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An Empirical Study to Determine the Effect of a Physical Fitness Program on Academic Achievement and Reading Ability

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AN EMPIRICAL STUDY TO DETERMINE THE EFFECT OF A PHYSICAL FITNESS PROGRAM ON ACADEMIC ACHIEVEMENT AND READING ABILITY

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AN EMPIRICAL STUDY TO DETERMINE THE EFFECT OF A PHYSICAL FITNESS PROGRAM ON ACADEMIC ACHIEVEMENT AND READING ABILITY

CHAPTER I

THE PROBLEM AND DEFINITION OF TERMS USED

The question of the relationship of physical fitness and academic achievement has never been adequately answered although there does appear to be some scientific evidence that the two are positively related. Some investigators believe that when one feels well physically, one is able to function better on a higher academic level (28:11-12).

Recently, studies have indicated that the type of movement experiences a young child may have had can influence his academic achievement. As physical exercise contributes to the physical fitness level and to a child's social and emotional adjustments, it also enables him to succeed well academically (17:443-445).

> Cowell and Ismail studied the results of motor aptitude tests and academic success and found that measures of coordination and balance were good predictors of academic achievement (28:12).

Recently there has been much concern about health and fitness since children from other countries have surpassed American children on some fitness tests. Much study and research has taken place to expand our knowledge of the effects of a poor fitness level, the importance of fitness,

and the value of a good physical education program to physical fitness.

> Hein and Ryan analyzed and assessed over one hundred clinical and research studies concerning the contributions of physical activity to physical health. They cite the following points as the values of physical exercise:
>
> 1. Maintenance of desirable weight, thereby indirectly reducing the possibility of degenerative diseases and a shorter life span associated with overweight
>
> 2. Improvement of health and the cardiovascular system
>
> 3. Preservation of the physical characteristics of youth and the accompanying psychological effects which exact a favorable influence on prolonging life
>
> 4. Enablement of the individual to meet emergencies more effectively and thus help to preserve health and to avoid disabilities. The habits of exercise if developed in childhood will lead to the enjoyment of these benefits, valuable at any age (28:8-9)

Thus physical exercise is a necessary part of living if a person is to enjoy all the benefits of a happy and fruitful life.

I. THE PROBLEM

Statement of the Problem

The purpose of this study was to determine the measured effect of a physical fitness program on reading ability and academic achievement among sixth grade boys and girls.

An experimental and a control group were comprised

of sixth grade students were selected. At the beginning of the study both groups were given a Washington State Physical Fitness Test, Metropolitan Achievement Test, and a Gates-MacGinitie Reading Test. Different forms of the Metropolitan and Gates tests were given at the end of the study.

Both groups were engaged in a physical education program for twenty minutes per day, four days per week with the control group engaging in a normal physical education program.

The experimental group received a fitness program conducted on a circuit-interval basis where each student rotated through five different stations, participating in a different exercise at each station.

The criterion used for academic achievement and reading ability was the difference between the beginning scores and the concluding scores of the Metropolitan Achievement and Gates-MacGinitie Reading Tests. Physical fitness was the difference between the beginning scores and the concluding scores measured by the Washington State Physical Fitness Test, 1966 Revision.

The Hypothesis Tested

Good physical fitness brought about through a structured physical education program for sixth grade students

will result in no significant gains in academic achievement and reading ability.

Importance of the Study

Public interest in physical fitness in the United States has increased since the concern of President Eisenhower during his administration and the continued emphasis by President Kennedy (8:3,5). Unfortunately most of this interest has been for the achievement of youth in physical fitness tests and athletic contests. The taxpayers supporting the school programs must be made more aware of all the benefits of physical fitness. A good physical education program not only results in more physically fit boys and girls but also results in such additional benefits as developing stamina for sustained strenuous activity and promoting an overall feeling of well being, good social adjustment and mental alertness. Studies supporting this view are cited by Harrison Clarke:

> A number of researches support the belief that physical fitness is related to mental accomplishments, especially as affecting mental alertness. . . . These studies indicate that the individual is more prone to be mentally alert, to be vigorous in his applications, and to suffer less from efficiency-destroying fatigue when he is fit than when he is unfit (4:106).

The question arises, then, whether there may not be some relationship between academic achievement, reading ability, and physical fitness.

Limitations of the Study

This study was limited to all the sixth grade students at Park Orchard Elementary School, Kent, Washington, who were already enrolled at the beginning of the school year, with the exception of those with physical handicaps or doctors' authorizations excusing them from the program.

The Metropolitan Achievement Test was the only criterion used to measure academic achievement. The Gates-MacGinitie Reading Test was the only criterion used to measure reading ability.

Physical fitness was determined by the sum of the scores achieved on the Washington State Physical Fitness Test.

II. DEFINITION OF TERMS USED

Academic Achievement

Academic achievement is the average of grade level scores on the ten test items of the Metropolitan Achievement Test.

Reading Ability

Reading ability is the average of grade level scores on the comprehension and vocabulary sections of the Gates-MacGinitie Reading Test.

Physical Fitness

> . . . it is a reflection of your ability to work with vigor and pleasure, without undue fatigue, with energy left for enjoying hobbies and recreational activities, and for meeting unforeseen emergencies. It relates to how you look and how you feel---and, because the body is not a compartment separate from the mind, it relates to how you feel mentally as well as physically (1:5).

III. SUMMARY

It is the purpose of this investigation then to test the hypothesis that physical fitness brought about through a structured physical education program will have no measured effect on academic achievement and reading ability. There will follow a review of the literature showing the importance of physical fitness to the human organism and some literature supporting both positive and negative relationships between these factors. The procedures used to promote the fitness of the subjects and the tests used to measure academic achievement and reading ability will be described. The data from these measurements will be analyzed as a basis for testing the hypothesis and for making recommendations for further investigations.

CHAPTER II

REVIEW OF THE LITERATURE

Importance of Physical Fitness

In order to survive, primitive man had to maintain a high level of bodily development and conditioning in order to carry out his life processes. He had to be able to hunt, fish, and fight his enemies in order to survive. This need to develop strength and endurance has been recognized as a requirement for living down through the ages (4:1).

In ancient Greece and Rome, physical activity was even more fully developed as a part of the culture of the people. "The Greeks attempted to relate the skills and practice of athletic activities to the prevailing mode of life at the time (27:6)." Principally athletics were used to prepare youth for war. This use has continued throughout the succeeding centuries right down to the present (27:5-6).

