 81 |
| 9. | 128 | 117 | -11 | 121 |
| 10. | 157 | 153 | - 4 | 16 |
| 11. | 204 | 238 | 34 | 1156 |
| 12. | 161 | 163 | 2 | 4 |
| 13. | 187 | 198 | 11 | 121 |
| 14. | 165 | 163 | - 2 | 4 |
| 15. | 90 | 117 | 27 | 729 |
| 16. | 163 | 175 | 12 | 144 |
| 17. | 167 | 185 | 18 | 324 |
| 18. | 116 | 156 | 40 | 1600 |
| 19. | 133 | 130 | - 3 | 9 |
| 20. | 141 | 158 | 17 | 289 |
| 21. | 106 | 101 | - 5 | 25 |
| 22. | 119 | 138 | 19 | 361 |
| 23. | 136 | 159 | 23 | 529 |
| 24. | 190 | 184 | - 6 | 36 |
| 25. | 144 | 160 | 16 | 256 |
| 26. | 183 | 170 | -13 | 169 |
| 27. | 134 | 169 | 35 | 1225 |
| 28. | 183 | 222 | 39 | 1521 |
| 29. | 175 | 177 | 2 | 4 |
| 30. | 180 | 210 | 30 | 900 |
| | 4604 | 5099 | 495 | 16497 |

Mean Score of Initial Test     153.47

Mean Score of Retest     169.97

Sum of the Differences     195

Sum of Dif. Squared     16497

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST  __Softball Throw__          GROUP  __Experimental__

N = _____30_

D = _____495_

$D^2$ = _____16497_

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$)  $= \dfrac{s_D}{\sqrt{N}} =$

$$\sqrt{\dfrac{D^2 - \dfrac{(\sum D)^2}{N}}{N-1}} \bigg/ \sqrt{N} \qquad \sqrt{\dfrac{16497 - \dfrac{(495)^2}{30}}{29}} \bigg/ \sqrt{30}$$

$S_{\overline{D}}$ = _3.09_

$\overline{D}$ (Mean Difference) = $\dfrac{D}{N}$ = $\dfrac{495}{30}$ = _16.50_

t = $\dfrac{\overline{D}}{S_{\overline{D}}}$ = $\dfrac{16.50}{5.09}$ = _5.34_

df = N - 1 = _29_

"t" at .01 level = 2.756

Significance of Difference is __beyond .01 level__

## INITIAL TEST AND RETEST OF CONTROL GROUP

## IN 600-YARD-RUN-WALK

| | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 129 | 128 | - 1 | 1 |
| 2. | 157 | 137 | -20 | 400 |
| 3. | 145 | 153 | 8 | 64 |
| 4. | 159 | 145 | -14 | 196 |
| 5. | 135 | 142 | 7 | 49 |
| 6. | 156 | 129 | -27 | 729 |
| 7. | 129 | 119 | -10 | 100 |
| 8. | 146 | 162 | 16 | 256 |
| 9. | 119 | 130 | 11 | 121 |
| 10. | 136 | 122 | -14 | 196 |
| 11. | 161 | 152 | - 9 | 81 |
| 12. | 151 | 159 | 8 | 64 |
| 13. | 134 | 127 | - 7 | 49 |
| 14. | 161 | 132 | -29 | 841 |
| 15. | 151 | 150 | - 1 | 1 |
| | 2169 | 2087 | -82 | 3148 |

Mean Score of Initial Test        144.60

Mean Score of Retest              139.13

Sum of the Differences          - 82

Sum of Dif. Squared               3148

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___600 Yard Run-Walk___     GROUP ___Control___

N = ___15___

D = ___-82___

$D^2$ = ___3148___

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$) $= \dfrac{S_D}{\sqrt{N}} =$

$$\dfrac{\sqrt{\dfrac{D^2 - \dfrac{(\ D)^2}{N}}{N-1}}}{\sqrt{N}} \qquad \dfrac{\sqrt{\dfrac{3148 - \dfrac{(-82)^2}{15}}{14}}}{\sqrt{15}}$$

$S_{\overline{D}}$ = 3.59

$\overline{D}$ (Mean Difference) = ___$\dfrac{D}{N}$___ = ___$\dfrac{-82}{15}$___ = ___5.47___

t = ___$\dfrac{\overline{D}}{S_{\overline{D}}}$___ = $\dfrac{5.47}{3.59}$ = ___1.52___

