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A Comparison of Physical Fitness Development of Physical Education Students and Athletes Compared to Normal Physical Maturation of Junior High Boys in Havre, Montana

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A COMPARISON OF PHYSICAL FITNESS DEVELOPMENT OF PHYSICAL EDUCATION STUDENTS AND ATHLETES COMPARED TO NORMAL PHYSICAL MATURATION OF JUNIOR HIGH BOYS IN HAVRE, MONTANA

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This thesis submitted by Neil C. Boyd in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

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ABSTRACT

The purpose of this study was to determine the changes in fitness levels shown among a Control Group and two Experimental Groups over a two year period. The Control Group consisted of seventy-two boys not taking instructional physical education or participating in any athletics. Experimental Group I consisted of one hundred subjects taking the regular physical education classes; Experimental Group II, of forty-eight subjects involved in a year round athletic program in addition to the regular physical education classes.

Pre and post test comparisons were made on the seven items of the American Association for Health, Physical Education, and Recreation Youth Fitness Test.

The null hypothesis was assumed with respect to the differences of means between groups. To determine if a significant difference existed, the analysis of covariance was used. Scheffe's test for multiple comparisons determined between which groups significance was found.

The conclusions indicated by this study were:

1. Participation in programs of interscholastic athletics or required physical education may improve an individual's physical fitness level. Between group comparisons revealed that the athletic group improved significantly more than did the Control Group on all parts of the physical fitness test.

2. The Physical Education Group changed significantly more than did the Control Group in five of the seven test items.

3. The Athletic Group changed significantly more than did the Physical Education Group in five of the seven test items.

CHAPTER I

INTRODUCTION

Life by its very nature is activity.

> To make your heart and nerve and
> sinew
> To serve your time long after they
> are gone
> And thus hold on when there is nothing
> in you
> Except the will which says to you,
> "hold on"!
>
> --Rudyard Kipling

The noblest thoughts in the minds of men are but wishful thinking in a body physically unable to put the thoughts in action. Kipling's "hold on" requires a physical wherewithal. Even charity, the ability to give of oneself without thought of return, is limited to the physical powers of the organism. The virtuous behavior of mankind and the rewards of a rich and full life are tied as closely to man's physical capacity as the bark of the tree is tied to the tree itself. Physical strength to initiate something and muscular and cardio-respiratory endurance to carry it through are still the essentials, the sine qua non, of a civilization.[1]

The Problem and Its Scope

The purpose of this study was to determine the effect of a selected physical education and athletic program on the fitness values

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[1]Carl E. Willgoose, "Physical Fitness - Our Primary Objective," Journal of Health, Physical Education and Recreation, November 1959, p. 32.

of the participants as compared to the changes in fitness values of a group in which change was due to normal physical maturation.

The specific problems of this study were as follows:

1. To find the physical fitness status of boys not involved in physical education classes nor participating in the athletic program when they entered the seventh grade. (Control Group)

2. To determine the levels of physical fitness presently maintained by those boys participating in the required physical education program when they entered the seventh grade. (Experimental Group I - Physical Education Group)

3. To determine the levels of physical fitness of those boys participating in both the required physical education program and the athletic program. (Experimental Group II - Athletic Group)

4. To find the physical fitness status of these three groups at the end of their eighth grade.

5. To determine if there was a significant difference between the levels of fitness of the Control Group and Experimental Group I at the end of the two year period.

6. To determine if there was a significant difference between the levels of fitness of the Control Group and Experimental Group II at the end of the two year period.

7. To determine if there was a significant difference between the levels of fitness of Experimental Group I and Experimental Group II at the end of the two year period.

Need for the Study

Physical fitness is an essential concern of a democratic society such as the United States endeavors to maintain. Such a democracy requires the combined efforts of all its citizens. These citizens' productivity depends upon their physical capabilities. Thus, in order to be worthwhile, contributing citizens, they must develop and preserve their physical capacities. But how do these citizens become physically fit? Whose job is it to establish standards and provide facilities? Are those responsible for this aspect of the nation's welfare doing an effective job? What is a satisfactory physical education program?

The field of physical education embodies many different theories, ideas, and/or practices as to what constitutes such a physical education program. The differences in these are evidenced by the variety of programs followed by those in the physical education field.

Youth is a time of growth and development, and nowhere is this change more evidenced in the majority than at the junior high school level. Therefore, it is the definite responsibility of every physical educator to provide for the maximum development of each individual. This will only be accomplished by providing the kind of physical education and activity program which will provide for the individual needs and differences of each student.

Considerable research and testing has been carried on in the various areas of physical fitness at the high school and college levels. The junior high school level, which perhaps exhibits the greatest degree of change contrast, has not received the emphasis it warrants.

By using one group of boys who participated in the physical education and athletic programs and another group who participated only in the required physical education program and comparing their test scores with boys who were not involved in any phase of either program, it was hoped that results might be obtained which would give answers to some of these questions.

Delimitations

This study was limited to two hundred and twenty boys of Havre Junior High School, Havre, Montana. The students ranged in age from twelve to fifteen years of age and were tested over a two year period.

The test used to measure the fitness development of the groups was the American Association for Health, Physical Education, and Recreation, Youth Fitness Test.[2] (The aquatic test was not included as one of the test items).

The boys enrolled in physical education participated in class activity four days a week, one hour per day. The boys participating in athletics attended practice sessions four or five days a week and participated in one game a week after the initial practice period of approximately two weeks.

No attempt was made to equate groups, nor was any attempt made to control the activity of the students outside the school sponsorship.

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[2]American Association for Health, Physical Education, and Recreation, Youth Fitness Test Manual, (Washington, D. C.: A.A.H.P.E.R., 1965).

Limitations

Accepted limitations on this study included:

1. Environmental influences were controlled only to the extent of keeping test situations as equal as possible.

2. The writer tried to encourage the best possible performances, but motivation was a factor difficult to measure.

3. The differences in individual abilities were important factors, but the investigator had no control over them.

Definitions

Control Group consisted of boys who did not participate in any phase of the physical education program or the intramural or athletic program.

Experimental Group I - Physical Education Group was composed of boys who participated in the required physical education classes four days a week for one hour each time the class met. These boys were limited to participation in one sport or one part of the intramural program.

Experimental Group II - Athletic Group was made up of boys participating in the junior high athletic program. They had to participate in three of the four competitive sports offered during the school term. Those four sports were: football, basketball, wrestling, and track. These students were also members of the regular physical education classes.

American Association for Health, Physical Education, and Recreation Youth Fitness Test was a battery of seven test items designed

to give a measure of physical fitness for both boys and girls in grades five to twelve. The tests were selected to evaluate specific aspects of physical status which, taken together, gave an over-all picture of the young person's general fitness. It is a widely accepted physical fitness test for which national norms have been determined. Test items include: sit-ups, pull-ups, shuttle run, standing broad-jump, 50-yard dash, softball throw, and the 600-yard run-walk.[3]

Physical Fitness

> . . . is the capacity to do work. It is determined by strength, endurance, and coordination. Each of these components in turn is founded upon the underlying biologic bases of age, sex, health status, and anatomic and bio-chemical condition. Furthermore, it is characterized by a high degree of specificity which changes with growth and development.[4]

Review of Related Literature

It is the purpose of this section to present a brief summary of the literature studied in this investigation. In reviewing the literature, emphasis was placed upon studies in which children, ages eight to sixteen, were the subjects. Due to the extensiveness of the material pertaining to this study, it is presented under the following major headings: Evidence of Change in Body Builds, Body Build and Physical Performance, The Place of Physical Education and Athletics in the Curriculum, The Relationship of Athletics and Physical Education to Physical Fitness.

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[3] Ibid., p. 7.

[4] Carl E. Willgoose, "Physical Fitness - Our Primary Objective," Journal of Health, Physical Education and Recreation, November, 1959, p. 32.

Evidence of Change in Body Builds

The effect of change and variance in a study such as this type was an extremely important variable, but one that has not always been realized and taken into consideration. In the past, due to the assumption that somatotypes do not change, the somatotypes of children during their growth periods have been assumed from their classifications when they reached physiological maturity. For example, Dupertuis and Michael concluded that somatotype rating made at the age of twenty-one years had remained fairly constant on the basis of height and weight measures throughout childhood.[5]

The acceptance of the adult somatotype as a valid representation of body constitution prior to and during adolescence ignores the possibility of physique changes resulting from the development of body systems at different rates or during the various phases of growth. It is obvious that small children differ from adults not only in size but also in body form. The human body does not grow at the same rate at the same time. In 1962, Tanner commented on the yearly growth of bone, muscle, and subcutaneous tissue during the period between eight and eighteen years; he stated that "fat had an early spurt, then decreased as bone underwent a spurt, followed by a muscle spurt."[6]

These differences in degree and timing of the growth of the various body segments produce changes in body proportions and contours

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[5]C. Wesley Dupertuis and Nancy B. Michael, "Comparison of Growth in Height and Weight Between Ectomorphic and Mesomorphic Boys," Child Development, XXIV (September-December, 1953), 203-14.

[6]J. M. Tanner, Growth at Adolescence (2d ed.; Springfield, Illinois: Charles C. Thomas, 1962), p. 24.

with age. It was reported by Breckenridge and Vincent that, while legs change from approximately three-eighths of the total body length at birth to about one half the total length at maturity, body length increases almost five times from birth. The head increases twice its size at birth and the trunk three times. The weight of the school age boy increases slowly each year, but the peak is usually not attained until at least six months after the height peak has been reached. The components of weight vary in their proportion to total weight with age. For example, at birth approximately 25 per cent of the total body weight is attributed to muscle, 16 per cent to the vital organs, and 15 per cent to the central nervous system. However, at maturity, these proportions are altered to 43, 11, and 3 per cent respectively.[7]

> In all normal human beings there appears to be a regular process of growth, development, and maturation which is operating from conception through maturity. However, each individual with his own unique heredity and environment will progress at his or her own rate and will attain the size, shape, weight, capacities, and developmental status which are his or hers at each stage of the life career.[8]

> Body size cannot be ignored as a significant factor influencing the level of motor performance. . . . The significance of weight as a contributing factor is quite obvious, for it will be recalled that approximately 40 per cent of the body weight normally is made up of muscle tissue. Hence differences in body weight theoretically imply proportionate differences in muscle tissue and similar differences in available strength. . . . The theoretical importance of height is associated with longer body levers, which if accompanied by the added muscular size and strength usually associated with increased height, permits not only a broader range of movement but also an increase in velocity

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[7]Marion E. Breckenridge and Lee E. Vincent, Child Development (5th ed.; Philadelphia: W. B. Saunders Company, 1965), p. 201.

[8]Lawrence K. Frank, "The Concept of Maturity," Child Development, XXI (1950), 21-4.

> at the ends of the moving levers. Age is of importance for it is a measure of the time which both endogenous and exogenous forces have had to influence growth. In a sense it is a rather crude index of both maturation and experience.[9]

Body Build and Physical Performance

Most studies dealing with body type and performance have been conducted with college-age students. However, previous investigations associated with the Medford Boy's Growth Study indicate that similar results may be expected with the prepubescent age group, that is, boys nine through twelve years of age.

With boys nine to thirteen years of age as subjects, Irving was specifically concerned with somatotype categories and their comparison in terms of maturity, structural and strength measures. He found that for mean cable-tension strength, the upper 25 per cent of the sample contained a greater percentage of mesomorphic and endo-mesomorphic boys: the lower 25 per cent had a greater percentage of ectomorphic boys. The 25 per cent with the highest Physical Fitness Indices contained a greater percentage of mesomorphs and ectomorphs; the lower 25 per cent reportedly contained a greater percentage of endomorphs and endo-mesomorphs.[10]

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[9]Lawrence G. Rarick, Motor Development During Infancy and Childhood. Quoted by Frank Lousis Smoll, "The Influence of Physical Growth and Muscular Strength Upon Motor Performance: Within and Between Year Observations," Microcard Thesis (M.S.), University of Wisconsin, 1966.

[10]Robert N. Irving, Jr., "Comparisons of Maturity, Structural, and Muscular Strength Measures for Five Somatotype Categories of Boys Nine Through Fifteen Years of Age," Microcard Doctoral Dissertation, University of Oregon, 1963.