With the gradual decay of the early empires, sport and physical education became professional, gambling was introduced, and the emphasis on physical education as an instrument for the training of youth slowly declined. This led to the virtual abolition of all planned physical activity during the Dark Ages, and the development of spirit and mind became all important. In the seventeenth century in our own colonies the church deemed all sport and dancing

as evil (27:8).

It was not until the nineteenth century that a physical education program developed in the United States.

> The first two school and college gymnasia, both of them outdoors, were opened in 1825 at the Round Hill School, Northampton, Massachusetts, and in 1826 at Harvard University. They were headed by two well-trained Germans, Charles Beck and Charles Follen. The apparatus, activities and methods were exact transplants from the Jahn system. During these early days, the German system of gymnastics had the most energetic promotion and greatest acceptance in this country (4:4).

Still, the idea of physical fitness never really caught on in the United States. In the early pioneering days, the people stayed robust and healthy as a consequence of their normal day to day activities and the schools did not find it necessary to promote physical development as part of the curriculum.

Ironically, it took the tragic lesson of World War I, when many men were found physically unfit to defend our nation against a powerful German enemy, to awaken the leadership of this country to include physical education in American schools (4:6).

> Prior to this time . . . Only two states, North Dakota and Idaho had state laws requiring this subject in their schools. By 1932, however, 36 states representing 90 per cent of the population, had enacted such laws. In 1948, all but eight states had statutes requiring physical education in their schools (4:6).

Still, physical education in this country did not emphasize fitness for the sake of the individual. Schools

allowed physical education programs to emphasize games and competition rather than physical fitness (8:6).

Lack of fitness in American children became evident when Kraus and Herschland disclosed their findings on the Kraus-Weber Test comparing the physical fitness of American children with that of European children.

> In 1955, Kraus and Hirschland published statistics showing that United States children had a great many more failures than did Italian, Switzerland, and Austrian children on the Kraus-Weber Test of Minimum Muscular Fitness. With this disclosure . . . President Dwight D. Eisenhower . . . treated with respect and concern the Kraus-Hirschland findings. Executive action followed with the establishment of a President's Council on Youth Fitness and a President's Citizens' Advisory Committee (4:16).

Subsequent to the interest in physical fitness aroused by the Kraus-Hirschland study, researchers produced studies showing that a program in physical education should progress from a "throw out the ball" philosophy to a program of individual fitness. It should also stress the other benefits of health such as the biological, psychological, and social needs of children (8:6-7).

The case for physical fitness from a biological standpoint has been studied and written about in great detail. Thousands of studies have shown the relationship of biological fitness to longevity. Dr. Paul Dudley White, an authority on exercise and the circulatory system, states

> Exercise of the muscles is as essential to the health of a mammal, including man, as is eating, sleeping, and

> the use of the brain. It is a great physiological aid to the circulation of blood. . . . It also has a beneficial psychological effect, serving as an excellent antidote for emotional stress and insomnia. And finally, it acts in some way, still to be elucidated, apparently biochemically, in retarding and even preventing atherosclerosis in young and middle-aged men (35:11-12).

The relationship of physical exercise to the psychological aspect of children is less well known. It is generally considered that if a person is more fit, his circulatory system functions at a higher level and thus his brain and nervous system work more efficiently. The whole bodily process improves and the body develops greater resistance to stress.

Other psychological benefits of exercise include reduced tension and fatigue (29:315-316). In a report released by the Mayo Clinic sometime ago, sleep seldom relieves chronic fatigue. Some five to ten per cent of all patients who reported to the clinic suffered from a chronic type of fatigue that produced a tense and anxious state of mind (7:32).

> It was found that buoyant energetic health . . . resulted from a program of physical exertion.
>
> The cumulative effect of these various benefits of exercise is very often a marked improvement in a person's mental state (7:32).

Physical fitness can also contribute to a number of social experiences which are favorable to the acquisition and development of attitudes of confidence. A person

becomes conscious of his capabilities because of his successes and the encouragement he receives. Thus, a person finds opportunities for success that are likely to improve his security feelings, his self-confidence, and his self-knowledge. The mastery of the body acquired through physical education strengthens a person's feelings of security and even influences the control of his emotions (10:39).

In a study undertaken in France, the contribution of physical activity to the cultural development of children was demostrated in a special experiment with eleven-year-olds.

> A comparison was made between the present "normal" course of study with 2½ hours of recreation and one hour of physical education per week, and a special course with 12 hours of varied physical activities per week (9:13).

The morpho-physiological gains in the children taking the special course were significant and

> Psychologically and morally, the difference in the children was significant; and, intellectually, they were at least as good as those children following the normal course of study (9:13).

Bud Wilkinson, speaking in his capacity as Consultant to the President on Physical Fitness, points up the importance of physical fitness to the total well-being of the individual when he states:

> We can't do anything about the genes we inherit that govern so many of our characteristics. We can improve our basic intelligence a little bit with some hard work, and we can do a reasonable amount with our emotional

> adjustments. But unless you are part of an extremely small minority that has a serious physical disability, exercise is one way that you can improve yourself dramatically, no matter what your age, no matter how out of shape you may be (36:15).

Relationship of Physical Fitness to Academic Achievement

Positive Studies. A number of studies have been carried out in the United States attempting to establish the relationship of physical fitness to scholastic success (9:13).

A well known and important study in this field was done by Lloyd O. Appleton (2:31,82) on the relationship between physical ability and success at the United States Military Academy. He checked the fitness scores and scholastic records of 1,062 cadets in their freshman year, 870 of whom went on to graduate, and concluded that there was a positive relationship of physical ability to scholastic achievement for those students who remained in the Academy for a year or longer.

Many researchers have conducted studies attempting to link physical fitness with academic achievement as a predictive factor in the success of students in college.

In 1964, Marcia E. Hart and Clayton T. Shay (17: 444-445) made a study attempting to determine whether there was any relationship of physical fitness to academic achievement of women at Springfield College. This study was

limited to sixty women which consisted of twenty-four physical education majors, eighteen teacher education students, eleven recreation majors, and seven general-studies students. Each student was tested at both the beginning and end of her freshman year. All students carried the same college load, ten semester hours per term. They concluded that although physical fitness is not a general predictor of success in college, it is high enough to be considered as a necessary factor in the general education of the college student.