df = N - 1 = 14

"t" at .01 level = 2.977

Not significant at .01 level

INITIAL TEST AND RETEST OF EXPERIMENTAL GROUP

IN 600-YARD RUN-WALK

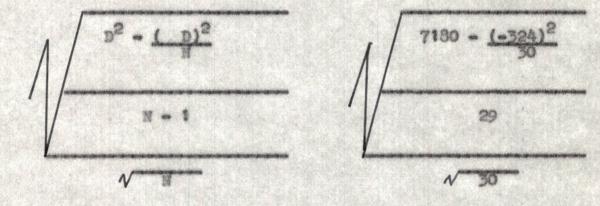|  | Initial Test | Retest | Sum of Difference | Difference Squared |
|---|---|---|---|---|
| 1. | 115 | 113 | - 2 | 4 |
| 2. | 116 | 104 | -12 | 144 |
| 3. | 101 | 93 | - 8 | 64 |
| 4. | 115 | 97 | -18 | 324 |
| 5. | 102 | 87 | -15 | 225 |
| 6. | 105 | 99 | - 6 | 36 |
| 7. | 113 | 105 | - 8 | 64 |
| 8. | 117 | 124 | 7 | 49 |
| 9. | 118 | 108 | -10 | 100 |
| 10. | 118 | 107 | -11 | 121 |
| 11. | 105 | 98 | - 7 | 49 |
| 12. | 108 | 107 | - 1 | 1 |
| 13. | 117 | 101 | -16 | 256 |
| 14. | 126 | 105 | -21 | 441 |
| 15. | 176 | 126 | -50 | 2500 |
| 16. | 122 | 96 | -26 | 676 |
| 17. | 125 | 105 | -20 | 400 |
| 18. | 138 | 108 | -30 | 900 |
| 19. | 138 | 127 | -11 | 121 |
| 20. | 134 | 115 | -19 | 361 |
| 21. | 108 | 108 | 0 | 0 |
| 22. | 130 | 120 | -10 | 100 |
| 23. | 115 | 113 | - 2 | 4 |
| 24. | 105 | 99 | - 6 | 36 |
| 25. | 127 | 120 | - 7 | 49 |
| 26. | 116 | 114 | - 2 | 4 |
| 27. | 98 | 95 | - 3 | 9 |
| 28. | 122 | 116 | - 6 | 36 |
| 29. | 120 | 125 | 5 | 25 |
| 30. | 103 | 94 | - 9 | 81 |
|  | 3553 | 3229 | -324 | 7180 |

Mean Score of Initial Test      118.43

Mean Score of Retest            107.63

Sum of the Differences          -324

Sum of Dif. Squared             7180

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

DERIVED FROM CORRELATED SCORES FROM SMALL SAMPLES

TEST ___600 Yard Run-Walk___    GROUP ___Experimental___

$N$ = ___30___

$D$ = ___-324___

$D^2$ = ___7180___

$S_{\overline{D}}$ (estimate of sampling error of $\overline{D}$) $= \dfrac{S_D}{\sqrt{N}} =$

$$\sqrt{\dfrac{D^2 - \dfrac{(\ D)^2}{N}}{N-1}} \Bigg/ \sqrt{N} \qquad \sqrt{\dfrac{7180 - \dfrac{(-324)^2}{30}}{29}} \Bigg/ \sqrt{30}$$

$S_{\overline{D}}$ = __2.06__

$\overline{D}$ (Mean Difference) $= \dfrac{D}{N} = \dfrac{-324}{30} = $ __10.80__

$t = \dfrac{\overline{D}}{S_{\overline{D}}} = \dfrac{10.80}{2.06} = $ __5.24__

$df = N - 1 = $ __29__

"t" at .01 level = 2.756

Significance of Difference is __beyond .01 level__

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

## DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

TEST: Sit-Ups

Experimental Group $\overline{D}$ = 13.20    Control Group $\overline{D}$ = 2.53

Experimental Group $S_{\overline{D}}$ = 5.06    Control Group $S_{\overline{D}}$ = 7.00

$S_{D_{M_D}}$    (the estimate of the sampling error for the distribution of differences between the mean differences)

$$ \overline{ \quad S_{\overline{D}_1}{}^2 \ + \ S_{\overline{D}_2}{}^2 \quad } \qquad \overline{ \quad (5.06)^2 \ + \ (7.00)^2 \quad } $$

$S_{D_{M_D}}$ = 8.63

$D_D = \overline{D}_1 - \overline{D}_2$ = 13.20 - 2.53 = 10.67

$t = \dfrac{D_D}{S_{D_{M_D}}} = \dfrac{10.67}{8.63} = 1.24$

df = $(N_1 - 1) + (N_2 - 1)$ = 29 + 14 = 43

"t" at .01 level = 2.69

Not significant at the .01 level

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

## DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

TEST: Pull-Ups

Experimental Group $\bar{D} = \underline{4.26}$        Control Group $\bar{D} = \underline{.53}$

Experimental Group $S_{\bar{D}} = \underline{.56}$        Control Group $S_{\bar{D}} = \underline{.41}$

$S_{D_{M_D}}$    (the estimate of the sampling error for the distribution of differences between the mean differences)

$$\sqrt{\left(S_{\bar{D}_1}\right)^2 + \left(S_{\bar{D}_2}\right)^2} \qquad \sqrt{(.56)^2 + (.41)^2}$$

