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A Comparison of Physical Fitness Levels Achieved by Grade Ten Girls Through a Physical Education Program and a Competitive Sports Program

Margaret M. Hallatt

A COMPARISON OF PHYSICAL FITNESS LEVELS ACHIEVED BY GRADE TEN GIRLS THROUGH A PHYSICAL EDUCATION PROGRAM AND A COMPETITIVE SPORTS PROGRAM

by

Margaret M. Hallatt

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

W. C. Koenig
Chairman

John L. Inaday

Elton M. Hale

Christopher J. Hanson
Dean of the Graduate School

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

The purpose of this study was to compare the physical fitness levels between grade ten girls enrolled in a physical education program which included inter-scholastic competitive sports activities and grade ten girls enrolled in a physical education program which did not include such activities.

This study was directly concerned with physical fitness as measured by the Grand Forks Public Schools Physical Efficiency Test. The students involved were 38 grade ten girls from Grand Forks Central High School, Grand Forks, North Dakota, and 38 grade ten girls from Brandon Collegiate Institute, Brandon, Manitoba.

The pretest was administered to both groups the sixth week of the 1965-66 school year. The post test was administered to both groups the second week of April of the 1965-66 school year.

The null hypothesis was assumed with respect to the differences between the means of both groups. The hypothesis was tested with the "t" technique for checking significance of difference between means.

The conclusions indicated by this study were:

1. Neither the Brandon physical education program nor the Grand Forks physical education program produced

significant changes in any of the selected measures of physical fitness at the criterion .05 level.

2. No significant differences were found between the two groups when the post test results were compared.

3. From the data collected in this study neither intramural nor interscholastic competition increased the physical fitness level of the participants.

CHAPTER I

INTRODUCTION

Nature of the Problem

The recent outbreak of publicity concerning the physical fitness of American youth seems to have failed to leave an impression on American girls. Physical fitness activities do not interest many girls for any length of time. There is a lack of meaning and a feeling of unrelatedness in activities designed solely for body-building. Therefore, it is necessary for the total physical education program to provide meaningful and related activities which make a high level of physical fitness a desired status.

Sports and games have much more meaning for a girl than physical fitness activities.

> We must . . . recognize that motor skill is important and that it plays into general health. However, we should not stress skill in ways which are unrelated to the child, and which appear as artificial tasks designed by adults to develop certain muscle groups or to beat the Europeans or the Russians. Physical competence should not, in educational practice, be isolated from the motivational system of the child.[1]

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[1] T. J. Gordon, "Fitness: Goal or Grail?" Educational Leadership, 20 (March, 1963), pp. 401-403.

Sandborn and Hartman[2] cited several studies which indicate that participation in good intramural and interscholastic competition result in increased strength, agility, and endurance.

In view of the lack of studies concerning competition for girls in North Dakota, this study was undertaken. The purpose of the writer was to investigate and compare the physical fitness level of girls involved in a physical education program which provided intramural and interscholastic competition and a physical education program which did not provide this competition.

Statement of the Problem

Definition of the Problem

From a test and retest situation, an attempt was made to determine the general physical fitness level of the individual students at both the beginning and at the end of a year of participation in a physical education program. One group participated in a physical education program which included intramural and interscholastic competition as well as two class periods weekly. The other group participated in a physical education program which consisted of two class periods weekly. A further attempt was made to establish which phyical education

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[2]M.D. Sandborn and R.G. Hartman, Issues in Physical Education (Philadelphia: Lea and Febiger, 1964), p. 86.

program contributed most to the over-all improvement of physical fitness.

Delimitations

This study was directly concerned with the measurement and improvement of physical fitness as determined by the Grand Forks Public Schools Physical Efficiency Test. The students involved in the study were the grade ten girls from Central High School, Grand Forks, North Dakota, and Brandon Collegiate Institute, Brandon, Manitoba. The average age was sixteen years.

The girls enrolled at Central High School met sixty minutes a day, twice a week. The girls enrolled at Brandon Collegiate Institute met forty-five minutes a day, twice a week. Extra-curricular activities offered by the Physical Education Department at Central High School were Girls' Athletic Association, swim show, cheerleading, and Pom-Poms Drill Team. These activities were all non-competitive in nature. Track and field and tennis were offered on a competitive level for the first time in the spring of 1966. Brandon Collegiate offered competition, at the intramural and interscholastic levels, in field hockey, volleyball, basketball, badminton, track and field, gymnastics, and cross-country running. Advancement to provincial tournaments in basketball and track and field was possible.

Justification of the Study

With the great emphasis recently placed on physical fitness, there has been some movement toward restoring competition for girls in many areas of the United States. Unfortunately, it appears that many teachers and leaders in physical education need to be convinced that a well administered competitive program for girls is not harmful, and that competition will aid in attaining one of the goals in physical education--physical fitness.

The Committee on the Medical Aspects of Sports of the American Medical Association[3] issued a statement expressing concern for the inadequate provision for physical activity for a large portion of the nation's female population. Sports contain potent motivational qualities that demand self-discipline with respect to health practices, and yield achievement and satisfaction. Combined, these elements are vital to total fitness. The healthful benefits are well established and tales of physiological harm are dissolved.

The writer hopes that this study will contribute to the knowledge needed to show that participation in competitive sports activities is a contributing factor to physical fitness, and therefore, a necessary part

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[3]The American Medical Association, Committee on Medical Aspects of Sports, "Sports Opportunities for Girls and Women," Journal of Health, Physical Education, and Recreation, (December, 1964), p. 46.

of the physical education program.

Review of Related Literature

Several studies have been conducted to determine the influence of participation in various physical education activities on those elements commonly associated with physical fitness, and comparing the youth of the United States with the youth of other countries. No real agreement has existed as to the meaning of physical fitness; however, performance on certain physical tests has usually been considered to be the outward manifestation of physical fitness.

The American Association for Health, Physical Education, and Recreation started its Youth Fitness Project in 1957 and conducted a nation wide survey testing 8500 boys and girls in grades five through twelve. The outcome of this study was the publication of the American Association of Health, Physical Education, and Recreation Youth Fitness Test Manual.[4] This manual enables students, teachers, and parents to compare their results with those of other students of similar age.

Wilbur[5] studied the effect on physical fitness

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[4]American Association for Health, Physical Education, and Recreation, Youth Fitness Test Manual (Washington 6, D.C.: A.A.H.P.E.R., 1958).

[5]Ernest A. Wilbur, "A Comparative Study of Physical Fitness Indices as Measured by Two Programs of Physical Education: The Sports Method and the Apparatus Method," Research Quarterly, XIV (October, 1943), p. 332.

of a sports program as compared to the effect of an apparatus program. The apparatus used included the parallel bars, tumbling mats, climbing ropes, horizontal bars, and rings. The sports taught were boxing, wrestling, track and field, soccer, and swimming. He reported the sports program superior to the apparatus program in improving total physical fitness, arm and shoulder girdle strength, body co-ordination, and agility. The programs were equally effective in the development of arm and shoulder co-ordination, speed and strength of the legs, and endurance.

Johnson[6] reported that, of men inducted into the service, it was found that those who had participated in vigorous intramural and interscholastic sports were better able to fit into the military framework than those who had not. Those who had not participated in such programs lacked rugged development. He found that the more they participated, the greater their fitness. Johnson went on to point out that the problem is in providing opportunities for all boys and girls to participate in interscholastic and intramural athletic programs.

Broer,[7] in a report which considered a number of

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[6]William H. Johnson, "Better Health and Physical Education," The American School Board Journal, 108 (March, 1944), pp. 16-17.

[7]Marion R. Broer, "For Physical Fitness Vary Your Program," Journal of Health, Physical Education, and Recreation, 27 (September, 1956), p. 18.

studies on the relative influence of various activities on physical fitness, came to the conclusion that a varied program is essential.