Another college study was made by Robert John Weber. The purpose of this study as it applies here was

> to investigate the relationship between physical fitness as measured by the Iowa Physical Efficiency Profile and success in school as measured by academic grades at the State University of Iowa (34:471).

The subjects used in this study consisted of 246 male freshmen who took physical education as a required course. There was a significant relationship between physical fitness scores and grade point averages for a year. "This finding indicates that good fitness as measured, tended to accompany, fairly well, achievement of academic success during the year for the subjects studied (34:473)." They go on to state, "It is possible that physical fitness should be given consideration when one attempts to predict academic success for entering male freshmen (34:474)."

Paul Kemp (20:24,29) studied the achievement of 296 successful and non-successful athletes who were on one or more freshmen athletic teams and concluded that successful athletes had higher grade point averages and stayed in school longer than non-successful athletes.

At the high school and junior high school level, the bulk of the research has also indicated that there is a positive relationship of fitness to academic achievement.

Garland L. McCollum (22:18,30) conducted a study comparing academic achievement of fifty-six physically fit and physically unfit male high school students. He concluded that fit students make better grades than do unfit students.

John G. Gregor (14:19,34) studied the relationship of physical fitness to academic success using 106 eighth grade boys at Whatcom Junior High School in Bellingham, Washington, computing correlations between "(1) grade point average and intelligence quotient; (2) grade point average and physical fitness index; (3) intelligence quotient and physical fitness index (14:19)." He found that the correlation between physical fitness and grade point average was very significant (.676) and his study indicated that physical fitness is a more important factor in determining grade point average than the intelligence quotient.

In a closely controlled study by Harrison Clark and Boyd Jarman (3:155-162), the relationship of scholastic

achievement to certain growth and physical measures was investigated. The subjects in this study were 217 white male students in the public schools in Medford, Oregon. The students were selected at random and broken down into 73 boys at nine years of age, 75 boys at twelve years of age, and 69 at fifteen years of age.

This study used an experimental design that consisted of forming a series of high and low groups of 20 boys picked on the basis of three strength and two growth measures. These groups were equated by the use of intelligence quotients. A contrast of the means of the groups were computed and the means were tested for significance.

It was found that there was a consistent tendency for the higher groups to have higher means on grade point averages and on academic achievement tests although there was not always a significant difference between means. It was significant to this study that the biggest mean difference was found between academic achievement measures and the Physical Fitness Index. For the different ages, least significance was found among the experimental variables at twelve years of age with the Physical Fitness Index only showing significance when it was applied to grade point averages.

In a related study, Boyd Jarman (19:2,34) studied 109 fifteen-year-old boys in the public schools of Medford,

Oregon, and found a positive relationship between scholastic ability and physical fitness.

It also appears that in those studies where girls are the subjects, the same conclusions are reached. Betty Jo McMillen (23:68-69) studied 339 girls in grades eight through twelve at Southwestern Central School, Jamestown, New York, to determine the relationship of physical fitness to the academic index of high school girls. This study found that using top and bottom quarters of the academic index distribution, a "t" of 2.11 (.05) indicated a higher level of physical fitness of those in the top quarter than of those in the bottom quarter.

In a study where a fitness test was given to 264 girls at Holman Junior High School, St. Ann, Missouri, Dorothy Meeks (24:36-37) established two groups using 27 girls who scored highest in the fit group and 27 girls who scored lowest in the unfit group. Her conclusions were that the physically fit girls achieved better grades, were better accepted and had better personalities than the unfit girls.

Shirley Mae Oakes (26:2,32-34) studied the relationship of physical fitness to success using grade point average as a measure of academic achievement. She used 116 seventh grade girls in Springstowne Junior High School in Vallejo, California, and found a positive relationship between physical fitness and academic success.

Few studies have been done in this area at the elementary school level. One was conducted by John Coefield (5:127) who examined the relationships between the academic achievement and maturity, physical and personality measures of twelve-year-old boys in the sixth grade at Medford, Oregon. Grade point averages plus Stanford Scholastic Achievement Tests were used as criteria for academic achievement. Significant correlations were found between scholastic achievement and physique type components and Roger's Law and mental ability.

An older study by J. C. Seegers and Otto Postpichal (30:104-109) on the relationship between intelligence and physical ability was conducted on 656 boys in two special schools in Philadelphia in 1936. They concluded that correlations between intelligence and scores in some athletic events were positive but too low to be used as a predictive tool. They also found that the correlations were higher for those events which involved more coordination and where more muscle groups were involved. These facts indicated a definite correlation between positive attributes of intelligence as measured in the study and physical ability. It was also found that brighter boys achieved better scores on the five test items of athletic ability.

Of significance to the present study is research

done in the related area of motor ability by Barbara Godfrey (13:65-66). Her article on motor therapy and school achievement indicates a definite relationship between these two factors. A program was begun by the Department of Physical Education for Women at Purdue University. Children between the ages of eight and eleven who had been having trouble in academic achievement and reading although of normal or higher intelligence were referred to this program. The results of this study are particularly interesting to educators in the physical education field.

All the participants showed improvement in subjects in school and on academic achievement tests. A matched group of non-participating students did not show comparable results. The sample in this original program was small but it included all the original cases. Not very profound conclusions can be drawn from such a limited study but considering the scholastic improvement made in the participating subjects and the lack of improvement in the non-participating subjects, it was felt that the motor therapy program could have made a definite contribution. "And the implication would seem to be that physical education has a contribution to make also to academic achievement in the elementary school (13:66)."

Negative Studies. Not all studies show a positive

relationship between physical fitness and academic achievement. A few studies not only show no significance in this area but a few have shown a negative relationship. A study by Ivah Sundholm (31:2,21) attempted to discover if there was any significant difference in general motor capacity and physical fitness between high and low achievers of sixty-six girls at Mason County Central Junior High School at Scottsville, Michigan. It was found that there was no significant difference in physical fitness between high and low achievers and high and low intelligence groups of junior high school girls.

A study of the relationships of college board scores and physical fitness to the prediction of academic success in college was undertaken by John Joseph Costello (6:5150). He used 164 male members, 135 of which successfully graduated and 29 who were dismissed for academic failure.