Barry and Cureton examined the relationship between physique factors and certain measures of motor performance of prepubescent boys aged seven to eleven years. They found that the ten performance measures included proved to be relatively free from the influence of morphological variables after general size had been disregarded. The results of this study indicated that size is more important than shape in relation to performance during the prepubescent stage of growth.[11]

In his investigation of twelve year old boys, Munroe reported that the relationship of somatotype components to strength was rather low and negative with ectomorphy. The fact that the muscular system develops later than the skeletal system in the pre-adolescent period of growth was offered in explanation of a low correlation obtained between strength and mesomorphy at this age. Furthermore, Munroe found that only endomorphy correlated significantly with muscular endurance or motor ability items, and these correlations were both negative and low. Thus the dominant endomorph was considered as handicapped in muscular endurance activities and as unable to control his bulk in motor ability activities.[12]

Borms concluded from a study of the relationship between selected maturity, physique, and motor factors, and the gross and relative strength of ten, thirteen, and sixteen year old boys that:

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[11]Alan J. Barry and Thomas K. Cureton, "Factor Analysis of Physique and Performance in Prepubescent Boys," Research Quarterly, XXXII (October, 1961), 283-300.

[12]Richard A. Munroe, "Relationships Between Somatotype Components and Maturity, Structural, Strength, Muscular Endurance, and Motor Ability Measures of Twelve Year Old Boys," Microcard Doctoral Dissertation, University of Oregon, 1964.

1. The higher strength groups had significantly higher means generally than did the lower strength groups on maturity and body size measures for all comparisons.

2. The differences between means for the high-low strength Physical Fitness Index groups on the three motor ability elements were significantly beyond the .01 level for all ages.

3. With one exception, the differences between the endomorphy means for all groups at all ages were significant beyond the .01 level.[13]

Hindmarch conducted a study of ninety-three boys involved in the Medford Growth Study concerning the significance of physiological characteristics in performance and found that:

1. The high cable-tension strength average group had superior means on all maturity, body size, and motor ability measures; these differences between means were significant at or beyond the .05 level.

2. Physical Fitness Index. When the high and low Physical Fitness Indices groups were compared on the various tests of maturity and body size, no significant differences between means were obtained.

3. Motor Ability. No significant differences between the high and low means were found in the measures of maturity, body size, and gross strength.[14]

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[13]Jan Borms, "Relationships Between Selected Maturity, Physique, and Body Size and Motor Factors and the Gross Relative Strength of Ten, Thirteen, and Sixteen Year Old Boys," Microcard Master of Science Thesis, University of Oregon, 1965.

[14]Robert G. Hindmarch, "Significance of Physique, Maturational, Body Size, Strength, Motor Ability, and Reaction Time Characteristics of Eight Year Old Boys," Microcard Thesis (Ed.D.), University of Oregon, 1962.

Glines correlated strength and anthropometric measures for thirteen year old boys. He found that body weight had a correlation coefficient of .68 with cable-tension strength average, .62 with Strength Index, .28 with arm strength, and .24 with Physical Fitness Index. Standing height correlated .62 with cable-tension strength average, .57 with Strength Index, .49 with arm strength, and .24 with the Physical Fitness Index. Other correlation coefficients between body size and strength measures obtained by the same investigator were as follows: upper arm girth, .65 with cable-tension strength average and .50 with Strength Index.[15]

In a study of physical and motor characteristics of nine, twelve, and fifteen year old boys classified into advanced, normal, and retarded groups, Harrison demonstrated that the boys who were more advanced in maturity were taller, broader, heavier, and stronger and had greater muscular explosive power than did those who were retarded in maturity.[16]

Degutis dealt with the relationships of pubescent development to various physical, maturity and motor factors for ten, thirteen, and sixteen year old boys. The thirteen and sixteen year old boys who were advanced in pubescent development had higher mean scores on almost all strength variables. At the age of ten years, the only significant

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[15]Don Glines, "Relationship of Reaction Movement and Completion Times to Certain Motor, Strength, and Anthropometric and Maturity Measures," Microcard Doctor of Philosophy Dissertation, University of Oregon, 1960.

[16]H. Harrison Clarke and James C. E. Harrison, "Differences in Physical and Motor Traits Between Boys of Advanced, Normal, and Retarded Maturity," Research Quarterly, XXXIII (March, 1962), 13-25.

difference was between the means of the average of twelve cable-tension strength tests.[17]

The effect of physical maturation, in an investigation such as this, conducted at Havre, Montana, was an extremely important variable. Crow concluded in his book on Human Development and Learning:

1. Nowhere in the span of education (k-12) is the degree of physical change as great as evidenced in the junior high school years.

2. Not only is the degree of change significant but also the variation of this change between individuals, in regard to motor learning, is most noticeable.

3. Accompanying this physical change is the emotional maturation of each individual. At this age level, it is even more difficult to separate the physical and mental variations of maturation. Each has such a profound influence on the other.[18]

The Place of Physical Education and Athletics in the Curriculum

The President's Council on Youth Fitness is concerned with the fitness of all American youth. It made the following statement concerning the place of sports as a contributor to the physical fitness of youth:

> Just as the Council is concerned with every youth, boy and girl, so does it include in the top priority bracket among the available tools in its fitness concept every wholesome sport. The Council recognizes no major favorites; nor is it cognizant

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[17]Ernest W. Degutis, "Relationships Between the Standing Broad Jump and Various Maturity, Structural, and Strength Measures of Twelve Year Old Boys," Microcard Master of Science Thesis, University of Oregon, 1958.

[18]Lester D. Crow and Alice Crow, Human Development and Learning, (New York: American Book Company, 1965).

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 contributor to health. It embraces sports for the generous contributions to social and citizenship development.

The Council sees competition as an 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 body-contact sports suited to the physiological and sociological ages of the participants. Particularly, the Council stresses sports which have carryover value and can become a rich part of a recreation and fitness program of the individual throughout his life.[19]

To further substantiate the position of athletics and physical education, Mannerstedt and Forbes 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.

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.[20]

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[19]President's Council on Youth Fitness, "Sports Yield Youth Fitness," Journal of Health, Physical Education, and Recreation (January, 1960), p. 66.

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

The Relationship of Athletics and Physical Education to Physical Fitness

The concern over the value of athletic competition and the place of physical education in the school curriculum has been a problem to educators since its recognition by the schools in the late 1800's. In order to arrive at any conclusions regarding the development of physical fitness through the interscholastic athletic and physical education programs, it was first necessary to make an analysis of some of the studies completed by other investigators.

A study conducted by Boschee, 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 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.[21]

A study by Moser 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:

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[21]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, 1961).

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 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.[22]

Gaddie 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, on the average, 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.[23]

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. The girls were tested on five items:

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

[23]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).

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 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. The study also indicated that neither intramural nor interscholastic competition increased the physical fitness levels of the participants.[24]

In a study conducted by Hasche, a comparison of the physical fitness levels attained by participants in interscholastic athletics and in the required physical education program was made. Results, based on the data collected, indicated that:

1. Participation in a program of interscholastic athletics can significantly improve the physical fitness levels of those involved.

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.

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[24]Margaret M. Hallatt, "A Comparison of Physical Fitness Levels Achieved by Grade Ten Girls Through a Physical Education Program and A Competitive Sports Program," (unpublished master's thesis, Department of Physical Education, University of North Dakota, 1968).

4. Interscholastic athletic programs have a justifiable place in our educational curricula along with required physical education programs with respect to physical fitness development.[25]

Vinger 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 education.

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 in which the experimental group engaged 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.

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[25]Carl E. Hasche, "A Comparison of the Physical Fitness Levels Attained by Participants in Interscholastic Athletics and in the Required Physical Education Program," (unpublished master's thesis, Department of Physical Education, University of North Dakota, 1967).

3. The control group did not change significantly in any of the measures of physical fitness levels, while the experimental group improved significantly in nearly all areas of physical fitness.[26]

The purpose of a study conducted by Leighton was to determine the effect of participating in each of twenty physical education (sports) activities for one college quarter 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. In summarizing the findings for each of the components, the following results were obtained:

1. Weight training was the only activity for which a significant strength gain was recorded.

2. Significant balance gains were recorded for the participants in 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 appeared to register the higher static balance development potential.

4. Significant agility gains were recorded for those participating in badminton, basketball, boxing, folk and square dancing, swimming, touch football, volleyball, and weight training.

5. Those activities requiring the greatest amount of movement from a fixed position or base during the performance of that activity

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

appeared to register the higher agility development potential. Weight training was the notable exception.

6. Those involved in basketball and swimming recorded significant gains in speed.

7. Basketball was the only activity for which a significant endurance gain was recorded for the participant.[27]

A study was made by Landiss to determine the influence of physical education on motor ability and physical fitness of college freshmen. 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.[28]

Coen conducted a study to determine if the participation in a regular physical education class would effect the physical fitness level of the student. The study was conducted over a three year period on boys ages thirteen, fourteen, fifteen, and sixteen, with the Minnesota Physical Efficiency Test used as the measuring instrument. The results of the study were:

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

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

1. The regular physical education class did not produce significant changes in the burpee test results for three of the four groups.

2. The regular physical education class did not produce significant changes in the sit-up test results in all four age groups.

3. The regular physical education class produced significant changes in the push-up test results in all four age groups.

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

5. The regular physical education class produced a significant change in only one of the four age groups tested for pull-ups.

6. The regular physical education class produced a significant change in only one of the four age groups tested for the broad jump.[29]

Sundre's study was to determine which of two programs of physical education was more effective in:

1. The development of physical fitness.

2. The development of good attitudes toward physical education.

3. The development of knowledge of sports skills.

The investigator organized introductory physical education programs at the University of North Dakota. One program consisted of recreational sports and the other program consisted of recreational sports supplemented by conditioning exercises. Results indicated that the conditioning exercises used in the second program increased the

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[29]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).

physical fitness of the group to a significant level. No change was shown in the attitude or the knowledge of sport skills in either group.[30]

Shaffer undertook a study to determine variables that affected Kraus-Weber failures among junior high school girls. It was found that a program based entirely on learning and playing games did not produce sufficient strength and flexibility to reduce the Kraus-Weber test failures below the level reported for American children. However, participation in conditioning exercises twice a week for part of one semester, brought the rate of success for all girls to the average of the European children and, in two semesters, to 5 per cent above the European average. The results of this research indicated that, if junior high school girls who are free from mental and physical disorders participate regularly in physical activities based on physiological needs during this age period when strength is built, they will pass the Kraus-Weber test.[31]

Summary of Related Literature

From the review of literature there is evidence to support the following conclusions:

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[30]Orlo A. Sundre, "A Comparative Study of Two Physical Education Programs for Male Students at the University of North Dakota," (unpublished master's thesis, Department of Physical Education, University of North Dakota, 1960).

[31]Gertrude K. Shaffer, "Variables Affecting Kraus-Weber Failures Among Junior High School Girls," Research Quarterly, XXX (March, 1958), 86.

1. The normal growth process produces remarkable changes and variations in the individual's physiological characteristics.

2. Physical education and athletics are important contributors to the total education of the student and as such demand a prominent place in the curriculum.

3. The physical characteristics that determine physical maturation have a direct relationship to the motor ability performance of the students.

4. There has been little evidence of the effect of physical education and athletics on physical fitness levels of junior high students. However, studies that have been conducted on the elementary, high school, and college levels have indicated that physical education and athletics do contribute significantly to the fitness levels of participants.

5. Physical education programs that were based entirely on learning and playing games did not produce as significant an improvement in fitness as did those which had as a basis the fundamental improvement of motor ability.

Normal physical maturation has a definite effect on the physical performance of junior high age subjects. The purpose of this study was to compare this change to that of two experimental groups each of which was involved in a program of additional physical training.

CHAPTER II

METHODOLOGY

Preliminary Planning and Group Selection

The data gathered in this study were obtained from the athletes, physical education participants, and students at Havre Junior High School, Havre, Montana.

Data were collected from three groups of male students. The boys were tested at the beginning of the seventh grade and again at the end of the eighth grade. The selection of groups was accomplished by assigning each boy to one of the three groups according to the criteria for these groups as established by the writer at the conclusion of the study.

Control Group: This group included seventy-two boys not participating in either the athletic program or the physical education program.

Experimental Group I: This group included one hundred boys who were members of the required physical education program.

Experimental Group II: This group included forty-eight boys actively engaged in the competitive athletic program. These boys were also members of the regular physical education classes.

Test Procedure

The seven items of the American Association for Health, Physical Education, and Recreation Youth Fitness Test were administered to all boys at the beginning of the seventh grade. The tests were administered on consecutive days with no more than two tests given on any one day. The three groups were again tested the final week of their eighth grade year, using the same testing procedure.

