8-1-1967

A Comparison of The Physical Fitness Levels Attained by Participants in Interscholastic Athletes and in the Required Physical Education Program

Carl E. Hasche

A COMPARISON OF THE PHYSICAL FITNESS LEVELS ATTAINED BY PARTICIPANTS IN INTERSCHOLASTIC ATHLETICS AND IN THE REQUIRED PHYSICAL EDUCATION PROGRAM

by

Carl E. Hasche

B.S. in Physical Education, Valley City State College 1960

A Thesis

Submitted to the Faculty

of the

University of North Dakota

for the Degree of

Master of Science

Grand Forks, North Dakota

August
1967

This thesis submitted by Carl E. Hasche 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. Quaday

A. W. Sturges

William Johnson
Dean of the Graduate School

ACKNOWLEDGEMENTS

The author wishes to express his sincere appreciation to all who so freely gave of their time, effort, and assistance in making this study possible.

A special appreciation is extended to Mr. W. C. Koenig for his unlimited assistance and guidance in helping the writer carry this study to its completion; and to Dr. John L. Quaday for his suggestions, criticisms and instruction. A special recognition is also extended to the Grafton High School Administration, athletic and physical education staff, athletes, and physical education students for their cooperation in conducting this study.

Finally, this writer is deeply grateful to his wife, Faye, for her constant encouragement, faith, and help during these years of graduate school.

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

The purpose of this study was to show the improvements in physical fitness levels between two experimental groups. Experimental Group I consisted of twenty-one athletes and Experimental Group II consisted of twenty-six students in the required physical education program. Intra and inter group comparisons were made from the data collected from a special eight-item physical fitness test.

The null hypothesis was assumed with respect to the difference between the means of both groups. The hypothesis was tested with the "t" technique for checking significance of difference between means, and the F technique for determining the significance of the difference among means.

The conclusions indicated by this study were:

1. Participation in programs of interscholastic athletics or required physical education may improve physical fitness. The Interscholastic Athletic Group showed significant improvement in six of the eight test items at the .01 level. The Physical Education Group showed significant improvements in two of the eight test items.

2. Participation in interscholastic athletic programs may have a tendency to produce superior levels of physical fitness when within group improvements made during the experimental period were compared on a between group basis. The

athletes had made significantly greater improvement than had the physical education group in four of the eight items tested. The interscholastic athletic group showed a more significant improvement in two of the eight items than the physical education group when comparing means by a one way analysis of covariance.

CHAPTER I

INTRODUCTION

Nature of the Problem

The physical fitness of the youth of America has been receiving much attention because of the interest of a few people, which has brought about national interest. The sources of the current importance placed on fitness are (1) the alarming number of draftee rejections during World War II and (2) Kraus and Herschland,[1] in a study of 4,458 normal healthy American school children between the ages of six and nineteen, which revealed that 56.6 per cent failed one or more items on a minimum requirement muscular fitness test and that 16.4 per cent failed two or more items. This same test given to 1,987 European children from Italy and Austria showed that only eight per cent failed.

As a result of Kraus's findings, President Eisenhower called a conference on Fitness of American Youth and later created the President's Council of Youth Fitness. President Kennedy, also showed much concern for the physical fitness of youth. His first presidential conference was on the physical

---

[1]Hans Kraus, M.D., Ruth P. Herschland, "Youth Fitness and Health", Journal of Health, Physical Education and Recreation, (December, 1953) p. 10-17.

fitness of youth, and later, he appointed Charles B. Wilkinson, Special Consultant on Fitness of Youth. At present the President's Youth Fitness Program is being encouraged in all schools and walks of life.[2]

In view of the importance placed on the physical fitness levels of youth, the logical place to begin such an important program is in the schools. The curriculum in the schools should provide an adequate opportunity for all students to improve their levels of physical fitness through a required physical education program, an intramural program, or the interscholastic athletic program. However, the interscholastic athletic programs have, throughout the years, been attacked for being "overemphasized" and, in one of the most recent critics of athletics, Dr. Conant stated:

> There is in both our schools and colleges today a vicious overemphasis on competitive athletics.

He also stated:

> That we need to de-emphasize interscholastic athletics and improve our physical education and intramural programs, which would in turn enable all school students to improve their physical fitness levels.[3]

The purpose of the writer was to make a comparison of the physical fitness levels attained by participants in two

---

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

[3]Dr. James B. Conant,"Athletics, the Poison Ivy of Our Schools", Look, Vol. 25, No. 2, (January 17, 1961), pp. 57 - 60.

different programs in the High School at Grafton, North Dakota.

Statement of the Problem

The problem of this study was to compare the physical fitness levels attained by participants in interscholastic athletics with those levels attained by the participants in the required physical education program.

A physical fitness test was administered to each group at the start of the school program in August, 1963 and again at the completion of the first semester of the 1963-64 school year. From these test results an attempt was made to determine whether the levels of physical fitness were significantly improved within each group, and later, an attempt was made to determine whether one group improved significantly over the other group. Experimental Group II, (Physical education group) participated in only the required physical education program which met three times weekly for one hour at each meeting. The Experimental Group I, (Interscholastic Athletic group) participated in the varsity sports of football and basketball or hockey. The interscholastic athletic program consisted of from four to five daily practice sessions of about two hours in length and either one or two games during that week.

DEFINITION OF TERMS

The Experimental Group I refers to the twenty-one members

participating on the interscholastic athletic teams at Grafton High School during the time the data for this study were collected.

The Experimental Group II refers to the twenty-six members of the boys' physical education classes at Grafton High School during the time the data for this study were collected.

Interscholastic athletics refers to those sports activities which are conducted between schools at the varsity level. In this study, football, basketball and hockey were the sport activities participated in between schools.

Physical education refers to the required program of physical activities in the school.

Physical fitness test refers to the eight item test drawn up for this study by this writer and Mr. W. C. Koenig.

Physical fitness level refers to the physical abilities of an individual to perform activities which can be measured against the performance of others or against one's own performance.

Physical fitness is the ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and to meet unforseen emergencies.[4]

---

[4]H. Harrison Clark, Application of Measurements to Health and Physical Education (Prentice Hall, Inc. New Jersey, 1957), p. 14.

Justification

The recent emphasis placed on the physical fitness of youth and the encouragement of schools to adopt better physical education programs, and at the same time, to de-emphasize interscholastic athletics has brought a need for studies of this nature.

Through an evaluation of different physical education curricula, a program may be developed which would meet the one objective "physical fitness" and still meet the other objectives of a good physical education program. Also, this writer will attempt to show that the interscholastic athletic program can produce a superior level of physical fitness and have a justifiable place in the educational program along with physical education in terms of physical fitness.

Delimitations

This study was directly concerned with physical fitness improvements as measured by a special physical fitness test adapted for the indoor facilities of the Grafton High School, Grafton, North Dakota. The school has a total enrollment in grades 9 through 12 of about 450 students. The physical education program is a required course for one semester per year for grades nine through eleven. The classes meet for three one hour sessions per week. The number of athletes to be sampled, similarly, was small because it was limited to those boys actively engaged in interscholastic athletics for

the entire semester.

The students involved in this study were boys in grades nine through twelve regularly enrolled in physical education or were active participants on the football and basketball or hockey teams. The boys enrolled in physical education were restricted in class activity to three days per week, one hour per day. The boys participating in athletics attended practice sessions from four to five days weekly and participated in one or two games a week after the initial practice sessions. Bias was inherent in this study because there was no attempt to equate the groups.

Review of Related Literature

Many studies have been made and many articles have been written concerning the physical fitness of the youth of this nation and the values of interscholastic athletics.

The interest in physical fitness received its impetus from the results of physical fitness tests given by Kraus[5] in 1953, which showed that the American youth were definitely inferior to a similar group of European children of the same age.

The concern over the place and value of interscholastic athletic competition has been a problem since its recognition by the schools in the late 1800's.

---

[5]Hans Kraus, and Ruth P. Herschland, pp. cit. p. 10-17.

In order to arrive at any conclusions regarding the development of physical fitness through the interscholastic athletic and physical education programs, an analysis must be made of the studies completed by other investigators.

Gaddie[6] conducted a study at the University of North Dakota in which he compared the athletes and non-athletes as measured by the Harvard Step Test. The results of this study showed that the students participating in athletics were superior to the students who participated in physical education, intramural sports, or were inactive. The athletes were about three points away from having a total score of excellent, while only one non-athlete received an excellent rating, and he had participated in physical education classes every semester for four years.

A study conducted by Boschee[7] comparing the physical fitness levels of selected participants in interscholastic football before the season, at the peak of the season, and one month later indicated that interscholastic football does significantly improve the physical fitness levels on certain

---

[6]Michael L. Gaddie, "A comparison of Athletes and Non-Athletes at the University of North Dakota as Measured by the Harvard Step Test". (unpublished individual research paper, Department of Physical Education, University of North Dakota, 1960).

[7]Floyd Boschee, "A Comparison in Physical Fitness Levels of Selected Participants in Interscholastic Football before the season, at the peak of the season, and one month later". (unpublished research paper, Department of Physical Education, University of North Dakota, August 1960).

items of the AAHPER Youth Fitness Test. The most improvement was evident in the standing broad jump, sit-ups, and fifty yard dash. Retention was greatest in the fifty yard dash, sit-ups, 600 yard run-walk, and the shuttle run.

Hoffman[8] conducted a study to determine whether or not participation in football, basketball, track and the physical activities program contributed to the strength and development of the participant according to the items measured by the Rogers Physical Capacity Test.