The purpose of the study was to test the hypothesis that students with a low fitness status would also perform low academically and that by increasing a student's fitness level, his academic performance would also improve. It was concluded that physical fitness as measured has no significant relationship to a student's academic index, and that physical fitness of male students who successfully graduate from college does not differ significantly from male students who are dismissed from college for academic failure.

Arthur Gross (15:5714) in a study to determine relationships of physical fitness to motor educability, scholastic aptitude, and scholastic achievement of college men, concluded that the degree of fitness a person possesses does not correlate with his performance on a scholastic aptitude test nor is physical fitness directly related to scholastic achievement as measured by a student's grade point average.

In a study conducted at Washington State University on two hundred randomly selected male freshmen, the physical fitness test used at Washington State showed no relationship with the A.C.E. Mental Ability Examination and grade point averages during the first semester. It was concluded that none of the fitness test items were general predictors of academic success (21:87).

In another study conducted at Lincoln High School in Seattle, Washington, the Washington State Physical Fitness Test was administered to all the male students in the school. Four groups were made and fitness test scores were correlated with average academic grades in each group during the fall term. Three of the correlations were positive but none were significant at the .05 level. One correlation was negative and it was surmised that this score apparently resulted from a high number of seniors who were repeating Physical Education in their last year (18:90).

At the elementary level, Margaret Thompson (32:1505)

conducted a study of the relationship between selected motor skill performances and mental achievement of children in the second, fourth, and sixth grades in public schools in Lafayette, Indiana. She concluded that "there was little evidence of a marked relationship between motor performance and mental achievement (32:1505)."

In an attempt to evaluate the effectiveness of mobility training as a technique for improving reading ability and intelligence test scores as outlined by Delacato, James Foster (11:3779) conducted a study on one hundred fourth and fifth grade boys with the problem of mixed dominance. Three evenly matched groups were established on the basis of reading achievement and intelligence. One group received a training program of motor skills and development of thirty minutes daily for five months as recommended by Delacato. A second group received training as nearly opposite to Delacato's methods as was possible to devise. A third group was used as a control and received a regular classroom program. The "analysis of data showed no significant difference on post test scores of reading achievement or intelligence quotient test scores among the three groups (11:3779)." It was concluded on the basis of the evidence of the data that Delacato's theory was apparently unsound.

Conclusion

On the basis of the research in the field, the majority of the evidence seems to indicate a positive relationship of physical fitness, motor ability and muscular development to scholastic achievement and reading ability. Some of the studies which resulted in negative results were well conducted but the number of studies showing positive relationships are greater than those showing either no significant differences or no difference at all.

CHAPTER III

PROCEDURES USED

This study proposed to use a circuit-interval method of physical instruction to facilitate an increase in the fitness level of the subjects. Seventy-four sixth grade male and female students at Park Orchard Elementary School, Kent, Washington, were used in this study. A doctor's recommendation was the only acceptable excuse for a student not participating in the program. Two groups were established, an experimental and a control group, with each group comprised of thirty-seven persons.

Tests Used

The Washington State Physical Fitness Test (33:V) was used to determine the fitness level of the subjects. Standardized norms were developed from test scores obtained from 16,667 children. The following information relating to test validity, reliability, and objectivity supports the worthiness of the instrument as a basis for this study.

> TEST VALIDITY: The Elementary School Physical Fitness Test described in this manual correlates .811 with the AAPHER Youth Fitness Test.
>
> TEST RELIABILITY: The reliability of each test item was determined by the test-retest procedure on 100 elementary school children ranging in age from six to twelve years.

	RELIABILITY
Standing Broad Jump	.764
Bench Push-up	.889

Curl-up	.948
Squat Jump	.930
30-Yard Dash	.840

TEST OBJECTIVITY: The objectivity of each test item was determined by correlating two independent test administrations on 100 elementary school children ranging in age from six to twelve years.

	OBJECTIVITY
Standing Broad Jump	.828
Bench Push-up	.777
Curl-up	.885
Squat Jump	.756
30-Yard Dash	.777

(33:45)

The Metropolitan Achievement Test (25:23-24) is a nationally accepted test of classroom achievement comprised of ten items: Word Knowledge, Reading, Spelling, Language, Language Study Skills, Arithmetic Computation, Arithmetic Problem Solving, Social Studies Information, Social Studies Study Skills, and Science. Norms were established using 500,000 pupils in 225 school systems throughout the United States. Average reliability coefficients of all ten test items is .870.

The Gates-MacGinitie Reading Test (12:2-8) was used because of its national acceptance. Norms were established by administering this test to 40,000 pupils in thirty-eight communities throughout the United States. It has a reliability coefficient of .860 on Vocabulary and Comprehension and a correlation of .750 with the Lorge-Thorndike Verbal I. Q. Test.

The fitness test was administered by this researcher to all the subjects. All five items of the test were administered the same day. The Gates-MacGinitie Reading Test and the Metropolitan Achievement Test were administered by the teachers of the sixth grade classes three days following the administering of the fitness battery. The Gates test was given in one day and the Metropolitan test was extended over a three day period. All testing was administered prior to the selection of the groups.

Selection of Groups

The groups were established using grade equivalent scores from the Metropolitan Achievement Test. All the subjects of the study were ranked from high to low and every even numbered student on the list was selected for the control group. The odd numbered students comprised the experimental group. Four students were exchanged in order to attain an equal mean in both groups.

Procedures Used in Control Group

The control group participated in a normal physical education program which has traditionally emphasized games and competition. This group was taught by the other two sixth grade teachers in the school.

Procedures Used in the Experimental Group

In order to achieve maximum fitness in the shortest

period of time, a plan of circuit-interval training was adopted for the experimental group. This program was conducted Tuesday through Friday for twenty minutes per day, broken down into five minutes of warm-up exercises and three minutes of exercises at five different stations. An additional twenty minutes two days per week were also provided during which the students played various games of their own choosing. The subjects in the group were divided into five sections consisting of three male groups of seven members each and two female groups of eight members each. The students in this group were told they were participating in this experimental program only on the basis of improving their fitness. Each section revolved through all five stations in the gymnasium, engaging in a different exercise at each station.

In the first week, each pupil in each section worked for five seconds and rested for fifteen seconds. At the end of a three minute period, all sections moved to another station. During the second week the work load was increased to ten seconds work with fifteen seconds rest. This work-rest cycle was increased each week until a maximum of thirty seconds work and five seconds rest at each station was reached. This program continued for a period of six months.