> All studies dealing with the conditioning exercise type of program found considerable improvement in many elements of physical fitness. This would be expected, since the material can be geared to those fitness elements found to be at a low level in the particular group, without being hampered by a framework as in the case of a sport activity. However, this type of program alone does not lead to the development of specific skills necessary to a high level of fitness in this civilization; its chief contribution is to the objectives of physical fitness. It seems obvious that a varied program will be necessary if all-round fitness is the goal.[8]

Frost and Rosenstein[9] studied boys and girls of high school age, in New York State, to determine whether the quality of the physical education program, and the number of hours of out-of-school physical activity affected the amount of improvement in physical fitness. They found that pupils who participated in high quality physical education programs improved more in physical fitness than did those who participated in poor programs. They also found some tendency for boys participating on inter-scholastic athletic teams to achieve greater physical fitness scores than those who did not participate on inter-scholastic athletic teams. Very little relationship

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[8] Ibid.

[9] Reuben B. Frost and Irwin Rosenstein, "Physical Fitness of Senior High School Boys and Girls Participating in Selected Physical Education Programs in New York State," Research Quarterly, Vol. 35 (October, 1964), pp. 403-407.

was found between the total number of hours of out-of-school physical activity and the fitness scores of the pupils in the study.

In an article written by Weiss,[10] it was claimed that in order to enjoy participation in sports the participant must be physically fit. This dispells the idea that some people have that participating in sports will make them physically fit. His idea was that physical fitness will help a person enjoy a sport, and participation in a sport will help a person maintain fitness. In a second article Weiss[11] stated that it was more important to develop the habit of being physically active than to develop high levels of physical fitness; he predicted that over-emphasis on physical fitness can lead to loss interest in physical activity. He thought it best to raise fitness to moderate levels and then teach skills and activities which will help sustain both fitness and interest.

Shaffer[12] is another writer concerned about the activities included in the total physical education

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[10]Raymond A. Weiss, "Do Sports Produce Fitness?" Journal of Health, Physical Education, and Recreation, March, 1961, pp. 20-21, 56.

[11]Raymond A. Weiss, "Is Physical Fitness Our Most Important Objective?" Journal of Health, Physical Education, and Recreation, February, 1964, pp. 16-17, 61-62.

[12]Gertrude Krauss Shaffer, "Why the American Children are Physically Unfit," The Physical Educator, May, 1960, pp. 60-61.

program. She concluded that part of the reason that the American youth is lacking in physical fitness is the failure of the schools to provide an adequate program. The schools are not giving them enough activity to compensate for modern living and its inactivity. Youth must be taught how to use their bodies and be provided with opportunities to use their knowledge.

Writing about physical fitness, Solley[13] stated that the methods used in teaching physical education, with physical fitness as an objective, must be carefully examined. Teachers must be certain that the activities taught encourage the development of fitness. They must be certain that they provide adequate vigorous and intensive activity, and avoid long waiting periods, passive skill drills, lectures and other methods which take time from activity. Carefully selected activities, which the students learn and like, will do much to develop physical fitness.

Knuttgen[14] used the American Association of Health, Physical Education, and Recreation Youth Fitness Test to compare the fitness of Danish and American school children. Two hundred and nine boys and one hundred and

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[13]William H. Solley, "Teaching for Physical Fitness," The Physical Educator, October, 1960, pp. 102-104.

[14]Howard C. Knuttgen, "Comparison of Fitness of Danish and American School Children," Research Quarterly, Vol. 32 (May, 1961), pp. 190-196.

thirty-four girls were tested. The results of the test revealed that the Danish girls exceeded the average scores of the American girls in all seven of the tests. In the fifty yard dash, seventy-one per cent of the Danish girls equalled or exceeded the American average score. The next best events were the softball throw, the sit-up, the standing broad jump, and the pull-up, where seventy-six per cent, eighty-two per cent, and ninety per cent, respectively, of the Danish girls exceeded the American averages. The most conclusive results were obtained in the shuttle-run and the six hundred yard run-walk where the figures for exceeding the American averages were ninety-six per cent in each event. More than fifty per cent of the boys exceeded the American averages in six events. The only event in which they fell short was the softball throw, where sixty-eight per cent of the scores were lower than the American average. Knuttgen feels that the amount of daily activity the Danish children have, riding bicycles for transportation, participating in good physical education programs, and taking part in extracurricular sports partially explains why the Danish children exceeded the Americans.

The AAHPER Test Battery has also been used by OPERATION FITNESS-USA to compare the physical fitness of American youth with the physical fitness of the youth of other countries.

> OPERATION FITNESS-USA was created as a symbol and medium through which professional effort in fitness could be mobilized and channeled over the nation.[15]

This group is the official framework for fitness action in the American Association for Health, Physical Education, and Recreation and the National Education Association and now is in operation in all states and many nations.

OPERATION FITNESS-USA made several studies comparing the American youth with the European youth. The first such study, Physical Fitness Test Comparisons of the Japanese and American Youth,[16] showed the results obtained on the AAHPER National Fitness Test battery by twenty thousand Japanese children. These tests given by competent Japanese fitness experts showed that Japanese children excelled over American children in almost all the basic components of physical fitness. The Japanese children excelled by wide margins in tests involving arm strength. In tests involving leg power the Japanese are superior at all age levels. Japanese girls excelled in this test by larger margins than the boys. In tests involving arm power the results were equal. In tests of endurance Americans rated poorly and at no age did the

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[15]Operation Fitness-USA, Progress Report, American Association for Health, Physical Education, and Recreation, and the National Education Association, September, 1961.

[16]Operation Fitness-USA, "Physical Fitness Comparisons of Japanese and American Youth," American Association for Health, Physical Education, and Recreation, and the National Education Association.

Americans exceed the Japanese. Americans did emerge with superior test marks in items involving abdominal endurance.

> The Japanese comparisons revealed above are all the more striking when it is realized that this nation has made significant progress in health and dental care, prevention and control of disease, and the discovery and use of many wonderful drugs. It must be realized also that one cannot completely isolate the physical components of total fitness; that emotional, social and spiritual fitness are equally important.
>
> It is very doubtful whether real fitness levels of attainment in the emotional, social and spiritual can be made without rather sound and basic health and physical fitness status. It is obvious that substitutes must be found in America to keep this nation strong and vibrant in the face of increasing mobility, lack of leg and muscle use, disregard for balanced diet, and growing apathy toward physical exertion.[17]

The American Association for Health, Physical Education, and Recreation Youth Fitness Test was also used by Dr. Pohndorf of the University of Illinois in cooperation with Dr. Campbell[18] of St. Lukes College in Exeter, England, to test ten thousand British children. The comparisons of the test results for boys showed on the average, for all tests the English boys were at the sixty-fourth percentile for the United States performance scales. Thus the British over-all average was fourteen per cent higher than the average for American boys. The

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[17] Ibid.

[18] Operation Fitness-USA, Physical Fitness of British Children and Youth, American Association for Health, Physical Education, and Recreation, and the National Education Association, 1962.

results indicated that only thirty per cent of the American boys exceeded the mean of the British boys in physical fitness testing. The comparisons of the test results for girls showed on the average for all tests that the English girls were at the seventy-third percentile of the United States' performance scales. This study indicates a very serious condition in the physical fitness of our youth.

Summary of Review of Literature

From the review of literature, there was evidence that participation in competitive sports aided in the development of total physical fitness. There was evidence reported that supports the theory that competitive sports for girls is not physiologically harmful. If such were the case, then a competitive sports program for girls is justified within our schools and every girl should be encouraged to participate in such a program.

CHAPTER II

METHODOLOGY

PROCEDURE AND ADMINISTRATION

Preliminary Planning

The data used in this study were obtained from the tenth grade girls at Central High School, Grand Forks, North Dakota, and Brandon Collegiate Institute, Brandon, Manitoba. All completed score cards were used. The Grand Forks Public Schools Physical Efficiency Test was administered to all subjects the sixth week of school. A retest was administered two weeks before the end of the school year.