By comparing the mean scores of the athletes and non-athletes, before and after participation, an attempt was made to determine in what particular season the greatest gains took place.

The results of this study showed that there was an increase in strength in both the athletes and non-athletes. However, the athletic group showed a gain of approximately twice that of the non-athletic group in all items tested except grip strength, where the increase was not as great.

Wieneke[9] conducted a study to compare the physical development of freshman athletes and non-athletes during a one-year period. The non-athletes were freshmen registered in

---

[8]Vern B. Hoffman, "Strength Comparison of Athletes and non-Athletes in the Items Measured by the Rogers Physical Capacity Test", (Masters thesis, University of Michigan, 1963).

[9]Kuhrt Wieneke, "A Comparison of Certain Physical Developments of Freshman Athletes and Non-Athletes," Research Quarterly, (May, 1932), pp. 224-234.

only the required physical education classes. The athletes were members of a freshman athletic team.

The athletes and non-athletes were paired with each other on the basis of a test given in the fall. Each group was tested for grip strength in the right and left hand, leg strength, and lung capacity.

The results of the study showed a very significant difference between the athletes and non-athletes in grip strength; favoring the athletes in approximately ninety eight cases out of one hundred. However, in the lung capacity test the difference was not significant but the athletes were favored in about sixty three cases out of one hundred.

A study by Moser[10] to determine effects of an entire season's participation in the interscholastic sports of basketball, wrestling, and hockey on physical fitness as measured by a six item test consisting of sit-ups, pull-ups, shuttle run, agility dribble, standing broad jump and treadmill showed the following results:

1. The physical fitness levels of the participants in each of the three sports improved.
2. The athletic program did very little to improve participants in agility as measured

---

[10]Clifford J. Moser, "A Comparison of the Effect of Seasonal Participation in Selected Interschool Sports on Physical Fitness", (unpublished masters thesis, Department of Physical Education, University of North Dakota, 1964).

by the agility dribble and shuttle run.

3. The wrestling group improved the most in physical fitness as measured by the test battery.

4. The basketball team was in the best physical condition at the times of both pre-and post-season tests.

A study was made by Landiss[11] to determine the influence of physical education on motor ability and physical fitness of many freshment. Eight physical education activities were selected; swimming, boxing, weight training, tennis, volleyball, tumbling-gymnastics, wrestling, and a basic conditioning course. The results of the test seemed to indicate that tumbling, gymnastics and wrestling best developed those abilities measured by the motor ability test. Tennis, swimming, and boxing were the least apt to develop physical fitness and motor ability.

Vinger[12] compared the physical fitness increases of senior high school boys participating in a selected physical education program with those who did not participate in physical

---

[11]Carl W. Landiss, "Influences of Physical Education Activities on Motor Ability and Physical Fitness of Male Freshmen", Research Quarterly, Vol. XXVI (October, 1955), pp. 295-307.

[12]Richard M. Vinger, "A Comparison of Physical Fitness Increases as the Result of a Selected Physical Education Program", (unpublished masters thesis, Department of Physical Education, University of North Dakota, 1964).

education.

The boys participating in the physical education program were called the experimental group, and the boys who did not participate in physical education were called the control group.

Each group was tested at the beginning of the school term and again at the end of the school term. The AAHPER Youth Fitness Test was the instrument used to determine the levels of physical fitness. A comparison was made between the experimental group and the control group to determine whether any significant changes occurred in the selected measures of physical fitness.

The results of the study showed that:

1. The required physical education curriculum which the experimental group engaged in did produce significant changes in all of the selected measures of physical fitness except the shuttle run at the criterion .01 level.
2. The control group who did not participate in any phase of the physical education program made no significant changes in any of the selected measures of physical fitness.
3. The between group comparison indicated a significant difference in pull-ups and the softball throw between the groups in terms of changes occurring during the experimental

period.

The changes in the other measures of physical fitness between the two groups were not significant at the criterion .01 level.

Coen[13] conducted a study to compare the physical fitness levels of adolescent boys, ages 13, 14, 15, and 16, after participation in a regular physical education program for three years as measured by the Minnesota Physical Efficiency Test.

The results of this study showed that:

1. The regular physical education class did not produce significant changes in the burpee test for three of the four age groups.
2. The regular physical education class did not produce significant changes in the sit-ups test in all four age groups.
3. The regular physical education class produced significant changes in the push-up test in all four age groups.
4. The regular physical education class produced only a significant change in one of the four age groups tested for pull-ups.

---

[13]David A. Coen, "A Comparison of Physical Fitness Levels of Adolescent Boys after Participation in a Regular Physical Education Program", (unpublished research paper, Department of Physical Education, University of North Dakota, 1963).

5. The regular physical education class produced significant changes in the vertical jump in three out of four age groups tested.

6. The regular physical education class produced only a significant change in one of the four age groups tested for the broad jump.

A comparison of physical fitness levels achieved by tenth grade girls through a physical education program and a competitive sports program was made by Hallatt.[14] The girls were tested on five items; pull-ups, sit-ups, squat thrust, shuttle run, and the standing broad jump. Two equated groups of girls were used. One group participated in a physical education program which consisted of two class periods weekly. The other group participated in a physical education program which included intramural and interscholastic competition as well as two class periods weekly. The conclusions from this study showed that neither group had any significant changes in any of the selected measures of physical fitness at the criterion .05 level at the close of the experimental period. There were no significant differences found in a comparison of the post test results between groups and the study also indicated that neither intramural nor interscholastic competi-

---

[14]Margaret M. Hallatt, "A Comparison of Physical Fitness Levels Achieved by Grade 10 Girls Through a Physical Education Program and a Competitive Sports Program," (unpublished masters thesis, Department of Physical Education, University of North Dakota, 1966).

tion increased the physical fitness levels of the participants.

Because of the lack of evidence in the sports participation area relating specific activity participation to the development of selected factors of physical fitness, Leighton[15] conducted a study of 20 physical education sports activities on selected components of physical fitness. The components selected were strength, balance, agility, speed, and endurance. A battery of tests was given to evaluate the five components. The findings were as follows:

1. Weight training was the only activity for which a significant strength gain was recorded.
2. Significant balance gains were recorded for fundamental gymnastics and golf.
3. Those activities requiring the least amount of movement from a fixed position or base during the execution of the skill appear to register the higher static balance development potential.
4. Significant agility gains were recorded for badminton, basketball, boxing, folk and square dancing, swimming, touch football, volleyball, and weight training.
5. Those activities requiring the greatest

---

[15]Jack R. Leighton, "Physical Fitness of Sports Activities", Journal of Health, Physical Education, and Recreation, (February, 1967), p. 59-60.

amount of movement from a fixed position or base during the performance of that activity appear to register the higher agility development potential. Weight training is the notable exception.

6. Significant speed gains were recorded for basketball and swimming.

7. Basketball was the only activity for which a significant endurance gain was recorded.

An evaluation of twenty physical education (sports) activities was made in terms of five components of physical fitness with the following results:

1. No significant changes were recorded in any physical fitness component for 10 of the activities (apparatus, archery, bowling, soccer, social dance, softball, tennis, trampoline, tumbling, and wrestling).

2. A significant change in only one physical fitness component was recorded for seven activities (badminton, boxing, folk and square dance, fundamental gymnastics, golf, touch football, and volleyball).

3. Significant change in only two physical fitness components was recorded for two activities (swimming and weight training).

4. A significant change in three physical fitness components was recorded for only one activity (basketball).

5. No activity evidenced significant changes in more than three of the five physical fitness components evaluated.

Rosenstein[16] found, through comparing the physical fitness of senior high school boys and girls participating in selected physical education programs in New York State, that there was statistically significant relationship between the final physical fitness test scores of athletes and non-athletes participating in physical education programs which were rated high and those participating in programs rated low. There was also a tendency for athletes participating in physical education programs rated high to achieve greater physical fitness scores than non-athletes participating in physical education programs rated high. A similar result was found between the participating athletes and non-participating athletes in physical education programs rated low.

The Council on Youth Fitness made this statement concerning youth participating in sports to promote physical fitness:

> Just as the council is concerned with every youth, boy and girl, so does it include in the top priority

---

[16]Irwin Rosenstein, "A Comparison of the Physical Fitness of Senior High School Boys and Girls Participating in Selected Physical Education Programs in New York State". (unpublished masters thesis, Department of Physical Education, Springfield College, 1963).

> bracket among the available tools in its fitness concept every wholesome sport. The council recognizes no major favorites; nor is it cognizant of any minor sports. It hails sports as the core of the physical education program in what may be called the American system. It salutes sports as the most inclusive and far reaching area of recreation activities. It sees sports as a generous contribution to social and citizenship development.
>
> The council sees competition as inevitable and generally desirable concomitant of most sports. This reflects the highly competitive society in which we live, and grows out of the wholesome urge of individuals, who begin to acquire individual skills or become part of coordinated teams. It measures ability and quality against what others can do or against par or what they did yesterday or even against natural obstacles and adversaries. The council finds merits in happily conceived and properly conducted contact sports suited to the physiological and sociological ages of the participants.[17]

Contrary to the foregoing studies, Weiss,[18] Professor of Education in the Department of Physical Education, Health and Recreation at New York University, stated that "limited participation in athletics will not produce a desired amount of physical fitness, and one must be physically fit in order to participate in athletics." He also tells that regular play may produce a desired amount of fitness for one to enjoy a friendly game. But where the objective is to win in competition, the chances are that the sport, by itself, will not

---

[17]Council on Youth Fitness-Official Statement from the President's Council on Youth Fitness Emphasized Contributions of Sports. "Sports Yield Youth Fitness", Journal of Health, Physical Education, and Recreation, (January, 1960), p. 66.

