8-1-1966

# A Comparative Study of Fitness Development Involving Two Different Methods of Administering Conditioning Exercises

Herbert Lee DeForest

# A Comparative Study of Fitness Development Involving Two Different Methods of Administering Conditioning Exercises

by

Herbert Lee DeForest

B.S. in Physical Education

University of North Dakota - Ellendale Center 1964

A Thesis

Submitted to the Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the Degree of

Master of Science

Grand Forks, North Dakota

August, 1966

This thesis, submitted by Herbert Lee DeForest 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.

W. C. Koenig
Chairman

John L. Quadracy

Russell E. Nelson

Christopher J. Hamre
Dean of the Graduate School

ACKNOWLEDGEMENTS

The author wishes to acknowledge his appreciation to Mr. Walter Koenig and Dr. John Quaday, for their guidance, assistance, and special efforts which helped make this study possible.

Appreciation is also extended to Mr. Neil Wilson, physical education instructor at the Benjamin Franklin Elementary School, for his help and consideration.

TABLE OF CONTENTS

LIST OF TABLES

## ABSTRACT

The purpose of this study was to determine the effects of two different methods of administering conditioning exercises. The two methods studied were the circuit training method and the calisthenic method.

The subjects selected for this study were thirty-nine fourth, fifth, and sixth grade boys from the Benjamin Franklin Elementary School in Grand Forks, North Dakota. The thirty-nine subjects were equated into three groups with thirteen in each group. The three groups were the circuit training group, the calisthenic group, and the control group. The circuit training group and the calisthenic group participated in their respective exercise programs for a period of seven weeks. The control group took part in nothing more than unrelated activities during the time of the study.

At the beginning of the experimental period each group was tested for fitness with the Grand Forks Fitness Test. The test was again administered to all three groups at the end of the experimental period.

Comparisons were made between the mean differences within each group on each test item as indicated by the pre-test and the re-test. The null hypothesis was assumed with respect to the differences within groups. 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 groups by testing the significance of the difference between the mean differences found

within groups. The between group comparison used the "t" technique for uncorrelated data from small samples.

Based on the results of this study, it seemed apparent that there were some differences on the test items within the groups. However, the treatment of the data with respect to the differences between the groups indicated no significant differences at the .05 level of significance.

# CHAPTER I

## Statement of the Problem

The problem of this study was to discover a method of administering conditioning exercises in physical education that is more interesting and more worthwhile than the methods that are being used by many of the physical educators of the United States today.

## Need for the Study

There is a definite need for better methods of teaching exercises so that all persons within a group will be properly benefited. Also a definite need is prevalent for better methods of motivating students to physically condition themselves through exercise.

It is hoped that this study will contribute toward the improvement of methods of teaching conditioning exercises in physical education.

## Delimitations

This study was limited to fourth, fifth, and sixth grade boys at the Benjamin Franklin Elementary School, Grand Forks, North Dakota.

There were three groups: a control group, a calisthenic group, and a circuit training group with twelve boys in each group.

The test used to equate and measure the fitness development of the groups was the Grand Forks Fitness Test. The items of the test are as follows:

1. Pull-ups
2. Sit-ups
3. Squat thrusts
4. Shuttle run
5. Vertical jump
6. Standing broad jump

The test was administered at the beginning of experimental period and at the end of the seventh week.

This experimental study was conducted during the second semester of the 1965-66 school year.

## Definitions

The control group consisted of twelve boys from the fourth, fifth, and sixth grades of the Benjamin Franklin Elementary School in Grand Forks, North Dakota. The boys of this group took part in nothing more than unrelated activities during the experimental period and were used to evaluate fitness changes on the part of the other two groups.

The calisthenic group consisted of twelve boys from the fourth, fifth, and sixth grades of the Benjamin Franklin Elementary School in Grand Forks, North Dakota. The boys of this group met every Monday, Wednesday, and Friday during the experimental

period for a planned program of exercise. Although there was planned progression for the group, each boy performed the same given number of repetitions as every other boy each time they met.

The circuit training group consisted of twelve boys from the fourth, fifth, and sixth grades of the Benjamin Franklin Elementary School in Grand Forks, North Dakota. The boys of this group met every Monday, Wednesday, and Friday during the experimental period for a planned program of exercise. Each boy in this group executed as many repetitions of each exercise as possible in given amounts of time. For example, everyone in this group would do as many push-ups as possible in thirty seconds, then squat thrusts, and so on.

Calisthenics is a type of conditioning that involves participation in a variety of physical exercises.

Circuit training is a type of conditioning that involves participation in a variety of physical activities in rapid succession.[1]

Overload is a term connected with physical conditioning that means subjecting the body to exercise that is more vigorous than that to which it is accustomed.[2]

---

[1]Donald R. Casady, Donald F. Mapes, and Louis E. Alley, Handbook of Physical Fitness Activities, (New York: The Macmillan Company, 1965) p. 26.

[2]Ibid., p. 24.

## Related Literature

The related literature selected for this study was limited to comparative studies involving either circuit training or calisthenics, or both, and literature on circuit training or calisthenics as individual methods for developing fitness.

### Comparative studies

#### White's study

White conducted a study in which he compared two methods of developing physical fitness in fourth and fifth grade boys. The two methods employed by White were the basic skill method through a regular program of game type activities and the calisthenic method.

An analysis of the data showed the following results:

1. The basic skill group made a significant gain over the calisthenic group in six of the seven items of Latchaw's Test of Motor Ability.
2. On the President's Physical Fitness Screening Test, the basic skill group made significant improvement over the calisthenic group in pull-ups at the .001 level of confidence. The basic skill group showed a slight improvement over the calisthenic group in the ability to do sit-ups, but the gain was not significant.
3. The calisthenic group recorded its only superiority over

the basic skill group in performing squat thrusts. However, this gain was not statistically significant.

4. The final results of the study indicated that an improved physical fitness rating can be attained through calisthenics or basic skill practice.
5. In some aspects of body development, basic skills practice can result in a greater development of physical fitness than calisthenics.[3]

Davis's study

Davis conducted a study with college freshmen males to determine the effectiveness of three different approaches to increasing physical fitness students of low fitness. The three approaches studied were a program of selected track events, a program of selected track events and calisthenics, and a program of selected track events and circuit training.

The results of the study revealed that the group which received a program of track events and circuit training, gained significantly more in physical fitness than either of the other two groups. The difference between the other two groups was not significant.[4]

Taylor's study

Taylor conducted a study with forty-two business men to de-

---

[3]Robert Eugene White, "A Comparison of Two Methods of Developing Physical Fitness In Fourth and Fifth-Grade Boys," Dissertation Abstracts, Vol. XXIV (July, 1963) p. 176.

[4]Robert McCue Davis, "A Comparison of Three Approaches to Increasing Physical Fitness In Students of Low Fitness," Dissertation Abstracts, Vol. XXIV (November, 1963) p. 1915.

termine the effects of certain fitness programs upon the cardio-vascular and muscular status of business men. The men were equated and put into three groups. One group underwent a program of calisthenics, another a circuit training program, and the third acted as a control group. At the end of the eighth week of the experimental period both experimental groups showed gains in performance that were significant in the cardiovascular and muscular strength tests. There were no significant differences between the two experimental groups. It was concluded that both calisthenics and circuit training can be effective methods of improving the cardiovascular and muscular status of businessmen.[5]

Watt's study

Watt conducted a study in which he compared two methods of physical fitness training in low fitness males. One group of 21 subjects was subjected to a developmental course of exercise. A second group of 17 subjects went through a developmental course in which circuit training was used. Watt found significant gains were shown by both the circuit training group and the group in the regular developmental program.[6]

---

[5] B.M. Taylor, "Effects of Certain Fitness Programs upon the Cardio-vascular and Muscular Status of Businessmen," Unpublished Master's Thesis, University of British Columbia, 1961.

[6] N.S. Watt, "Comparison of Two Methods of Physical Fitness Training in Low Fitness Males at the University of Oregon," Unpublished Master's Thesis, University of Oregon, 1961.

Webb's study

Webb conducted a study to determine the effects of three warm-up procedures upon physical performance in the baseball throw for distance and accuracy.

The three warm-up procedures were: (1) no warm-up, (2) an unrelated warm-up which was actually a program of calisthenics performed to generally activate the body systems at a non-fatiguing level, and (3) related warm-ups which involved movements similar to those required in the actual test activities.

The results of the study showed the following:

1. There was no statistical significant difference at the .05 level of confidence in favor of any one of the three methods.
2. The related warm-up method showed a greater mean score in both the distance test and accuracy test.
3. The unrelated warm-up method which was comprised of calisthenic exercises had the lowest mean score in both the distance and accuracy tests.[7]

Literature on Calisthenic Exercises

The chief limitation of calisthenics as a means for devel-

---

[7]James L. Webb, "The Effects of No Warm-up, Related Warm-up and Unrelated Warm-up on the Performance of the Baseball Throw for Accuracy and Distance," Unpublished Master's Thesis, University of North Dakota, 1963.

oping physical fitness is that if a program of calisthenics is used for a long period of time it may prove to be boring and monotonous to many people. Also, the types and amount of overload are limited with calisthenics.[8]

Campney and Wehr's study

In order to evaluate the effects of calisthenics on selected components of physical fitness, Campney and Wehr set up a program of calisthenics in which male and female undergraduate college students took part for a period of 10 weeks. The calisthenics used were in accordance with the President's Council on Physical Fitness.