Procedure

The tests were administered according to the recommendations and instructions of the Grand Forks Public Schools Physical Efficiency Test pamphlet. The vertical jump was excluded from the test battery because of the discrepancies in measurement. Also, the measurements from the vertical jump seem to give the same measure of explosive leg strength as does the measurement from the standing broad jump. The procedures used in setting up and administering the test have been

presented in Appendix A, page 37.

Selection of Groups

Two groups of tenth grade girls were selected according to the types of extracurricular activities available to them.

Group I: This group included grade ten girls enrolled at Brandon Collegiate Institute. This group had available to them a well administered competitive intramural and interscholastic program. Activities included were basketball, volleyball, badminton, cross country, track and field, field hockey and gymnastics.

Group II: This group included grade ten girls enrolled at Central High School. This group had available to them a very limited program. Activities included were Girls' Athletic Association, swim show, cheerleading, and Pom-Pom Drill Team. Track and field and tennis were offered at a competitive level for the first time in the spring of 1966.

Test Administration

Included in the test battery were the following items:

1. modified pull-ups
2. sit ups
3. squat thrust
4. shuttle run
5. standing broad jump

The entire test battery was given indoors at each school. The same sequence and directions were used with both groups.

Test Assistants

The testing of both groups was under the supervision of this writer. Mrs. Judy Bethel, instructor of Girls' Physical Education at Grand Forks Central, administered the test to Group II. Miss Margaret Milne, instructor of Girls' Physical Education at Brandon Collegiate Institute, administered the test to Group I.

Equation of Groups

Using an assumed mean of fifty and an assumed standard deviation of ten, the following formula[1] was used to convert the individual raw scores into standard scores.

$$X^1 = \frac{\sigma^1}{\sigma}(X - M) + M^1$$

A total standard score for each case for the pretest and post-test was obtained. From the 128 completed score cards from Central High School, thirty-eight total standard scores from the pretest of this group were matched with the 38 total standard scores from the Brandon group. The matched pair technique was used and verified by comparing the means and the

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[1] H.E. Garrett, Statistics in Psychology and Education (Fifth edition; New York: Longmans, Green and Company, 1958), p. 313.

standard deviations of the two groups. Therefore it could be said that the two groups were equated and could therefore be treated as being comparable.

Statistical Procedure

A test, re-test situation was used and within group and between group comparisons were made on the various items of the test. This investigator assumed the null hypothesis in analyzing the difference between the initial test and the re-test within each group and between groups. 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 significance of the difference between means derived from correlated scores from small samples was suitable for use in this study. This test[1] determines the ratio between the difference between means and the standard error between means. 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

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

[3]Garrett, op. cit., pp. 190, 216-217.

the difference between means and the standard error of the difference between means.

For this study it was decided to retain the null hypothesis at the .05 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 are presented in Appendix B, page 46.

CHAPTER III

ANALYSIS OF DATA

The purpose of the testing in this study was to discover whether or not there were any significant differences between fitness levels of the experimental group, Brandon Collegiate Institute grade ten girls, as compared to the control group, Grand Forks Central grade ten girls. The bases of comparison were results obtained through the use of the Grand Forks Public Schools Physical Efficiency Test.

The following results were obtained by an analysis of the data collected in this study.

Results of the Grand Forks (Control)

Within Group Comparison

Pullups

The control group had a mean standard score of 51.77 pullups in the pretest and a mean standard score of 49.11 pullups in the post test. The pullups measured arm and shoulder-girdle strength.

This group had a mean difference 2.66 decrease between the pretest and the post test. The standard error of the difference between means was 2.66. The "t" value of -1.00 with 37 degrees of freedom was below

the criterion .05 level.

Situps

The control group had a mean standard score of 51.04 situps in the pretest and a mean standard score of 49.72 situps in the post test. The situps measured abdominal strength and endurance.

The group had a mean difference 1.32 decrease between the pretest and the post test. The standard error of the difference between means was 1.95. The "t" value of -.68 with 37 degrees of freedom was below the criterion .05 level.

Squat Thrust

The Grand Forks group had a mean standard score of 52.03 squat thrusts in the pretest and a mean standard score of 52.66 squat thrusts in the post test. The squat thrust measured agility and endurance.

This group had a mean difference .63 increase between the pretest and the post test. The standard error of the difference between means was .75. The "t" value of .08 with 37 degrees of freedom was below the criterion .05 level.

Shuttle Run

The control group had a mean standard score of 51.35 in the shuttle run in the pretest and a mean standard score of 49.71 in the shuttle run in the post

test. The shuttle run measured speed and agility.

The group had a mean difference 1.64 improvement between the pretest and the post test. The standard error of the difference between means was 2.39. The "t" value of .69 with 37 degrees of freedom was below the criterion .05 level.

Standing Broad Jump

The Grand Forks group had a mean standard score of 52.05 in the standing broad jump in the pretest and a mean standard score of 51.32 in the standing broad jump in the post test. The standing broad jump measured the explosive power of the legs.

The group had a mean difference .73 decrease between the pretest and the post test. The standard error of the difference between means was 1.64. The "t" value of -.45 with 37 degrees of freedom was below the criterion .05 level.

Results of the Brandon (Experimental) Within Group Comparison

Pullups

The experimental group had a mean standard score of 50.58 pullups in the pretest and a mean standard score of 49.64 pullups in the post test. The pullups measured arm and shoulder girdle strength.

This group had a mean difference .94 decrease

between the pretest and the post test. The standard error of the difference between means was 2.24. The "t" value of -.42 with 37 degrees of freedom was below the criterion .05 level.

Situps

The Brandon group had a mean standard score of 50.62 situps in the pretest and a mean standard score of 51.15 situps in the post test. The situps measured abdominal strength and endurance.

This group had a mean difference .53 increase between the pretest and the post test. The standard error of the difference between means was 2.26. The "t" value of .23 with 37 degrees of freedom was below the criterion .05 level.

Squat Thrust

The experimental group had a mean standard score of 50.05 squat thrusts in the pretest and a mean standard score of 49.72 in the post test. The squat thrust measured speed and agility.

This group had a mean difference .33 decrease between the pretest and the post test. The standard error of the difference between means was 2.39. The "t" value of -.14 with 37 degrees of freedom was below the criterion .05 level.

Shuttle Run

The experimental group had a mean standard score

of 52.74 in the shuttle run in the pretest and a mean standard score of 50.44 in the shuttle run in the post test. The shuttle run measured speed and agility.

The experimental group had a mean difference 2.30 improvement between the pretest and the post test. The standard error of the difference between means was 2.28. The "t" value of 1.01 with 37 degrees of freedom was below the criterion .05 level.

Standing Broad Jump

The experimental group had a mean standard score of 50.96 in the standing broad jump in the pretest and a mean standard score of 49.82 in the standing broad jump in the post test. The standing broad jump measured the explosive power of the legs.

The group had a mean difference 1.41 decrease between the pretest and the post test. The standard error of the difference between means was 2.09. The "t" value of -.55 was below the criterion .05 level.

Neither the experimental nor the control group showed significant changes between the pretest and the post test on any test item.

Results of Between Group Comparisons

As demonstrated in Table 3, page 27, the Grand Forks post test means decreased on three test items; the pullups, the situps, and the standing broad jump.

There was an increase in the post test mean in the squat thrust. None of the changes were statistically significant.

As demonstrated in Table 3, page 27, the Brandon post test means decreased on three test items: the pull-ups, the squat thrust, and the standing broad jump. There was an increase in the post test mean in the situps. None of the changes were statistically significant.

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 post tests. The null hypothesis was tested in this case by the use of the "t" technique for correlated data from small samples.[1]

In all the statistical tests and applications between groups no statistically significant differences were found.