[18]Raymond Weiss, "Do Sports Produce Fitness", Journal of Health, Physical Education, and Recreation, Vol. XXXII, (March, 1961), pp. 20-21.

develop the level of strength and endurance that competition demands. Instead, the value of sports lies in its motivational power. It makes calisthenics or weight training fitness producing activities easier.

Mattson[19] conducted a study of the effects of track and field events on physical fitness as measured by the Youth Fitness test. A control group participated in only the activities set up for the recreation program in Grand Forks, North Dakota. The experimental group participated in an organized program of track and field. The study ran for four weeks. The results of this study showed that there was no significant difference between the two groups.

A study conducted by Hallatt[20] at the University of North Dakota to compare the physical fitness levels between male freshman honor students not enrolled in physical education and male freshman students enrolled in physical education 101, using the American Association for Health, Physical Education, and Recreation Youth Fitness Test had the following conclusions:

1. The required physical education course in which the service group engaged produced

---

[19]Neil A. Mattson, "The Effects of Track and Field Events on Physical Fitness as Measured by the Youth Fitness Test", (unpublished research paper, Department of Physical Education, University of North Dakota, 1962).

[20]Douglas A. Hallatt, "A Comparison of Physical Fitness Levels Between Male Freshmen Honor Students and Male Freshmen Students Enrolled in Physical Education 101 at the University of North Dakota", (unpublished masters thesis, Department of Physical Education, University of North Dakota, 1966).

significant results in all of the selected measures of physical fitness except the shuttle run at the criterion .01 level.

2. The honors students were not required to participate in any phase of the physical education program. As measured by the prescribed test, this group achieved fitness below the levels achieved by the average University freshman of 1965-1966.

Two general theories exist among physical educators regarding the development of physical fitness through the physical education program. One theory of the physical educators is that physical fitness can be developed only through formalized programs of a rather routine nature. The other theory of the physical educators is that physical fitness may be developed solely through participation in sports programs.

Rowe[21] found that the growth rate of junior high school boys taking part in interscholastic athletics was considerably lower than the non-athletes or boys taking part only in physical education classes. The three growth areas measured were height, weight and lung capacity. Because of variables which cannot be measured regarding the growth rate of the boys in the physical education group, these findings may

---

[21]Floyd A. Rowe, "Growth Comparison of Athletes and Non-Athletes", Research Quarterly, Vol. IV., No. 3, (October, 1933), pp. 108-116.

not be entirely true but do cause one to consider the possibility that interscholastic competition should not be undertaken at this age.

Summary of Review of Literature

From the review of literature there is considerable evidence that, through participation in interscholastic athletics and the required physical education program, fitness levels of participants are significantly increased over those students who do not take part in either program. Further evidence indicates:

1. The physical fitness levels of those students participating in interscholastic athletics is superior to that of the students taking part in physical education only.

If this evidence is true, both physical education and interscholastic athletics are needed in the school curriculum.

To further substantiate the position of interscholastic activities and physical education, Mannerstedt and Forbes[22] stated that:

> Athletics are, and should be, an integral part of physical education. For athletics certainly are 'physical' in that the body is involved also 'educational' in that aptitudes and skills have to be developed and improved in order to achieve proficiency.

---

[22]Mannerstedt, C. and Forbes, T. W. "Athletics: A Part of Physical Education" California Journal of Secondary Education, (January, 1958), p. 46-50.

The purpose of physical education and athletics is to contribute to fitness and the fullest possible enjoyment of life not only for a few world champions, but for everyone.

Physical education contributes basic body development and basic skills and coordination. The various forms of athletics, by participation, develop a more specialized and higher degree of skill and coordination. Therefore, in a sense, athletics can be considered as a further extension of physical education--shall we say, post-graduate work.

CHAPTER II

METHODOLOGY

PROCEDURE AND ADMINISTRATION

Preliminary Planning and Group Selection

The data used in this study were obtained from the athletes and physical education students in the public High School, Grafton, North Dakota.

Two groups of male students, grades nine through twelve, attending the Grafton Public High School were used.

Experimental Group I: This group included twenty-one male athletes, grades ten through twelve. The participants in this group were actively engaged in interscholastic athletic competition and did not attend physical education classes for the semester of school during which this study was undertaken.

Experimental Group II: This group included twenty-six male members of the required physical education program, grades nine through eleven. This group did not take part in interscholastic athletics for that semester of school during which this study was undertaken.

Procedure

A special physical fitness test was administered to two experimental groups.

Experimental Group I was tested on the first and second days of football practice and again at the close of the first semester of school. Experimental Group II was tested the first and second class periods of the semester and again on the final two class periods of the semester.

Test Administration

The physical fitness test battery consisted of the following items:

1. pull-ups
2. push-ups
3. sit-ups
4. shuttle run
5. dodge run
6. standing broad jump
7. standing shot put
8. modified treadmill

All tests were administered in the high school gymnasium. All necessary apparatus and extra equipment were located in the gymnasium. The physical fitness tests were administered on two days. The physical fitness test items given the first day were: pull-ups, push-ups, sit-ups, and standing shot put. The physical fitness test items administered on the second

day of testing were: shuttle run, dodge run, standing broad jump and modified treadmill. Experimental Group I was tested on consecutive days, but Experimental Group II had a one day lapse between tests because the classes met on alternate days. The same sequence and directions for administering the test items were used for each group.

Test Assistants

The testing of both groups was under the supervision of this writer. The interscholastic athletic group tests were administered by this writer, assisted by Mr. Alan Taylor and Mr. Stanley Paschke, assistant football, head basketball and hockey coaches, respectively, at Grafton High School. The physical education group tests were administered by Mr. Stanley Paschke, boys' physical education instructor, Grafton High School.

Directions for Tests

A complete description of the directions for the test is presented in Appendix A, Page 51.

Statistical Procedure

The data for this study were obtained from a test, re-test situation. Comparisons were made within groups and between groups on the various test items. To analyze the differences between the initial test and the re-test within each group

and between groups the null hypothesis was assumed. This hypothesis[1] asserts that there is no true difference between two population means, and that the difference found between sample means is, therefore, accidental and unimportant. Several possibilities were available for testing the null hypothesis. The "t" technique for testing the significance of the difference between means derived from correlated group scores for small samples and the F technique for determining the significance of the difference among means were found suitable for this study. The "t" test[2] determines the ratio between the difference between means and the standard error of the difference 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 degrees of freedom (N-1) allowed in determining the relationship between the difference between means and the standard error of the difference between means. The F test[3], or variance ratio, is determined by dividing the "among means" variance by the "within group" variance. The results are then checked in a table of F.

For this study it was decided to retain the null hypothesis at the .01 level of significance for the within group comparisons and the between group comparison on the post

---

[1]H. E. Garrett, Statistics in Psychology and Education (Fourth edition; New York: Longmans, Green and Company, 1953), p. 213.

[2]Ibid., p. 213-215.

[3]Ibid, 1959, p. 295.

tests means. However, when comparing the improvements between groups on the one tailed analysis of covariance tests, the null hypothesis was retained at the .01 or .05 level of significance.

The details of the mathematical processes employed in the analysis of each testing area are found in Appendix B, Page

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 the levels of physical fitness attained by those who participated in the interscholastic athletic program as compared to those in the required physical education program. The bases of comparison were the results obtained from administering a special pre-post physical fitness test.

The results obtained from an analysis of the data collected for this study were as follows:

Results of the Interscholastic Athletic (Experimental Group I) Within Group Comparison

Pull-ups

Experimental Group I had a mean score of 7.10 pull-ups on the pretest and a mean score of 8.29 pull-ups on the post test, an increase of 1.19.

The standard error of the difference between means was .40. The "t" value of 2.98 with 19 degrees of freedom was significant at the criterion .01 level.

Push-ups

Experimental Group I had a mean score of 21.81 push-ups on the pretest and a mean score of 30.62 on the post test, an increase of 8.81. The standard error of the difference between means was 1.81. The "t" value of 4.87 with 19 degrees of freedom was significant at the criterion .01 level.

Sit-ups

Experimental Group I had a mean score of 36.38 sit-ups on the pretest and a mean score of 48.24 sit-ups on the post test, an increase of 11.83. The standard error of the difference between means was 3.67. The "t" value of 3.23 with 19 degrees of freedom was significant at the criterion .01 level.

Shuttle Run

Experimental Group I had a mean score of 9.90 seconds in the shuttle run for the pretest and a mean score of 9.35 seconds in the shuttle run for the post test, an improvement of .55 seconds. The standard error of the difference between means was .21. The "t" value of 2.62 with 19 degrees of freedom was not significant at the criterion .01 level.

Dodge Run

Experimental Group I had a mean score of 6.79 seconds in the dodge run for the pretest and a mean score of 6.73 seconds

for the post test, an improvement of .06 seconds. The standard error of the difference between means was .12. The "t" value of .50 with 19 degrees of freedom was not significant at the criterion .01 level.

Standing Broad Jump

Experimental Group I had a mean score of 82.52 inches in the standing broad jump for the pretest and a mean score of 93.19 inches in the standing broad jump for the post test, an increase of 10.67. The standard error of the difference between means was 2.81. The "t" value of 3.80 with 19 degrees of freedom was significant at the criterion .01 level.

Standing Shot Put

Experimental Group I had a mean score of 315.05 inches in the standing shot put for the pretest and a mean score of 337.71 inches in the standing shot put for the post test, an increase of 22.66. The standard error of the difference between means was 7.91. The "t" value of 2.86 with 19 degrees of freedom was significant at the criterion .01 level.