Retesting Procedures

At the end of the six month period the students were

retested using a different form of the Gates-MacGinitie Reading Test and a different form of the Metropolitan Achievement Test. The day on which the Washington State Physical Fitness Test was administered marked the termination of the study. Three days later the Gates-MacGinitie Reading Test was administered. After two more days testing for academic achievement began and extended over a three day period.

Uncontrollable Factors

Continuous motivation for a time period of six months was difficult for some students. Three boys and two girls were unwilling to extend themselves in the fitness program. Consultation with the teachers of the children revealed that these students also lacked motivation in the classroom.

Two of the three sixth grade classes changed teachers, one at mid-year and the other two months before the end of the school term.

CHAPTER IV

ANALYSIS OF THE DATA

The first phase of the study was to determine the level of physical fitness, academic achievement, and reading ability of the male and female sixth grade students.

Tests were administered at the beginning and conclusion of the study to assess any change which may have occurred in these areas as a result of the fitness program which was described in Chapter Three.

Total test scores were recorded for both the experimental and control groups and a comparison was made of the difference between these two scores. The total Fall test scores on the Gates-MacGinitie Reading Test were 288.30 for the experimental group and 290.10 for the control group with a mean of 7.79 for the experimental group and 7.84 for the control group. The total test scores on the Spring test were 290.60 for the experimental group and 306.40 for the control group with a mean of 7.85 and 8.28 respectively. The differences between these means equalled .38 which favored the control group. (See Table I, page 29)*

The total Fall test scores on the Metropolitan Achievement Test were 259.20 for the experimental group and 261.00 for the control group with a mean of 7.00 for the experimental group and 7.05 for the control group. The total test scores on the Spring test were 281.30 and 288.10

TABLE I

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE GATES-MACGINITIE READING TEST

	Experimental Group	Control Group
Fall Test		
Total Test Scores	288.30	290.10
Mean	7.79	7.84
Spring Test		
Total Test Scores	290.60	306.40
Mean	7.85	8.28
Difference Between Fall and Spring Tests	+2.30	+16.30
Mean Difference	.06	.44

*.38 was calculated by subtracting the mean difference, .06 from .44.

with means of 7.60 and 7.78. The difference between the means was .13 which favored the control group. (See Table II, page 31)*

In the last comparison, on the Washington State Physical Fitness Test, there was considerable gain of the means between the Fall and Spring tests of the experimental group. The total Fall scores on the fitness test were 9,001 for the experimental group and 8,834 for the control group with means of 243.10 and 238.00. Spring test scores were 10,737 for the experimental group and 9,956 for the control group with means of 290.70 and 269.00. The difference between the means was 16.60 which highly favored the experimental group. (See Table III, page 32)*

Because the number of members in both groups totaled thirty-seven each, the following $\overline{Z}$ test was used to determine whether any significant change occurred in the experimental group. $$\overline{Z} = \frac{M_1 - M_2}{\sigma_{d_m}}$$

(16:175)

The differences between the Fall and Spring tests of the experimental and control groups were computed and an inverse relationship was found on the Metropolitan Achievement Test scores and the Gates-MacGinitie Reading Test scores. The obtained $\overline{Z}$ on the Metropolitan Achievement Test

TABLE II

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE METROPOLITAN ACHIEVEMENT TEST

	Experimental Group	Control Group
Fall Test		
Total Test Scores	259.20	261.00
Mean	7.00	7.05
Spring Test		
Total Test Scores	281.30	288.10
Mean	7.60	7.78
Difference Between Fall and Spring Tests	+22.10	+27.10
Mean Difference	.60	.73

*.13 was calculated by subtracting the mean difference, .60 from .73.

TABLE III

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE WASHINGTON STATE PHYSICAL FITNESS TEST

	Experimental Group	Control Group
Fall Test		
Total Test Scores	9,001.00	8,834.00
Mean	243.10	238.00
Spring Test		
Total Test Scores	10,737.00	9,956.00
Mean	290.70	269.00
Difference Between Fall and Spring Tests	+1,736.00	+1,622.00
Mean Difference	47.60	31.00

*16.60 was calculated by subtacting the mean difference, 31.00 from 47.60.

equalled -1.01 and the obtained $\bar{Z}$ on the Gates-MacGinitie Reading Test equalled -1.90 which was not significant at the .05 level of confidence. Although the .05 level was used to determine significance in this study, the $\bar{Z}$ obtained on the Washington State Physical Fitness Test equalled +3.19 which was significant at the .01 level. (See Table IV, page 34)

To determine if sex changed the results found on the $\bar{Z}$ test, the scores of males and females were separated and calculated. The girls' scores in the experimental group were compared with the girls' scores in the control group on the three test batteries. Boys' scores in both groups were compared in the three tests. This resulted in sixteen girls in the control group and sixteen girls in the experimental group and twenty-one boys in each group making equal numbers of subjects in the four groups. Because this reduced the size of the sample, the following t test was used to measure the level of significance:

$$t = \frac{M_1 - M_2}{\sqrt{\frac{\Sigma x_i^2 + \Sigma x_i^2}{N_i (N_i - 1)}}} \qquad (16:184)$$

The results of the test scores and the levels of significance were similar to the results found for the total groups of boys and girls. On the Fall Gates-MacGinitie

TABLE IV

COMPARISON OF $\bar{Z}$ SCORES ON THE WASHINGTON STATE PHYSICAL FITNESS TEST, METROPOLITAN ACHIEVEMENT TEST, AND GATES-MACGINITIE READING TEST BETWEEN EXPERIMENTAL AND CONTROL GROUPS OF BOYS AND GIRLS

	$\bar{Z}$ Scores
Metropolitan Achievement Test	- 1.01
Gates-MacGinitie Reading Test	- 1.90
Washington State Physical Fitness Test	+ 3.19*

*Significant at the .01 Level of Confidence

Reading Test the boys in the experimental group had a total score of 155.50 with a mean of 7.40 and the boys in the control group had a total score of 155.90 with a mean of 7.42. On the Spring test the boys in the experimental group had a total score of 157.50 with a mean of 7.50 and the boys in the control group had a score of 166.10 with a mean of 7.91. The difference between the means of the two groups on both tests was .385 which favored the control group. (See Table V, page 36)*