Test Administration

The tests were administered in accordance with the recommendations and instructions of the AAHPER Youth Fitness Test Manual.[31] Test items included:

1. sit-ups
2. pull-ups
3. shuttle run
4. standing broad jump
5. 50-yard dash
6. softball throw
7. 600-yard walk-run

An indoor gymnasium was used for the administration of four test items: sit-ups, pull-ups, shuttle run, and standing broad jump. All equipment and apparatus necessary for these tests were located in the gymnasium. The 50-yard dash, softball throw, and 600-yard run-walk were administered to the boys on the outdoor athletic field.

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[31] American Association for Health, Physical Education, and Recreation, Youth Fitness Test Manual, (Washington, D. C.: A.A.H.P.E.R., 1965).

The boys were given instructions and recommendations on the proper execution of each test item. However, they were allowed no practicing other than that specified by the Test Manual as warm-up.

All testing was done under the supervision of this investigator. Some assistance was given by Mr. Jim Kravik and Mr. Bob Parsley, who were student teaching under the writer, during the final testing period.

Test Directions

Sit-up

Equipment: The sit-ups were done on mats on the gymnasium floor.

Description: The pupil lay on his back, with legs extended and feet about two feet apart. His hands were placed on the back of the neck with the fingers interlaced. Elbows were retracted. A partner held the ankles down, the heels being in contact with the mat or floor at all times. The pupil sat up, turning the trunk to the left and touching the right elbow to the left knee, returned to starting position, then sat up turning the trunk to the right and touching the left elbow to the right knee. The exercise was repeated, alternating sides.

Rules:
1. The fingers had to remain in contact behind the neck throughout the exercise.
2. The knees had to be on the floor during the sit-up but could be slightly bent when touching elbow to knee.

3. The back was to be rounded and the head and elbows brought forward when sitting up, as in a "curl" up.
4. When returning to starting position, elbows had to be flat on the mat before sitting up again. There was a required momentary pause between movements.

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

Pull-up

Equipment: A horizontal bar, approximately one and a half inches in diameter, was adjusted to the proper height for each individual.

Description: The bar was high enough so that the pupil could hang with his arms overhead and legs fully extended and his feet free of the floor. He was instructed to use the overhead grasp, palms forward. After assuming the hanging position, the pupil raised his body, using his arms, until his chin could be placed over the bar and then lowered his body to a full hang as in the starting position. The exercise was repeated as many times as possible.

Rules: 1. One trial was allowed unless it was obvious that the pupil had not had a fair chance.
2. The body could not swing during the execution of the movement. If the pupil started swinging, this

was checked by the tester holding a straight arm across the front of the student's thighs.

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

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

Shuttle run

Equipment: Two blocks of wood - two inches by two inches by four inches, and a stop watch. The pupils wore sneakers or ran bare footed.

Description: Two parallel lines were marked thirty feet apart on the floor. The blocks of wood were placed behind one of the lines. The pupil started from behind the other line. On the signal, "Ready? Go!" the pupil ran to the blocks, picked one up, ran back to the starting line, and placed the block behind the line; he then ran back and picked up the second block, which he carried back across the starting line.

Rules: Two trials were allowed with some rest between.

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

Standing broad jump

Equipment: An indoor jumping mat (marked off in inch and foot gradations) and yardstick or pointer were necessary.

Description: Each pupil stood with his feet several inches apart and his toes just behind the take-off line. Preparatory to jumping, the pupil swung his arms backward and bent his knees. The jump

was accomplished by simultaneously extending his knees and swinging his arms forward.

Rules: 1. Three trials were allowed.

2. Measurement was made from the take-off line to the heel or other part of the body that touched the mat nearest the take-off line.

3. The scorer stood to the side and marked the jump to the nearest inch with the pointer. The recorder read the measurement from this indicator and recorded the distance of the jump.

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

50-yard dash

Equipment: A split-second stop watch and a 50-yard straightaway on a track.

Description: This test was administered to two pupils at a time. Each one took a position behind the starting line. The starter used the commands, "Are you ready?" and "Go!" The latter was accompanied by a downward sweep of the starter's arm to give a visual signal to the timer, who stood at the finish line.

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

Scoring: The score was recorded to the nearest tenth of a second.

Softball throw for distance

Equipment: A softball (12-inch), small metal stakes, and a tape were used.

Description: The football field was marked in conventional fashion (five-yard intervals). The pupil threw the ball while remaining within two parallel restraining lines, six feet apart. The point where the ball landed was marked with one of the small stakes. If his second or third throw was farther, the stake was moved accordingly, so that after three throws, the stake was at the point of the pupil's best throw. It was found expedient to have the pupil jog out to his stake and stand there; and then, after five pupils had completed their throws, the measurements were taken. By having the pupil at his particular stake, there was little danger of recording the wrong score.

Rules:
1. Only an overhand throw could be used.
2. Three throws were allowed.
3. If the pupil went over the restraining line, the throw was not allowed.
4. The distance recorded was the distance measured at right angles from the point of landing to the restraining line.

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

600-yard run-walk

Equipment: A football field measured off in a 600-yard distance and a stopwatch were used.

Description: Four pupils ran at a time, beginning with standing starts. At the signal "Ready? Go!" the boys began running the 600-yard distance. The running could be interspersed with walking. Each runner had a partner whose duty it was to remember the runner's time as he crossed the finish line. The timer merely called out the times as the boys crossed the finish.

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

Scoring: The time was recorded in minutes and seconds.

Handling of the Data

The data were collected and recorded on a group data sheet. (Appendix A) From there it was transferred and recorded on the I.B.M. data sheets. The data sheets were then punched on cards and the appropriate program was fed into the I.B.M. 360-30 computer.

Each boy, at the time of the initial test and again at the final test, was classified according to the Neilson-Cozens Classification Index. This index which is presented in the test manual, translates into exponent form, age to the nearest month, height in inches to the nearest half-inch, and weight to the nearest pound.

Having been assigned a specific classification, according to his maturation, each boy was then scored by percentile, using national norms established by AAHPER. This method of classification allowed for differences in physiological characteristics and subsequent performance by each individual.

Statistical Procedure

The data for this study were obtained from a test, retest situation over a two year period. Comparisons were made within and between groups on the seven fitness items of the American Association of Health, Physical Education, and Recreation Youth Fitness Test.

This investigator, to analyze the difference between the initial test and the retest within each group, assumed the null hypothesis. This hypothesis asserts that there is no true difference between two population means and that the difference found between sample means is, therefore, accidental and unimportant.[32]

An analysis of variance and analysis of covariance for a randomized group design, as described by Edwards,[33] were found suitable for this study. This method was chosen because of the necessity to test the significance of the difference between three means. Analysis of variance basically grouped the data together under a common measure and arranged it in logical content. Analysis of covariance represented an extension of analysis of variance to allow for the correlation between initial and final scores. Through covariance analysis, the investigator was able to affect adjustments in final scores which would allow for differences in some initial variable.

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[32]H. E. Garrett, Statistics in Psychology and Education (5th ed.; New York: Longmans, Green, and Company, 1961), p. 213.

[33]Allen L. Edwards, Experimental Design in Psychological Research (New York: Holt, Rineholt, and Winston, Inc., 1968), pp. 115-29, 326-42.

The writer tested for significance between group means by using Scheffe's "S^2-test" for multiple comparisons. It was a method useful for determining comparisons involving differences between pairs of means, as well as contrasts between and among the means.[34] The procedure for comparisons between pairs of means was as follows:

$$S^2 = \frac{(\bar{x}_i - \bar{x}_j)^2}{M_{S_w}\left(\frac{1}{n_i} + \frac{1}{n_j}\right)}$$

where $\bar{x}_i$ and $\bar{x}_j$ were the means of the treatment groups being compared, and "n" was the number of the subjects in the subscripted treatment group.

The statistical procedures for the "S^2" test were all handled on an Underwood Calculator.

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[34] Ibid., pp. 150-3.

CHAPTER III

ANALYSIS OF DATA

The purpose of the testing in this study was to determine whether or not there were any significant differences between the physical fitness values of two experimental groups as compared to that of a control group over a two year period. The bases of comparison were the results obtained from the American Association for Health, Physical Education, and Recreation Youth Fitness Test.

Analysis of covariance enabled a comparison to be made of the correlation relationship between initial and final scores by determining whether a difference existed in the post test as a result of the experimental treatments. By this same method comparisons were also made between the groups on the pretest results. By the analysis of covariance method, an "F" value which indicated significance or lack of significance between groups was found. If the "F" value indicated significance at the .01 level of confidence, Scheffe's formula was then applied to determine between which groups the variance was significant.

The statistical results of this study are presented under four headings: Pretest Between Group Comparisons, Analysis of Covariance Between Groups, Post Test Between Group Comparisons, and Within Group

Mean Percentile Comparisons. A detailed description of the statistical procedures appears in Appendix B.

Pretest Between Group Comparisons

Sit-up

The Control Group had a mean score of 57.68 sit-ups on the pretest. Experimental Group I had a mean score of 59.43 sit-ups, while Experimental Group II had a mean score of 63.19 sit-ups on the pretest. The difference between means of the Control Group and Experimental Group I was 1.75 sit-ups. The "S^2" score, which is a result of a comparison of means using Scheffe's formula, of .38 did not indicate a significant difference at the .01 level between the means. The Control Group and Experimental Group II had a mean difference of 5.51 sit-ups with an "S^2" value of 2.57. This value was not significant at the .01 level. Experimental Groups I and II demonstrated a mean difference of 3.76 sit-ups. The "S^2" score for the difference between means for these two groups was 1.35 which was not significant at the .01 level of confidence.

TABLE 1

COMPARISON OF PRETEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE SIT-UP TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	57.68	59.43		1.75	.38	No
Comparison II	57.68		63.19	5.51	2.57	No
Comparison III		59.43	63.19	3.76	1.35	No

*"S^2" at the .01 level = 9.42

Shuttle run

The Control Group had a mean score of 11.15 seconds on the pretest while Experimental Group I and Experimental Group II had mean scores of 11.19 and 10.78 seconds respectively on the pretest. The mean difference between the Control Group and Experimental Group I was .04 seconds. The "S^2" score of .64 was not significant at the .01 level of confidence. The Control Group and Experimental Group II had a mean difference of .37 seconds which, with an "S^2" score of 46.10, was significant at the .01 level. A comparison of the means between Experimental Group I and Experimental Group II showed a mean difference of .41 seconds. The "S^2" value of 62.57 was significant at the .01 level of confidence.

TABLE 2

COMPARISON OF THE PRETEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE SHUTTLE RUN TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	11.15	11.19		.04	.64	No
Comparison II	11.15		10.78	.37	46.10	Yes
Comparison III		11.19	10.78	.41	62.57	Yes

*"S^2" at the .01 level = 9.42

Pull-up

In the pull-up pretest the Control Group had a mean score of 1.61 pull-ups. Experimental Group I had a mean score of 1.43 pull-ups, and Experimental Group II had a mean score of 2.33 pull-ups on the pretest. The difference between the means of the Control Group and Experimental Group I was .18 pull-ups. The "S^2" value of .55 indicated no significant difference at the .01 level. Between the Control Group and Experimental Group II there was a mean difference of .72 pull-ups which with an "S^2" score of 6.1 was not significant at the .01 level. The mean difference between Experimental Group I and Experimental Group II was .90 pull-ups. The "S^2" value of 10.74 was significant at the .01 level of confidence.

TABLE 3

COMPARISON OF PRETEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE PULL-UP TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	1.61	1.43		.18	.55	No
Comparison II	1.61		2.33	.72	6.10	No
Comparison III		1.43	2.33	.90	10.74	Yes

*"S^2" at the .01 level = 9.42

Standing Broad Jump

In the standing broad jump pretest the Control Group had a mean score of 64.97 inches. Experimental Group I had a mean score of 64.89 inches while Experimental Group II had a mean score of 67.45 inches on the pretest. The difference between the means of the Control Group and Experimental Group I was .08 inches. The "S^2" score of .01 did not indicate a significant difference at the .01 level between the means. The Control Group and Experimental Group II had a mean difference of 2.48 inches with an "S^2" value of 7.07. This value was not significant at the .01 level of confidence. Experimental Group I and II demonstrated a mean difference of 2.56 inches. The "S^2" score for the difference between means for these two groups was 8.48 which was not significant at the .01 level.