Modified Treadmill

Experimental Group I had a mean score of 90.14 in the modified treadmill for the pretest and a mean score of 118.71 in the modified treadmill for the post test, an increase of 28.57. The standard error of the difference between means

was 7.01. The "t" value of 4.08 with 19 degrees of freedom was significant at the criterion .01 level.

Table 1 shows the mean scores for the selected physical fitness items on the pre-post tests, the differences between means, the "t" values, and the significance of "t" at the .01 level for the interscholastic athletic group.

TABLE 1

COMPARISONS OF THE PRETEST AND POST TEST MEANS OF THE INTERSCHOLASTIC ATHLETIC GROUP ON THE SELECTED ITEMS

Area of Comparison	Mean of Pre Test	Mean of Post Test	Difference Between Means	"t" Value	Significant at .01 level
Pullups	7.10	8.29	1.19	2.98	Yes
Pushups	21.81	30.62	8.81	4.87	Yes
Situps	36.38	48.24	11.86	3.23	Yes
Shuttle Run	9.90	9.35	.55	2.62	No
Dodge Run	6.79	6.73	1.06	1.50	No
Standing Broad Jump	82.52	93.19	10.67	3.80	Yes
Standing Shot Put	315.05	337.71	22.66	2.86	Yes
Modified Treadmill	90.14	118.71	28.57	4.08	Yes

"t" value at the .01 level must be 2.86 for significance.

Results of the Physical Education (Experimental Group II) Within Group Comparison

Pull-ups

Experimental Group II had a mean score of 4.19 pull-ups on the pretest and a mean score of 4.66 pull-ups on the post test, an increase of .47. The "t" value of .61 with 25 degrees of freedom was not significant at the criterion .01 level.

Push-ups

Experimental Group II had a mean score of 17.81 push-ups on the pretest and a mean score of 20.23 push-ups on the post test, an increase of 2.42. The standard error of the difference between means was 2.11. The "t" value of 1.15 with 25 degrees of freedom was not significant at the criterion .01 level.

Sit-ups

Experimental Group II had a mean score of 35.19 sit-ups on the pretest and a mean score of 41.81 sit-ups on the post test, an increase of 6.62. The standard error of the difference between means was 6.15. The "t" value of 1.08 with 25 degrees of freedom was not significant at the criterion .01. level.

Shuttle Run

Experimental Group II had a mean score of 10.97 seconds in the shuttle run for the pretest and a mean score of 9.50 seconds in the shuttle run for the post test, an improvement of 1.47 seconds. The standard error of the difference between means was .18. The "t" value of 8.17 with 25 degrees of freedom was highly significant at the criterion .01 level.

Dodge Run

Experimental Group II had a mean score of 7.23 seconds in the dodge run for the pretest and a mean score of 7.05 seconds in the dodge run for the post test, an improvement of .18 seconds. The standard error of the difference between means was .13. The "t" value of 1.38 with 25 degrees of freedom was not significant at the criterion .01 level.

Standing Broad Jump

Experimental Group II had a mean score of 70.58 inches in the standing broad jump for the post test, an increase of 6.84 inches. The standard error of the difference between means was 2.30. The "t" value of 2.97 with 25 degrees was significant at the criterion .01 level.

Standing Shot Put

Experimental Group II had a mean score of 255.68 in the standing shot put for the pretest and a mean score of 277 in

the standing shot put on the post test, an increase of 21.32 inches. The standard error of the difference between means was 17.23. The "t" value of 1.24 with 18 degrees of freedom was not significant at the criterion .01 level.

Modified Treadmill

Experimental Group II had a mean score of 71.92 in the modified treadmill for the pretest and a mean score of 96.27 in the treadmill for the post test, an increase of 24.35. The standard error of the difference between means was 8.95. The "t" value of 2.72 with 25 degrees of freedom was not significant at the criterion .01 level.

Table 2, page 34, shows the mean scores for the selected physical fitness items on the pre-post tests, the differences between means, the "t" values, and the significance of "t" at the .01 level for the physical education group.

TABLE 2

COMPARISON OF THE PRETEST AND POST TEST MEANS OF THE PHYSICAL EDUCATION GROUP ON THE SELECTED ITEMS

Area of Comparison	Mean of Pre Test	Mean of Post Test	Difference Between Means	"t" Value	Significant at .01 Level
Pullups	4.19	4.66	.47	1.61	No
Pushups	17.81	20.23	2.42	1.15	No
Situps	35.19	41.81	6.62	1.08	No
Shuttle Run	10.97	9.50	1.47	8.17	Yes
Dodge Run	7.23	7.05	.18	1.38	No
Standing Broad Jump	70.58	77.42	6.84	2.97	Yes
Standing Shot Put	255.68	277	21.32	1.24	No
Modified Treadmill	71.92	96.27	24.35	2.72	No

"t" value at .01 level must be 2.79 for significance.

Post Test Results of Between Group Comparisons

Pull-ups

Experimental Group I had a mean score of 8.29 push-ups on the post test. Experimental Group II had a mean score of 4.66 pull-ups on the post test. The difference between the means of the two groups was 3.63. The standard error of the difference between means of the two groups was .87. The "t" value of 4.17 with 45 degrees of freedom indicates a significant difference at the .01 level between the means of the experimental group I and the experimental group II in pull-ups.

Push-ups

Experimental Group I had a mean score of 30.62 push-ups on the post test. Experimental Group II had a mean score of 20.23 pushups on the post test. The difference between the means of the two groups was 10.39. The standard error of the difference between means of the two groups was 2.15. The "t" value of 4.83 with 45 degrees of freedom indicates a significant difference at the .01 level between the means of experimental group I and experimental group II in push-ups.

Sit-ups

Experimental Group I had a mean score of 48.24 sit-ups on the post test. Experimental Group II had a mean score of 41.81 sit-ups on the post test. The difference between the means of the two groups was 6.43. The standard error of the

difference between means of the two groups was 7.16. The "t" value of .90 with 45 degrees of freedom indicates no significance at the .01 level between the means of experimental group I and experimental group II.

Shuttle Run

Experimental Group I had a mean score of 9.35 seconds in the shuttle run on the post test. Experimental Group II had a mean score of 9.50 seconds in the shuttle run on the post test. The difference between the mean differences of the two groups was a .15 seconds. The standard error of the difference between means of the two groups was .28. The "t" value of .28 with 45 degrees of freedom indicates no significant difference at the .01 level between the means of experimental group I and experimental group II.

Dodge Run

Experimental Group I had a mean score of 6.73 seconds in the dodge run on the post test. Experimental Group II had a mean score of 7.05 seconds in the shuttle run on the post test. The difference between the mean differences of the two groups was .32 seconds. The standard error of the differences between means of the two groups was .18. The "t" value of 1.78 with 45 degrees of freedom indicates no significant difference at the .01 level between the means of experimental group I and experimental group II.

Standing Broad Jump

Experimental Group I had a mean score of 93.19 inches in the standing broad jump on the post test. Experimental Group II had a mean score of 77.42 inches in the standing broad jump on the post test. The difference between the mean differences of the two groups was 15.77 inches. The standard error of the difference between means for the two groups was 3.63. The "t" value of 4.34 with 45 degrees of freedom indicates a significant difference at the .01 level between the experimental group I and experimental group II.

Standing Shot Put

Experimental Group I had a mean score of 337.71 inches in the standing shot put on the post test. Experimental Group II had a mean score of 277 inches in the standing shot put on the post test. The difference between the mean differences of the two groups was 60.71 inches. The standard error of the difference between means of the two groups was 18.96. The "t" value of 3.20 with 38 degrees of freedom indicates a significant difference at the .01 level between the means of experimental group I and experimental group II.

Modified Treadmill

Experimental Group I had a mean score of 118.71 in the modified treadmill on the post test. Experimental Group II had a mean score of 96.27 in the modified treadmill for the

post test. The difference between the mean differences for the two groups was 22.44. The standard error of the difference between means for the two groups was 11.37. The "t" value of 1.97 with 45 degrees of freedom indicates no significant difference at the .01 level between the means of experimental group I and experimental group II.

Table 3, page 38, shows the post test means for the two experimental groups, the difference between post test scores, the "t" value, and the significance of "t" at the .01 level.

TABLE 3

COMPARISON OF THE POST TEST MEANS BETWEEN THE INTERSCHOLASTIC ATHLETIC GROUP AND THE PHYSICAL EDUCATION GROUP ON THE SELECTED ITEMS

Area of Comparison	Mean of I.A. Post Test	Mean of P.E. Post Test	Difference Between Means	"t" Value	Significant at .01 Level
Pullups	30.62	20.23	10.39	4.83	Yes
Pushups	8.29	4.66	3.63	4.17	Yes
Situps	48.24	41.81	6.43	.90	No
Shuttle Run	9.35	9.50	.15	.54	No
Dodge Run	6.73	7.05	.32	1.78	No
Standing Broad Jump	93.19	77.42	15.77	4.34	Yes
Standing Shot Put	337.71	277	60.71	3.20	Yes
Modified Treadmill	118.71	96.27	22.44	1.97	No

"t" value at .01 level must be 2.69 for significance.

Experimental Group I showed an improvement in all items of the physical fitness test except the shuttle run. In six of the eight test items experimental group I showed a significant improvement in physical fitness at the .01 level. For these six items the null hypothesis was rejected.

Experimental Group II showed only a slight improvement in six test items. In two test items, the shuttle run and the standing broad jump, Experimental Group II showed a significant improvement in physical fitness at the .01 level.