The study revealed the following:

1. The calisthenic program produced significant increases in strength for men and women except in isolated instances.
2. Flexibility in the men was improved by active participation in the program, but the exercises of the program did not seem to meet the standard for increasing the flexibility of the women.
3. The improvement of endurance, coordination, and efficiency of men was not significant, but the women did show some significant improvement.
4. The program did not produce significant improvements

---

[8] Donald R. Casday, Donald F. Mapes, and Louis E. Alley, Handbook of Physical Fitness Activities (New York: The Macmillan Company, 1965) p. 37.

in general appearance for men and women in terms of segmental girths and total body weight.[9]

Fabricius's study

A study was conducted by Helen Fabricius to determine the effect of added calisthenics on the physical fitness of fourth and fifth grade boys and girls. About three minutes of additional calisthenics were added to the regular physical education program. The results of the study showed that both groups improved significantly in physical fitness in the six month period from September 1962 to March 1963. The experimental group having the added calisthenics did, however, improve significantly more than the control group.[10]

## Literature on Circuit Training

Morgan and Adamson's study

An experiment of progressive loading which led to circuit training was performed by Morgan and Adamson. Two balanced groups of fourteen and fifteen year old boys who had three physical education periods per week were used for the experiment. An additional overload program of thirty minutes per week for one month was added to the experimental group. The results of the study showed that the

---

[9]Harry K. Campney and Richard W. Wehr, "Effects of Calisthenics on Selected Components of Physical Fitness, " The Research Quarterly, Volume 36, No. 4, (December, 1965) p. 401.

[10]Helen Fabricius, "Effect of Added Calisthenics on the Physical Fitness of Fourth Grade Boys and Girls," The Research Quarterly, Volume 35, No. 2, (May, 1964) p. 139.

small amount of overload training used by the experimental group produced significant increases in strength, efficiency, and fitness indices.[11]

Howell, Hodgson, and Sorenson's study

A study was conducted by Howell, Hodgson, and Sorenson on the effects of circuit training on the performance of the modified Harvard Step Test. The study revealed that circuit training over a four-week period twice a week caused a statistically significant improvement in the performance of the modified Harvard Step Test. The control group which participated in a service program consisting of volleyball and badminton showed no statistically significant gains in the performance of the modified Harvard Step Test.[12]

Brown's study

Brown conducted a study on physical fitness improvement by the use of circuit training. It was concluded that a physical education program for fifth grade girls which included a 10 minute circuit training program improved physical fitness as measured by the American Association for Health, Physical Education, and Recreation Youth Fitness Test.[13]

Nunney's study

Nunney conducted a study to find out if circuit training

---

[11] R.E. Morgan and G.T. Adamson, Circuit Training (London: G. Bell and Sons, 1957) pp. 25-30.

[12] Maxwell L. Howell, James L. Hodgson, and Thomas J. Sorenson, "Effects of Circuit Training on the Modified Harvard Step Test," Research Quarterly, (May, 1963) Volume 34, p. 156.

[13] A.M. Brown, "Effects of Circuit Training on the Physical Fitness of Grade Five Girls," Unpublished Master's Thesis University of British Columbia, 1961.

could be beneficial in improving the fitness of swimmers. Two groups of 12 college men were equated and used in the study. The experimental group combined swimming and circuit training in the program; the control group participated in swimming only. The results showed that the experimental group made significant gains in swimming endurance and speed, weight, and ability to perform chins and push-ups. The control group made significant gains in weight and swimming endurance. Significantly greater gains in weight and chins were made by the experimental group than were made by the control group.[14]

---

[14] D.N. Nunney, "Relation of Circuit Training to Swimming," The Research Quarterly, Volume 31 (May, 1960) pp. 188-199.

## CHAPTER II

### Procedure

This study was conducted at the Benjamin Franklin Elementary School in Grand Forks, North Dakota, with thirty-six boys. The boys were divided into three groups with twelve boys in each group. The Grand Forks Fitness Test was used as a basis for testing and equating the three groups.

For the purpose of this study the control group was made up of fourth, fifth, and sixth grade boys who were assigned to nothing more than their regular physical education classes. The other two groups were also made up of fourth, fifth, and sixth grade boys who met every Monday, Wednesday, and Friday, after school, for about 15 minutes to perform a number of repetitions of from 5 to 7 selected exercises. This was in addition to their regular physical education class program.

The same exercises were performed by both groups, and in the same sequence, but by a different method.

The calisthenic group performed its exercises in the regular calisthenic manner with everyone in the group performing the same number of repetitions of each exercise. As time went on repetitions were added for group progression.

The circuit training group performed each of its exercises with the same basic physical movements as the calisthenic group,

but with each person executing as many repetitions of each exercise as posible in given amounts of time. For example, everyone in this group would do as many push-ups as possible in thirty seconds, then squat thrusts, and so on.

Record cards were kept by the circuit training group and improvement was checked from time to time. This was possible because all the exercises were listed on the cards and the same time period was allotted for the execution of each of the exercises. The record cards used in circuit training served as a very good motivational device.

Test Administration

At the beginning of the study all the boys were tested for fitness by use of the Grand Forks Fitness Test and were placed into one of three groups. The groups were equated on the basis of total fitness scores. Like scores were matched and put into different groups for the study. For example, if three boys each scored 35 on the test they would likely be placed in different groups.

The items of the test are as follows:

1. Squat thrusts - number in 30 seconds
2. Sit-ups - number in 2 minutes
3. Pull-ups
4. Shuttle run

5. Vertical jump

6. Standing broad jump

The method used in testing was the same for the re-testing as it was for the pre-testing.

The boys were evenly divided into groups and were rotated from one testing station to another as they completed the various phases of the test.

Three men were used to test the boys and each man was in charge of one testing station where he tested the boys on two items of the test and then sent them to another station. He would then test another group of boys and continue until he had tested all the boys on the two test item at his station.

## Method of Scoring

For the purpose of analysis the individual test items and the total fitness score of each boy was computed by use of the norms that were established for the Grand Forks Fitness Test. The established norms for the test can be found in Appendix A on page 40.

## Statistical Procedure

This investigator assumed the null hypothesis in analyzing the differences between the means obtained on the initial test and the re-test. That hypothesis[2] asserts that there is no true

---

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

difference between the two mean scores, and 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 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 a "t" and is checked for significance in a "t" table. The value of "t" is proportional to the degrees 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 reject the null hypothesis at the .05 level of significance.

Details of the mathematical process employed in the analysis for each testing area is presented in Appendix B.

## CHAPTER III

## Analysis of the Data

The purpose of the testing in this study was to determine whether or not any significant changes resulted in certain areas of physical fitness within groups and between the circuit training group, the calisthenic group, and the control group. The bases for comparisons were the results obtained from the Grand Forks Fitness Test.

For the purpose of analysis the scores of the individual test items and the total fitness scores are expressed as norm scores throughout this paper. It must be kept in mind that a high norm score indicates a better performance than a low norm score. . For example, a score of 5 on the shuttle run indicates a faster time than a score of 4.

### Results of Comparison

#### Pull-ups

The circuit training group had a mean score on the pull-ups of 5.08 in the pre-test and a mean score of 6.75 in the re-test. This represented a mean increase of 1.67 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .71. The "t" value of 2.35 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The calisthenic group had a mean score on the pull-ups

of 5.08 in the pre-test and a mean score of 6.58 in the re-test. This represented a mean increase of 1.5 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .54. The "t" value of 2.78 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The control group had a mean score on the pull-ups of 4.08 in the pre-test and a mean score of 5.33 in the re-test. This represented a mean increase of 1.25 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .28. The "t" value of 4.46 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

All three groups gained significantly, from the pre-test to the re-test, in the number of pull-ups they were able to perform.

Sit-ups

The circuit training group had a mean score on the sit-ups of 7.92 in the pre-test and a mean score of 10.5 in the re-test. This represented a mean increase of 2.58 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .53. The "t" value of 4.87 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The calisthenic group had a mean score in the sit-ups of 7.83 in the pre-test and a mean score of 11.0 in the re-test. This represented a mean increase of 3.17 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .58. The "t" value of 5.47 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The control group had a mean score on the sit-ups of 7.67 in the pre-test and a mean score of 10.42 in the re-test. This represented a mean increase of 2.75 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .54. The "t" value of 5.09 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

All three groups gained significantly, from the pre-test to the re-test, in the number of sit-ups they were able to perform.

Squat Thrusts

The circuit training group had a mean score on the squat thrusts of 5.25 in the pre-test and a mean score of 9.25 in the re-test. This represented a mean increase of 4.0 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .92. The "t" value of 4.34 with 11

degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The calisthenic group had a mean score on the squat thrusts of 6.08 in the pre-test and a mean score of 7.5 in the re-test. This represented a mean increase of 1.42 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .82. The "t" value of 1.73 with 11 degrees of freedom indicated no significant difference at the .05 level of significance, and the null hypothesis was therefore retained.