On the Fall Metropolitan Achievement Test the boys in the experimental group had a total score of 143.00 with a mean of 6.81 and the boys in the control group had a total score of 145.00 with a mean of 6.90. On the Spring test the boys in the experimental group had a total score of 155.10 with a mean of 7.39 and the control group had a score of 159.60 with a mean of 7.60. The difference between the means was .12 which slightly favored the control group. (See Table VI, page 37)*

On the Fall Washington State Physical Fitness Test, the boys in the experimental group had a total score of 5,157 with a mean of 245.57 and the boys in the control group had a total score of 5,078 with a mean of 241.81. On the Spring test the boys in the experimental group had a total score of 6,075 with a mean of 289.29 and the control group had a score of 5,638 with a mean of 268.48. The

TABLE V

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE GATES-MACGINITIE READING TEST, BOYS

	Experimental Group	Control Group
Fall Test		
Total Test Scores	155.50	155.90
Mean	7.40	7.42
Spring Test		
Total Test Scores	157.50	166.10
Mean	7.50	7.91
Difference Between Fall and Spring Tests	+2.00	+10.20
Mean Difference	.10	.485

*.385 was calculated by subtracting the mean difference, .10 from .485.

TABLE VI

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE METROPOLITAN ACHIEVEMENT TEST, BOYS

	Experimental Group	Control Group
Fall Test		
Total Test Scores	143.00	145.00
Mean	6.81	6.90
Spring Test		
Total Test Scores	155.10	159.60
Mean	7.39	7.60
Difference Between Fall and Spring Tests	+12.10	+14.60
Mean Difference	.58	.70

*.12 was calculated by subtracting the mean difference, .58 from .70.

TABLE VII

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE WASHINGTON STATE PHYSICAL FITNESS TEST, BOYS

	Experimental Group	Control Group
Fall Test		
Total Test Scores	5,157.00	5,078.00
Mean	245.57	241.81
Spring Test		
Total Test Scores	6,075.00	5,638.00
Mean	289.29	268.48
Difference Between Fall and Spring Tests	+918.00	+560.00
Mean Difference	43.71	26.67

*17.04 was calculated by subtracting the mean difference, 26.67 from 47.71.

difference between the means was 17.04 which highly favored the experimental group. (See Table VII, page 38)*

The Fall Gates-MacGinitie Reading Test scores of the girls in the experimental group totaled 132.80 with a mean of 8.30 and the scores for the girls in the control group totaled 134.20 with a mean of 8.39. On the Spring test the girls in the experimental group had a total score of 133.10 with a mean of 8.31 and the girls in the control group had a total score of 140.30 with a mean of 8.77. The differences between means of both groups on the Fall and Spring tests were .363 which favored the control group. (See Table VIII, page 40)*

On the Fall Metropolitan Achievement Test, the girls in the experimental group had a total score of 116.20 with a mean of 7.26 and the girls in the control group had a total score of 116.00 with a mean of 7.25. On the Spring test, the girls in the experimental group had a total score of 126.20 with a raise in mean to 7.89 and the girls in the control group had a total score of 128.50 with a raise in mean to 8.03. The differences between the means was .156 which favored the control group. (See Table IX, page 41)*

On the Fall Washington State Physical Fitness Test, the girls in the experimental group had a total score of 3,844 with a mean of 240.25 while the control group had a total score of 3,756 with a mean of 234.75. On the Spring

TABLE VIII

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE GATES-MACGINITIE READING TEST, GIRLS

	Experimental Group	Control Group
Fall Test		
Total Test Scores	132.80	134.20
Mean	8.30	8.39
Spring Test		
Total Test Scores	133.10	140.30
Mean	8.31	8.77
Difference Between Fall and Spring Tests	+.30	+6.10
Mean Difference	.018	.381

*.363 was calculated by subtracting the mean difference, .018 from .381.

TABLE IX

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE METROPOLITAN ACHIEVEMENT TEST, GIRLS

	Experimental Group	Control Group
Fall Test		
Total Test Scores	116.20	116.00
Mean	7.26	7.25
Spring Test		
Total Test Scores	126.20	128.50
Mean	7.89	8.03
Difference Between Fall and Spring Tests	+10.00	+12.50
Mean Difference	.625	.781

*.156 was calculated by subtracting the mean difference, .625 from .781.

test the experimental group had a total score of 4,662 and a mean of 291.38 and the control group had a total score of 4,318 with a mean of 269.87. The difference in the means was a gain of 16.00 which highly favored the experimental group. (See Table X, page 43) *

Significance was computed using Fisher's t for testing a difference between the means of the experimental and control groups. The results for boys were as follows: Gates-MacGinitie Reading Test, t = 2.95, inversely significant at the .05 level of confidence; Metropolitan Achievement Test, t = .652; Washington State Physical Fitness Test, t = 2.57, significant at the .05 level of confidence. (See Table XI, page 44)

Results for girls were as follows: Gates-MacGinitie Reading Test, t = 1.06; Metropolitan Achievement Test, t = .739; Washington State Physical Fitness Test, t = 1.66. None of the results obtained for the girls were significant at the .05 level of confidence. (See Table XII, page 45)

Summary

The Washington State Physical Fitness Test showed the following results: for combined groups of boys and girls, gains were significant at the .01 level of confidence; for boys only, gains were significant at the .05 level of confidence; for girls only, there was a positive gain but no significant difference.

TABLE X

COMPARISON OF SCORES, MEANS, AND DIFFERENCES OF EXPERIMENTAL AND CONTROL GROUPS ON THE WASHINGTON STATE PHYSICAL FITNESS TEST, GIRLS

	Experimental Group	Control Group
Fall Test		
Total Test Scores	3,844.00	3,756.00
Mean	240.25	234.75
Spring Test		
Total Test Scores	4,662.00	4,318.00
Mean	291.38	269.87
Difference Between Fall and Spring Tests	+818.00	+562.00
Mean Difference	51.13	35.13

*16.00 was calculated by subtracting the mean difference, 35.13 from 51.13.