In the between group comparisons using the "t" technique for determining significance between post test means Experimental Group I showed a significant superiority over Experimental Group II at the .01 level on the following test items: pullups, pushups, standing broad jump, and standing shot put. Experimental Group I showed an improvement over Experimental Group II in the modified treadmill and situps but below the criterion .01 level. Experimental Group II did show a slight by better improvement than Experimental Group I in the shuttle run and the dodge run, but the difference was below the criterion .01 level.

A further treatment of the data, by a one tailed test of analysis of coveriance, was made to compare the differences in inprovement shown by the experimental groups between the pretest and post test. The F technique was used to compare the differences between the improvements shown by the two experimental groups. The interscholastic athletic group

showed a significant difference over the physical education group in two test items: pushups and situps. The interscholastic athletic group showed a significant difference at the .01 level on the test item pushups, as indicated in Table 4, page 40.

TABLE 4

Date Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Push-ups

	SS	DF	MS	F	Significant
Treatments	655.28	1	655.28	22.27	.01
Error	1294.67	44	29.42		
Total	1949.95	45			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	21.81	30.70	29.25
Experimental Group II	18.00	20.23	21.34

The interscholastic athletic group showed a difference over the physical education group in the test item situps, significant at the .05 level as indicated in Table 5, page 41.

TABLE 5

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Sit-ups

	SS	DF	MS	F	Significant
Treatments	568.09	1	568.09	4.58	.05
Error	5462.93	44	124.16		
Total	6031.02	45			

"F" at .05 level = 4.06

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	36.38	48.23	47.52
Experimental Group II	33.62	39.92	40.50

CHAPTER IV

Discussion

The purpose of this study was to determine whether the physical fitness levels of students participating in a required physical education program or an interscholastic athletic program would be improved and to determine if one of these programs would produce a higher level of physical fitness than the other. Before the evidence can be discussed there were certain limiting factors which may have biased the results of this study. The boys participating in athletics are there of their own choice. Their mental motivation to improve their physical condition is somewhat necessary if they are to become proficient performers. The program is more intense, the activity periods are longer and more frequent. One of the objectives of most coaches is to condition his athletes to a sufficient extent so that they will be able to execute the objective of the game over a longer period of time. Athletic programs are offered throughout the school year, and, during the summer months, organized athletics are available. Athletes taking advantage of this opportunity are able to stay in condition the year around and, as a result, are improving or maintaining their physical fitness levels at all times. In as much as the above evidence may tend to bias the data it

must also be pointed out that certain conditions may limit the athletes' ability to improve in physical fitness. An athlete conditioning the year around would remain at a higher level of physical fitness. Therefore, when tested and re-tested in a physical fitness evaluation program, his degree of improvement would possibly be less significant than that of a student non-athlete who was tested and then re-tested after a period of conditioning. The limiting factors, which tend to bias the results of this study, when weighed against each other, would tend to favor the interscholastic athletic group because of the length of time involved and self motivation on the part of athletes.

When comparing the results attained by the interscholastic athletic group in the pre and post-tests of the physical fitness battery, improvement was exhibited in all eight items. In six of the test items, (pullups, pushups, situps, standing broad jump, standing shot put and modified treadmill,) the improvement was statistically significant at the .01 level. In the remaining items, shuttle run and dodge run, the improvement was not significant, although the "t" value for the shuttle run was .24 from being significant at the .01 level. The test results showing the least improvement were those in the dodge run. At this point in the discussion the question arises, why do the two test items, shuttle run and dodge run, and particularly the latter, show such little improvement? To answer this question, this writer feels that certain extrinsic

factors prevailed. In each of the test items the length of the run in the exercise was short and required sudden changes in direction. The surface used for the test items was a wooden floor and the condition of this floor might not have provided the traction necessary for sudden starting, stopping and turning. Finally, the performance of the athlete on the first test was of such quality that improvement on a retest was not great enough to show a statistical significance.

A comparison of the data collected from the physical fitness pre and post tests for the physical education group indicated a slight physical fitness improvement in each test item. However, only two items, the shuttle run and the standing broad jump, showed a statistical significance at the .01 level. One other test item, the modified treadmill, had a "t" value just .07 from significance at the .01 level. The fact that the physical education group did not show a statistical significance in more areas could be attributed in part to the number of class sessions held during the semester. The pupils participating in the physical education group attended 49 activity sessions, each one hour in length. A question then arises, why did the two test items, shuttle run and standing broad jump produce a significant change at the .01 level? In analyzing these results, one must consider each item separately. First, in the shuttle run, a student not accustomed to running, or starting and stopping, would not perform well on the pretest. However, after participating in

a variety of activities, including a period of calisthenics designed to produce strength and endurance, one should be able to perform at a higher level in a post test. The nature of one activity participated in by the physical education group, dodge ball, might also lead to an improved score on the post test in the shuttle run. In playing dodgeball, participants are running, starting, stopping, bending and, in general, improving their reactions as they attempt to dodge a ball that is being thrown at them. Secondly, all of the activities participated in by the physical education group emphasize the use of the legs. As a result of this continual demand put on the legs to run and jump, the legs may have become stronger more quickly than other parts of the anatomy. It was also quite possible that muscles of the legs were more fully developed as a result of certain jobs and recreational activities which required extensive use of the legs.

The between group comparisons, of the post test means, showed that the interscholastic athletic group had a significant difference, at the .01 level, in four test items, pull-ups, push-ups, standing broad jump, and standing shot put.

The data were treated by a one way analysis of covariance to determine if the improvement shown by each group was significant. The interscholastic athletic group showed a significant difference in two of the eight test items, pushups and situps. The difference shown in pushups was significant at the .01 level, and the difference shown in situps was signi-

ficant at the .05 level. The data showed a tendency to favor the interscholastic athletic group in the test items, pullups, standing broad jump, and standing shot put.

The physical education group did not show a significant difference in any test item on either of the methods of between group comparisons, the post test mean comparison or the one way analysis of covariance. However, the physical education group did show a difference in two test items, the shuttle run and the dodge run. Although the differences on the previously mentioned items were not significant the data indicate a tendency to favor the physical education group in the dodge run. In the opinion of this writer the difference exhibited by the physical education group over the interscholastic athletic group in the two items previously mentioned was due, by and large, to the degree of proficiency of the interscholastic group on the pretest.

The between group comparison on the modified treadmill test did not show a significant difference or a tendency to favor either group, when comparing the post test means or by the analysis of covariance.

The results of this study indicate that physical fitness levels may be improved through programs of competitive interscholastic athletics or required physical education. The results of the study also indicate that a program of competitive interscholastic athletics can produce a superior level of physical fitness over the required physical education program.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The forty-seven subjects used in this study were volunteers from the interscholastic athletic teams and the required physical education program of the Grafton Public High School, Grafton, North Dakota.

The volunteers were divided into two experimental groups. Experimental group I consisted of twenty one boys in grades ten through twelve. The subjects in this group were actively participating in the sports of football and basketball or hockey for one semester. Experimental group II consisted of twenty six students, grades nine through eleven, who participated in a program of required physical education three days a week for one semester.

Experimental group I was administered a physical fitness test on the first day of football practice and again during the last week of school prior to the completion of the semester. The physical fitness test consisted of eight items: pullups, pushups, situps, shuttle run, dodge run, standing broad jump, standing shot put, and modified treadmill. The physical fitness test was administered in the Grafton High

School gymnasium.

Experimental group II was administered the same physical fitness test on the first day of class activity and again during the last week of class activity at the close of the semester.

Comparisons were made on each physical fitness test item within each experimental group and between experimental groups. The comparisons were made to determine whether the students in each group had improved in physical fitness and to determine if one experimental group had improved significantly more than the other.

The "null" hypothesis was assumed with respect to the difference between the means of the two experimental groups and within each experimental group. The hypothesis was tested with the "t" technique for the difference between means derived from uncorrelated scores from small samples, and the F technique for determining the significance of the difference among means.

Conclusions

On the bases of the data collected for this study the following conclusions seem warranted.

1. Participation in a program of interscholastic athletics can significantly improve the physical fitness levels of those involved. In six of eight physical fitness test items the improvement was

significant at the .01 level.

2. Participation in a required physical education program may improve the physical fitness levels of those participating, although, in this study only two of eight test items revealed results in which the physical fitness levels increased significantly at the .01 level.

3. Participation in a program of interscholastic athletics produced a greater level of physical fitness than did a program of required physical education for the subjects involved in this study. When comparing between group post test means, the interscholastic athletic group showed a significant improvement, at the .01 level, in four of the eight test items. The interscholastic athletic group showed a significant improvement in two of the eight items than the physical education group when comparing means by a one way analysis of covariance.

4. Interscholastic athletic programs have a justifiable place in our educational curricula along with required physical education programs with respect to physical fitness development.

Recommendations

From an interpretation of the data collected for this study the following recommendations seem warranted:

1. A similar study should be designed in which the physical education class would meet each school day for a one hour period.
2. A re-evaluation of the physical education curricula at Grafton High School should be made to determine if the existing curricula is extensive enough to provide an adequate physical education program with respect to physical fitness goals.
3. A special study be undertaken to test the ability of athletes to improve their agility as a result of participation in interscholastic athletic competition.

SCORE CARD

Name_____ Class_____ Sport_____

P.E._____

	Test No. 1	Test No. 2
Pull-ups		
Push-ups		
Sit-ups		
Shuttle Run		
Dodge Run		
Standing Broad Jump		
Standing Shot Put		
Modified Treadmill		

Test Directions

Pullups

Equipment: A bar, comfortable to grip, and of sufficient height.