The control group had a mean score on the squat thrusts of 6.0 in the pre-test and a mean score of 7.75 in the re-test. This represented a mean increase of 1.75 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .58. The "t" value of 3.02 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The circuit training group and the control group gained significantly, from the pre-test to the re-test, in the number of squat thrusts they were able to perform. The calisthenic group showed an improvement, but it was not significant at the .05 level of significance.

Shuttle Run

The circuit training group had a mean score on the shuttle run of 7.08 in the pre-test and a mean score of 5.75

in the re-test. This represented a mean decrease of -1.33 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .85. The "t" value of -1.58 with 11 degrees of freedom indicated no significant difference at the .05 level of significance, and the null hypothesis was therefore retained.

The calisthenic group had a mean score on the shuttle run of 6.83 in the pre-test and a mean score of 6.42 in the re-test. This represented a mean decrease of -.47 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .83. The "t" value of -.51 with 11 degrees of freedom indicated no significant difference at the .05 level of significance, and the null hypothesis was therefore retained.

The control group had a mean score on the shuttle run of 6.83 in the pre-test and a mean score of 7.25 in the re-test. This represented a mean increase of .42 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .13. The "t" value of 3.23 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The control group gained significantly, from the pre-test to the re-test, in the speed at which it was able to perform the shuttle run. The circuit training group and the calisthenic group

showed a decrease in their ability to perform the shuttle run with speed.

Vertical Jump

The circuit training group had a mean score on the vertical jump of 2.58 in the pre-test and a mean score of 2.67 in the re-test. This represented a mean increase of .09 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .15. The "t" value of .53 with 11 degrees of freedom indicated no significant difference at the .05 level of significance, and the null hypothesis was therefore retained.

The calisthenic group had a mean score on the vertical jump of 2.25 in the pre-test and a mean score of 2.67 in the re-test. This represented a mean increase of .42 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .15. The "t" value of 2.8 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The control group had a mean score on the vertical jump of 1.75 in the pre-test and a mean score of 3.25 in the re-test. This represented a mean increase of 1.5 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .23. The "t" value of 2.17 with 11 degrees of freedom indicated no significant difference at the .05 level

of significance, and the null hypothesis was therefore retained.

The calisthenic group gained significantly, from the pre-test to the re-test, in the height at which its members were able to jump in the vertical jump. The circuit training group and the control group showed an improvement, but their improvements were not significant at the .05 level of significance.

Standing Broad Jump

The circuit training group had a mean score on the standing broad jump of 6.0 in the pre-test and a mean score of 6.83 in the re-test. This represented a mean increase of .83 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .33. The "t" value of 2.59 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The calisthenic group had a mean score on the standing broad jump of 5.92 in the pre-test and a mean score of 6.33 in the re-test. This represented a mean increase of .41 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .19. The "t" value of 2.21 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The control group had a mean score on the standing broad jump of 6.25 in the pre-test and a mean score of 6.42 in

the re-test. This represented a mean increase of .17 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .37. The "t" value of .46 with 11 degrees of freedom indicated no significant difference at the .05 level of significance, and the null hypothesis was therefore retained.

The circuit training group and the calisthenic group gained significantly, from the pre-test to the re-test, in the distance that they were able to jump in the standing broad jump. The control group showed an improvement, but it was not significant at the .05 level of significance, and the null hypothesis was therefore retained.

Within Group Comparisons

The circuit training group had a mean score, for the total of the fitness test scores, of 33.93 on the pre-test and a mean score of 41.75 on the re-test. This represented a mean increase of 7.82 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was 1.38. The "t" value of 5.67 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The calisthenic group had a mean score, for the total of the fitness scores, of 34.0 on the pre-test and a mean score of 40.5 on the re-test. This represented a mean increase of 6.5

between the pre-test and the re-test. The estimate of the sampling error of this mean difference was 1.13. The "t" value of 5.75 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

The control group had a mean score, for the total of the fitness test scores, of 33.58 on the pre-test and a mean score of 40.42 on the re-test. This represented a mean increase of 6.84 between the pre-test and the re-test. The estimate of the sampling error of this mean difference was .88. The "t" value of 7.76 with 11 degrees of freedom indicated significance at the .05 level of significance, and the null hypothesis was therefore rejected.

All three groups gained significantly, from the pre-test to the re-test, in their cumulative fitness scores.

Between Group Comparisons

The mean increase of the total fitness scores between the pre-test and the re-test was 7.83 for the circuit training group and 6.83 for the control group. The difference between the mean differences of these two groups was 1.0. The estimate of the sampling error for the distribution of the differences between the mean differences was 1.63. 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 .61. With 22 degrees of freedom, this "t" value indicated no significant difference between the groups and therefore the null hypothesis was retained.

The mean increase of the total fitness scores between the pre-test and the re-test was 6.83 for the control group and 6.5 for the calisthenic group. The difference between the mean differences of the two groups was..33. The estimate of the sampling error for the distribution of the differences between the mean differences was 1.59. 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 .21. With 22 degrees of freedom, this "t" value indicated no significant difference between the two groups and therefore the null hypothesis was retained.

The mean increase of the total fitness scores between the pre-test and the re-test was 7.83 for the circuit training group and 6.5 for the calisthenic group. The difference between the mean differences of the two groups was 1.33. 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 was .69. With 22 degrees of freedom, this "t" value

indicated no significant difference between the two groups and therefore the null hypothesis was retained.

The circuit training group showed a slightly greater improvement in its cumulative fitness scores, from the pre-test to the re-test, than did the other two groups, however, none of the three groups gained signifcantly more than any other.

TABLE I

MEAN SCORES IN TEST ITEMS

| | Circuit Training | | Calisthenic | | Control | |
|---|---|---|---|---|---|---|
| | Pre-test | Re-test | Pre-test | Re-test | Pre-test | Re-test |
| Pull-ups | 5.08 | 6.75 | 5.08 | 6.58 | 4.08 | 5.33 |
| Sit-ups | 7.92 | 10.5 | 7.83 | 11 | 7.67 | 10.42 |
| Squat thrusts | 5.25 | 9.25 | 6.08 | 7.5 | 6 | 7.75 |
| Shuttle run | 7.08 | 5.75 | 6.83 | 6.42 | 6.83 | 7.25 |
| Vertical jump | 2.58 | 2.67 | 2.25 | 2.67 | 1.75 | 3.25 |
| St. broad jump | 6 | 6.83 | 5.92 | 6.33 | 6.25 | 6.42 |

MEAN DIFFERENCES WITHIN GROUPS
BETWEEN THE TEST ITEMS OF THE
PRE-TEST AND THE RE-TEST

| | Circuit Training | Calisthenic | Control |
|---|---|---|---|
| | Mean Difference | Mean Difference | Mean Difference |
| Pull-ups | 1.67 | 1.5 | 1.25 |
| Sit-ups | 2.58 | 3.17 | 2.75 |
| Squat thrusts | 4 | 1.42 | 1.75 |
| Shuttle run | -1.33 | -.47 | .42 |
| Vertical jump | .09 | .42 | 1.5 |
| St. broad jump | .83 | .41 | .17 |

TABLE II

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

| | Circuit training | Calisthenic | Control |
|---|---|---|---|
| Pull-ups | Significant at .05 level | Significant at .05 level | Significant at .05 level |
| Sit-ups | Significant at .05 level | Significant at .05 level | Significant at .05 level |
| Squat thrusts | Significant at .05 level | Not Significant at .05 level | Significant at .05 level |
| Shuttle run | Not Significant at .05 level | Not Significant at .05 level | Significant at .05 level |
| Vertical jump | Not Significant at .05 level | Significant at .05 level | Not Significant at the .05 level |
| St. broad jump | Significant at .05 level | Significant at .05 level | Not Significant at .05 level |

TABLE III

"t" AND THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE MEANS, OF THE TOTAL OF THE TEST SCORES, WITHIN GROUPS ON THE PRE-TEST AND RE-TEST

| | |
|---|---|
| Circuit Training Group | 5.67 Significant at the .05 level |
| Calisthenic Group | 5.75 Significant at the .05 level |
| Control Group | 7.76 Significant at the .05 level |

TABLE IV

"t" AND THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN
THE MEAN DIFFERENCES, OF THE TOTAL OF THE TEST SCORES, BETWEEN GROUPS

| Area of Comparison | "t" Value and Significance |
|---|---|
| Circuit training group<br>Control group | .61 Not Significant<br>at the .05 level |
| Control group<br>Calisthenic group | .21 Not Significant<br>at the .05 level |
| Circuit training group<br>Calisthenic group | .69 Not Significant<br>at the .05 level |

# CHAPTER IV

## Discussion

While working on this study the author discovered certain facets that should go into the making of a well planned and well administered physical conditioning program.

A good fitness program must, first of all, attempt to provide for the needs of every participant. The physical educator who directs the group to do fifteen push-ups, twenty-five sit-ups, or thirty squat thrusts is not making a very good attempt to meet the needs of every participant in his program. Fifteen push-ups may not even be a good warm-up for the star athlete in the class, and it might be a near impossible feat for a boy who has spent most of his spare time in front of a television set. This is one of the phases of fitness development that makes circuit training a very desirable method for administering conditioning exercises. In circuit training every participant within a group works to his own capacity.