TABLE 4

COMPARISON OF THE PRETEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE STANDING BROAD JUMP TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	64.97	64.89		.08	.01	No
Comparison II	64.97		67.45	2.48	7.07	No
Comparison III		64.89	67.45	2.56	8.48	No

*"S^2" at the .01 level = 9.42

50-Yard Dash

For the 50-yard dash test the Control Group showed a mean of 7.97 seconds on the pretest. Experimental Group I had a mean score of 7.93 seconds, and Experimental Group II had a mean score of 7.60 seconds on the pretest. The difference between the means of the Control Group and Experimental Group I was .01 seconds. The "S^2" value of .05 indicated no significance at the .01 level of confidence. Between the Control Group and Experimental Group II there was a mean difference of .34 seconds which, with an "S^2" score of 83.80, indicated significance at the .01 level. The mean difference between Experimental Group I and Experimental Group II was .33 seconds. The "S^2" value of 90.49 was significant at the .01 level.

TABLE 5

COMPARISON OF PRETEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE 50-YARD DASH TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	7.94	7.93		.01	.05	No
Comparison II	7.94		7.60	.34	83.80	Yes
Comparison III		7.93	7.60	.33	90.49	Yes

*"S^2" at the .01 level = 9.42

Softball Throw

In the softball throw test, the Control Group had a mean score of 117.44 feet on the pretest while Experimental Group I and Experimental Group II had mean scores of 118.27 and 132.68 feet, respectively, on the pretest. The mean difference between the Control Group and Experimental Group I was .83 feet. The "S^2" score of .25 was not significant at the .01 level of confidence. The Control Group and Experimental Group II had a mean difference of 15.24 feet which with an "S^2" score of 57.49 was significant at the .01 level. A comparison of the means between Experimental Group I and Experimental Group II showed a mean difference of 14.41 feet. The "S^2" value of 62.57 was significant at the .01 level of confidence.

TABLE 6

COMPARISON OF PRETEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE SOFTBALL THROW TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Differ-ence	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	117.44	118.27		.83	.25	No
Comparison II	117.44		132.68	15.24	57.49	Yes
Comparison III		118.27	132.68	14.41	62.57	Yes

*"S^2" at the .01 level = 9.42

600-Yard Run-Walk

For the 600-yard run-walk test, the Control Group showed a mean of 146.51 seconds on the pretest. Experimental Groups I and II had mean scores of 144.43 seconds and 135.62 seconds on the pretest. The mean difference between the Control Group and Experimental Group I was 2.08 seconds. The "S^2" score of 2.77 was not significant at the .01 level of confidence. A comparison of the means between the Control Group and Experimental Group II showed a mean difference of 10.89 seconds. The "S^2" value of 52.19 was significant at the .01 level. Experimental Groups I and II demonstrated a mean difference of 8.81 seconds. The "S^2" value for the difference between means for these two groups was 38.62, which was significant at the .01 level of confidence.

TABLE 7

COMPARISON OF PRETEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE 600-YARD RUN WALK

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	146.51	144.43		2.08	2.77	No
Comparison II	146.51		135.62	10.89	52.19	Yes
Comparison III		144.43	135.62	8.81	38.62	Yes

*"S^2" at the .01 level = 9.42

The two hundred and twenty subjects used in this study were students at the Havre Junior High School. Because all the male students of the junior high were tested at the beginning of the seventh grade, no attempt was made to equate groups. However, by the pretest between group comparison, it was found that there was no significant difference at the .01 level of confidence on any of the seven test items between the Control Group and Experimental Group I. The pretest means between the Control Group and Experimental Group II indicated a significance at the .01 level in the shuttle run, 50-yard dash, softball throw, and 600-yard run-walk. The sit-up, pull-up, and standing broad jump results indicated no significant difference between means. A pretest comparison of the difference between means

of Experimental Group I and Experimental Group II showed no significant difference between the means of the sit-up and the standing broad jump test items.

Analysis of Covariance Between Groups

From the data received from the I. B. M. 360-30 computer, covariance that was significant at the .01 level of confidence was found between the Control Group, Experimental Group I, and Experimental Group II on all seven items of the Youth Fitness Test. Table 8 presents the "F" values for the seven test items.

TABLE 8

ANALYSIS OF COVARIANCE BETWEEN GROUPS

Test Item	"F" Value*	Significant at .01 level
Sit-Up	27.77	Yes
Pull-Up	31.41	Yes
Shuttle Run	20.47	Yes
Standing Broad Jump	9.89	Yes
50-Yard Dash	5.59	Yes
Softball Throw	11.83	Yes
600-Yard Run-Walk	29.89	Yes

*"F" at the .01 level = 4.71

Post Test Between Group Comparisons

Sit-Up

The Control Group had a mean score of 67.94 sit-ups on the post test. Experimental Group I had a mean score of 84.33 sit-ups, while Experimental Group II had a mean score of 91.82 sit-ups on the post test. The difference between the means of the Control Group and Experimental Group I was 16.39 sit-ups. The "S^2" score of 33.04 indicates a significant difference at the .01 level. The Control Group and Experimental Group II had a mean difference of 23.88 sit-ups with an "S^2" value of 48.33. This value was significant at the .01 level. Experimental Groups I and II demonstrated a mean difference of 7.49 sit-ups. The "S^2" score for the difference between means for these two groups was 5.36 which was not significant at the .01 level.

TABLE 9

COMPARISON OF POST TEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE SIT-UP TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Differ-ence	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	67.94	84.33		16.39	33.04	Yes
Comparison II	67.94		91.82	23.88	48.33	Yes
Comparison III		84.33	91.82	7.49	5.36	No

*"S^2" at the .01 level = 9.42

Pull-Up

The Control Group had a mean score of 2.22 pull-ups on the post test. Experimental Group I had a mean score of 3.21 pull-ups and Experimental Group II had a mean score of 4.54 pull-ups on the post test. The difference between the means of the Control Group and Experimental Group I was .99. The "S^2" score of 16.75 indicated a significant difference between groups at the .01 level of confidence. Between the Control Group and Experimental Group II there was a mean difference of 2.32 which, with an "S^2" score of 63.29, was found to be significant at the .01 level. The mean difference between Experimental Group I and Experimental Group II was 1.33. This resulted in an "S^2" value of 23.46 which was significant at the .01 level.

TABLE 10

COMPARISON OF POST TEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE PULL-UP TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	2.22	3.21		.99	16.75	Yes
Comparison II	2.22		4.54	2.32	63.29	Yes
Comparison III		3.21	4.54	1.33	23.46	Yes

*"S^2" at the .01 level = 9.42

Shuttle Run

The Control Group had a mean score of 10.74 seconds on the post test while Experimental Group I and Experimental Group II had mean scores of 10.56 and 10.39 seconds respectively on the post test. The mean difference between the Control Group and Experimental Group I was .18 seconds. The "S^2" score of 15.58 was significant at the .01 level of confidence. The Control Group and Experimental Group II had a mean difference of .35 seconds. The "S^2" score of 41.74 indicates a significant difference at the .01 level between the means. Experimental Groups I and II demonstrated a mean difference of .17 seconds on the post test. The "S^2" score of 11.41 was significant at the .01 level of confidence.

TABLE 11

COMPARISON OF POST TEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE SHUTTLE RUN TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	10.74	10.56		.18	15.58	Yes
Comparison II	10.74		10.39	.35	41.74	Yes
Comparison III		10.56	10.39	.17	11.41	Yes

*"S^2" at the .01 level = 9.42

Standing Broad Jump

In the standing broad jump post test the Control Group had a mean score of 70.67 inches. Experimental Group I had a mean score of 72.55 inches, and Experimental Group II had a mean score of 74.85 inches. The difference between the means of the Control Group and Experimental Group I was 1.88 inches. The "S^2" value of 5.89 indicates no significant difference at the .01 level between the means of the two groups. The Control Group and Experimental Group II had a mean difference of 4.18 inches with an "S^2" value of 20.67. This value was significant at the .01 level of confidence. Experimental Group I and Experimental Group II showed a difference between means of 2.30 inches. The "S^2" score for the difference between means on the post test of these two groups was 6.85 which indicated no significance at the .01 level of confidence.

TABLE 12

COMPARISON OF POST TEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE STANDING BROAD JUMP TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	70.67	72.55		1.88	5.89	No
Comparison II	70.67		74.85	4.18	20.67	Yes
Comparison III		72.55	74.85	2.30	6.85	No

*"S^2" at the .01 level = 9.42

50-Yard Dash

The Control Group had a mean score of 7.54 seconds in the 50-yard dash on the post test. Experimental Group I had a mean score of 7.45 seconds and Experimental Group II a mean score of 7.12 seconds on the post test. The mean difference between the Control Group and Experimental Group I was .09 seconds. The "S^2" score of 8.75 indicated no significant difference at the .01 level. The Control Group and Experimental Group II showed a mean difference of .42 seconds which, with a "S^2" score of 129.73 was significant at the .01 level of confidence. Experimental Group I and Experimental Group II showed a mean difference of .33 seconds on the post test. This resulted in a "S^2" value of 89.74 which was significant at the .01 level of confidence.

TABLE 13

COMPARISON OF POST TEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE 50-YARD DASH TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	7.54	7.45		.09	8.75	No
Comparison II	7.54		7.12	.42	129.73	Yes
Comparison III		7.45	7.12	.33	89.74	Yes

*"S^2" at the .01 level = 9.42

Softball Throw

The Control Group had a mean score of 139.29 feet in the softball throw on the post test. Experimental Group I had a mean score of 137.53 feet while Experimental Group II had a mean score of 164.23 feet. The mean difference between the Control Group and Experimental Group I was 8.24 feet. The "S^2" score of 24.42 indicated significant difference at the .01 level of confidence. Between the Control Group and Experimental Group II there was a mean difference of 24.94 feet which gave an "S^2" value of 153.96. This value was significant at the .01 level. A comparison of the means between Experimental Group I and Experimental Group II showed a mean difference of 16.70 feet. The "S^2" value of 77.90 was significant at the .01 level of confidence.

TABLE 14

COMPARISON OF POST TEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE SOFTBALL THROW TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	139.29	147.53		8.24	24.42	Yes
Comparison II	139.29		164.23	24.94	153.96	Yes
Comparison III		147.53	164.23	16.70	77.90	Yes

*"S^2" at the .01 level = 9.42

600-Yard Run-Walk

For the 600-yard run-walk test the Control Group showed a mean of 132.13 seconds on the post test. Experimental Group I and Experimental Group II had mean scores of 125.51 seconds and 120.55 seconds respectively on the post test. The mean difference between the Control Group and Experimental Group I was 6.62 seconds. The "S^2" score of 28.09 indicated significance at the .01 level. The Control Group and Experimental Group II had a mean difference of 11.58 seconds. The "S^2" value of 59.07 for the difference between means indicated significance at the .01 level of confidence. Experimental Group I and Experimental Group II showed a difference between means of 4.96 seconds. The "S^2" score of 12.24 was significant at the .01 level of confidence for the difference between means of these two groups.

TABLE 15

COMPARISON OF POST TEST MEANS OF THE CONTROL GROUP AND THE TWO EXPERIMENTAL GROUPS ON THE 600-YARD RUN-WALK TEST

	Mean of Control Group	Mean of Exper. Group I	Mean of Exper. Group II	Mean Difference	"S^2"* Value	Significant at .01 Level of Confidence
Comparison I	132.13	125.51		6.62	28.09	Yes
Comparison II	132.13		120.55	11.58	59.07	Yes
Comparison III		125.51	120.55	4.96	12.24	Yes

*"S^2" at the .01 level = 9.42

In the between group comparisons, using the "S^2-test" for multiple comparisons, Experimental Group I showed a significant improvement over the Control Group at the .01 level on the following: sit-ups, pull-ups, shuttle run, standing broad jump, and 600-yard run-walk. Experimental Group II showed a significant improvement over the Control Group in all seven items of the physical fitness test at the .01 level. There was significant improvement at the .01 level shown by Experimental Group II over Experimental Group I in the push-up, shuttle run, 50-yard dash, softball throw, and 600-yard run-walk.

Within Group Mean Percentile Comparisons

The American Association for Health, Physical Education, and Recreation had established national norms for the seven items of the Youth Fitness Test. These norms included maturation as the fundamental control for improvement in physical skill. Maturation should be accompanied by improvement in raw score on the test items. A boy was at maturation level "B" at the time of the pretest. He did 50 sit-ups which had a ranking at the 50th percentile on the national norm scale. Two years later he was at maturation level "D". This time he did 65 sit-ups but was still at the 50th percentile. He had to do 70 sit-ups to gain on the percentile scale because of his change in maturation level.

In Tables 16, 17, and 18 all raw scores for each individual were changed into percentiles according to the AAHPER norms for the seven test items. These were then totaled and average mean percentiles for the pre and post tests was determined for each group.

A comparison of these was made in Graphs 1 and 2 (Appendix C). The average mean percentile difference is then a demonstration of the improvement shown according to the maturation level as shown in Graph 3 (Appendix C).