Starting Position: The pupil grasps the bar with palms facing forward; and hangs fully stretched with his feet free of the floor. A partner stands to one side of the pupil being tested and counts the number of successful pullups.

Action:
1. The pupil raised his body by his arms until his chin can be placed over the bar.
2. The body is lowered until the arms are fully stretched.
3. The exercise is repeated as many times as possible.

Rules:
1. The pull must not be a snap movement.
2. The knees must not be raised.
3. Kicking the legs is not permitted.
4. The body must not swing. If the pupil starts to swing, his partner will check the swing by holding an extended arm across the front of the thighs.
5. One complete pullup is allowed each time the pupil places his chin over the bar.

Pushups

Starting Position: The pupil assumes a front leaning rest position. The arms are placed straight below the shoulder with the fingers facing straight ahead. The head is held straight from the shoulders, the back is straight, with the legs and feet together. The partner will kneel along side and count the number of successful pushups.

Action:
1. The body is lowered until the chest lightly touches the floor.
2. The body is raised until the elbows are fully extended.

Rules:
1. The body must bend at any point other than the elbow during the exercise.
2. No snap movements will be allowed.
3. The weight of the pupil must not be relieved from the arms during the exercise.
4. One complete pushup is counted each time and the pupil returns to the starting position.

Situps

Starting Position: The pupil lies on his back, with legs extended and feet about two feet apart. The hands are placed on the back of the neck with fingers interlocked. The other pupil will hold his partner's ankles, to keep them in contact with the floor, while counting each successful situp.

Action: 1. The pupil sits up, turns the trunk to the left and touching the right elbow to the left knee.

2. He returns to the starting position.

3. The pupil sits up,turns the trunk to the right and touches the left elbow to the right knee.

4. He returns to the starting position.

5. The pupil repeats the exercise, alternating sides.

Rules: 1. The pupil must not stop to rest once the exercise begins.

2. The pupil must keep the fingers in contact with the neck at all times during the exercise.

3. The pupil must keep the knees on the floor during the situp but may be bent when touching elbow to knee.

4. One complete situp is counted each time the pupil returns to the starting position.

Shuttle Run

Equipment: Two blocks of wood 2 in. x 2 in. x 4 in. (blackboard erasers may be used) and a stopwatch are needed. Two parallel are marked on the floor 30 feet apart. The blocks of wood are placed behind one of the lines.

Starting Position: The pupil stands behind the line opposite the blocks, assuming a running position.

Action: On the signal "Ready-Go!" the pupil runs to the blocks,

picks one up, returns to the starting line and places the block behind the line. He then runs and picks up the second block and carries it back across the starting line.

Rules: 1. The pupils were allowed two trials.

2. If the block was dropped or thrown that trial was disqualified.

3. The better of the two trials was recorded to the nearest tenth of a second.

Dodge Run

Equipment: A flat surface (gymnasium floor), a stop watch and an object (chair) to run around are needed. A starting position is designated at a point on one side of the gymnasium floor. The finish point will be located on the opposite side of the gymnasium floor. The object to run around is placed in the middle of the floor 65 feet from the starting line. The finish line is then established 49 feet from the object opposite the side of the starting position. The length of the dodge run is 38 yards.

Starting Position: The pupil stands behind the starting line in a position ready to run.

Action: On the signal, "Ready-Go!", the pupil runs to and around the object; then through the finish line.

Rules: 1. One practice trial was allowed.

2. The pupil could not be aided by grasping the object being run around nor by pushing off a wall.

3. The pupil must pass across the designated finish line.
4. The time, correct to the nearest tenth of a second, was recorded.

Standing Broad Jump

Equipment: Any level surface and a tape measure are needed.
Starting Position: The pupil stands with feet a comfortable distance apart, and toes just behind the take off line.
Action: The pupil executes the jump by swinging the arms backward, bending the knees and simultaneously extending the knees and swinging the arms forward and upward. The take off will be from the balls of the feet.
Rules:
1. Three trials are allowed.
2. The distance is measured from the take off line to the heel or any part of the body that touches the surface nearest the take off line.
3. The best of the three trials is recorded to the nearest inch.

Standing Shot Put

Equipment: One twelve-pound indoor shot put, and a tape measure are needed.
Starting Position: The pupil stands just behind the designated putting point. The shot put is held in the fingers and placed against the neck or cheek. The knees are bent and the feet

are spread. His shoulders should be perpendicular to the putting point.

Rules: 1. The pupil must push the shot from its stationary position against the neck.

2. The pupil must stay behind the putting point before, during, and after the put.

3. No movement of the feet is allowed before putting the shot.

4. Two trials are allowed.

5. Measure each trial from the starting point to the point to the spot where the shot put lands.

6. Record the best trial to the nearest inch.

Modified Tread Mill

Starting Position: The pupil assumes a position with his hands on the floor, one leg flexed forward under the chest and the other leg extended to the back. A partner will kneel slightly to one side to observe the action of the knees and count repetitions.

Action: On the command "Go" from a partner the pupil alternates the position of his legs.

Rules: 1. The knee must come as close to the chest as possible inside the elbow.

2. The leg must be completely extended to the back.

3. One repetition is counted each time the legs exchange positions.

The Physical Education Program

The physical education curricula offered at Grafton High School during the time this study was made operated on a semester basis of eighteen weeks. All students, grades 9-11, were required to attend during the semester assigned them according to their class schedule. The physical education classes met three times weekly. Each meeting was one hour in length. There were to be 54 scheduled class sessions, but five sessions had to be dropped because the physical education facilities were being used by other organizations.

The class period was broken down into the following time intervals: Dressing - 5 minutes

Calisthenics - 10-15 minutes

Activity - 30-35 minutes

Shower and dressing - 10 minutes

At the opening of each class session, when possible, a 10-15 minute period of formalized calisthenics was used. During certain activities, mentioned in the activity program, the formal calisthenic period had to be shortened or dropped because of facilities, or structure of the unit. In order to avoid loss of time roll was taken and other administrative problems solved by a student teacher during the dressing period.

The calisthenic items used were:

1. Side straddle hops

2. Pushups
3. Situps
4. Leg raisers
5. Alternate toe touches standing
6. Alternate toe touches sitting
7. Modified treadmill
8. Bicycle
9. Woodchoppers
10. Burpees

Each of the exercises was performed in a four count cadence, and the number of repetitions varied with the exercise.

The class completed from 25-50 repetitions of side straddle hops, situps, alternate toe touching (standing), alternate toe touching (sitting), woodchoppers, and burpees; from 10-20 repetitions in the following items: pushups and leg raisers, and from 75 to 100 repetitions in the treadmill.

The activities participated in by the students in the physical education program during the semester were:

1. Touch football. This activity was a six week unit. During this unit the students had to run three city blocks to and from the activity field. In addition to the running, one-half of the calisthenics previously mentioned was used. Selection of exercises varied from day to day.
2. Dodgeball. This activity was a two week unit. During the activity, the maximum 15 minute

calisthenic period was used, and 30 minutes were devoted to the activity.

3. Bowling. This activity was a two week unit. The activity period was about 40 minutes in length. The remaining time was allotted to driving to and from the bowling alleys because of the distance involved.
4. Volleyball. This activity was a five week unit. During this activity, the maximum 15 minute calisthenic period was used and the remaining time, about 30 minutes, was spent in the activity itself.
5. Archery and Table Tennis. This was a one week unit. No calisthenics were used. The full class period was used in activity participation.
6. Basketball. This activity was a two week unit. During this activity, the maximum 15 minute calisthenic period was used, and 30 minutes were devoted to the activity.

The Football Program

The football program started two weeks prior to the opening of school in the fall, and ran for ten consecutive weeks. The total number of practice sessions was about 50 with eight games. The average length of the practice sessions was about one hour and forty-five minutes. The practice period was

broken up into four phases: (1) Twelve minutes of conditioning. The conditioning program consisted of an eight station circuit. The exercises performed during the circuit were: pullups, pushups, situps, squat jump, modified treadmills, neck isometrics, burpees and a 300 yard run. (2) Individual and sled drills. (3) Group and team drills. (4) Scrimmage and wind sprints. This schedule was followed as closely as possible except for days prior to games when the routine was changed to a lighter work out.

The Hockey Program

The hockey program started the first week in November. The conditioning program consisted of an eight station circuit. This circuit consisted of the same items and was operated exactly the same as the circuit used by the football team.

During the first week of conditioning, the boys participating in this study that had been members of the football team, practiced three days only. However, during the second week and continuously to the completion of this study, all members of the hockey team practiced as a unit five days per week until team competition began. During the second week and until the hockey team was able to get on the ice, the weekly practice sessions consisted of three days of circuit training and two days of puck shooting in the gymnasium. As soon as the team could get on ice, which consisted of the small ponds outside, the circuit was discontinued. The early

outside practice sessions were from 45 minutes to one hour in length. The practice session included general skating, various individual drills, shooting practice on goalie and ended with 30 yards of short starts and stops. As soon as the indoor ice was ready and prior to the first game, the practice sessions increased to one hour and 45 minutes in length. The same general practice plan was followed but increased to include offensive and defensive drills, team techniques and scrimmage. During the season the practice sessions were shortened to about one and a half hours, with the same general practice plan followed as was used in the earlier indoor practices. Also the practice sessions were reduced in number to four per week. The practice sessions prior to games were limited to one-half hour on the ice going over the game plan.