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[1] Ibid., p. 223.

TABLE 1

COMPARISON OF THE PRE- AND POST TEST MEANS OF THE GRAND FORKS GROUP ON THE SELECTED MEASURES

Area of Comparison	Mean of Pre Test	Mean of Post Test	Difference Between Means	"t" Value	Significant at .05 level
Pullups	51.77	49.11	-2.66	-1.00	No
Situps	51.04	49.72	-1.32	-0.68	No
Squat Thrust	52.03	52.66	0.63	0.08	No
Shuttle Run	51.35	49.71	1.64	0.69	No
Standing Broad Jump	52.05	51.32	-0.73	-0.45	No

"t" value at .05 level must be 2.20 for significance.

TABLE 2

COMPARISON OF THE PRE- AND POST TEST MEANS
OF THE BRANDON GROUP ON THE
SELECTED MEASURES

Area of Comparison	Mean of Pre Test	Mean of Post Test	Difference Between Means	"t" Value	Significant at .05 level
Pullups	50.58	49.64	-0.94	-0.42	No
Situps	50.62	51.15	0.53	0.23	No
Squat Thrust	50.05	49.72	-0.33	-0.14	No
Shuttle Run	52.74	50.44	2.30	1.01	No
Standing Broad Jump	50.96	49.82	-1.14	-0.55	No

"t" value at .05 level must be 2.20 for significance.

TABLE 3

COMPARISON OF THE POST TEST MEANS BETWEEN THE GRAND FORKS GROUP AND THE BRANDON GROUP ON THE SELECTED MEASURES

Area of Comparison	Mean of Grand Forks Post Test	Mean of Brandon Post Test	Difference Between Means	"t" Value	Significant at .05 Level
Pullups	49.11	49.64	0.53	0.21	No
Situps	49.72	51.15	1.43	0.59	No
Squat Thrust	52.66	49.72	-2.94	-1.61	No
Shuttle Run	49.71	50.44	-0.73	-0.35	No
Standing Broad Jump	51.32	49.82	-1.50	-0.61	No

"t" value at .05 level must be 2.20 for significance.

CHAPTER IV

DISCUSSION

As revealed in the previous chapter, there were no significant changes made in the physical fitness levels of either the Grand Forks group or the Brandon group. It now becomes the task of this investigator to try and present some pertinent information which may partially explain why no significant changes were made by the two groups involved in the study.

The fact that the individuals involved in this study were girls may, in itself, be a factor to examine. It is the feeling of this writer that most girls are neither trained nor motivated to put forth a maximum effort while participating in physical activity. The old wives' tale that extreme physical exertion is detrimental to a girl's health and well being is still prevalent in the philosophy of many women physical educators, and is evident in the types of physical education programs provided for girls. If this were the case with the girls involved in this study, it would seem safe to assume that they were neither internally nor externally motivated to perform to their utmost capacity throughout the course of their respective

school physical education programs. The lack of significant changes by either group as evidenced by this study may have been influenced by this point of discussion.

This point in itself cannot, however, bear the full responsibility for the lack of significant changes in either group.

There were some factors involved in the study which either could not be or were not controlled by this investigator. Even though the two programs were similar in some respects there were also differences between the two which may have affected the final outcome of this study. Before the test was administered in October the Brandon group had participated in field hockey in physical education classes, in intramurals, and in interscholastic competition. During the same period the Grand Forks group participated in volleyball. By the very nature of the two activities field hockey would seem to provide better conditioning than volleyball just prior to the initial testing. By this line of reasoning it would seem that the Brandon girls may have been in better physical condition than the Grand Forks girls at the time of the first test.

During the period between tests there was another major difference between the programs which may have influenced the final results. The Grand Forks

program included an eight week unit of swimming in which all the girls involved in the study participated. During this same period the emphasis in the Brandon program was on basketball, volleyball, badminton and tumbling. The Grand Forks girls would seem to have the advantage of a more vigorous and strenuous activity. The strenuousness of this activity would seem to be advantageous to the Grand Forks group. However, the teaching method used in swimming, or any other activity, may change the outcomes of the activity in terms of physical fitness benefits.

The post test was administered prior to the track and field season. Therefore, any possible contributions to physical fitness through track and field were not measured by this study.

Although the teachers of each group were both first year teachers, and both trained at the University of North Dakota, it stands to reason that there were differences between the two. Differences between personalities, teaching methods and rapport with students may have affected the results obtained by this study.

Both groups involved in the study had only two periods of physical education per week. This relatively short period of activity each week may result in a physical education program which lacks enough intensity

to provide significant changes in the physical fitness levels of the girls involved. This lack of intensity could also be extended to the Brandon interscholastic sports program. There were no daily workouts or practice sessions connected with the program. Practices were called at the discretion or convenience of the teacher.

The test selected for this study was chosen because it was already in use in the Grand Forks Public School System. It was, therefore, convenient to use it for the purposes of this study. A question can be raised about the advantage the Grand Forks girls would seem to have because they would have been tested by this instrument twice each year they had been in the Grand Forks Public School system. However, the Brandon girls had been tested in previous years by other physical fitness tests which contained many similar test items. Therefore, it would seem that one group should not have a decided advantage over the other group because of test familiarity.

The test itself does not contain items to measure all aspects of physical fitness. There were no test items to measure speed or cardiovascular efficiency. To a limited extent, the situps measure endurance. Had the measuring instrument contained items which could have evaluated speed, endurance and cardiovascular

efficiency there might have been changes discovered in either or both groups.

This discussion has served to point out some of the factors which may have played a part in influencing the results of this investigation. However, the fact still remains that there were no significant changes in the physical fitness levels of the students who participated in either type of physical education program through this investigation.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENTATIONS

Summary

The 76 subjects selected for this study were grade ten girls. Thirty-eight were selected from Grand Forks Central High School, Grand Forks, North Dakota, and 38 from Brandon Collegiate Institute, Brandon, Manitoba. The group from Grand Forks was part of an initial group of 128. The 38 selected were matched with the Brandon group on the results of total standard scores of the physical fitness pretest. The two groups were statistically equated by the matched pair technique. Each group was tested relative to the fitness level in accordance with the Grand Forks Public Schools Physical Efficiency Test. The test was administered to both groups the sixth week of the 1965-1966 school year. The post test was administered the third week of April of the same school year.

The Brandon physical education program consisted of two class periods per week, an intramural program, and a competitive sports program. The Grand Forks physical education program consisted of two class periods per week, Girls' Athletic Association, cheer-

leading, a Pom Pom Drill Team and a swim show. The Grand Forks group was compared with the Brandon group to determine whether significant differences were evident in the selected measures of physical fitness.

Comparisons were made within both groups on the pre- and post tests. Comparisons were made between the Grand Forks group and the Brandon group on the post test. These comparisons were made by testing the significance of the difference between the means found for the groups. The null hypothesis was assumed with respect to the differences between the means of both groups. This hypothesis was tested with the "t" technique for the difference between means derived from correlated scores. This technique utilizes the critical ratio established by dividing the actual difference between the means by the standard error of the difference between the means.

No significant changes were found when between group comparisons of the post test or within group comparisons of the pre- and post test results were made.

Conclusions

The following conclusions seem warranted on the basis of the data collected in this study.

1. Neither the Brandon physical education program nor the Grand Forks physical education program produced significant changes in any of the selected measures of

physical fitness at the criterion .05 level.

2. No significant changes were found between the two groups when the post test results were compared.

3. From the data collected in this study neither intramural nor interscholastic competition increased the physical fitness level of the participants.

Recommendations

The following recommendations have been made relative to this study:

1. A similar study should be made using a control group and an experimental group, both participating in the same physical education program. The only difference should be the experimental group's participation in interscholastic competition.

2. A physical fitness test other than the Grand Forks Public Schools Physical Efficiency Test should be used to conduct a similar study. This test should include measures of speed, endurance and cardiovascular efficiency.