Secondly, a good fitness program should produce results in the form of physically improved participants. If a boy can do seventy-five push-ups and two hundred sit-ups after a course in physical conditioning, he probably is pretty well fit, but he didn't achieve much if he was able to do the same number of repetitions of each exercise when the program began. A physical

conditioning program must work on the overload system. If a person is to improve physically, he must push himself beyond his previous performances. If the body is worked hard enough and long enough, it will respond with increased strength. Experience gained through this study indicates a preference for the circuit training method for developing physical fitness. In circuit training the participant works to his fullest capacity for a designated period of time. Each time he attempts to push himself beyond past performances. Few other methods offer such excellent opportunities to employ overload.

## Thoughts on the Study

Although this study did not conclusively reveal that one method for administering conditioning exercises is significantly more worthwhile than another, it is believed that if this study had been carried on for a longer period of time it might have shown circuit training to be a significantly more worthwhile method of administering conditioning exercises than is calisthenics.

A different choice of subjects to be used in the study might also have made this study more revealing. There is the possibility that the subjects used in this study might have been a little immature for a study of this type.

One might assume than since the control group, as well as the experimental groups, showed significant improvements

in physical fitness, there is little to be gained from the type of exercise programs used by the circuit training or calisthenic groups. It is believed, however, that maturation of the subjects was a major reason why the control group showed a significant gain in fitness, and that maturation played a part in concealing the true benefits that can be gained from the type of exercise programs that were employed by the experimental groups.

# CHAPTER V

## Summary, Conclusions and Recommendations

### Summary

The purpose of this study was to determine the effects of two different methods of administering conditioning exercises. The two methods studied were the circuit training method and the calisthenic method.

The subjects selected for this study were thirty-nine fourth, fifth, and sixth grade boys from the Benjamin Franklin Elementary School in Grand Forks, North Dakota. The thirty-nine subjects were equated into three groups with thirteen in each group. The three groups were the circuit training group, the calisthenic group, and the control group. The circuit training group and the calisthenic group participated in their respective exercise programs for a period of seven weeks. The control group took part in nothing more than unrelated activities during the time of the study.

At the beginning of the experimental period each group was tested for fitness with the Grand Forks Fitness Test. The test was again administered to all three groups at the end of the experimental period.

Comparisons were made between the mean differences within each group on each test item as indicated by the pre-test and

the re-test. The null hypothesis was assumed with respect to the differences within the groups. 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 groups by testing the significance of the difference between the mean differences found within groups. The between group comparison used the "t" technique for uncorrelated data from small samples.

## Conclusions

The following conclusions were believed justified by this study:

1. The circuit training group gained significantly at the .05 level of significance in four of the six fitness measures of the test. The circuit training group showed a decrease in the mean score on the shuttle run, from the pre-test to the re-test, and showed only a slight improvement, that was not significant, in the vertical jump.
2. The calisthenic group gained significantly at the .05 level of significance in four of the six fitness measures of the test. The calisthenic group showed a decrease in the mean score on the shuttle run, from the pre-test

to the re-test, and only a slight improvement, that was not significant, was shown in the squat thrusts.

3. The control group gained significantly at the .05 level of significance in four of the six fitness measures of the test. The control group showed only a slight improvement, that was not significant, on the vertical jump and the standing broad jump.
4. All three groups gained significantly, from the pre-test to the re-test, in the means of their cumulative fitness scores.
5. The circuit training group showed a slightly greater improvement in its cumulative fitness scores, from the pre-test to the re-test, than did the other two groups, however, none of the three groups gained significantly more than any other.

## Recommendations

1. It is recommended that further investigation be made in this area using more mature subjects and a longer training period.
2. Because the circuit training group and the calisthenic group showed a decrease in their ability to perform the shuttle run with speed, it is recommended that a study be conducted to determine whether similar results will be consistently obtained or whether these findings were phenomena particular to this study alone.

# BIBLIOGRAPHY

## Books

Casady, Donald R., Mapes, Donald F., and Alley, Louis E., Handbook of Physical Fitness Activities, (New York: The Macmillan Company, 1965) pp. 24, 26, 37.

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

Morgan, R.E. and Adamson, G.T., Circuit Training (London: G. Bell and Sons, 1957) pp. 25-30.

## Articles and Periodicals

Campney, Harry K, and Wehr, Richard W., "Effects of Calisthenics on Selected Components of Physical Fitness," The Research Quarterly, Volume 36, No. 4, (December, 1965) p. 401.

Davis, Robert McCue, "A Comparison of Three Approaches to Increasing Physical Fitness In Students of Low Fitness," Dissertation Abstracts, Vol. XXIV (November, 1963) p. 1915.

Fabricius, Helen, "Effect of Added Calisthenics on Physical Fitness of Fourth Grade Boys and Girls," The Research Quarterly, Volume 35, No. 2, (May, 1964) p. 139.

Howell, Maxwell L., Hodgson, James L., and Sorenson, Thomas J., "Effects of Circuit Training on the Modified Harvard Step Test," The Research Quarterly, (May, 1963) Volume 34, p. 156.

Nunney, D.N., "Relation of Circuit Training to Swimming," The Research Quarterly, Volume 31, (May, 1960) pp. 188-199.

White, Robert Eugene, "A Comparison of Two Methods of Developing Physical Fitness In Fourth and Fifth-Grade Boys," Dissertation Abstracts, Vol. XXIV (July, 1963) p. 176.

## Unpublished Material

Brown, A.M., "Effects of Circuit Training on the Physical Fitness of Grade Five Girls," Unpublished Master's Thesis,University of British Columbia, 1961.

Taylor, B.M., "Effects of Certain Fitness Programs upon the Cardio-vascular and Muscular Status of Businessmen," Unpublished Master's Thesis, University of British Columbia, 1961.

Watt, N.S.,"Comparison of Two Methods of Physical Fitness Training in Low Fitness Males at the University of Oregon," Unpublished Master's Thesis, University of Oregon, 1961

Webb, James L., "The Effects of No Warm-up, Related Warm-up and Unrelated Warm-up on the Performance of the Baseball Throw for Accuracy and Distance," Unpublished Master's Thesis, University of North Dakota, 1963.

# GRAND FORKS FITNESS TEST NORMS

## Squat Thrusts
boys and girls

| no. done | score |
|---|---|
| over 25 | 15 |
| 25 | 14 |
| 24 | 13 |
| 23 | 12 |
| 22 | 11 |
| 21 | 10 |
| 20 | 9 |
| 19 | 8 |
| 18 | 7 |
| 17 | 6 |
| 16 | 5 |
| 14 | 4 |
| 12 | 3 |
| 8 | 2 |
| 4 | 1 |

## Pull-ups

boys

| no. done | score |
|---|---|
| over 15 | 20 |
| 15 | 18 |
| 14 | 16 |
| 13 | 14 |
| 12 | 13 |
| 11 | 12 |
| 10 | 11 |
| 9 | 10 |
| 8 | 9 |
| 7 | 8 |
| 6 | 7 |
| 5 | 6 |
| 4 | 5 |
| 3 | 4 |
| 2 | 3 |
| 1 | 2 |

girls

| no. done | score |
|---|---|
| over 38 | 20 |
| 38 | 19 |
| 36 | 18 |
| 34 | 17 |
| 32 | 16 |
| 30 | 15 |
| 28 | 14 |
| 26 | 13 |
| 24 | 12 |
| 22 | 11 |
| 20 | 10 |
| 18 | 9 |
| 16 | 8 |
| 14 | 7 |
| 12 | 6 |
| 10 | 5 |
| 8 | 4 |
| 6 | 3 |
| 4 | 2 |
| 2 | 1 |

## Sit-ups
boys and girls

| no. done | score |
|---|---|
| over 80 | 15 |
| 80 | 14 |
| 75 | 13 |
| 70 | 12 |
| 65 | 11 |
| 60 | 10 |
| 55 | 9 |
| 50 | 8 |
| 45 | 7 |
| 40 | 6 |
| 35 | 5 |
| 30 | 4 |
| 25 | 3 |
| 18 | 2 |
| 10 | 1 |

GRAND FORKS FITNESS TEST NORMS - continued

Shuttle Run
boys and girls

| time | score |
|---|---|
| 9.0 | 20 |
| 9.1-9.2 | 19 |
| 9.3-9.4 | 18 |
| 9.5-9.7 | 17 |
| 9.8-10 | 16 |
| 10.1-10.3 | 15 |
| 10.4-10.5 | 14 |
| 10.6-10.7 | 13 |
| 10.8 | 12 |
| 10.9 | 11 |
| 11.0 | 10 |
| 11.1-11.3 | 9 |
| 11.4-11.7 | 8 |
| 11.8-12.2 | 7 |
| 12.3-12.4 | 6 |
| 12.5-12.9 | 5 |
| 13.0-13.4 | 4 |
| 13.5-13.9 | 3 |
| 14.0-14.4 | 2 |
| 14.5-16.0 | 1 |