TABLE 16

PERCENTILE MEAN COMPARISONS FOR THE CONTROL GROUP

	Pretest Mean	Post Test Mean	Mean Difference
Sit-Up	54.17	58.17	4.00
Pull-Up	41.04	38.69	-2.35
Shuttle Run	43.96	45.12	1.16
Standing Broad Jump	48.46	50.31	1.85
50-Yard Dash	44.83	44.88	.05
Softball Throw	44.99	48.56	3.57
600-Yard Run-Walk	45.53	47.21	1.68

The Control Group demonstrated a slight percentile improvement on the sit-up, shuttle run, standing broad jump, 50-yard dash, soft ball throw, and 600-yard run-walk tests. The pull-up, which was a test of arm and shoulder strength, showed a percentile decrease over the two-year period. The average mean difference of this group was 1.28 per cent. On the pretest the average mean for the Control Group

on six of the seven test items was below the national average. On the post test this group was below the national average on five of the seven test items.

TABLE 17

PERCENTILE MEAN COMPARISONS FOR EXPERIMENTAL GROUP I

	Pretest Mean	Post Test Mean	Mean Difference
Sit-Up	56.09	78.09	22.88
Pull-Up	40.48	50.44	9.96
Shuttle Run	43.88	51.32	7.44
Standing Broad Jump	47.89	55.17	7.28
50-Yard Dash	43.99	47.89	3.90
Softball Throw	46.78	58.70	11.92
600-Yard Run-Walk	47.19	62.24	15.05

Experimental Group I showed a below average pretest mean on all of the test items except the sit-up test. The post test mean was above the national average on six of the seven test items. It was only on the 50-yard dash that Experimental Group I's post test mean was below the national average. The mean difference average was 11.20 per cent for the seven physical fitness tests.

TABLE 18

PERCENTILE MEAN COMPARISONS FOR EXPERIMENTAL GROUP II

	Pretest Mean	Post Test Mean	Mean Difference
Sit-Up	61.37	90.00	28.63
Pull-Up	48.31	61.27	15.04
Shuttle Run	54.56	65.08	10.52
Standing Broad Jump	56.85	68.25	11.40
50-Yard Dash	58.54	69.13	9.59
Softball Throw	59.85	73.83	13.98
600-Yard Run-Walk	58.42	80.15	21.73

Experimental Group II had means on the pretest that were above the 50th percentile on all of the physical fitness tests except the pull-up. The lowest post test mean shown by this group was 61.27 per cent on the pull-up test. The mean difference average, which was an indication of improvement, was 15.84 per cent over the two year period.

CHAPTER IV

DISCUSSION OF DATA

Before the evidence can be discussed, there were certain limiting factors which may have biased the results of this study. In the review of related literature, Mannerstedt[35] termed athletics as the post-graduate of physical education which requires a specialization of skills and abilities. In addition, the subjects who participated as members of the athletic group were there of their own choice. Their mental motivation to improve their physical ability was evidenced by the fact that they were out for athletics. The athletic program by nature, was more intense and required a higher degree of concentration and endurance. One of the first objectives of most coaches is to condition their players for performance to meet this demand. The main criterion of the athletic group was participation in a competitive sport throughout the school year. In addition, athletic programs were offered during the summer months through the city recreation program. Those individuals taking advantage of such opportunities were able to stay in condition the year around, while improving their conditioning constantly. An athlete conditioning the year around would remain at a higher level of physical fitness. The fact that the athletic group evidenced a higher mean on all seven items of the pretest (Table 19)

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[35]See n. 20, p. 14.

would tend to favor them. But, this may also work in reverse. That they demonstrated a higher proficiency to begin with would seemingly allow less room for improvement.

The Control Group may also be biased by lack of motivation. Because of scheduling, they were not members of the physical education classes. However, they were encouraged to participate in the athletic and intramural programs. Their lack of interest would most likely be accompanied by a lack of motivation to improve and maintain any level of physical fitness. However, this group had the greatest opportunity to show improvement because of the below average mean established during the pretest.

TABLE 19

COMPARISON OF THE CONTROL GROUP, EXPERIMENTAL GROUP I, AND EXPERIMENTAL GROUP II ON THE PRETEST

	Mean of Control Group	Mean of Experimental Group I	Mean of Experimental Group II
Sit-Ups	57.68 sit-ups	59.43	63.19
Pull-Ups	1.61 pull-ups	1.43	2.33
Shuttle Run	11.15 seconds	11.19	10.78
Standing Broad Jump	64.97 inches	64.89	67.45
50-Yard Dash	7.94 seconds	7.93	7.60
Softball Throw	117.44 feet	118.27	132.68
600-Yard Run-Walk	146.51 seconds	144.43	135.62

These limiting factors, which would seem to bias the results of the study were, for the most part, eliminated at the time of the pretest. The subjects were not placed into any of the three groups until the conclusion of the post tests at the end of the eighth grade. At the time of the pretest, each subject did not know whether he would be involved in athletics or the required physical education classes. Similarly, all students were tested as one group with no prior arrangements as to ability grouping having been made.

When comparing the results attained by the Control Group in the pretest and post test of physical fitness, slight percentile improvement was demonstrated on all test items with the exception of the pull-up test where a negative difference was the result (Table 20). This indicated that the philosophy behind the establishment of the norms according to maturation is correct. Improvement in physical proficiency was to be expected, but this improvement would remain at a constant rate if left to natural maturation.

Experimental Group I demonstrated improvement on all of the seven items of the physical fitness test. The mean difference percentile improvements between the Control Group and Experimental Group I are shown in Table 20.

The analysis of covariance showed the differences to be significant at the .01 level in five of the seven test items (sit-ups, pull-ups, shuttle run, softball throw, and 600-yard run-walk). The question arises, why was there not significant change in the 50-yard dash and standing broad jump tests? This writer feels that the natural physical characteristics of straight ahead speed and leg spring

are the traits least affected by training and coaching. Speed is an inherent quality, and improvement can only be slight. Times may be improved through improvement in starting, but actual improvement in speed would come only from added strength. The shuttle run and 600-yard run-walk do not fit into the same category since the first is a test of agility and quickness, while the 600 is supposedly a test of cardio-respiratory endurance. Together with speed, above-average spring or explosiveness is a characteristic that is found in very few. What improvement was shown was due to better technique and gains in muscular strength.

A comparison of the data collected from the physical fitness pre and post tests for Experimental Group II indicated improvement on all of the test items. Table 20 shows a percentile mean difference improvement comparison between the Control Group and Experimental Group II.

By the analysis of covariance, improvement on all seven test items was shown to be significant at the .01 level of confidence. Those individuals in the athletic group were involved in a one hour physical education class four days a week, as well as a one and a half hour practice session for each sport. This amounted to an average of two and one half hours of physical activity per day. Approximately one half hour to forty-five minutes of this time was devoted directly to the improvement of physical fitness characteristics such as strength, agility, flexibility, and endurance. Much of the remaining time was involved in using these characteristics to improve physical skills. The American Association for Health, Physical Education, and Recreation

together with the President's Council on Youth Fitness, as a part of their physical fitness emphasis, have established the "President's Physical Fitness Emblem." In order to qualify, a boy must pass each of the seven items of the physical fitness test at or above the 85 percentile level. Out of curiosity, this writer checked the fitness levels of the fifteen members of the eighth grade basketball team at the conclusion of the season. Five boys qualified for this award with only one boy scoring below the 50th percentile on any of the seven tests. The mean percentile average on the sit-up test was 100 with the 600-yard run-walk showing a mean average of 91.49. The mean percentile improvement of these fifteen boys on the pull-up test was 37.15 compared to the total Experimental Group II improvement of 15.04 percentile points. These are exceptions, but the importance of athletics as a contributor to the physical fitness levels of the participants cannot be over emphasized.

In a comparison of mean percentile improvements between Experimental Group I and Experimental Group II (Table 20), Experimental Group II showed improvement above that of Experimental Group I in all seven test items.

TABLE 20

MEAN PERCENTILE COMPARISONS OF THE CONTROL GROUP, EXPERIMENTAL GROUP I, AND EXPERIMENTAL GROUP II

	Mean Difference Percentiles of Control Group	Mean Difference Percentiles of Exper. Group I	Mean Difference Percentiles of Exper. Group II
Sit-Up	4.00	22.88	28.63
Pull-Up	-2.35	9.96	15.04
Shuttle Run	1.16	7.44	10.52
Standing Broad Jump	1.85	7.28	11.40
50-Yard Dash	.05	3.90	9.59
Softball Throw	3.57	11.92	13.98
600-Yard Run-Walk	1.68	15.05	21.73

The analysis of covariance method of comparison indicated a significant difference at the .01 level in the pull-up, shuttle run, 50-yard dash, softball throw, and 600-yard run-walk tests. Although Experimental Group II did show improvement over that of Experimental Group I in the sit-up and standing broad jump tests, there was no significant difference indicated at the .01 level of confidence. Athletics were described as the post-graduate work of physical education and the three main physical characteristics of this level are strength, agility, and cardio-respiratory endurance. The three tests, pull-ups, shuttle run, and 600-yard run-walk are the respective tests of these characteristics and all showed significant improvement at the

.01 level of confidence. Because the majority of the subjects that were in Experimental Group II were members of the track team, much of the improvement in the 50-yard dash can be attributed to increases in strength and the development of proper technique in starting as well as a more efficient running style. The city recreation program supports an extensive summer baseball program. For the most part, those in Experimental Group II participated in this program, which, together with significant increases in strength, would account for the improvement demonstrated in the softball throw test. A possible explanation for lack of significant differences between Experimental Groups I and II on the sit-up test was that each group had attained a high mean performance on the post test. Consequently, there was no significant difference in improvement.

The results of this study indicate that physical fitness levels may be improved through programs of competitive athletics or required physical education at the junior high school level. The results of this study also indicate that athletic competition can produce a superior level of physical fitness over the required physical education program. This writer feels that because of the rapid maturation changes that this age level is undergoing, good programs of athletics and physical education have a much greater effect on the improving of the physical fitness levels of the participants than at any other age level.

The writer also feels a certain sense of satisfaction from the fact that on the pretest means for six of the seven test items

Experimental Group I demonstrated a below average mean percentile. On the post test this same group had improved its physical fitness level to above that of the national average.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Restatement of Purpose. The purposes of this study were: (1) to determine the effects of a selected physical education program on the physical fitness levels of the participants, (2) to determine the effects of a year round athletic program on the physical fitness levels of the participants, (3) to compare the levels of physical fitness attained by the physical education and athletic groups with that of a control group whose change was due to normal maturation, (4) to compare the physical education and athletic groups on their levels of physical fitness.

The two hundred and twenty subjects selected for this study were male students at Havre Junior High School, Havre, Montana. The Control Group consisted of students not taking physical education or taking an active part in the athletic program. Experimental Group I included boys taking physical education as a regular required course. In addition they were limited to one sport offered in the athletic program. Experimental Group II consisted of students that actively participated in three of the four competitive sports offered during the school year and were also members of the regular physical education classes.

Each subject, at the beginning of the seventh grade, was tested in accordance with the American Association for Health, Physical Education, and Recreation Youth Fitness Test. The test was given again to each student the final week of his eighth grade year.

Comparisons were made between groups on the pre and post test means of the seven fitness items that composed the Youth Fitness Test. These comparisons were made to determine if the experimental groups had improved to a significant level over that shown by the control group. In addition, within group comparisons were made to determine whether students in each group had improved.

The null hypothesis was assumed for differences between means. An analysis of covariance together with Scheffe's test for multiple comparisons were used to test for differences between groups. The data were arranged and computed through the Computer Center at the University of North Dakota.

Conclusions

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

1. At the junior high level, a program of physical education produced an increase in the physical fitness levels of the participants.

2. Participation in a year round program of competitive athletics resulted in improvement in the physical fitness levels of the participants.

3. Experimental Group II, which participated in both the athletic and physical education programs, improved significantly more than

Experimental Group I at the .01 level on pull-up, shuttle run, standing broad jump, 50-yard dash, and 600-yard run-walk tests.

4. From the data analyzed in this study, physical education instruction contributes to physical fitness and therefore has a definite place in the education curricula.

5. Competitive athletics, at the junior high school level, can and do contribute to the acquisition of an above average fitness level and the maintaining of this level. If one accepts the fact that physical fitness is important to the life of each individual, athletics belong in the school curriculum.

Recommendations

From an interpretation of the data collected for this study, the following recommendations are made:

1. A more intensive study should be made on the changes of specific body types and how they relate to increases or decreases in the physical fitness levels of the subjects.