3. In any similar study undertaken, the interscholastic competitive program should be one which adheres to an intensive conditioning and practice schedule.

4. In any similar study undertaken, the physical education program from which both groups are taken should be one which meets for more than two sixty minute class

periods per week.

5. The instrument used to test physical fitness in the Grand Forks Public School System should be re-examined. The instrument currently used does not measure endurance or cardiovascular efficiency.

6. The teaching methods used for the existing activities in both programs should be evaluated to be certain that maximum physical fitness benefits are derived from these activities.

7. A study of the existing physical education curricula of both schools involved in this study should be made to determine whether existing activities provide adequate physical fitness benefits or whether these curricula should be revised to include activities which would result in higher physical fitness levels of the students involved.

GRAND FORKS PUBLIC SCHOOLS PHYSICAL EFFICIENCY TEST

Definition-Background

The term "Physical Fitness" has been defined in numerous ways, but perhaps a brief and concise definition by a modern day writer would suffice. That definition is "A capacity for sustained physical activity." Physical fitness testing is generally divided into three major areas of testing. These areas are:

(A) Cardiovascular Tests

(B) Strength and Endurance Tests

(C) Motor Performance Tests

The test that is herein developed does fall into the category of a motor performance and/or motor fitness test. Specifically, it is thought that this test does measure power, flexibility, speed, agility and balance.

The six items contained within this test are by no means new, but are, for the most part, contained in many of the modern day physical fitness-motor performance tests. It is hoped that following a two or three year trial period this system can form a new set of norms based on the performances of students within the Grand Forks City School System.

Test Administration

This test herein after called the Grand Forks City School Youth Fitness Test shall be given within the following periods of time during the course of the school year.

First Testing: During the last 2 weeks of October

Second Testing: During the 32nd and 33rd week of school

This test should be administered to all students in a like manner. Each test item is clearly described and directions for administration of tabulation sheet is included at the conclusion of the test.

Sit-Up (Boys and Girls)

Equipment: Mat

Description: The pupil will lie on his back, on a mat, with legs extended and feet about shoulder width apart. His hands are placed on the back of the neck with the fingers interlaced. Elbows are retracted. A partner holds the ankles down, the heels being in contact with the mat at all times.

The pupil sits up, turning the trunk to the left and touching the right elbow to the left knee, returns to starting position then sits up turning the trunk to the right and then touching the left elbow to the right knee. The exercise is repeated, alternating sides.

Rules: 1. The fingers must be interlaced behind the neck

throughout the exercise. Any exercise done without fingers interlaced does not count; however, pupil may continue after making adjustment.

2. The knees must be on the floor during the sit-up, but may be slightly bent when touching elbow to knee.
3. When returning to starting position, elbows must be flat on the mat before sitting up again.
4. Pupil can stop and rest if he or she feels it is necessary to do so.

Scoring: The total number of legal sit-ups (see rules) completed during a 2 minute time limit shall be recorded.

Pull-Up (Boys Only)

Equipment: A metal or wooden bar approximately one and one-half inches in diameter is preferred. A doorway gym bar can be used and, if no regular equipment is available, a piece of pipe or even the rungs of a ladder can also serve the purpose.

Description: The bar should be high enough so that the pupil can hang with his arms and legs fully extended and his feet free of the floor. Use the overhand grasp. After assuming the hanging position, the pupil raises his body by his arms until his chin can be placed over the bar and then lowers his body to a full hang as in the starting position. The exercise is repeated as many

times as possible.

Rules: 1. Allow only one trial unless it is obvious that the pupil has not had a fair chance.

2. The body must not swing during the execution of the movement. The pull must in no way be a snap movement. If the pupil starts swinging, check this by holding your extended arm across the front of the thighs.

3. The knees must not be raised and kicking of the legs is not permitted.

Modified Pull-Up (Girls Only)

Equipment: A metal or wooden bar approximately one and one-half inches in diameter is preferred. A doorway gym bar can be used and, if no regular equipment is available, a piece of pipe can also serve the purpose. In some instances, it is possible to use the aisle between bleacher seats and have the bleachers support the pipe at the desired height.

Description: If possible adjust the height of the bar so it is approximately at belt level. Use an overhand grasp. The pupil extends her legs under the bar and extends the arms fully. The arms should form an angle of 90 degrees with the body line. The heels should be braced to prevent slipping; they can be resting on a mat or against an improvised rest to prevent slipping. From this position the pupil raises her body by her

arms until the chest touches the bar, then lowers her body to a full hang.

Rules: 1. No resting is permitted.

2. No pull-up shall be counted in which the pupil fails to keep the body straight, come to a full extension of the arms, or touch the chest to the bar.

Scoring: Record the number of completed pull-ups.

Shuttle Run (Boys and Girls)

Equipment: Two erasers and stop-watch. Pupils should wear sneakers or run barefooted.

Description: Two parallel lines are marked on the floor 30 feet apart. The width of a regulation volleyball court serves as a suitable area. Place the erasers 12 inches apart and parallel to end line. The pupil starts from behind the other line. On the signal "Ready? Go!", the pupil runs to the eraser, picks one up, runs back to the starting line and places the eraser behind the line; he then runs back and picks up the second eraser which he carries back across the starting line. To eliminate the necessity of returning the eraser after each race, start the races alternately, first from behind one line and then from behind the other.

Rules: Record the time of the trial to the nearest tenth of a second. The runner does not have to go over the line before turning around to go back the other way.

Only one trial will be given in all cases.

Standing Broad Jump (Boys and Girls)

Equipment: Mat and tape measure

Description: Pupil stands with the feet several inches apart and the toes just behind the take-off line. Preparatory to jumping, the pupil swings the arms backward and bends the knees. The jump is accomplished by simultaneously extending the knees and swinging forward the arms.

Rules: 1. Allow two trials. It is recommended that the second trial immediately follow the first.

2. Measure from the take-off line to the heel of other part of the body that touches the floor nearest the take-off line.

3. It is convenient to tape the tape measure to the floor at right angles to the take-off line and have the pupils jump along the tape. The scorer stands to the side and observes the mark to the nearest inch made.

Scoring: Record the best of the two trials in feet and inches to the nearest inch made.

Vertical Jump (Boys and Girls)

Equipment: A piece of slate (black or green) mounted on the wall. This slate must be placed at such a height that its lower edge can be reached by all pupils

and its length must be great enough so that no pupil can jump higher from a full-reach position than the top edge. Several pieces of chalk approximately 1" in length will be necessary along with a yard stick or tape measure.

Description: Stand facing the wall and reach as high as possible and mark the wall. Move comfortably away from and parallel to the wall and get ready to jump. With the chalk in the near hand, jump as high as possible and make a mark on the board at the maximum height of the jump. The jump should be measured from the reaching height to the maximum height made in the jump to the nearest inch made.

Rules: 1. Each pupil must stand with both heels on the floor when determining his reach preparatory to jumping.

2. Each pupil receives two consecutive trials with the best trial being recorded.

Scoring: Record the best jump of the two trials to the nearest inch made.

Burpee - Squat Thrusts (Boys and Girls)

Equipment: Stop-watch.

Description: The pupil is directed in the following manner: The starting position is "Attention". Squat and place hands on floor approximately 8 inches in front of feet. Thrust feet backward, arms straight,

legs and back straight. Return to squat position, and then return to "Attention" position. Count 1 point for each full squat thrust.

Rules: 1. The squat thrust will not be counted if any of the following occur:

(A) Feet start backward before hands are on the floor.

(B) Hips are above shoulder line when feet are in back.

(C) Pupil does not completely straighten on the fourth count.