TABLE XI

t SCORES ON WASHINGTON STATE PHYSICAL FITNESS TEST, METROPOLITAN ACHIEVEMENT TEST, AND GATES-MACGINITIE READING TEST OF BOYS

	t Scores
Washington State Physical Fitness Test	2.57*
Metropolitan Achievement Test	.652
Gates-MacGinitie Reading Test	2.95**

*Significant at .05 Level of Confidence
**Inversely Significant at .05 Level of Confidence

t SCORES ON WASHINGTON STATE PHYSICAL FITNESS TEST, METROPOLITAN ACHIEVEMENT TEST, AND GATES-MACGINITIE READING TEST OF GIRLS

	t Scores
Washington State Physical Fitness Test	1.66
Metropolitan Achievement Test	.739
Gates-MacGinitie Reading Test	1.06

The Gates-MacGinitie Reading Test showed no significance at the .05 level for combined groups of boys and girls or for the groups containing only girls. The boys' scores showed an inverse significance at the .05 level on the Gates-MacGinitie Reading Test. Scores for the boys only, girls only, or combined groups were not significant at the .05 level of confidence on the Metropolitan Achievement Test.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary and Conclusions

In an attempt to determine whether any change occurred as a result of the physical fitness program on academic achievement and reading ability, experimental and control groups were tested in these areas both before and after undergoing a program of physical education. Analysis of the data indicated a significant difference in the Washington State Physical Fitness Test scores of the experimental group after their circuit-interval physical training program. The gain for boys and girls in this area showed a $\bar{Z}$ of 3.19, which was significant at the .01 level of confidence. When the boys' scores were separated from the girls' scores, the gain was still significant, $t = 2.57$ at the .05 level, but lower than the scores of both boys and girls combined. When the girls' scores were separated from the combined scores, a t score of 1.66 was obtained, which was not significant at the .05 level of confidence.

Metropolitan Achievement Test scores revealed no significant difference, indicating that in this study the level of fitness of the subjects did not influence their academic achievement. The gain in this area showed a $\bar{Z}$ of 1.01, which was not significant at the .05 level. When boys' and girls' scores were separated, there remained no

significant difference, boys' scores showing a t of .652 and girls' scores a t of .739.

Scores on the Gates-MacGinitie Reading Test indicated no significant difference between fitness and reading ability. Combined scores of boys and girls and of girls only showed no significant difference, $\bar{Z}$ for combined scores being -1.90 and t for girls' scores being -1.06. The results of the scores of boys, t = 2.95, showed an inverse significance at the .05 level of confidence. This may or may not be attributable to a sharp rise or decline in some individual scores on the Gates-MacGinitie Reading Test. No other significant results were obtained from reading scores in the experimental or control groups.

These data, then, tend to support the hypothesis that increased physical fitness will have no measured effect on academic achievement and reading ability.

Recommendations

The researcher recommends further study of elementary school children in the area of the relationship of physical fitness to academic achievement and reading ability. A more complete study using larger samples from different socio-economic populations extending over a three-year period is indicated. A second recommendation is to correlate physical fitness to all ten items of the Metropolitan Achievement Test.

Of further interest would be a study conducted at the second or third grade level to discover whether a physical fitness program would influence academic achievement and reading ability of younger children.

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APPENDIX

EXPERIMENTAL GROUP

Subject	Gates			Metro.			Wash. Fitness		
	Fall	Spring		Fall	Spring		Fall	Spring	
1	11.1	10.7	- .40	10.6	9.9	- .70	250	315	+65
2	10.1	10.6	+ .50	9.5	10.2	+ .70	265	296	+31
3	11.4	11.4	.00	9.2	10.2	+1.00	199	289	+90
4	8.9	9.9	+1.00	8.9	9.0	+ .10	198	253	+55
5	10.0	9.9	- .10	8.9	8.3	- .60	293	299	+ 6
6	8.9	9.7	+ .80	8.8	9.1	+ .30	196	211	+15
7	9.8	10.6	+ .80	8.6	9.4	+ .80	259	333	+74
8	9.9	11.5	+1.60	8.5	9.6	+1.10	248	267	+19
9	10.5	9.2	-1.30	8.2	8.5	+ .30	250	290	+40
10	7.8	9.0	+1.20	8.1	8.7	+ .60	231	281	+50
11	9.4	10.7	+1.30	7.8	8.8	+1.00	211	291	+80
12	11.1	9.9	-1.20	7.6	8.3	+ .70	207	268	+61
13	8.1	8.6	+ .50	7.6	9.0	+1.40	246	280	+34
14	10.5	8.8	-1.70	7.5	8.5	+1.00	259	325	+66
15	8.4	5.7	-2.70	7.4	6.7	- .70	276	325	+49
16	9.2	9.7	+ .50	7.3	8.0	+ .70	187	263	+76
17	9.1	9.1	.00	7.3	8.4	+1.10	305	330	+25
18	8.6	9.4	+ .80	7.0	8.5	+1.50	228	262	+34
19	6.6	7.5	+ .90	7.0	7.3	+ .30	297	301	+ 4
20	7.2	9.8	+2.60	7.0	8.4	+1.40	270	293	+23
21	7.2	7.3	+ .10	6.9	6.7	- .20	290	333	+43
22	8.3	7.9	- .40	6.7	7.5	+ .80	274	333	+59

Subject	Gates			Metro.			Wash. Fitness		
	Fall	Spring		Fall	Spring		Fall	Spring	
23	7.4	7.6	+ .20	6.6	7.1	+ .50	274	348	+74
24	6.5	7.7	+1.20	6.4	7.8	+1.40	284	281	- 3
25	7.2	7.6	+ .40	6.3	7.1	+ .80	103	208	+105
26	5.7	5.7	.00	6.3	6.9	+ .60	303	356	+53
27	6.9	4.2	-2.70	6.3	6.2	- .10	208	250	+42
28	5.5	6.6	+1.10	6.2	7.5	+1.30	237	296	+59
29	7.7	5.5	-2.20	5.9	5.9	.00	232	274	+42
30	5.9	7.2	+1.30	5.8	5.6	- .20	239	308	+69
31	6.9	6.2	- .70	5.5	6.4	+ .90	191	256	+65
32	5.9	5.1	- .80	5.2	6.0	+ .80	206	294	+88
33	4.8	4.7	- .10	5.2	6.3	+1.10	260	337	+77
34	4.0	4.3	+ .30	4.7	5.8	+1.10	254	285	+31
35	3.5	4.3	+ .80	4.6	4.7	+ .10	292	274	-18
36	5.5	4.6	- .90	4.0	5.1	+1.10	234	284	+50
37	2.8	2.4	- .40	3.8	3.9	+ .10	245	248	+ 3