St. Broad Jump

| boys | | girls | |
|---|---|---|---|
| distance | score | distance | score |
| 9' | 15 | 7' | 15 |
| 8'9" | 14 | 6'9" | 14 |
| 8'6" | 13 | 6'6" | 13 |
| 8' | 12 | 6'3" | 12 |
| 7'6" | 11 | 6' | 11 |
| 7' | 10 | 5'9" | 10 |
| 6'6" | 9 | 5'6" | 9 |
| 6' | 8 | 5'3" | 8 |
| 5'6" | 7 | 5' | 7 |
| 5' | 6 | 4'9" | 6 |
| 4'6" | 5 | 4'6" | 5 |
| 4' | 4 | 4' | 4 |
| 3'6" | 3 | 3'6" | 3 |
| 3' | 2 | 3' | 2 |
| 2'6" | 1 | 2'6" | 1 |

Vertical Jump

| boys | | girls | |
|---|---|---|---|
| height | score | height | score |
| 25" | 15 | 21" | 15 |
| 24" | 14 | 20" | 14 |
| 23" | 13 | 19" | 13 |
| 22" | 12 | 18" | 12 |
| 21" | 11 | 17" | 11 |
| 20" | 10 | 16" | 10 |
| 19" | 9 | 15" | 9 |
| 18" | 8 | 14" | 8 |
| 17" | 7 | 13" | 7 |
| 16" | 6 | 12" | 6 |
| 15" | 5 | 11" | 5 |
| 14" | 4 | 10" | 4 |
| 13" | 3 | 9" | 3 |
| 12" | 2 | 8" | 2 |
| 6" | 1 | 6" | 1 |

CIRCUIT TRAINING PROGRESS CARD

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sit-ups | | | | | | | | | | | | | |
| Push-ups | | | | | | | | | | | | | |
| Pull-ups | | | | | | | | | | | | | |
| Squat Thrusts | | | | | | | | | | | | | |
| Side Straddles | | | | | | | | | | | | | |
| Tread Mills | | | | | | | | | | | | | |
| Heel Slaps | | | | | | | | | | | | | |
| Toe Touches | | | | | | | | | | | | | |
| Crab Walk | | | | | | | | | | | | | |
| Sprint Drill | | | | | | | | | | | | | |

# APPENDIX B

Area of Comparison: Pull-ups

Individual Norm Scores of Circuit Training Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 0 | 2 | 2 | 4 |
| 2. | 0 | 0 | 0 | 0 |
| 3. | 4 | 5 | 1 | 1 |
| 4. | 2 | 4 | 2 | 4 |
| 5. | 2 | 0 | -2 | 4 |
| 6. | 6 | 9 | 3 | 9 |
| 7. | 7 | 7 | 0 | 0 |
| 8. | 5 | 8 | 3 | 9 |
| 9. | 9 | 9 | 0 | 0 |
| 10. | 5 | 6 | 1 | 1 |
| 11. | 8 | 10 | 2 | 4 |
| 12. | 13 | 21 | 8 | 64 |
| | $\Sigma 61$ | $\Sigma 81$ | $\Sigma 20$ | $\Sigma 100$ |

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

$N = 12$
$\Sigma D = 20$
$\Sigma D^2 = 100$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D2 - \frac{(\Sigma D)2}{N}}{N-1}} \Big/ \sqrt{N}$$

$$= \sqrt{\frac{100 - \frac{400}{12}}{12-1}} \Big/ \sqrt{12} \qquad = 100 - \frac{400}{12} = 66.67$$

$$= \frac{66.67}{11} = 6.06 \qquad = \sqrt{6.06} \Big/ \sqrt{12} = \frac{2.46}{3.46}$$

$$S_{\bar{D}} = .77$$

$\bar{D}$ (mean difference) $= \frac{20}{12} = 1.67$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{1.67}{.77} = 2.35$$

$df = N-1 = 11$
"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison Sit-ups

Individual Norm Scores of Circuit Training Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 5 | 6 | 1 | 1 |
| 2. | 6 | 6 | 0 | 0 |
| 3. | 5 | 9 | 4 | 16 |
| 4. | 10 | 14 | 4 | 16 |
| 5. | 9 | 11 | 2 | 4 |
| 6. | 6 | 11 | 5 | 25 |
| 7. | 6 | 10 | 4 | 16 |
| 8. | 9 | 14 | 5 | 25 |
| 9. | 8 | 11 | 3 | 9 |
| 10. | 11 | 11 | 0 | 0 |
| 11. | 6 | 8 | 2 | 4 |
| 12. | 14 | 15 | 1 | 1 |
| | $\Sigma$ 95 | $\Sigma$ 126 | $\Sigma$ 31 | $\Sigma$ 117 |

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

$N = 12$
$\Sigma D = 31$
$\Sigma D^2 = 117$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Bigg/ \sqrt{N}$$

$$= \sqrt{\frac{117 - \frac{961}{12}}{12-1}} \Bigg/ \sqrt{12} \qquad = 117 - \frac{961}{12} = 36.92$$

$$= \frac{36.92}{11} = 3.36$$

$$= \frac{\sqrt{3.36}}{\sqrt{12}} = \frac{1.83}{3.46} = .53$$

$\bar{D}$ (mean difference) $= \frac{31}{12} = 2.58$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{2.58}{.53} = 4.87$$

$df = N-1 = 11$
"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison: Squat Thrusts

Individual Norm Scores of Circuit Training Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 3 | 10 | 7 | 49 |
| 2. | 3 | 9 | 6 | 36 |
| 3. | 4 | 8 | 4 | 16 |
| 4. | 4 | 7 | 3 | 9 |
| 5. | 4 | 7 | 3 | 9 |
| 6. | 3 | 10 | 7 | 49 |
| 7. | 11 | 6 | -5 | 25 |
| 8. | 5 | 9 | 4 | 16 |
| 9. | 5 | 10 | 5 | 25 |
| 10. | 5 | 10 | 5 | 25 |
| 11. | 6 | 12 | 6 | 36 |
| 12. | 10 | 13 | 3 | 9 |
| | $\Sigma$ 63 | $\Sigma$ 111 | $\Sigma$ 48 | $\Sigma$ 304 |

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

$N = 12$
$\Sigma D = 48$
$\Sigma D^2 = 304$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Bigg/ \sqrt{N}$$

$$= \sqrt{\frac{304 - \frac{2304}{12}}{12-1}} \Bigg/ \sqrt{12} \qquad 304 - \frac{2304}{12} = 112$$

$$= \frac{112}{11} = 10.18 \qquad = \frac{\sqrt{10.18}}{\sqrt{12}} = \frac{3.19}{3.46}$$

3.46 | 3.19.100 — 92 — 760

$$S_{\bar{D}} = .92$$

$$\bar{D} \text{ (mean difference)} = \frac{48}{12} = 4$$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{4}{.92} = 4.34$$

$df = N-1 = 11$
"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison: Shuttle Run

Individual Norm Scores of Circuit Training Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 5 | 4 | -1 | 1 |
| 2. | 4 | 3 | -1 | 1 |
| 3. | 5 | 1 | -4 | 16 |
| 4. | 4 | 7 | 3 | 9 |
| 5. | 8 | 4 | -4 | 16 |
| 6. | 10 | 7 | -3 | 9 |
| 7. | 5 | 7 | 2 | 4 |
| 8. | 5 | 9 | 4 | 16 |
| 9. | 7 | 4 | -3 | 9 |
| 10. | 10 | 7 | -3 | 9 |
| 11. | 10 | 9 | -1 | 1 |
| 12. | 12 | 7 | -5 | 25 |
| | $\Sigma$ 85 | $\Sigma$ 69 | $\Sigma$ -16 | $\Sigma$ 116 |

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

$N = 12$

$\Sigma D = -16$

$\Sigma D^2 = 116$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Bigg/ \sqrt{N}$$

$$= \sqrt{\frac{116 - \frac{256}{12}}{12-1}} \qquad 116 - \frac{256}{12} = 94.27$$

$$= \frac{94.27}{11} \sqrt{12} = 8.57 = \frac{\sqrt{8.57}}{\sqrt{12}} = \frac{2.93}{3.46} =$$

$S_{\bar{D}} = .85$

$\bar{D}$ (mean difference) $= \frac{-16}{12} = -1.33$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{-1.33}{.85} = -1.58$$

$df = N-1 = 11$

"t" at the .05 level = 2.20

Difference is not significant at .05 level

Area of Comparison: Verticle jump

Individual Norm Scores of Circuit Training Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 2 | 2 | 0 | 0 |
| 2. | 2 | 2 | 0 | 0 |
| 3. | 2 | 2 | 0 | 0 |
| 4. | 2 | 3 | 1 | 1 |
| 5. | 2 | 2 | 0 | 0 |
| 6. | 2 | 2 | 0 | 0 |
| 7. | 2 | 2 | 0 | 0 |
| 8. | 3 | 3 | 0 | 0 |
| 9. | 3 | 3 | 0 | 0 |
| 10. | 3 | 3 | 0 | 0 |
| 11. | 6 | 5 | -1 | 1 |
| 12. | 2 | 3 | 1 | 1 |
| | $\Sigma 31$ | $\Sigma 32$ | $\Sigma 1$ | $\Sigma 3$ |

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

$N = 12$
$\Sigma D = 1$
$\Sigma D^2 = 3$

$$\frac{S}{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{3 - \frac{1}{12}}{12-1}}}{\sqrt{12}} = 3 - \frac{1}{12} = 2.92$$

$$= \frac{2.92}{11} = .27 = \frac{\sqrt{.27}}{\sqrt{12}} = \frac{.52}{3.46}$$

$$\frac{S}{\bar{D}} = .15$$

$$\bar{D} \text{ (mean difference)} = \frac{1}{12} = .08$$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{\frac{S}{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{.08}{.15} = .53$$