2. Only those squat thrusts that the pupil can do in 30 seconds.

Statistical Procedure for Determining the Variance Between the Groups After the Matched Pairs Technique of Correlation

$$\sigma = \sqrt{\frac{N \Sigma X^2 - (\Sigma X)^2}{N}}$$ [1]

Brandon Pretest σ = 27.815

Grand Forks Pretest σ = 28.06

Standard Error Between Standard Deviations[2]

$$S.E._{\sigma} = \frac{.71 \times \sigma}{\sqrt{N}}$$

Brandon Pretest $S.E._{\sigma}$ = 3.21

Grand Forks Pretest $S.E._{\sigma}$ = 3.23

"t" = $\frac{\text{Actual Difference between standard deviations}}{\text{Standard error between standard deviations}}$

"t" = .044

Not significant at .01 level.

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[1] Joseph Saupe, Formulas for Machine Computation, Michigan State University, 1966.

[2] Garrett, op. cit., p. 233.

Formula Used for Converting Raw Scores to Standard Scores[3]

$$X^1 = \frac{\sigma^1}{\sigma} (X - M) + M^1$$

$$\sigma^1 = 10$$

$$M^1 = 50$$

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[3] Ibid., p. 313.

Data Received from 1620 I.B.M. Computor

Grand Forks Group

Test	Pre-Test		Post Test	
	Mean Raw Score	Raw Score Standard Deviation	Mean Raw Score	Raw Score Standard Deviation
Pull Ups	8.789	4.203	10.171	4.903
Sit Ups	40.609	10.800	44.867	10.527
Squat Thrust	14.070	2.513	14.843	2.148
Shuttle Run	11.731	.953	11.671	1.145
Standing Broad Jump	5.278	.634	5.214	.630

Data Received from 1620 I.B.M. Computor

Brandon Group

Test	Pre-Test		Post Test	
	Mean Raw Score	Raw Score Standard Deviation	Mean Raw Score	Raw Score Standard Deviation
Pull Ups	21.184	8.604	25.447	9.144
Sit Ups	27.289	15.466	29.894	13.449
Squat Thrust	17.736	7.454	19.657	7.179
Shuttle Run	11.102	.941	10.878	1.023
Standing Broad Jump	5.168	.979	5.369	.896

GRAND FORKS PRE- AND POST TEST

STANDARD SCORES FOR PULLUPS

Number	Pretest	Post Test
1	45.71	45.51
2	40.95	39.39
3	45.71	37.35
4	36.19	37.35
5	36.19	31.22
6	45.71	47.55
7	45.51	38.57
8	60.00	57.76
9	57.62	39.39
10	33.81	33.27
11	57.62	51.63
12	45.71	41.43
13	43.33	43.47
14	38.57	35.27
15	48.10	49.59
16	50.50	45.51
17	43.33	41.43
18	52.86	43.47
19	48.10	49.59
20	50.50	49.59
21	56.66	63.98
22	60.00	49.59
23	57.62	61.84
24	48.10	35.27
25	55.24	53.67
26	40.95	55.71
27	55.24	51.63
28	57.62	70.00
29	60.00	57.76
30	55.24	51.63
31	64.76	47.55
32	40.95	47.55
33	55.24	51.63
34	62.38	67.96
35	55.24	45.51
36	76.67	45.51
37	81.43	70.00
38	64.76	78.16

GRAND FORKS PRE- AND POST TEST

STANDARD SCORES FOR SITUPS

Number	Pretest	Post Test
1	18.89	27.24
2	42.04	43.47
3	42.04	37.71
4	28.15	40.57
5	37.40	27.24
6	39.26	39.62
7	45.93	52.00
8	24.44	26.29
9	36.48	35.81
10	50.37	47.24
11	45.74	49.14
12	48.52	42.48
13	54.07	54.86
14	43.89	38.67
15	39.45	37.71
16	51.30	45.33
17	52.22	45.33
18	54.07	60.57
19	58.70	62.47
20	53.15	47.24
21	53.15	51.05
22	56.85	57.71
23	53.15	52.95
24	57.78	61.52
25	35.56	35.81
26	67.96	64.38
27	54.07	50.10
28	55.93	49.14
29	62.41	71.05
30	59.63	54.86
31	59.63	59.62
32	44.81	46.29
33	62.41	57.71
34	58.70	52.00
35	67.04	73.90
36	51.30	54.86
37	60.56	60.57
38	64.26	74.86

GRAND FORKS PRE- AND POST TEST

STANDARD SCORES FOR SQUAT THRUST

Number	Pretest	Post Test
1	49.60	41.43
2	37.60	46.19
3	37.60	50.95
4	49.60	55.71
5	49.60	39.52
6	49.60	41.43
7	49.60	46.19
8	37.60	46.19
9	37.60	46.18
10	49.60	46.18
11	37.60	36.67
12	29.60	36.67
13	45.60	31.90
14	52.60	55.71
15	43.20	46.19
16	53.60	55.71
17	41.60	55.71
18	46.40	46.19
19	49.60	65.24
20	61.60	60.48
21	49.60	55.71
22	41.60	50.95
23	53.60	46.19
24	57.60	55.71
25	69.60	55.71
26	53.60	50.95
27	53.60	50.95
28	61.60	60.48
29	57.60	65.24
30	49.60	50.95
31	61.60	65.24
32	64.15	65.24
33	57.60	46.19
34	69.60	70.00
35	53.60	65.24
36	53.60	50.95
37	65.60	74.76
38	57.60	70.00

GRAND FORKS PRE- AND POST TEST

STANDARD SCORES FOR SHUTTLE RUN

Number	Pretest	Post Test
1	44.74	51.82
2	49.95	53.64
3	49.95	47.27
4	74.21	58.18
5	61.58	54.55
6	54.21	50.91
7	43.68	47.27
8	62.63	53.64
9	44.74	45.45
10	42.63	48.18
11	53.16	70.00
12	72.11	80.00
13	58.42	57.27
14	62.63	55.45
15	60.53	49.09
16	56.32	40.00
17	74.21	65.64
18	44.74	50.91
19	43.68	50.00
20	44.74	49.09
21	43.68	42.73
22	49.89	50.91
23	50.00	43.64
24	50.00	43.64
25	56.31	52.73
26	46.84	47.27
27	45.79	46.36
28	44.74	41.82
29	52.11	54.55
30	41.58	43.64
31	41.58	43.64
32	68.95	51.82
33	51.05	53.64
34	40.53	40.00
35	45.79	41.82
36	41.58	37.27
37	42.63	64.55
38	71.05	32.73

GRAND FORKS PRE- AND POST TEST

STANDARD SCORES FOR STANDING BROAD JUMP

Number	Pretest	Post Test
1	40.00	46.67
2	35.83	39.67
3	37.30	50.83
4	28.10	34.17
5	41.59	35.50
6	36.98	38.33
7	50.48	53.67
8	45.24	49.33
9	55.87	52.17
10	57.14	57.83
11	42.70	41.17
12	45.24	39.67
13	40.00	35.50
14	38.89	41.17
15	51.90	46.67
16	54.44	56.33
17	42.07	41.17
18	55.87	52.17
19	55.87	57.83
20	48.10	53.67
21	58.57	56.33
22	54.60	49.33
23	49.21	44.00
24	51.90	56.33
25	51.90	45.33
26	61.11	64.67
27	63.49	63.33
28	53.17	50.83
29	45.24	43.33
30	73.81	57.83
31	53.17	49.33
32	63.65	66.00
33	57.14	67.50
34	60.32	60.67
35	70.32	70.00
36	70.63	62.00
37	57.14	50.83
38	57.14	68.83