The Basketball Program

The basketball program started the first week in November and continued throughout this study. Practice sessions were held daily during the school week. The length of the practice sessions varied with the needs of the program. The first one and one-half weeks were spent in selecting the varsity, "B", and Freshman squads. During this time, the practice sessions lasted for about one and a half hours. The practice sessions included a variety of basketball drills which developed individual fundamentals of the game and, at the same time, conditioned the prospective basketball players, scrimmage, and

the practice finished with a short conditioning period. The activities used in the conditioning period consisted of toe raisers, 15 to 25 repetitions, fingertip pushups, as many could be done, ball tap on wall, 100 with each hand, and bleacher laps, 8-12 repetitions.

After the selection of the teams, the practice sessions increased to two hours in length, and were broken down as follows:

15 minutes - general shooting

20-25 minutes - full court passing drills, fast break drills, defensive drills, and offensive drills.

50 minutes - half court work on installing and perfecting team offensive and defensive techniques, game techniques for the coming opponent.

10 minutes - full court work perfecting above, fifty minutes of work.

10 minutes - spot shooting with partner.

7 minutes - bleacher laps or line drills with ankle weights.

8-10 minutes - free throw shooting.

This heavy practive routine was held three days during the week and the day before the games the routine would be cut in time and intensity. This practice routine was followed throughout this study.

DATA RECEIVED FROM FRIEDN CALCULATOR

Interscholastic Athletic Group

Pull-ups

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M Post Test
7.10	8.29	4.34	3.59	.97	3.59

Standard Error of the Difference Between Means = .40

"t" value---------- 2.98

Significant at .01 Level---------- Yes

Push-ups

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
21.81	30.62	4.71	6.60	1.05	1.48

Standard Error of the Difference Between Means = 1.81

"t" value---------- 4.87

Significant at .01 level---------- Yes

Sit-ups

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
36.38	48.24	11.99	11.16	2.68	2.50

Standard Error of the Difference Between Means = 3.67

"t" value---------- 2.62

Significant at .01 Level---------- No

Shuttle Run

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
9.90	9.35	.76	.57	.17	.13

Standard Error of the Difference Between Means = .21

"t" value---------- 2.62

Significant at .01 Level---------- No

Dodge Run

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
6.79	6.73	.43	.31	.10	.07

Standard Error of the Difference Between Means = .12

"t" value---------- .50

Significant at .01 Level---------- No

Standing Broad Jump

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
82.52	93.19	8.89	8.87	1.99	1.98

Standard Error of the Difference Between Means = 7.91

"t" value---------- 2.86

Significant at .01 Level---------- Yes

Standing Shot Put

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
315.05	337.71	66.93	35.38	14.97	7.92

Standard Error of the Difference Between Means = 7.91

"t" value---------- 2.86

Significant at .01 Level---------- Yes

Modified Treadmill

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M Pretest	S.E.M Post Test
90.14	118.71	18.73	25.16	4.19	5.63

Standard Error of the Difference Between Means - 7.01

"t" value---------- 4.08

Significant at .01 Level---------- Yes

Physical Education Group

Pull-ups

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M Post Test
4.19	4.66	2.33	3.09	.45	.62

Standard Error of the Difference Between Means = .77

"t" value---------- .61

Significant at .01 Level---------- No

Push-ups

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
17.81	20.23	7.36	7.61	1.47	1.52

Standard Error of the Difference Between Means = 2.11

"t" value---------- 1.15

Significant at .01 Level---------- No

Sit-ups

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
35.19	41.81	24.59	18.42	4.92	3.68

Standard Error of the Difference Between Means = 6.15

"t" value---------- 1.08

Significant at .01 Level---------- No

Shuttle Run

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
10.97	9.50	.70	.61	.14	.12

Standard Error of the Difference Between Means = .18

"t" value---------- 1.38

Significant at .01 Level---------- No

Physical Education Group

Dodge Run

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
7.23	7.65	.52	.40	.10	.08

Standard Error of the Difference Between Means = .13

"t" value---------- 1.38

Significant at .01 Level---------- No

Standing Broad Jump

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
70.58	77.42	7.66	8.62	1.53	1.72

Standard Error of the Difference Between Means = 2.30

"t" value---------- 2.97

Significant at .01 Level---------- Yes

Standing Shot Put

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
255.68	277	62.37	40.42	14.70	9.53

Standard Error of the Difference Between Means = 17.23

"t" value---------- 1.24

Significant at .01 Level---------- No

Modified Treadmill

M Pretest	M Post Test	σ Pretest	σ Post Test	S.E.M. Pretest	S.E.M. Post Test
71.92	96.27	31.03	32.26	6.20	6.45

Standard Error of the Difference Between Means = 8.95

"t" value---------- 2.72

Significant at the .01 Level---------- No

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

Between Group Comparisons

Pull-ups

Standard Error of the Difference Between Uncorrelated Means[1]

$$\text{S.E. diff} = \sqrt{\text{S.E.m}_1^2 + \text{S.E.m}_2^2}$$

$$\text{S.E. diff} = \sqrt{.40^2 + .77^2}$$

$$\text{S.E. diff} = \sqrt{.16 + .5929}$$

$$\text{S.E. diff} = \sqrt{.7529}$$

$$\text{S.E. diff} = .87$$

"d" = Actual Mean difference

"d" = 8.29 - 4.66

"d" = 3.63

Actual Post Test Mean Difference

"t" = S.E. Difference Between Means

$$\text{"t"} = \frac{3.63}{.87}$$

"t" = 4.17

Degrees of Freedom = $(N_1 - 1) + (N_2 - 1)$

$= 21 - 1 + 26 - 1$

$= 45$

"t" at .01 Level-- =2.69

Significant at .01 Level.

---

[1]H. E. Garrett, Statistics in Psychology and Education, New York: Longman's, Green, and Co., 1958, p. 211-214.

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

Between Group Comparisons

Push-ups

Standard Error of the Difference Between Uncorrelated Means

$$\text{S.E. diff} = \sqrt{S.E.m_1^2 + S.E.m_2^2}$$

$$\text{S.E. diff} = \sqrt{1.15^2 + 1.81^2}$$

$$\text{S.E. diff} = \sqrt{1.32 + 3.28}$$

$$\text{S.E. diff} = \sqrt{4.60}$$

$$\text{S.E. diff} = 2.15$$

"d" = Actual Mean Difference

"d" = 30.62 - 20.23

"d" = 10.39

"t" = $\frac{\text{Actual Post Test Mean Difference}}{\text{S.E. Difference Between Means}}$

"t" = $\frac{10.39}{2.15}$

"t" = 4.83

Degrees of Freedom = $(N_1 - 1) + (N_2 - 1)$

$= 21 - 1 + 26 - 1$

$= 45$

"t" at .01 Level =2.69

Significant at .01 Level. 2.69

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

Between Group Comparisons

Sit-ups

Standard Error of the Difference Between Uncorrelated Means

$$\text{S.E. diff} = \sqrt{\text{S.E.m}_1^{\,2} + \text{S.E.m}_2^{\,2}}$$

$$\text{S.E. diff} = \sqrt{3.67^2 + 6.15^2}$$

$$\text{S.E. diff} = \sqrt{13.4689 + 37.8225}$$

$$\text{S.E. diff} = \sqrt{51.2914}$$

$$\text{S.E. diff} = 7.16$$

"d" = Actual Mean Difference

"d" = 48.24 - 41.81

"d" = 6.43

$$\text{"t"} = \frac{\text{Actual Post Test Mean Difference}}{\text{S.E. Difference Between Means}}$$

$$\text{"t"} = \frac{6.43}{7.16}$$

"t" = .90

Degrees of Freedom = $(N_1 - 1) + (N_2 - 1)$

= 21 - 1 + 26 - 1

= 45

"t" at .01 Level =2.69

Not Significant at .01 Level.

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

Between Group Comparisons

Shuttle Run

Standard Error of the Difference Between Uncorrelated Means

$$S.E.\ diff = \sqrt{S.E.m_1^2 + S.E.m_2^2}$$

$$S.E.\ diff = \sqrt{.21^2 + .18^2}$$

$$S.E.\ diff = \sqrt{.0441 + .0324}$$

$$S.E.\ diff = \sqrt{.0765}$$

$$S.E.\ diff = .28$$

"d" = Actual Mean Difference

"d" = 9.35 - 9.50

"d" = -.15

"t" = $\frac{\text{Actual Post Test Mean Difference}}{\text{S.E. Difference Between Means}}$

"t" = $\frac{-.15}{.28}$

"t" = -.54

Degrees of Freedom = $(N_1 - 1) + (N_2 - 1)$

$= 21 - 1 + 26 - 1$

$= 45$

"t" at .01 Level = 2.69

Not Significant at .01 Level.

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

Between Group Comparisons

Dodge Run

Standard Error of the Difference Between Uncorrelated Means

$$\text{S.E. diff} = \sqrt{\text{S.E.}m_1^2 + \text{S.E.}m_2^2}$$

$$\text{S.E. diff} = \sqrt{.12^2 + .13^2}$$

$$\text{S.E. diff} = \sqrt{.0144 + .0169}$$

$$\text{S.E. diff} = \sqrt{.0313}$$

$$\text{S.E. diff} = .18$$

"d" = Actual Mean Difference

"d" = 6.73 - 7.05

"d" = -.32

$$\text{"t"} = \frac{\text{Actual Post Test Mean Difference}}{\text{S.E. Difference Between Means}}$$

$$\text{"t"} = \frac{-.32}{.18}$$

"t" = 1.78

Degrees of Freedom = $(N_1 - 1) + (N_2 - 1)$

= 21 - 1 26 - 1

= 45

"t" at .01 Level = 2.69

Not Significant at .01 Level.