$df = N-1 = 11$
"t" at the .05 level = 2.20

Difference is not significant at .05 level

Area of Comparison Standing Broad Jump

Individual Norm Scores of Circuit Training Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 2 | 6 | 4 | 16 |
| 2. | 5 | 5 | 0 | 0 |
| 3. | 6 | 7 | 1 | 1 |
| 4. | 5 | 6 | 1 | 1 |
| 5. | 6 | 7 | 1 | 1 |
| 6. | 6 | 7 | 1 | 1 |
| 7. | 6 | 6 | 0 | 0 |
| 8. | 6 | 7 | 1 | 1 |
| 9. | 8 | 8 | 0 | 0 |
| 10. | 7 | 7 | 0 | 0 |
| 11. | 8 | 9 | 1 | 1 |
| 12. | 7 | 7 | 0 | 0 |
| | $\Sigma$ 72 | $\Sigma$ 82 | $\Sigma$ 10 | $\Sigma$ 22 |

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

$N = 12$
$\Sigma D = 10$
$\Sigma D^2 = 22$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Bigg/ \sqrt{N}$$

$$= \sqrt{\frac{22 - \frac{100}{12}}{12 - 1}} \Bigg/ \sqrt{12} = 22 - \frac{100}{12} = 13.67$$

$$= \frac{13.67}{11} = 1.24 = \frac{\sqrt{1.24}}{\sqrt{12}} = \frac{1.11}{3.46}$$

$S_{\bar{D}} = .32$

$\bar{D}$ (mean difference) $= \frac{10}{12} = .83$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{.83}{.32} = 2.59$$

$df = N-1 = 11$
"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison: Pull-ups

Individual Norm Scores of Calisthenic Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 0 | 0 | 0 | 0 |
| 2. | 0 | 0 | 0 | 0 |
| 3. | 2 | 2 | 0 | 0 |
| 4. | 3 | 5 | 2 | 4 |
| 5. | 4 | 6 | 2 | 4 |
| 6. | 2 | 2 | 0 | 0 |
| 7. | 4 | 4 | 0 | 0 |
| 8. | 8 | 11 | 3 | 9 |
| 9. | 9 | 12 | 3 | 9 |
| 10. | 9 | 11 | 2 | 4 |
| 11. | 8 | 8 | 0 | 0 |
| 12. | 12 | 18 | 6 | 36 |
| | $\Sigma$ 61 | $\Sigma$ 79 | $\Sigma$ 18 | $\Sigma$ 66 |

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

$N = 12$

$\Sigma D = 18$

$\Sigma D^2 = 66$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Bigg/ \sqrt{N}$$

$$= \sqrt{\frac{66 - \frac{324}{12}}{12-1}} \Bigg/ \sqrt{12} \qquad 66 - \frac{324}{12} = 39$$

$$= \frac{39}{11} = 3.55 = \frac{\sqrt{3.55}}{\sqrt{12}} = \frac{1.88}{3.46}$$

$S_{\bar{D}} = .54$

$\bar{D}$ (mean difference) $= \frac{18}{12} = 1.5$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{1.5}{.54} = 2.78$$

$df = N-1 = 11$

"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison: Sit-ups

Individual Norm Scores of Calisthenic Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 2 | 8 | 6 | 36 |
| 2. | 8 | 10 | 2 | 4 |
| 3. | 6 | 7 | 1 | 1 |
| 4. | 6 | 11 | 5 | 25 |
| 5. | 4 | 11 | 7 | 49 |
| 6. | 8 | 9 | 1 | 1 |
| 7. | 10 | 11 | 1 | 1 |
| 8. | 9 | 11 | 2 | 4 |
| 9. | 9 | 12 | 3 | 9 |
| 10. | 9 | 12 | 3 | 9 |
| 11. | 12 | 15 | 3 | 9 |
| 12. | 11 | 15 | 4 | 16 |
| | $\Sigma$ 94 | $\Sigma$ 132 | $\Sigma$ 38 | $\Sigma$ 164 |

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

$N = 12$
$\Sigma D = 38$
$\Sigma D^2 = 164$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Big/ \sqrt{N}$$

$$= \sqrt{\frac{164 - \frac{1444}{12}}{12-1}} \Big/ \sqrt{12} \qquad 164 - \frac{1444}{12} = 43.67$$

$$= \frac{43.67}{11} = 3.97 = \frac{\sqrt{3.97}}{\sqrt{12}} = \frac{1.99}{3.46}$$

$S_{\bar{D}} = .58$

$\bar{D}$ (mean difference) $= \frac{38}{12} = 3.17$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{3.17}{.58} = 5.47$$

$df = N-1 = 11$
"t" at .05 level = 2.20

Difference is significant at .05 level

Area of Comparison: Squat Thrusts

Individual Norm Scores of Calisthenic Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 4 | 3 | -1 | 1 |
| 2. | 5 | 5 | 0 | 0 |
| 3. | 5 | 3 | -2 | 4 |
| 4. | 6 | 10 | 4 | 16 |
| 5. | 6 | 4 | -2 | 4 |
| 6. | 7 | 5 | -2 | 4 |
| 7. | 6 | 8 | 2 | 4 |
| 8. | 5 | 8 | 3 | 9 |
| 9. | 5 | 11 | 6 | 36 |
| 10. | 7 | 10 | 3 | 9 |
| 11. | 5 | 10 | 5 | 25 |
| 12. | 12 | 13 | 1 | 1 |
| | $\Sigma$ 73 | $\Sigma$ 90 | $\Sigma$ 17 | $\Sigma$ 113 |

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

$N = 12$
$\Sigma D = 17$
$\Sigma D^2 = 113$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Big/ \sqrt{N}$$

$$= \sqrt{\frac{113 - \frac{289}{12}}{12-1}} \Big/ \sqrt{12} = 113 - \frac{289}{12} = 88.92$$

$$= \frac{88.92}{11} = 8.08 = \frac{\sqrt{8.08}}{\sqrt{12}} = \frac{2.84}{3.46}$$

$S_{\bar{D}} = .82$

$\bar{D}$ (mean difference) $= \frac{17}{12} = 1.42$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{1.42}{.82} = 1.73$$

$df = N-1 = 11$
"t" at the .05 level = 2.20

Difference is not significant at .05 level

Area of Comparison: Shuttle Run

Individual Norm Scores of Calisthenic Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 2 | 2 | 0 | 0 |
| 2. | 1 | 5 | 4 | 16 |
| 3. | 7 | 9 | 2 | 4 |
| 4. | 7 | 5 | -2 | 4 |
| 5. | 8 | 7 | -1 | 1 |
| 6. | 8 | 7 | -1 | 1 |
| 7. | 5 | 7 | 2 | 4 |
| 8. | 7 | 6 | -1 | 1 |
| 9. | 5 | 7 | 2 | 4 |
| 10. | 8 | 8 | 0 | 0 |
| 11. | 13 | 10 | -3 | 9 |
| 12. | 11 | 4 | -7 | 49 |
| | $\Sigma$ 82 | $\Sigma$ 77 | $\Sigma$ -5 | $\Sigma$ 93 |

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

$N = 12$

$\Sigma D = -5$

$\Sigma D^2 = 93$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{93 - \frac{25}{12}}{12-1}}}{\sqrt{12}} \qquad = 93 - \frac{25}{12} = 90.92$$

$$= \frac{90.92}{11} = 8.27 = \frac{\sqrt{8.27}}{\sqrt{12}} = \frac{2.88}{3.46}$$

$S_{\bar{D}} = .83$

$\bar{D}$ (mean difference) $= \frac{-5}{12} = -.42$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of Sampling Error of } \bar{D})} \qquad \frac{-.42}{.83} = -.51$$

df = N-1 = 11

"t" at the .05 level = 2.20

Difference is not significant at .05 level

Area of Comparison: Vertical Jump

Individual Norm Scores of Calisthenic Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 1 | 2 | 1 | 1 |
| 2. | 2 | 2 | 0 | 0 |
| 3. | 2 | 3 | 1 | 1 |
| 4. | 2 | 3 | 1 | 1 |
| 5. | 2 | 2 | 0 | 0 |
| 6. | 2 | 2 | 0 | 0 |
| 7. | 2 | 2 | 0 | 0 |
| 8. | 2 | 2 | 0 | 0 |
| 9. | 2 | 3 | 1 | 1 |
| 10. | 2 | 2 | 0 | 0 |
| 11. | 4 | 4 | 0 | 0 |
| 12. | 4 | 5 | 1 | 1 |
| | $\Sigma$ 27 | $\Sigma$ 32 | $\Sigma$ 5 | $\Sigma$ 5 |

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

$N = 12$

$\Sigma D = 5$

$\Sigma D^2 = 5$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{12}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{5 - \frac{25}{12}}{12-1}}}{\sqrt{12}} = 5 - \frac{25}{12} = 2.92$$

$$= \frac{2.92}{11} = .27 \qquad = \frac{\sqrt{.27}}{\sqrt{12}} = \frac{.52}{3.46}$$