BRANDON PRE- AND POST TEST

STANDARD SCORES FOR PULLUPS

Number	Pretest	Post Test
1	69.53	52.75
2	47.44	45.16
3	58.37	48.46
4	45.12	47.36
5	64.88	61.65
6	52.09	47.36
7	57.07	61.65
8	56.74	59.45
9	53.26	51.76
10	41.63	42.97
11	49.77	52.86
12	43.26	45.16
13	57.91	57.25
14	59.07	58.35
15	63.72	58.35
16	53.26	57.25
17	39.30	40.77
18	49.07	46.26
19	57.91	52.86
20	49.60	59.45
21	71.86	73.74
22	46.28	46.28
23	47.91	47.14
24	62.56	61.65
25	31.16	35.27
26	35.81	29.78
27	36.98	39.67
28	45.12	46.26
29	53.26	51.76
30	67.21	62.75
31	42.79	39.67
32	39.30	35.27
33	39.30	35.27
34	55.58	57.25
35	40.47	39.67
36	53.26	57.25
37	41.63	37.47
38	40.47	42.97

BRANDON PRE- AND POST TEST

STANDARD SCORES FOR SITUPS

Number	Pretest	Post Test
1	68.52	72.46
2	45.29	44.10
3	58.19	57.54
4	49.16	47.84
5	64.65	63.51
6	60.13	57.54
7	71.09	76.19
8	66.58	65.00
9	63.35	49.33
10	51.74	52.51
11	60.77	61.27
12	63.35	65.00
13	53.68	50.07
14	60.13	61.27
15	54.97	55.30
16	52.39	53.80
17	42.06	39.63
18	53.03	53.81
19	49.81	50.07
20	60.77	65.00
21	58.84	56.04
22	58.19	61.27
23	45.29	46.34
24	48.52	46.34
25	35.61	35.15
26	36.26	38.13
27	35.61	36.64
28	42.71	42.61
29	49.81	46.34
30	41.42	61.12
31	42.06	41.87
32	37.55	36.64
33	35.61	38.13
34	47.23	46.34
35	42.71	43.36
36	46.58	47.84
37	37.55	39.63
38	35.61	38.88

BRANDON PRE- AND POST TEST

STANDARD SCORES FOR SQUAT THRUSTS

Number	Pretest	Post Test
1	54.40	57.36
2	53.07	50.42
3	39.73	43.47
4	59.73	57.36
5	79.73	78.19
6	58.40	60.14
7	46.40	46.25
8	66.40	71.25
9	58.40	57.36
10	53.07	50.42
11	53.07	53.19
12	55.73	50.42
13	66.40	71.25
14	57.07	58.75
15	51.73	50.42
16	53.07	51.81
17	46.40	47.64
18	55.73	54.58
19	46.40	42.08
20	66.40	64.31
21	42.40	43.47
22	53.07	50.42
23	43.73	42.08
24	46.40	46.25
25	33.07	29.58
26	34.40	39.31
27	41.07	36.53
28	49.07	43.47
29	45.07	43.47
30	54.40	49.03
31	27.93	33.75
32	42.40	42.08
33	43.73	43.47
34	43.73	49.03
35	45.07	49.03
36	43.73	49.03
37	46.40	43.47
38	45.07	46.25

BRANDON PRE- AND POST TEST

STANDARD SCORES FOR SHUTTLE RUN

Number	Pretest	Post Test
1	67.02	36.27
2	67.02	36.27
3	43.62	46.36
4	59.51	58.18
5	43.62	41.82
6	43.62	41.82
7	46.81	41.82
8	52.13	50.99
9	46.81	41.82
10	46.81	41.82
11	43.62	41.82
12	70.21	41.82
13	54.26	50.91
14	52.13	50.91
15	48.94	50.91
16	46.81	41.82
17	43.62	46.36
18	57.44	55.45
19	48.94	46.36
20	54.26	50.91
21	38.30	49.18
22	38.30	41.82
23	59.57	60.00
24	48.94	60.00
25	70.21	69.09
26	59.57	60.00
27	70.21	69.09
28	59.57	69.09
29	56.38	55.45
30	54.26	55.45
31	70.21	69.09
32	64.89	51.45
33	64.89	70.91
34	38.30	41.82
35	54.26	54.55
36	38.30	41.82
37	43.62	41.82
38	38.30	41.82

BRANDON PRE- AND POST TEST

STANDARD SCORES FOR STANDING BROAD JUMP

Number	Pretest	Post Test
1	47.96	62.22
2	69.18	65.67
3	58.16	54.89
4	50.51	50.22
5	59.79	60.33
6	63.27	61.33
7	70.41	79.78
8	49.59	45.56
9	58.16	58.44
10	48.78	40.89
11	49.78	45.56
12	57.14	40.89
13	48.78	38.11
14	40.31	36.22
15	49.78	49.22
16	59.16	58.44
17	32.65	34.44
18	37.76	48.33
19	38.57	40.00
20	41.12	39.11
21	61.53	60.33
22	58.16	56.67
23	48.78	46.46
24	57.35	56.67
25	43.67	41.89
26	34.39	36.22
27	47.14	32.67
28	44.59	45.56
29	56.53	55.78
30	60.71	59.44
31	42.04	39.11
32	44.59	43.78
33	53.06	53.00
34	56.53	54.89
35	49.59	50.22
36	49.59	49.22
37	43.67	42.78
38	56.53	55.78

GRAND FORKS AND BRANDON TOTAL PRE- AND POST TEST STANDARD SCORES

	Grand Forks		Brandon	
	Pretest	Post Test	Pretest	Post Test
1	198.94	212.67	307.43	291.06
2	205.37	222.36	282.00	244.62
3	211.60	224.11	258.07	250.72
4	216.25	225.98	263.03	260.96
5	216.36	188.03	312.67	305.50
6	225.76	226.84	277.51	268.19
7	228.26	244.65	293.78	305.69
8	229.91	233.21	291.44	292.25
9	232.31	219.00	279.98	258.71
10	233.55	232.65	242.03	228.41
11	236.82	248.61	256.01	254.70
12	241.18	240.25	289.69	242.49
13	241.42	223.00	281.03	267.59
14	241.58	224.27	288.71	265.50
15	243.18	229.25	268.14	264.20
16	246.16	243.28	263.69	263.12
17	253.43	247.28	204.03	208.84
18	253.94	253.31	253.03	258.43
19	255.95	285.13	241.63	231.37
20	258.09	260.07	272.15	278.78
21	261.66	269.70	272.93	282.81
22	262.94	258.49	254.00	256.44
23	263.58	248.62	245.28	242.02
24	265.38	250.47	263.77	270.91
25	268.61	243.25	213.72	210.98
26	270.46	282.98	200.43	203.44
27	272.19	262.37	231.01	214.60
28	273.06	272.27	241.06	246.99
29	277.36	291.93	261.05	252.80
30	279.86	259.91	278.00	287.79
31	280.74	265.38	225.03	223.49
32	282.51	256.90	228.73	209.22
33	283.44	276.67	236.59	240.78
34	291.53	290.63	241.37	249.38
35	291.99	296.47	232.10	236.83
36	293.78	250.59	231.46	245.16
37	307.36	320.71	212.87	205.17
38	314.81	324.58	215.98	225.70

STANDARD DEVIATIONS (σ) OF GRAND FORKS PRETESTS

I Pullups $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 106183.28 - (1967.18)^2}{38}}$

$= 10.69$

II Sit-Ups $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 99037.39 - (1939.45)^2}{38}}$

$= 1.16$

III Squat Thrust $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 102412.22 - (1977.15)^2}{38}}$

$= -3.48$

IV Shuttle Run $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 105171.26 - (1951.48)^2}{38}}$

$= 11.42$

V Standing Broad Jump $\sigma = \frac{\sqrt{N\Sigma X^2 - (\Sigma X)^2}}{N}$

$= \frac{\sqrt{38 \times 103814.51 - (1977.91)^2}}{38}$

$= 2.63$

STANDARD DEVIATIONS (σ) OF GRAND FORKS POST TESTS

I Pullups $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 97517.75 - (1866.13)^2}{38}}$

$= 12.43$

II Sit-Ups $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 99389.17 - (1889.37)^2}{38}}$