2. Further investigations should be made in determining the effect of one unit in physical education or one sport in competitive athletics as it contributes to physical fitness at the junior high level.

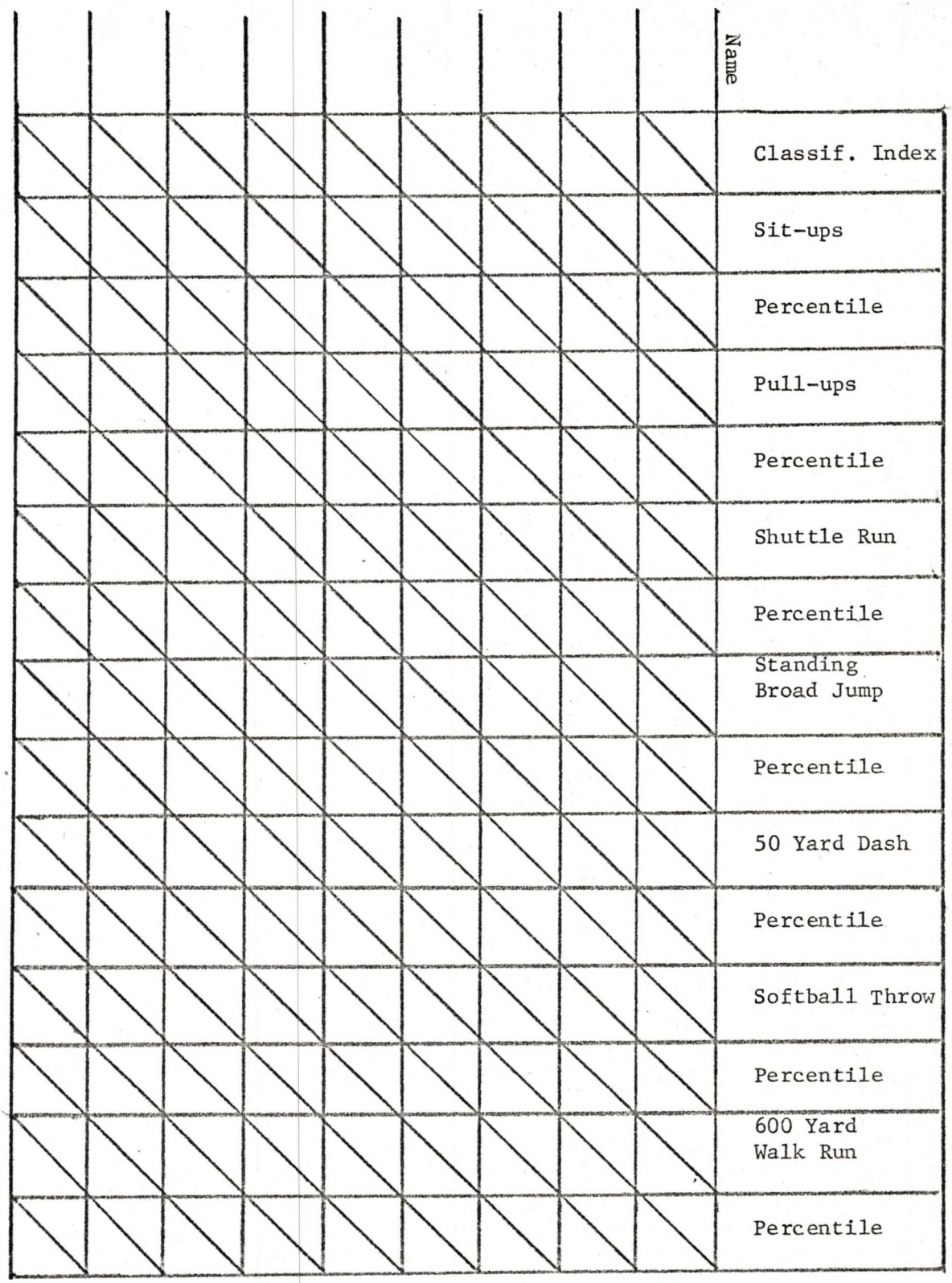
3. That motivation is an important part of physical performance cannot be denied, but how it affects the physical performance of a group such as the control group would make an interesting investigation.

4. It is recommended that further investigation be made into the retention of the physical fitness level attained by Experimental Group II at the time of the post test. Upon entering high school many of

these boys may drop out of competitive athletics and theoretically could lose much of their fitness. But would they still maintain an above average level in the years to come?

5. A re-evaluation of the junior high curriculum at Havre, Montana, is necessary so that physical education is a requirement of all students.

APPENDIX A


Name
Classif. Index
Sit-ups
Percentile
Pull-ups
Percentile
Shuttle Run
Percentile
Standing Broad Jump
Percentile
50 Yard Dash
Percentile
Softball Throw
Percentile
600 Yard Walk Run
Percentile

APPENDIX B

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

SCHEFFE'S "S-TEST"

$$S^2 = \frac{(\bar{X}_i - \bar{X}_j)^2}{Ms_w(\frac{1}{n_i} + \frac{1}{n_j})}$$

This formula is used throughout Appendix B.

$\bar{X}_i$ and $\bar{X}_j$ are the means of the treatment groups being compared.

"n" is the number of the subjects in the subscripted treatment.

Ms_w is the mean square within treatments determined by analysis of covariance.

SIT-UP TEST

$$S^2 = \frac{(57.68 - 59.43)^2}{(340.06)(.0239)}$$

$$S^2 = \frac{(1.75)^2}{8.13}$$

$$S^2 = \frac{3.06}{8.13}$$

$$S^2 = \underline{\underline{.38}}$$

Comparison I
Pre test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Not significant at .01 level

$$S^2 = \frac{(57.68 - 63.19)^2}{(340.06)(.0347)}$$

$$S^2 = \frac{(5.51)^2}{11.80}$$

$$S^2 = \frac{30.36}{11.80}$$

$$S^2 = \underline{\underline{2.57}}$$

Comparison II
Pre test between Control Group and Experimental Group II

Not significant at .01 level

$$S^2 = \frac{(59.43 - 63.19)^2}{(340.06)(.0308)}$$

$$S^2 = \frac{(3.76)^2}{10.47}$$

$$S^2 = \frac{14.14}{10.47}$$

$$S^2 = \underline{\underline{1.35}}$$

Comparison III
Pre test between Experimental Group I and Experimental Group II

Not significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

PULL-UP TEST

$$S^2 = \frac{(1.61 - 1.43)^2}{(2.45)(.0239)}$$

$$S^2 = \frac{(.18)^2}{.0585}$$

$$S^2 = \frac{.0324}{.0585}$$

$$S^2 = .55$$

Comparison I

Pre test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Not significant at .01 level

$$S^2 = \frac{(1.61 - 2.33)^2}{(2.45)(.0347)}$$

$$S^2 = \frac{(.72)^2}{.0850}$$

$$S^2 = \frac{.5185}{.0850}$$

$$S^2 = 6.10$$

Comparison II

Pre test between Control Group and Experimental Group II

Not significant at .01 level

$$S^2 = \frac{(1.43 - 2.33)^2}{(2.45)(.0308)}$$

$$S^2 = \frac{(.90)^2}{.0754}$$

$$S^2 = \frac{.81}{.0754}$$

$$S^2 = 10.74$$

Comparison III

Pre test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

SHUTTLE RUN TEST

$$s^2 = \frac{(111.54 - 111.90)^2}{(8.51)(.0239)}$$

$$s^2 = \frac{(.36)^2}{.2034}$$

$$s^2 = \frac{.1296}{.2034}$$

$$s^2 = .64$$

Comparison I

Pre test between Control Group and Experimental Group I

The s^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Not significant at .01 level

$$s^2 = \frac{(111.54 - 107.85)^2}{(8.51)(.0347)}$$

$$s^2 = \frac{(3.69)^2}{.2952}$$

$$s^2 = \frac{13.61}{.2952}$$

$$s^2 = 46.10$$

Comparison II

Pre test between Control Group and Experimental Group II

Significant at .01 level

$$s^2 = \frac{(111.90 - 107.85)^2}{(8.51)(.0308)}$$

$$s^2 = \frac{(4.05)^2}{.2621}$$

$$s^2 = \frac{16.40}{.2621}$$

$$s^2 = 62.57$$

Comparison III

Pre test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFF'S TEST FOR MULTIPLE COMPARISONS

STANDING BROAD JUMP TEST

$$S^2 = \frac{(64.97 - 64.89)^2}{(25.09)(.0239)}$$

$$S^2 = \frac{(.08)^2}{.5996}$$

$$S^2 = \frac{.0064}{.5996}$$

$$S^2 = \underline{.011}$$

Comparison I
Pre test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Not significant at .01 level

$$S^2 = \frac{(64.97 - 67.45)^2}{(25.09)(.0347)}$$

$$S^2 = \frac{(2.48)^2}{.8706}$$

$$S^2 = \frac{6.15}{.8706}$$

$$S^2 = \underline{7.07}$$

Comparison II
Pre test between Control Group and Experimental Group II

Not significant at .01 level

$$S^2 = \frac{(64.89 - 67.45)^2}{(25.09)(.0308)}$$

$$S^2 = \frac{(2.56)^2}{.7727}$$

$$S^2 = \frac{6.550}{.7727}$$

$$S^2 = \underline{8.48}$$

Comparison III
Pre test between Experimental Group I and Experimental Group II

Not significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFF'S TEST FOR MULTIPLE COMPARISONS

50-YARD DASH TEST

$$S^2 = \frac{(79.36 - 79.29)^2}{(3.79)(.0239)}$$

$$S^2 = \frac{(.07)^2}{.0905}$$

$$S^2 = \frac{.0049}{.0905}$$

$$S^2 = \underline{.054}$$

Comparison I
Pre test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Not significant at .01 level

$$S^2 = \frac{(79.36 - 76.04)^2}{(3.79)(.0347)}$$

$$S^2 = \frac{(3.32)^2}{.1315}$$

$$S^2 = \frac{11.02}{.1315}$$

$$S^2 = \underline{83.80}$$

Comparison II
Pre test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(79.29 - 76.04)^2}{(3.79)(.0308)}$$

$$S^2 = \frac{(3.52)^2}{.1167}$$

$$S^2 = \frac{10.56}{.1167}$$

$$S^2 = \underline{90.49}$$

Comparison III
Pre test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

SOFTBALL THROW TEST

$$S^2 = \frac{(117.44 - 118.27)^2}{(116.35)(.0239)}$$

$$S^2 = \frac{(.83)^2}{2.78}$$

$$S^2 = \frac{.6889}{2.78}$$

$$S^2 = .25$$

Comparison I

Pre test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Not significant at .01 level

$$S^2 = \frac{(117.44 - 132.68)^2}{(116.35)(.0347)}$$

$$S^2 = \frac{(15.24)^2}{4.04}$$

$$S^2 = \frac{232.26}{4.04}$$

$$S^2 = 57.49$$

Comparison II

Pre test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(118.27 - 132.68)^2}{(116.35)(.0308)}$$

$$S^2 = \frac{(14.41)^2}{3.58}$$

$$S^2 = \frac{207.64}{3.58}$$

$$S^2 = 58.00$$

Comparison III

Pre test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

600-YARD RUN-WALK TEST

$$S^2 = \frac{(146.51 - 144.43)^2}{(65.39)(.0239)}$$

$$S^2 = \frac{(2.08)^2}{1.56}$$

$$S^2 = \frac{4.32}{1.56}$$

$$S^2 = \underline{2.77}$$

Comparison I
Pre test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Not significant at .01 level

$$S^2 = \frac{(146.51 - 135.62)^2}{(65.39)(.0347)}$$

$$S^2 = \frac{(10.89)^2}{2.27}$$

$$S^2 = \frac{118.59}{2.27}$$

$$S^2 = \underline{52.19}$$

Comparison II
Pre test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(144.43 - 135.62)^2}{(65.39)(.0308)}$$

$$S^2 = \frac{(8.81)^2}{2.01}$$

$$S^2 = \frac{77.61}{2.01}$$

$$S^2 = \underline{38.62}$$

Comparison III
Pre test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

SIT-UP TEST

$$S^2 = \frac{(67.94 - 84.33)^2}{(340.060)(.0239)}$$

$$S^2 = \frac{(16.39)^2}{8.13}$$

$$S^2 = \frac{268.63}{8.13}$$

$$S^2 = \underline{\underline{33.04}}$$

Comparison I

Post test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Significant at .01 level