$S_{\bar{D}} = .15$

$\bar{D}$ (mean difference) $= \frac{5}{12} = .42$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{.42}{.15} = 2.8$$

df = N-1 = 11

"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison Standing Broad Jump

Individual Norm Scores of Calisthenic Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 6 | 8 | 2 | 4 |
| 2. | 7 | 7 | 0 | 0 |
| 3. | 6 | 6 | 0 | 0 |
| 4. | 7 | 7 | 0 | 0 |
| 5. | 6 | 6 | 0 | 0 |
| 6. | 7 | 7 | 0 | 0 |
| 7. | 6 | 7 | 1 | 1 |
| 8. | 6 | 6 | 0 | 0 |
| 9. | 6 | 6 | 0 | 0 |
| 10. | 5 | 5 | 0 | 0 |
| 11. | 4 | 5 | 1 | 1 |
| 12. | 5 | 6 | 1 | 1 |
| | $\Sigma 71$ | $\Sigma 76$ | $\Sigma 5$ | $\Sigma 7$ |

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

$N = 12$

$\Sigma D = 5$

$\Sigma D^2 = 7$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \sqrt{\frac{7 - \frac{25}{12}}{12-1}} = 7 - \frac{25}{12} = 4.92$$

$$= \frac{4.92}{11} = .45 = \frac{\sqrt{.45}}{\sqrt{12}} = \frac{.67}{3.46}$$

$S_{\bar{D}} = .19$

$\bar{D}$ (mean difference) $= \frac{5}{12} = .42$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{.42}{.19} = 2.21$$

$df = N-1 = 11$

"t" at the .05 level = 2.20

Difference is significant at the .05 level

Area of Comparison Pull-ups

Individual Norm Scores of Control Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 0 | 0 | 0 | 0 |
| 2. | 0 | 0 | 0 | 0 |
| 3. | 3 | 6 | 3 | 9 |
| 4. | 2 | 3 | 1 | 1 |
| 5. | 7 | 9 | 2 | 4 |
| 6. | 4 | 5 | 1 | 1 |
| 7. | 4 | 5 | 1 | 1 |
| 8. | 2 | 3 | 1 | 1 |
| 9. | 6 | 9 | 3 | 9 |
| 10. | 7 | 8 | 1 | 1 |
| 11. | 8 | 9 | 1 | 1 |
| 12. | 6 | 7 | 1 | 1 |
| | $\Sigma$ 49 | $\Sigma$ 64 | $\Sigma$ 15 | $\Sigma$ 29 |

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

$N = 12$

$\Sigma D = 15$

$\Sigma D^2 = 29$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{29 - \frac{225}{12}}{12-1}}}{\sqrt{12}} = \frac{29 - \frac{225}{12}}{} = 10.25$$

$$= \frac{10.25}{11} = .93 = \frac{\sqrt{.93}}{\sqrt{12}} = \frac{.96}{3.46} =$$

$S_{\bar{D}} = .28$

$\bar{D}$ (mean difference) $= \frac{15}{12} = 1.25$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{1.25}{.28} = 4.46$$

df = N - 1 = 11

"t" at .05 level = 2.20

Difference is significant at .05 level

Area of Comparison: Sit-ups

Individual Norm Scores of Control Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 3 | 6 | 3 | 9 |
| 2. | 4 | 10 | 6 | 36 |
| 3. | 4 | 6 | 2 | 4 |
| 4. | 6 | 9 | 3 | 9 |
| 5. | 12 | 13 | 1 | 1 |
| 6. | 9 | 14 | 5 | 25 |
| 7. | 11 | 11 | 0 | 0 |
| 8. | 8 | 11 | 3 | 9 |
| 9. | 6 | 11 | 5 | 25 |
| 10. | 8 | 9 | 1 | 1 |
| 11. | 12 | 15 | 3 | 9 |
| 12. | 9 | 10 | 1 | 1 |
| | $\Sigma$ 92 | $\Sigma$ 125 | $\Sigma$ 33 | $\Sigma$ 129 |

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

$N = 12$

$\Sigma D = 33$

$\Sigma D^2 = 129$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Bigg/ \sqrt{N}$$

$$= \sqrt{\frac{129 - \frac{1089}{12}}{12-1}} \Bigg/ \sqrt{12} \qquad 129 - \frac{1089}{12} = 38.25$$

$$= \frac{38.25}{11} = 3.48 = \frac{\sqrt{3.48}}{\sqrt{12}} = \frac{1.87}{3.46}$$

$S_{\bar{D}} = .54$

$\bar{D}$ (mean difference) $= \frac{33}{12} = 2.75$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{2.75}{.54} = 5.09$$

$df = N - 1 = 11$

"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison Squat Thrusts

Individual Norm Scores of Control Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 2 | 5 | 3 | 9 |
| 2. | 5 | 4 | -1 | 1 |
| 3. | 7 | 9 | 2 | 4 |
| 4. | 7 | 5 | -2 | 4 |
| 5. | 4 | 4 | 0 | 0 |
| 6. | 5 | 8 | 3 | 9 |
| 7. | 7 | 8 | 1 | 1 |
| 8. | 8 | 10 | 2 | 2 |
| 9. | 7 | 8 | 1 | 1 |
| 10. | 8 | 11 | 3 | 9 |
| 11. | 5 | 10 | 5 | 25 |
| 12. | 7 | 11 | 4 | 16 |
| | $\Sigma$ 72 | $\Sigma$ 92 | $\Sigma$ 21 | $\Sigma$ 81 |

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

$N = 12$

$\Sigma D = 21$

$\Sigma D^2 = 81$

$$S_{\bar{D}} = \text{(estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Bigg/ \sqrt{N}$$

$$= \sqrt{\frac{81 - \frac{441}{12}}{12 - 1}} \Bigg/ \sqrt{12} \qquad 81 - \frac{441}{12} = 44.25$$

$$= \frac{44.25}{11} = 4.02 \qquad = \frac{\sqrt{4.02}}{\sqrt{12}} = \frac{2}{3.46}$$

$S_{\bar{D}} = .58$

$\bar{D}$ (mean difference) $= \frac{21}{12} = 1.75$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{1.75}{.58} = 3.02$$

$df = N-1 = 11$

"t" at .05 level = 2.20

Difference is significant at .05 level

Area of Comparison: Shuttle Run

Individual Norm Scores of Control Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 4 | 4 | 0 | 0 |
| 2. | 5 | 5 | 0 | 0 |
| 3. | 2 | 7 | 5 | 25 |
| 4. | 9 | 7 | -2 | 4 |
| 5. | 4 | 4 | 0 | 0 |
| 6. | 7 | 8 | 1 | 1 |
| 7. | 5 | 8 | 3 | 9 |
| 8. | 7 | 8 | 1 | 1 |
| 9. | 8 | 7 | -1 | 1 |
| 10. | 8 | 7 | -1 | 1 |
| 11. | 8 | 8 | 0 | 0 |
| 12. | 15 | 14 | -1 | 1 |
| | $\Sigma$ 82 | $\Sigma$ 87 | $\Sigma$ 5 | $\Sigma$ 43 |

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

$N = 12$

$\Sigma D = 5$

$\Sigma D^2 = 43$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{43 - \frac{25}{12}}{12-1}}}{\sqrt{12}} = 43 - \frac{25}{12} = 2.08$$

$$= \frac{2.08}{11} = .19 = \frac{\sqrt{.19}}{\sqrt{12}} = \frac{.44}{3.46}$$

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

$\bar{D}$ (mean difference) $= \frac{5}{12} = .42$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{.42}{.13} = 3.23$$

df = N-1 = 11

"t" at .05 level = 2.20

Difference is significant at .05 level

Area of Comparison Vertical Jump

Individual Norm Scores of Control Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 2 | 1 | -1 | 1 |
| 2. | 2 | 2 | 0 | 0 |
| 3. | 2 | 2 | 0 | 0 |
| 4. | 2 | 2 | 0 | 0 |
| 5. | 1 | 2 | 1 | 1 |
| 6. | 2 | 3 | 1 | 1 |
| 7. | 2 | 3 | 1 | 1 |
| 8. | 2 | 2 | 0 | 0 |
| 9. | 2 | 4 | 2 | 4 |
| 10. | 3 | 3 | 0 | 0 |
| 11. | 3 | 4 | 1 | 1 |
| 12. | 10 | 11 | 1 | 1 |
| | $\Sigma 33$ | $\Sigma 39$ | $\Sigma 6$ | $\Sigma 10$ |