$= 11.98$

III Squat Thrust $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 109188.21 - (2000.9)^2}{38}}$

$= 5.17$

IV Shuttle Run $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 97246.34 - (1869.07)^2}{38}}$

$= 9.37$

v Standing Broad Jump $\sigma = \frac{\sqrt{N\Sigma X^2 - (\Sigma X)^2}}{N}$

$= \frac{\sqrt{38 \times 103681.38 - (1949.99)^2}}{38}$

$= 9.76$

STANDARD DEVIATIONS (σ) OF BRANDON PRETESTS

I Pullups $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 100962.96 - (1921.95)^2}{38}}$

$= 9.94$

II Sit-ups $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 101721.80 - (1923.41)^2}{38}}$

$= 10.72$

III Squat Thrust $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 98948.78 - (1902.07)^2}{38}}$

$= 9.92$

IV Shuttle Run $\sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N}}$

$= \sqrt{\frac{38 \times 109582.16 - (2004.28)^2}{38}}$

$= 10.09$

V Standing Broad Jump $\sigma = \frac{\sqrt{N \Sigma X^2 - (\Sigma X)^2}}{N}$

$$= \frac{\sqrt{38 \times 101664.11 - (1893.12)^2}}{38}$$

$$= 5.87$$

STANDARD DEVIATIONS (σ) OF BRANDON POST TESTS

I Pullups $\sigma = \frac{\sqrt{N\Sigma X^2 - (\Sigma X)^2}}{N}$

$= \frac{\sqrt{38 \times 97147.52 - (1886.23)^2}}{38}$

$= 9.62$

II Sit-Ups $\sigma = \frac{\sqrt{N\Sigma X^2 - (\Sigma X)^2}}{N}$

$= \frac{\sqrt{38 \times 102474.77 - (1943.71)^2}}{38}$

$= 8.96$

III Squat Thrust $\sigma = \frac{\sqrt{N\Sigma X^2 - (\Sigma X)^2}}{N}$

$= \frac{\sqrt{38 \times 98391.11 - (1869.18)^2}}{38}$

$= 10.85$

IV Shuttle Run $\sigma = \frac{\sqrt{N\Sigma X^2 - (\Sigma X)^2}}{N}$

$= \frac{\sqrt{38 \times 100345.46 - (1916.87)^2}}{38}$

$= 9.80$

V Standing Broad Jump $\sigma = \frac{\sqrt{N \Sigma X^2 - (\Sigma X)^2}}{N}$

$= \frac{\sqrt{30 \times 99281.91 - (1893.12)^2}}{30}$

$= 11.43$

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

Grand Forks Within Group Comparison

Pullups

Standard Error of Mean in Large Samples[4]

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{12.43}{6.16} = 2.01$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{10.69}{6.16} = 1.74$$

Standard Error of the Difference Between Means[5]

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{2.01^2 + 1.74^2}$$

$$= 2.66$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{-2.66}{2.66} = -1$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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[4]Garrett, op. cit., p. 186.

[5]Ibid., p. 214.

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

Grand Forks Within Group Comparison

Sit-ups

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{11.98}{6.16} = 1.94$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{1.16}{6.16} = .19$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{2.01^2 + 1.74^2}$$

$$= 2.66$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{-1.32}{1.95} = -.68$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Grand Forks Within Group Comparison

Squat Thrust

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{3.17}{6.16} = .51$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{-3.48}{6.16} = -.56$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{.51^2 + (-.56)^2}$$

$$= .75$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{.63}{.75} = .08$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Grand Forks Within Group Comparison

Shuttle Run

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{9.37}{6.16} = 1.52$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{11.42}{6.16} = 1.85$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.52^2 + 1.85^2}$$

$$= 2.39$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{1.64}{2.39} = .69$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Grand Forks Within Group Comparison

Standing Broad Jump

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{9.76}{6.16} = 1.58$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{2.63}{6.16} = .43$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.58^2 + .43^2}$$

$$= 1.64$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{-.73}{1.64} = .69$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Brandon Within Group Comparison

Pullups

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{9.62}{6.16} = 1.56$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{9.94}{6.16} = 1.61$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}^2 + S.E._{M_2}^2}$$

$$= \sqrt{1.56^2 + 1.61^2}$$

$$= 2.24$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{-.94}{2.24} = -.42$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Brandon Within Group Comparison

Sit Ups

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{8.96}{6.16} = 1.45$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{10.72}{6.16} = 1.74$$

Standard Error of the Difference Between Means

$$S.E.\ diff = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.45^2 + 1.74^2}$$

$$= 2.26$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{.53}{2.26} = .23$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Brandon Within Group Comparison

Squat Thrust

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{10.85}{6.16} = 1.76$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{9.92}{6.16} = 1.61$$

Standard Error of the Difference Between Means

$$S.E.\ diff = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.76^2 + 1.61^2}$$

$$= 2.39$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{-.33}{2.39} = -.14$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Brandon Within Group Comparison

Shuttle Run

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{9.80}{6.16} = 1.59$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{10.09}{6.16} = 1.64$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.59^2 + 1.64^2}$$

$$= 2.28$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{2.30}{2.28} = -1.01$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Brandon Within Group Comparison

Standing Broad Jump

Standard Error of Mean in Large Samples

Pretest

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{11.43}{6.16} = 1.86$$

Post Test

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{5.87}{6.16} = .95$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.86^2 + .95^2}$$

$$= 2.09$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{-1.14}{2.09} = -.55$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Between Group Comparison of Post Test Results

Pullups

Standard Error of Mean in Large Samples

Brandon

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{9.62}{6.16} = 1.56$$

Grand Forks

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{12.43}{6.16} = 2.01$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}^2 + S.E._{M_2}^2}$$

$$= \sqrt{1.56^2 + 2.01^2}$$

$$= 2.54$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{.53}{2.54} = .21$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Between Group Comparison of Post Test Results

Situps

Standard Error of Mean in Large Samples

Brandon

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{8.96}{6.16} = 1.45$$

Grand Forks

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{11.98}{6.16} = 1.94$$

Standard Error of the Difference Between Means

$$S.E.\ diff = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.45^2 + 1.94^2}$$

$$= 2.42$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{1.43}{2.42} = .59$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Between Group Comparison of Post Test Results

Squat Thrust

Standard Error of Mean in Large Samples

Brandon

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{10.85}{6.16} = 1.76$$

Grand Forks

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{3.17}{6.16} = .51$$

Standard Error of the Difference Between Means

$$S.E.\ diff = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.76^2 + .51^2}$$

$$= 1.86$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{-2.94}{1.83} = -1.61$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Between Group Comparison of Post Test Results

Shuttle Run

Standard Error of Mean in Large Samples

Brandon

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{9.80}{6.16} = 1.59$$

Grand Forks

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{9.37}{6.16} = 1.52$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.59^2 + 1.52^2}$$

$$= 2.20$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{.75}{2.20} = .33$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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

Between Group Comparison of Post Test Results

Standing Broad Jump

Standard Error of Mean in Large Samples

Brandon

$$S.E._{M_1} = \frac{\sigma}{\sqrt{N}} = \frac{11.43}{6.16} = 1.86$$

Grand Forks

$$S.E._{M_2} = \frac{\sigma}{\sqrt{N}} = \frac{9.76}{6.16} = 1.58$$

Standard Error of the Difference Between Means

$$S.E.\ diff. = \sqrt{S.E._{M_1}{}^2 + S.E._{M_2}{}^2}$$

$$= \sqrt{1.86^2 + 1.58^2}$$

$$= 2.44$$

$$\text{"t"} = \frac{\text{Actual difference between Means}}{\text{S.E. difference between Means}} = \frac{-1.50}{2.44} = -.61$$

Degrees of Freedom = N - 1 = 37

"t" at .05 level = 2.20

Not Significant at .05 level.

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