$S_{D_{M_D}} = \underline{.69}$

$D_{\bar{D}} = \bar{D}_1 - \bar{D}_2 = 4.26 - .53 = \underline{3.70}$

$t = \dfrac{D_{\bar{D}}}{S_{D_{M_D}}} = \dfrac{3.70}{.69} = \underline{5.36}$

$df = (N_1 - 1) + (N_2 - 1) = 29 + 14 = \underline{43}$

"t" at .01 level = 2.69

Significant at the .01 level

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

## DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

TEST: Shuttle Run

Experimental Group $\bar{D}$ = .14        Control Group $\bar{D}$ = .15

Experimental Group $S_{\bar{D}}$ = .12        Control Group $S_{\bar{D}}$ = .13

$S_{D_{M_D}}$        (the estimate of the sampling error for the dis-
tribution of differences between the mean dif-
ferences)

$$\sqrt{\left(S_{\bar{D}_1}\right)^2 + \left(S_{\bar{D}_2}\right)^2} \qquad \sqrt{(.12)^2 + (.13)^2}$$

$S_{D_{M_D}}$ = .18

$\frac{D}{D} = \bar{D}_1 - \bar{D}_2 = .14 - .15 = -.01$

$t = \dfrac{\frac{D}{D}}{S_{D_{M_D}}} = \dfrac{-.01}{.18} = -.056$

df = $(N_1 - 1) + (N_2 - 1)$ = 29 + 14 = 43

"t" at .01 level = 2.69

Not significant at the .01 level

## THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS
## DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

TEST:  50-Yard Dash

Experimental Group $\overline{D}$ = .16          Control Group $\overline{D}$ = .34

Experimental Group $S_{\overline{D}}$ = .06          Control Group $S_{\overline{D}}$ = .15

$S_{D_{M_D}}$     (the estimate of the sampling error for the distribution of differences between the mean differences)

$$\sqrt{\left(S_{\overline{D}_1}\right)^2 + \left(S_{\overline{D}_2}\right)^2} \qquad \sqrt{(.06)^2 + (.15)^2}$$

$S_{D_{M_D}}$ = .19

$D_D = \overline{D}_1 - \overline{D}_2 = .16 - .34 = -.18$

$t = \dfrac{D_D}{S_{D_{M_D}}} = \dfrac{-.18}{.19} = -.947$

df = $(N_1 - 1) + (N_2 - 1)$ = 29 + 14 = 43

"t" at .01 level = 2.69

Not significant at the .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

TEST: Standing Broad Jump

Experimental Group $\bar{D}$ = 3.60     Control Group $\bar{D}$ = .73

Experimental Group $S_{\bar{D}}$ = 1.07     Control Group $S_{\bar{D}}$ = 1.58

$S_{D_{MD}}$     (the estimate of the sampling error for the distribution of differences between the mean differences)

$$\sqrt{\left(S_{\bar{D}_1}\right)^2 + \left(S_{\bar{D}_2}\right)^2} \qquad \sqrt{(1.07)^2 + (1.58)^2}$$

$S_{D_{MD}}$ = 1.91

$D_D = \bar{D}_1 - \bar{D}_2 = 3.60 - .73 = 2.87$

$t = \dfrac{D_D}{S_{D_{MD}}} = \dfrac{2.87}{1.91} = 1.50$

$df = (N_1 - 1) + (N_2 - 1) = 29 + 14 = 43$

"t" at .01 level = 2.69

Not significant at the .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

TEST: Softball Throw

Experimental Group $\bar{D}$ = 16.50    Control Group $\bar{D}$ = 3.00

Experimental Group $S_{\bar{D}}$ = 3.09    Control Group $S_{\bar{D}}$ = 3.42

$S_{D_{M_D}}$    (the estimate of the sampling error for the distribution of differences between the mean differences)

$$\sqrt{\left(S_{\bar{D}_1}\right)^2 + \left(S_{\bar{D}_2}\right)^2} \qquad \sqrt{(3.09)^2 + (3.42)^2}$$

$S_{D_{M_D}}$ = 4.61

$D_{\bar{D}} = \bar{D}_1 - \bar{D}_2 = 16.50 - 3.00 = 13.50$

$t = \dfrac{D_{\bar{D}}}{S_{D_{M_D}}} = \dfrac{13.50}{4.61} = 2.95$

$df = (N_1 - 1) + (N_2 - 1) = 29 + 14 = 43$

"t" at .01 level = 2.69

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

TEST: 600-Yard Run-Walk

Experimental Group $\bar{D}$ = 10.80     Control Group $\bar{D}$ = 5.47

Experimental Group $S_{\bar{D}}$  2.06     Control Group $S_{\bar{D}}$ = 3.52

$S_{D_{M_D}}$     (the estimate of the sampling error for the distribution of differences between the mean differences)

$$\sqrt{\left(S_{\bar{D}_1}\right)^2 + \left(S_{\bar{D}_2}\right)^2} \qquad \sqrt{(2.06)^2 + (3.59)^2}$$

$S_{D_{M_D}}$ = 4.14

$D_{\bar{D}}$ = $\bar{D}_1$ - $\bar{D}_2$ = 10.80 - 5.47 = 5.33

$t = \dfrac{D_{\bar{D}}}{S_{D_{M_D}}} = \dfrac{5.33}{4.14} = 1.29$

df = $(N_1 - 1) + (N_2 - 1)$ = 29 + 14 = 43

"t" at .01 level = 2.69

Not significant at .01 level

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