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

$N = 12$

$\Sigma D = 6$

$\Sigma D^2 = 10$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}} \Bigg/ \sqrt{N}$$

$$= \sqrt{\frac{10 - \frac{36}{12}}{12-1}} \Bigg/ \sqrt{12} = 10 - \frac{36}{12} = 7$$

$$\neq \frac{7}{11} = .64 = \frac{\sqrt{.64}}{\sqrt{12}} = \frac{.8}{3.46}$$

$S_{\bar{D}} = .23$

$\bar{D}$ (mean difference) $= \frac{6}{12} = .5$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{.5}{.23} = 2.17$$

df= N-1 = 11

"t" at .05 level = 2.20

Difference is not significant at .05 level

Area of Comparison: Standing Broad Jump

Individual Norm Scores of Control Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 6 | 5 | -1 | 1 |
| 2. | 4 | 6 | 2 | 4 |
| 3. | 6 | 5 | -1 | 1 |
| 4. | 5 | 7 | 2 | 4 |
| 5. | 5 | 5 | 0 | 0 |
| 6. | 6 | 6 | 0 | 0 |
| 7. | 5 | 6 | 1 | 1 |
| 8. | 7 | 6 | -1 | 1 |
| 9. | 6 | 7 | 1 | 1 |
| 10. | 7 | 7 | 0 | 0 |
| 11. | 8 | 6 | -2 | 4 |
| 12. | 10 | 11 | 1 | 1 |
| | $\Sigma 75$ | $\Sigma 77$ | $\Sigma 2$ | $\Sigma 18$ |

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

$N = 12$
$\Sigma D = 2$
$\Sigma D^2 = 18$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{18 - \frac{4}{12}}{12-1}}}{\sqrt{12}} = 18 - \frac{4}{12} = 17.67$$

$$= \frac{17.67}{11} = 1.61 = \frac{\sqrt{1.61}}{\sqrt{12}} = \frac{1.27}{3.46}$$

$S_{\bar{D}} = .37$

$\bar{D}$ (mean difference) $= \frac{2}{12} = .17$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{.17}{.37} = .46$$

$df = N-1 = 11$
"t" at the .05 level = 2.20

Difference is not significant at .05 level

Area of Comparison Totals of total fitness scores

Individual Norm Scores of Circuit Training Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 17 | 30 | 13 | 169 |
| 2. | 20 | 25 | 5 | 25 |
| 3. | 26 | 32 | 6 | 36 |
| 4. | 27 | 41 | 14 | 196 |
| 5. | 31 | 31 | 0 | 0 |
| 6. | 33 | 46 | 13 | 169 |
| 7. | 35 | 39 | 4 | 16 |
| 8. | 35 | 49 | 14 | 196 |
| 9. | 40 | 45 | 5 | 25 |
| 10. | 41 | 44 | 3 | 9 |
| 11. | 44 | 53 | 9 | 81 |
| 12. | 58 | 66 | 8 | 64 |
| | $\Sigma$ 407 | $\Sigma$ 501 | $\Sigma$ 94 | $\Sigma$ 986 |

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

$N = 12$
$\Sigma D = 94$
$\Sigma D^2 = 986$

$$S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{986 - \frac{8836}{12}}{12-1}}}{\sqrt{12}} = 986 - \frac{8836}{12} = 249.67$$

$$= \frac{249.67}{11} = 22.7 = \frac{\sqrt{22.7}}{\sqrt{12}} = \frac{4.76}{3.46}$$

$S_{\bar{D}} = 1.38$

$\bar{D}$ (mean difference) $= \frac{94}{12} = 7.83$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{7.83}{1.38} = 5.67$$

$df = N-1 = 11$
"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison Totals of total fitness scores

Individual Norm Scores of Calisthenic Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 14 | 21 | 7 | 49 |
| 2. | 20 | 27 | 7 | 49 |
| 3. | 27 | 29 | 2 | 4 |
| 4. | 30 | 40 | 10 | 100 |
| 5. | 30 | 36 | 6 | 36 |
| 6. | 33 | 32 | -1 | 1 |
| 7. | 34 | 39 | 5 | 25 |
| 8. | 37 | 44 | 7 | 49 |
| 9. | 37 | 52 | 15 | 225 |
| 10. | 41 | 49 | 8 | 64 |
| 11. | 49 | 54 | 5 | 25 |
| 12. | 56 | 63 | 7 | 49 |
| | $\Sigma$ 408 | $\Sigma$ 486 | $\Sigma$ 78 | $\Sigma$ 676 |

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

$N = 12$

$\Sigma D = 78$

$\Sigma D^2 = 676$

$$S_{\bar{D}} \text{ (estimate of sampling error } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D^2)}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{676 - \frac{6084}{12}}{12-1}}}{\sqrt{12}} = 676 - \frac{6084}{12} = 169$$

$$= \frac{169}{11} = 15.36 = \frac{\sqrt{15.36}}{\sqrt{12}} = \frac{3.92}{3.46} =$$

$S_{\bar{D}} = 1.13$

$\bar{D}$ = (mean difference) $= \frac{78}{12} = 6.5$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{6.5}{1.13} = 5.75$$

df = N-1 = 11

"t" at the .05 level = 2.20

Difference is significant at .05 level

Area of Comparison Totals of total fitness scores

Individual Norm Scores of Control Group

| | Pre-test | Re-test | D | $D^2$ |
|---|---|---|---|---|
| 1. | 17 | 21 | 4 | 16 |
| 2. | 20 | 27 | 7 | 49 |
| 3. | 24 | 35 | 11 | 121 |
| 4. | 31 | 33 | 2 | 4 |
| 5. | 33 | 37 | 4 | 16 |
| 6. | 33 | 44 | 11 | 121 |
| 7. | 34 | 41 | 7 | 49 |
| 8. | 34 | 40 | 6 | 36 |
| 9. | 35 | 46 | 11 | 121 |
| 10. | 41 | 45 | 4 | 16 |
| 11. | 44 | 52 | 8 | 64 |
| 12. | 57 | 64 | 7 | 49 |
| | $\Sigma$ 403 | $\Sigma$ 485 | $\Sigma$ 82 | $\Sigma$ 662 |

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

$N = 12$

$\Sigma D = 82$

$\Sigma D^2 = 662$

$$S_{\bar{D}} = (\text{estimate of sampling error } \bar{D}) = \frac{S_D}{\sqrt{N}} = \frac{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N-1}}}{\sqrt{N}}$$

$$= \frac{\sqrt{\frac{662 - \frac{6724}{12}}{12-1}}}{\sqrt{12}} = 101.67$$

$$= \frac{101.67}{11} = 9.24 = \frac{\sqrt{9.24}}{\sqrt{12}} = \frac{3.04}{3.46} =$$

$S_{\bar{D}} = .88$

$\bar{D} = (\text{mean difference}) = \frac{82}{12} = 6.83$

$$\text{"t"} = \frac{\bar{D} \text{ (mean difference)}}{S_{\bar{D}} \text{ (estimate of sampling error of } \bar{D})} = \frac{6.83}{.88} = 7.76$$

$df = N-1 = 11$

"t" at the .05 level = 2.20

Difference is significant at .05 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

$\bar{D}$ and $S_{\bar{D}}$ of the Total Pre-test and Re-test Fitness Scores

Circuit Training $\bar{D} = 7.83$ Control $\bar{D} = 6.83$

Circuit Training $S_{\bar{D}} = 1.38$ Control $S_{\bar{D}} = .88$

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

$$\sqrt{\left(S_{\bar{D}_1}\right)^2 + \left(S_{\bar{D}_2}\right)^2} = \sqrt{(1.38)^2 + (.88)^2}$$

$S_{D_M} = 1.63$

$\frac{D}{D} = \bar{D}_1 - \bar{D}_2 = 7.83 - 6.83 = 1$

$$\text{"t"} = \frac{\frac{D}{D}}{S_{D_M}} = \frac{1}{1.63} = .61$$

$df = (N_1 - 1) + (N_2 - 1) = 22$

"t" at .05 level = 2.07

Difference is not significant at .05 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

$\bar{D}$ and $S_{\bar{D}}$ of the Total Pre-test and Re-test Fitness Scores

Control $\bar{D} = 6.83$ Calisthenic $\bar{D} = 6.5$

Control $S_{\bar{D}} = .88$ Calisthenic $S_{\bar{D}} = 1.33$

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

$$\sqrt{\left(S_{\bar{D}_1}\right)^2 + \left(S_{\bar{D}_2}\right)^2} = \sqrt{(.88)^2 + (1.33)^2}$$

$S_{D_M} = 1.59$

$\frac{D}{D} = \bar{D}_1 - \bar{D}_2 = 6.83 - 6.5 = .33$

$$\text{"t"} = \frac{\frac{D}{D}}{S_{D_M}} = \frac{.33}{1.59} = .21$$

$df = (N_1 - 1) + (N_2 - 1) = 22$

"t" at .05 level = 2.07

Difference is not significant at the .05 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS

DERIVED FROM UNCORRELATED SCORES FROM SMALL SAMPLES

$\bar{D}$ and $S_{\bar{D}}$ of the Total Pre-test and Re-test Fitness Scores

Circuit Training $\bar{D} = 7.83$ Calisthenic $\bar{D} = 6.5$

Circuit Training $S_{\bar{D}} = 1.38$ Calisthenic $S_{\bar{D}} = 1.33$

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

$$\sqrt{\left(S_{\bar{D}_1}\right)^2 + \left(S_{\bar{D}_2}\right)^2} = \sqrt{(1.38)^2 + (1.33)^2}$$

$S_{D_M} = 1.91$

$\bar{D} = \bar{D}_1 - \bar{D}_2 = 7.83 - 6.5 = 1.33$

$$\text{"t"} = \frac{\bar{D}}{S_{D_M}} = \frac{1.33}{1.91} = .69$$

$df = (N_1 - 1) + (N_2 - 1) = 22$

"t" at .05 level = 2.07

Difference is not significant at .05 level