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

Standing Broad Jump

Standard Error of the Difference Between Uncorrelated Means

$$\text{S.E. diff} = \sqrt{\text{S.E.}m_1^2 + \text{S.E.}m_2^2}$$

$$\text{S.E. diff} = \sqrt{2.81^2 + 2.30^2}$$

$$\text{S.E. diff} = \sqrt{7.8961 + 5.2900}$$

$$\text{S.E. diff} = \sqrt{13.1861}$$

$$\text{S.E. diff} = 3.63$$

"d" = Actual Mean Difference

"d" = 93.19 - 77.42

"d" = 15.77

$$\text{"t"} = \frac{\text{Actual Post Test Mean Difference}}{\text{S.E. Difference Between Means}}$$

$$\text{"t"} = \frac{15.77}{3.63}$$

"t" = 4.34

Degrees of Freedom = (N - 1) + (N - 1)

= 21 - 1 + 26 - 1

= 45

"t" at .01 Level = 2.69

Significant at .01 Level.

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

Between Group Comparisons

Standing Shot Put

Standard Error of the Difference Between Uncorrelated Means

$$\text{S.E. diff} = \sqrt{\text{S.E.}m_1^2 + \text{S.E.}m_2^2}$$

$$\text{S.E. diff} = \sqrt{7.91^2 + 17.23^2}$$

$$\text{S.E. diff} = \sqrt{62.5681 + 296.8729}$$

$$\text{S.E. diff} = \sqrt{359.4410}$$

$$\text{S.E. diff} = 18.96$$

"d" = Actual Mean Difference

"d" = 337.71 - 277

"d" = 60.71

$$\text{"t"} = \frac{\text{Actual Post Test Mean Difference}}{\text{S.E. Difference Between Means}}$$

$$\text{"t"} = \frac{60.71}{18.96}$$

"t" = 3.20

Degrees of Freedom = (N - 1) + (N - 1)

= 21 - 1 19 - 1

= 38

"t" at .01 Level = 2.72

Significant at .01 Level.

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

Between Group Comparisons

Modified Treadmill

Standard Error of the Difference Between Uncorrelated Means

$$S.E.\ diff = \sqrt{S.E.m_1^2 + S.E.m_2^2}$$

$$S.E.\ diff = \sqrt{7.01^2 + 8.95^2}$$

$$S.E.\ diff = \sqrt{49.1401 + 80.1025}$$

$$S.E.\ diff = \sqrt{129.2426}$$

$$S.E.\ diff = 11.37$$

"d" = Actual Mean Difference

"d" = 118.71 - 96.27

"d" = 22.44

$$\text{"t"} = \frac{\text{Actual Post Test Mean Difference}}{\text{S.E. Difference Between Means}}$$

$$\text{"t"} = \frac{22.44}{11.37}$$

"t" = 1.97

Degrees of Freedom = $(N_1 - 1 0 + (N_2 - 1)$

$= 21 - 1 + 26 - 1$

$= 45$

"t" at .01 Level = 2.69

Not Significant at the .01 Level.

APPENDIX B

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Pull-ups

	SS	DF	MS	F	Significant
Treatments	7.86	1	7.86	1.42	No
Error	242.42	44	5.51		
Total	250.28	45			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	7.10	8.29	6.35
Experimental Group II	3.38	3.77	5.33

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Push-ups

	SS	DF	MS	F	Significant
Treatments	655.28	1	655.28	22.27	.01
Error	1294.67	44	29.42		
Total	1949.95	45			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	21.81	30.70	29.25
Experimental Group II	18.00	20.23	21.34

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Sit-ups

	SS	DF	MS	F	Significant
Treatments	568.09	1	568.09	4.58	.05
Error	5462.93	44	124.16		
Total	6031.02	45			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	36.38	48.23	47.52
Experimental Group II	33.62	39.92	40.50

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Shuttle Run

	SS	DF	MS	F	Significant
Treatments	13.79	1	13.79	.34	No
Error	1798.93	44	40.88		
Total	1812.72	45			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	85.24	93.14	93.50
Experimental Group II	109.69	95.04	94.75

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Dodge Run

	SS	DF	MS	F	Significant
Treatments	39.56	1	39.55	3.25	No
Error	534.67	44	12.15		
Total	574.23	45			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	67.86	67.29	67.97
Experimental Group II	72.27	70.54	69.99

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Standing Broad Jump

	SS	DF	MS	F	Significant
Treatments	497.61	1	497.61	2.73	No
Error	8008.24	44	182.01		
Total	8505.85	45			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	86.24	92.52	86.86
Experimental Group II	70.12	73.27	77.84

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Standing Shot Put

	SS	DF	MS	F	Significant
Treatments	493.19	1	493.19	1.10	No
Error	16595.56	37	448.53		
Total	17088.75	38			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	319.81	337.71	313.17
Experimental Group II	260.95	277.00	304.13

Data Received from 1620 I.B.M. Computor

TABLE OF ONE WAY ANALYSIS OF COVARIANCE FOR BETWEEN GROUP COMPARISON

Modified Treadmill

	SS	DF	MS	F	Significant
Treatments	439.86	1	439.86	184	No
Error	22918.95	44	520.89		
Total	23358.80	45			

"F" at .01 level = 7.24

TABLE OF ADJUSTED TREATMENT OF MEANS

	Pretest	Post Test	Adjusted Post Test Means
Experimental Group I	90.14	116.14	108.75
Experimental Group II	71.92	96.27	102.24

BIBLIOGRAPHY

BIBLIOGRAPHY

Books

American Association for Health, Physical Education, and Recreation. Youth Fitness Test Manual. Washington 6, D.C., 1958.

Clark, Harrison H. Application of Measurement to Health and Physical Education. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1957.

Garrett, Henry E. Statistics in Psychology and Education. New York: Longmans, Green and Co., 1958.

Articles and Periodicals

Conant, Dr. James B. "Athletics, the Poison Ivy of our Schools," Look, XXV (January, 1961), 57-60.

Council on Youth Fitness. Official Statement from the Presidents Council on Youth. "Sports Yield Youth Fitness," Journal of Health,Physical Education and Recreation, (January, 1960), 66.

Kraus, Hans and Herschland, Ruth P. "Youth Fitness and Health," Journal of Health, Physical Education and Recreation, (December, 1953), 10-17.

Landiss, Carl W. "Influences of Physical Education Activities on Motor Ability, on Physical Fitness of Male Freshmen," Research Quarterly, XXVI (October, 1955), 295-307.

Leighton, Jack R. "Physical Fitness of Sports Activities," Journal of Health, Physical Education and Recreation, (February, 1967), 59-60.

MacKenzie, Donald H. "Effect of Various Physical Activities on the Physical Fitness of University Men," Research Quarterly, VI (March, 1935), 125-144.

Mannerstedt, C. and Forbes, T. W. "Athletics, A Part of Physical Education," California Journal of Secondary Education, (January, 1958), 46-50.

Rowe, Floyd A. "Growth Comparisons of Athletes and Non-Athletes," Research Quarterly, IV (October, 1933), 108-116.

Wieneke, Kuhrt. "A Comparison of Certain Physical Developments of Freshman Athletes and Non-Athletes," Research Quarterly, III (May, 1932), 224-234.

Weiss, Raymond. "Do Sports Produce Fitness," Journal of Health, Physical Education and Recreation, XXXII, (March, 1961), 20-21

Unpublished Material

Boschee, Floyd. "A Comparison in Physical Fitness Levels of Selected Participants in Interscholastic Football before the Season, at the Peak of the Season, and one Month Later." Unpublished Master's thesis, Department of Physical Education, University of North Dakota, 1962.

Coen, David A. "A Comparison of Physical Fitness Levels of Adolescent Boys after Participation in a Regular Physical Education Program," Unpublished individual research paper, Department of Physical Education, University of North Dakota, 1963.

Gaddie, Micheal L. "A Comparison of Athletes and Non-Athletes at the University of North Dakota as Measured by the Harvard Step Test," Unpublished individual research paper, Department of Physical Education, University of North Dakota, 1960.

Hallatt, Douglas A. "A Comparison of Physical Fitness Levels Between Male Freshmen Honor Students and Male Freshmen Students Enrolled in Physical Education 101 at the University of North Dakota," Unpublished Master's thesis, University of North Dakota, 1966.

Hallatt, Margaret M. "A Comparison of Physical Fitness Levels Achieved by Grade 10 Girls Through a Physical Education Program and a Competitive Sports Program," Unpublished Master's thesis, Department of Physical Education, University of North Dakota, 1966.

Hoffman, Vern B. "Strength Comparison of Athletes and Non-Athletes in the Items Measured by the Rogers Physical Capacity Test," Master of Science thesis, University of Michigan, 1963.

Mattson, Neil A. "The Effects of Track and Field Events on Physical Fitness as Measured by the Youth Fitness Tests," Unpublished research paper, Department of Physical Education, University of North Dakota, 1962.

Moser, Clifford J. "A Comparison of the Effect of Seasonal Participation in Selected Interschool Sports on Physical Fitness," Unpublished Master of Science thesis, Department of Physical Education, University of North Dakota, 1964.

Rosenstein, Irwin. "A Comparison of the Physical Fitness of Senior High School Boys and Girls Participating in Selected Physical Education Programs in New York State. Master's thesis, Department of Physical Education, Springfield College, Springfield, Massachusetts, 1963.

Vinger, Richard M. "A Comparison of Physical Fitness Increases as the Result of a Selected Physical Education Program," Unpublished Master's thesis, University of North Dakota, 1964.