$$S^2 = \frac{(67.94 - 91.82)^2}{(340.06)(.0347)}$$

$$S^2 = \frac{(23.88)^2}{11.80}$$

$$S^2 = \frac{570.25}{11.80}$$

$$S^2 = \underline{\underline{48.33}}$$

Comparison II

Post test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(84.33 - 91.82)^2}{(340.06)(.0308)}$$

$$S^2 = \frac{(7.49)^2}{10.47}$$

$$S^2 = \frac{56.1}{10.47}$$

$$S^2 = \underline{\underline{5.36}}$$

Comparison III

Post test between Experimental Group I and Experimental Group II

Not significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

PULL-UP TEST

$$S^2 = \frac{(2.22 - 3.21)^2}{(2.45)(.0239)}$$

$$S^2 = \frac{(.99)^2}{.0585}$$

$$S^2 = \frac{.9801}{.0585}$$

$$S^2 = \underline{16.75}$$

Comparison I

Post test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Significant at .01 level

$$S^2 = \frac{(2.22 - 4.54)^2}{(2.45)(.0347)}$$

$$S^2 = \frac{(2.32)^2}{.085}$$

$$S^2 = \frac{5.38}{.085}$$

$$S^2 = \underline{63.29}$$

Comparison II

Post test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(3.21 - 4.54)^2}{(2.45)(.0308)}$$

$$S^2 = \frac{(1.33)^2}{.0754}$$

$$S^2 = \frac{1.7689}{.0754}$$

$$S^2 = \underline{23.46}$$

Comparison III

Post test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

SHUTTLE RUN TEST

$$S^2 = \frac{(107.40 - 105.62)^2}{(8.51)(.0239)}$$

$$S^2 = \frac{(1.78)^2}{.2034}$$

$$S^2 = \frac{3.17}{.2034}$$

$$S^2 = \underline{\underline{15.58}}$$

Comparison I

Post test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Significant at .01 level

$$S^2 = \frac{(107.40 - 103.89)^2}{(8.51)(.0347)}$$

$$S^2 = \frac{(3.51)^2}{.2952}$$

$$S^2 = \frac{12.32}{.2952}$$

$$S^2 = \underline{\underline{41.74}}$$

Comparison II

Post test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(105.62 - 103.89)^2}{(8.51)(.0308)}$$

$$S^2 = \frac{(1.73)^2}{.2621}$$

$$S^2 = \frac{2.99}{.2621}$$

$$S^2 = \underline{\underline{11.41}}$$

Comparison III

Post test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

STANDING BROAD JUMP TEST

$$s^2 = \frac{(70.67 - 72.55)^2}{(25.09)(.0239)}$$

$$s^2 = \frac{(1.88)^2}{.5996}$$

$$s^2 = \frac{3.53}{.5996}$$

$$s^2 = \underline{\underline{5.89}}$$

Comparison I

Post test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Not significant at .01 level

$$s^2 = \frac{(70.67 - 74.85)^2}{(25.09)(.0347)}$$

$$s^2 = \frac{(4.18)^2}{.8706}$$

$$s^2 = \frac{17.47}{.8706}$$

$$s^2 = \underline{\underline{20.07}}$$

Comparison II

Post test between Control Group and Experimental Group II

Significant at .01 level

$$s^2 = \frac{(72.55 - 74.85)^2}{(25.09)(.0308)}$$

$$s^2 = \frac{(2.30)^2}{.7727}$$

$$s^2 = \frac{5.29}{.7727}$$

$$s^2 = \underline{\underline{6.85}}$$

Comparison III

Post test between Experimental Group I and Experimental Group II

Not significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

50-YARD DASH TEST

$$S^2 = \frac{(75.36 - 74.47)^2}{(3.79)(.0239)}$$

$$S^2 = \frac{(.89)^2}{.0905}$$

$$S^2 = \frac{.7921}{.0905}$$

$$S^2 = \underline{8.75}$$

Comparison I
Post test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.
Not significant at .01 level

$$S^2 = \frac{(75.36 - 71.23)^2}{(3.79)(.0347)}$$

$$S^2 = \frac{(4.13)^2}{.1315}$$

$$S^2 = \frac{17.06}{.1315}$$

$$S^2 = \underline{129.73}$$

Comparison II
Post test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(74.47 - 71.23)^2}{(3.79)(.0308)}$$

$$S^2 = \frac{(3.24)^2}{.1167}$$

$$S^2 = \frac{10.49}{.1167}$$

$$S^2 = \underline{89.74}$$

Comparison III
Post test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

SOFTBALL THROW TEST

$$S^2 = \frac{(139.29 - 147.53)^2}{(116.35)(.0239)}$$

$$S^2 = \frac{(8.24)^2}{2.78}$$

$$S^2 = \frac{67.89}{2.78}$$

$$S^2 = \underline{\underline{24.42}}$$

Comparison I

Post test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Significant at .01 level

$$S^2 = \frac{(139.29 - 164.23)^2}{(116.35)(.0347)}$$

$$S^2 = \frac{(24.94)^2}{4.04}$$

$$S^2 = \frac{622.00}{4.04}$$

$$S^2 = \underline{\underline{153.96}}$$

Comparison II

Post test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(147.53 - 164.23)^2}{(116.35)(.0308)}$$

$$S^2 = \frac{(16.70)^2}{3.58}$$

$$S^2 = \frac{278.89}{3.58}$$

$$S^2 = \underline{\underline{77.90}}$$

Comparison III

Post test between Experimental Group I and Experimental Group II

Significant at .01 level

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS USING SCHEFFE'S TEST FOR MULTIPLE COMPARISONS

600-YARD RUN-WALK TEST

$$S^2 = \frac{(132.13 - 125.51)^2}{(65.39)(.0239)}$$

$$S^2 = \frac{(6.62)^2}{1.56}$$

$$S^2 = \frac{43.82}{1.56}$$

$$S^2 = \underline{28.09}$$

Comparison I
Post test between Control Group and Experimental Group I

The S^2 value with 218 degrees of freedom = 9.42 at the .01 level of confidence.

Significant at .01 level

$$S^2 = \frac{(132.13 - 120.55)^2}{(65.39)(.0347)}$$

$$S^2 = \frac{(11.58)^2}{2.27}$$

$$S^2 = \frac{134.09}{2.27}$$

$$S^2 = \underline{59.07}$$

Comparison II
Post test between Control Group and Experimental Group II

Significant at .01 level

$$S^2 = \frac{(125.51 - 120.55)^2}{(65.39)(.0308)}$$

$$S^2 = \frac{(4.96)^2}{2.01}$$

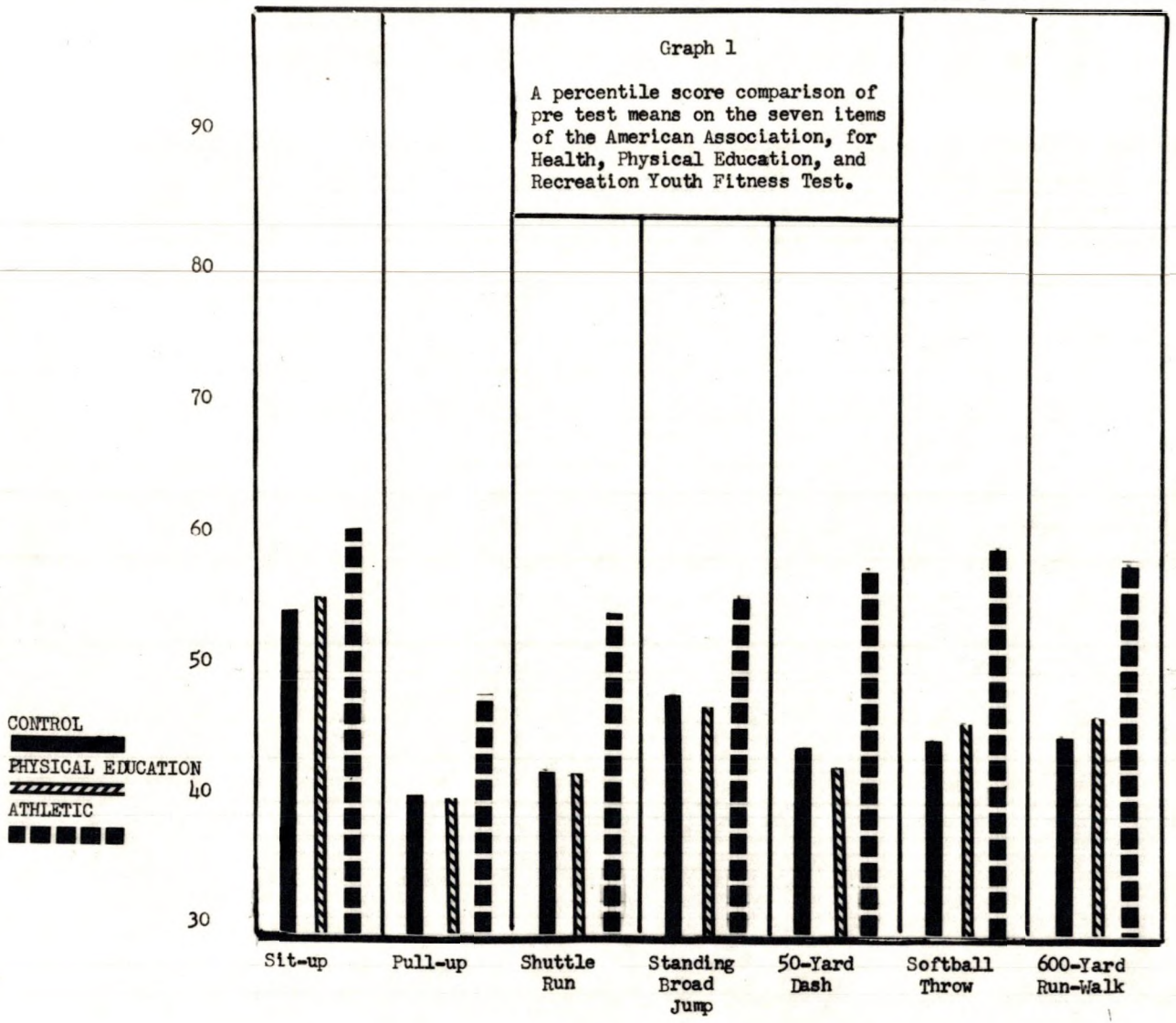
$$S^2 = \frac{24.60}{2.01}$$

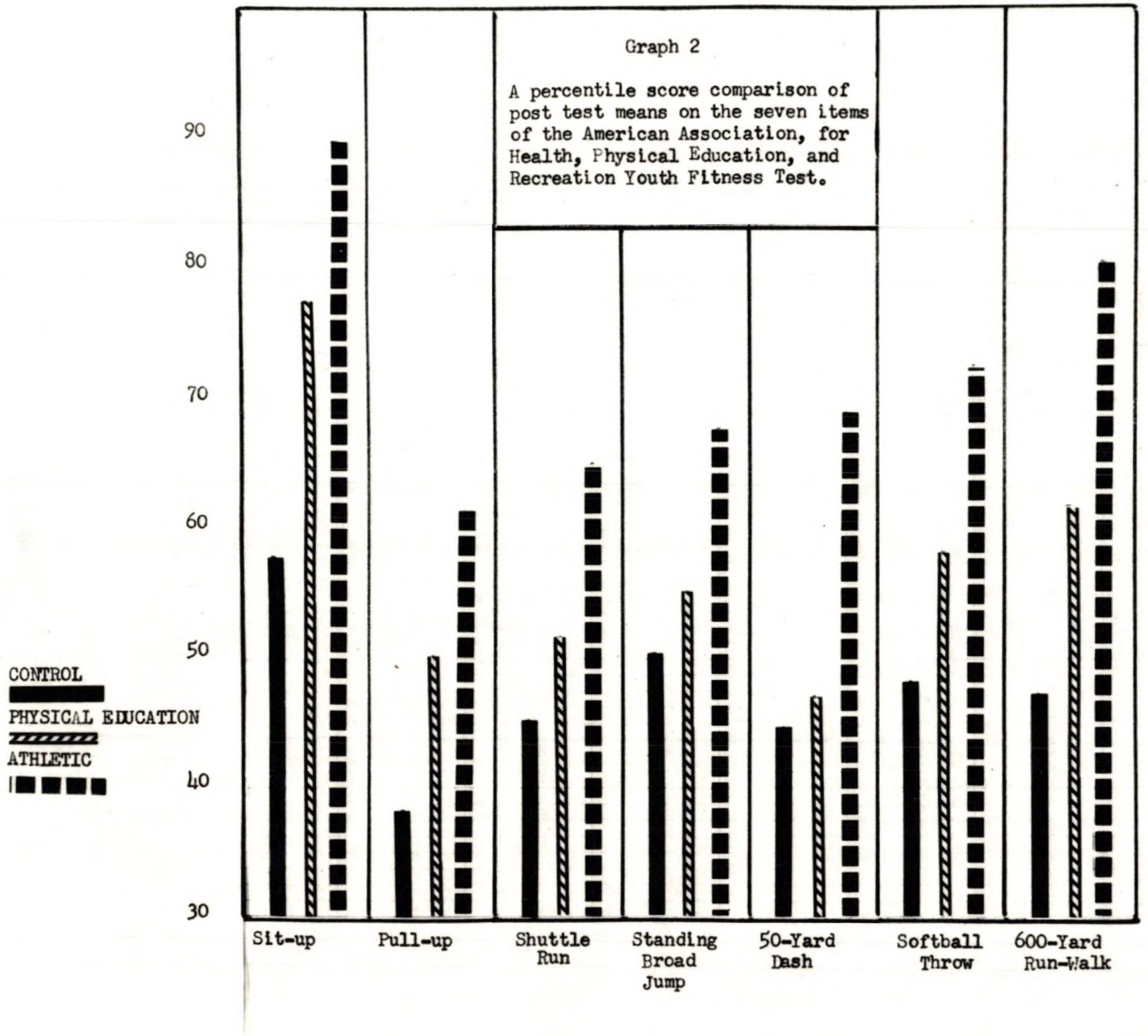
$$S^2 = \underline{12.24}$$

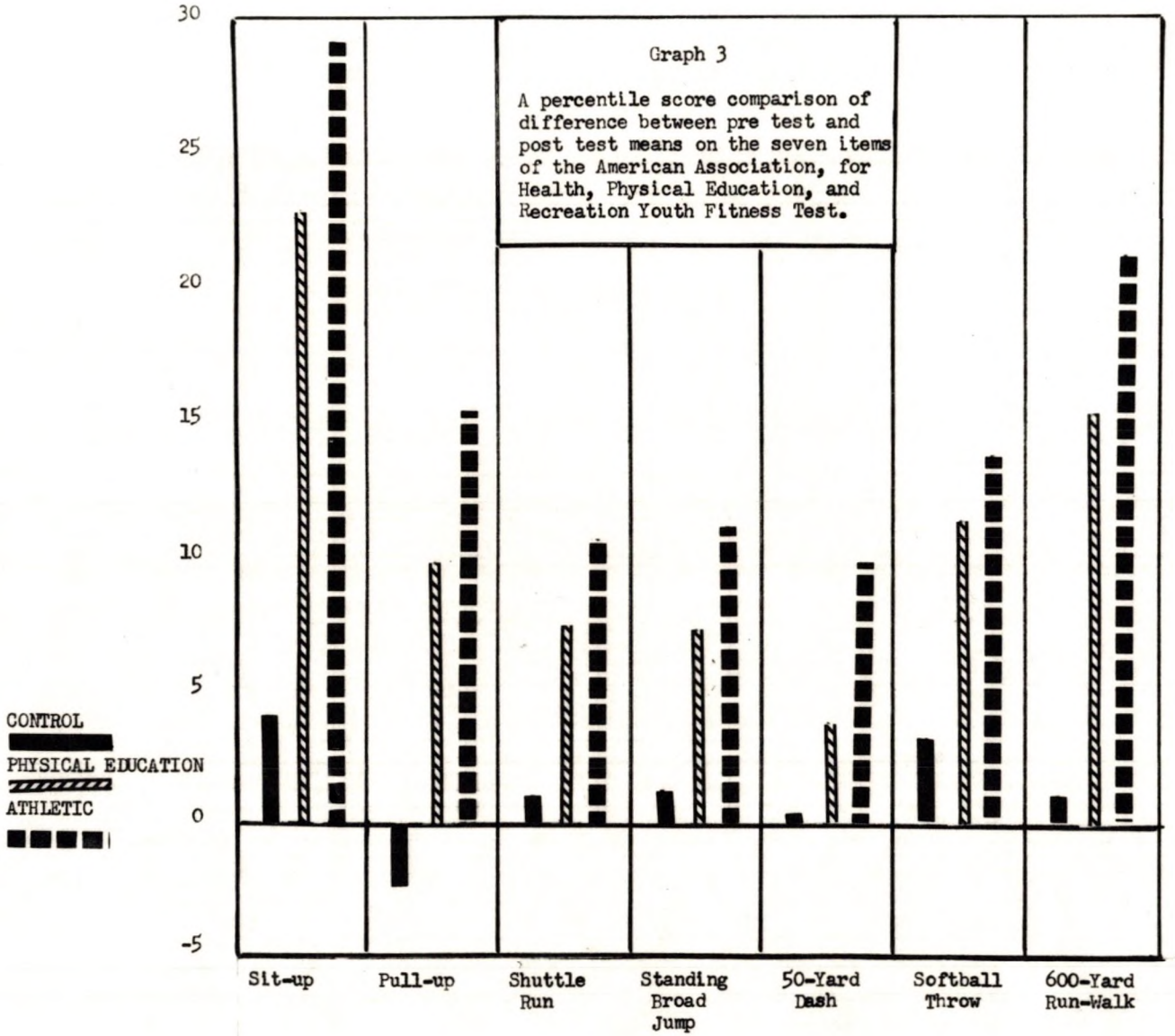
Comparison III
Post test between Experimental Group I and Experimental Group II

Significant at .01 level

APPENDIX C


Graph 1
A percentile score comparison of pre test means on the seven items of the American Association, for Health, Physical Education, and Recreation Youth Fitness Test.
90
80
70
60
50
40
30
CONTROL
PHYSICAL EDUCATION
ATHLETIC
Sit-up
Pull-up
Shuttle Run
Standing Broad Jump
50-Yard Dash
Softball Throw
600-Yard Run-Walk


Graph 2
A percentile score comparison of post test means on the seven items of the American Association, for Health, Physical Education, and Recreation Youth Fitness Test.
90
80
70
60
50
40
30
CONTROL
PHYSICAL EDUCATION
ATHLETIC
Sit-up
Pull-up
Shuttle Run
Standing Broad Jump
50-Yard Dash
Softball Throw
600-Yard Run-Walk



Graph 3

A percentile score comparison of difference between pre test and post test means on the seven items of the American Association, for Health, Physical Education, and Recreation Youth Fitness Test.

APPENDIX D

THE PHYSICAL EDUCATION PROGRAM

The physical education curricula, offered at Havre Junior High School, during the time this study was made, operated on a two semester basis with each semester being eighteen weeks. All students, with the exception of those described under the control group, were required to attend. The physical education classes met four times weekly. Each class period was one hour in length.

Each class period was broken down into the following time intervals:

1. Dressing - 5 minutes
2. Calisthenics - 10-15 minutes
3. Activity - 30-35 minutes
4. Shower and dressing - 10 minutes

At the opening of each class session, when possible, a 10-15 minute period of formalized and semi-formalized calisthenics was used. During certain activities the calisthenic period was shortened or dropped because of facilities or structure of the unit.

The calisthenic items used in the physical education program were:

1. Side straddle hops
2. Pushups
3. Situps
4. Leg raisers
5. Alternate toe touches
6. Burpees

7. Leg Stretchers
8. Thigh Stretchers
9. Individual isometrics
10. Buddy isometrics
11. Obstacle run
12. Bench jump

All these exercises were not performed during each period. It was up to the student leader for the day as to which were performed. As the year progressed the repetitions for each selected exercise were increased. Also variations were added which increased the difficulty of the exercises.

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

1. Touch football. This activity was a six week unit. During this unit the students had to run 5 city blocks to and from the activity field. Part of this unit was devoted to related games such as speedball, crab ball, flag ball, and razzle dazzle.
2. Gymnastic and weight training unit. This activity was a six week unit. Part of this unit included methods and exercises in weight training. The gymnastic portion was conducted in circuit training fashion with trampoline, side horse, horizontal bar, etc. serving as stations. So much time was alloted to each station.
3. Volleyball. This activity was a three week unit. During this activity, the maximum 15 minute calisthenic period was used

and the remaining time was spent working on the fundamentals in the activity itself.

4. Basketball. This activity was a three week unit. The maximum 15 minute calisthenic period was used, with the remaining time devoted to fundamentals as well as the activity itself. Also included were several variations of the game.
5. Dancing. This activity was a three week unit. Included were modern, folk, and native dances.
6. Physical fitness unit. This was a three week unit. Included were various methods of achieving physical fitness. In addition to the how of the activity the why was stressed. Little experiments in physical training and conditioning were also included.
7. Wrestling. This was a three week unit. Considerable time was spent on physical conditioning of the body as well as agility and speed. Some time each day was spent in actual competitive wrestling.
8. Game and relay unit. Various games and relays were included as a part of this activity unit. The majority of the games and relays included some form of physical conditioning.
9. Soccer. This activity was a three week unit. The first 5-10 minutes were spent in conditioning for the skills that are required of this unit. Fifteen minutes of each class period were devoted to fundamental skills. The remaining time was spent on the activity.

10. Softball. This activity was a three week unit. Fifteen minutes of each period were spent on the basic skills involved with the remaining time devoted to the activity. The final week was coeducational.

THE ATHLETIC PROGRAM

Football

The football program for the Havre Junior High School started the first week of school in the fall, and ran for eight consecutive weeks. The first two weeks were concerned mainly with conditioning. The total number of practices was about thirty with six regularly scheduled games. The practice sessions were about one hour and thirty minutes in length. This time was divided into four phases: (1) Ten to twelve minutes of conditioning. Exercises performed were: push-ups, sit-ups, leg stretchers, jumping jacks, grass drills, paired isometrics, agility drills, and crabbing drills. Also included were ten 15 yard sprints as well as a 300 yard run. (2) Individual drills on technique and basic fundamentals of blocking, tackling, throwing, catching, running, kicking, etc. (3) Group and team drills. (4) Scrimmaging followed by wind sprints or hill runs. Following the end of practice those desiring extra work could stay for an extra 15 minutes.

Basketball

The basketball program started the third week in November and continued through the last week in February. Practice sessions were held daily throughout the week and were usually one hour and fifteen minutes in length. The first week was spent in selecting the fifteen members of the seventh grade team. The first ten minutes of each practice were devoted to conditioning. This included an endurance run over an obstacle course followed by basketball sprints. Prior to each

practice session each player was required to do fifty fingertip push-ups and two hundred jumps with a jump rope. Practice sessions included a variety of basketball drills which developed fundamentals of the game and, at the same time, conditioned the players. Fifteen to twenty minutes each day were devoted to scrimmage and or scrimmage like drills. All practice sessions were finished with a short conditioning period. Those wishing extra work were allowed to stay for ten additional minutes. A typical practice session would be as follows:

Prior to each practice a player was to do a minimum of fifty fingertip push-ups and two hundred jumps with the jump rope.

10 minutes - Endurance run followed by basketball sprints.

15 minutes - Shooting drills, lay-ups, jump shots, etc.

10 minutes - Fast break drills, full court drills.

10 minutes - Defensive drills.

15 minutes - Half court work on installing and perfecting team offense and defensive techniques.

15 minutes - Full court scrimmage.

5 minutes - Sprint conditioning.

Post practice - 10 to 15 minutes of extra individual work or free throw shooting.

Heavy practice sessions were usually held four days a week with a light workout the day before the game.

Wrestling

The wrestling season was from the middle of February to the last week in March for a total of six weeks. Practice sessions were one and a half hours in length with the first half hour being devoted

to conditioning exercises and drills. Thirty minutes each day was then spent on the learning of new techniques and individualized instruction. Five to ten minutes was then spent on all out wrestling for each boy with this time increasing as the season progressed. Two dual meets, the regional, and state meets were included as a part of the season.

Track

The track season begins the second week in April and continues until the last week in May. If the weather allows the practices are held outside (usually the first two weeks are spent in the gym). Each practice session is one and a half hours in length. Everyone runs opening sprints and takes the required half mile lap. Individual exercises are a part of loosing up for each man. Thirty to forty minutes each day are devoted to individual events. Each man is given a workout sheet he is to follow for his particular event or events. Each day is concluded with time trials or relays in which everyone participates. Since the track season is so short we hopefully have three meets a season.

Intramurals

The Havre Junior High School conducts an intramural program which includes basketball and volleyball in the winter and softball and soccer in the spring. Each activity meets twice a week with part of the time devoted to instruction in fundamentals and the remainder given to a schedule of games. Very little time is given to conditioning as such for the activity.

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