CONTROL GROUP

Subject	Gates			Metro.			Wash. Fitness		
	Fall	Spring		Fall	Spring		Fall	Spring	
1	11.4	11.7	+ .30	9.5	10.3	+ .80	192	231	+39
2	11.1	10.9	- .20	9.5	10.0	+ .50	220	253	+33
3	10.9	11.2	+ .30	9.3	10.2	+ .90	235	246	+11
4	11.1	10.4	- .70	9.2	10.2	+ .80	239	283	+44
5	9.9	11.7	+1.80	9.1	9.6	+ .50	242	257	+15
6	11.4	11.7	+ .30	8.6	8.6	.00	213	237	+24
7	10.2	10.2	.00	8.6	9.1	+ .50	248	280	+32
8	10.2	8.7	-1.50	8.4	8.8	+ .40	206	217	+11
9	8.1	10.7	+2.60	7.9	8.8	+ .90	270	299	+29
10	9.4	9.4	.00	7.8	8.8	+1.00	250	278	+28
11	9.3	10.2	+ .90	7.7	9.5	+1.80	303	325	+22
12	8.9	8.6	- .30	7.7	9.1	+1.40	234	294	+60
13	8.5	7.6	- .90	7.6	8.7	+1.10	312	293	-19
14	6.7	8.3	+1.60	7.5	7.5	.00	289	323	+34
15	9.9	10.5	+ .60	7.5	8.0	+ .50	143	222	+79
16	7.0	5.6	-1.40	7.5	7.2	- .30	240	274	+34
17	8.7	9.2	+ .50	7.4	9.0	+1.60	203	246	+43
18	10.1	10.9	+ .80	7.2	8.1	+ .90	254	307	+53
19	9.0	9.7	+ .70	7.2	8.1	+ .90	241	268	+27
20	8.6	8.3	- .30	6.9	8.1	+1.20	222	269	+47
21	7.5	8.1	+ .60	6.8	7.1	+ .30	220	249	+29
22	7.0	7.5	+ .50	6.8	6.8	.00	205	207	+ 2

Subject	Gates			Metro.			Wash. Fitness		
	Fall	Spring		Fall	Spring		Fall	Spring	
23	8.1	8.0	- .10	6.7	8.5	+1.80	223	266	+43
24	8.0	7.5	- .50	6.7	6.9	+ .20	241	267	+26
25	6.4	5.9	- .50	6.5	6.4	- .10	290	328	+38
26	6.1	7.7	+1.60	6.5	7.2	+ .70	256	294	+38
27	6.8	6.3	- .50	6.3	6.8	+ .50	280	291	+11
28	5.6	7.3	+1.70	6.1	7.7	+1.68	240	302	+62
29	6.7	8.7	+2.00	6.1	6.9	+ .80	251	261	+10
30	5.4	6.6	+1.20	5.9	6.6	+ .70	196	236	+40
31	5.8	8.4	+2.60	5.6	7.3	+1.70	251	276	+25
32	3.8	5.2	+1.40	5.3	6.2	+ .90	228	224	- 4
33	4.9	4.5	- .40	5.0	5.0	.00	240	268	+28
34	5.3	5.0	- .30	4.8	6.0	+1.20	270	285	+15
35	4.3	4.6	+ .30	4.7	5.5	+ .80	221	266	+45
36	4.5	5.3	+ .80	4.7	5.5	+ .80	232	288	+56
37	3.5	4.3	+ .80	4.4	4.2	- .20	234	246	+12

EXPERIMENTAL GROUP - BOYS

Subject	Gates			Metro.			Wash. Fitness		
	Fall	Spring		Fall	Spring		Fall	Spring	
1	8.9	9.9	+1.00	8.9	9.0	+ .10	198	253	+55
2	8.9	9.7	+ .80	8.8	9.1	+ .30	196	211	+15
3	10.5	9.2	-1.30	8.2	8.5	+ .30	250	290	+40
4	7.8	9.0	+1.20	8.1	8.7	+ .60	231	281	+50
5	9.4	10.7	+1.30	7.8	8.8	+1.00	211	291	+80
6	11.1	9.9	-1.20	7.6	8.3	+ .70	207	268	+61
7	8.1	8.6	+ .50	7.6	9.0	+1.40	246	280	+34
8	8.4	5.7	-2.70	7.4	6.7	- .70	276	325	+49
9	9.1	9.1	.00	7.3	8.4	+1.10	305	330	+25
10	8.6	9.4	+ .80	7.0	8.5	+1.50	228	262	+34
11	7.2	9.8	+2.60	7.0	8.4	+1.40	270	293	+23
12	7.2	7.3	+ .10	6.9	6.7	- .20	290	333	+43
13	8.3	7.9	- .40	6.7	7.5	+ .80	274	333	+59
14	5.7	5.7	.00	6.3	6.9	+ .60	303	356	+53
15	6.9	4.2	-2.70	6.3	6.2	- .10	208	250	+42
16	5.5	6.6	+1.10	6.2	7.5	+1.30	237	296	+59
17	5.9	7.2	+1.30	5.8	5.6	- .20	239	308	+69
18	6.9	6.2	- .70	5.5	6.4	+ .90	191	256	+65
19	4.8	4.7	- .10	5.2	6.3	+1.10	260	337	+77
20	3.5	4.3	+ .80	4.6	4.7	+ .10	292	274	-18
21	2.8	2.4	- .40	3.8	3.9	+ .10	245	248	+ 3

CONTROL GROUP - BOYS

Subject	Gates			Metro.			Wash. Fitness		
	Fall	Spring		Fall	Spring		Fall	Spring	
1	9.9	11.7	+1.80	9.1	9.6	+ .50	242	257	+15
2	11.4	11.7	+ .30	8.6	8.6	.00	213	237	+24
3	10.2	8.7	-1.50	8.4	8.8	+ .40	206	217	+11
4	8.1	10.7	+2.60	7.9	8.8	+ .90	270	299	+29
5	9.4	9.4	.00	7.8	8.8	+1.00	250	278	+28
6	9.3	10.2	+ .90	7.7	9.5	+1.80	303	325	+22
7	8.5	7.6	- .90	7.6	8.7	+1.10	312	293	-19
8	6.7	8.3	+1.60	7.5	7.5	.00	289	323	+34
9	7.0	5.6	-1.40	7.5	7.2	- .30	240	274	+34
10	8.7	9.2	+ .50	7.4	9.0	+1.60	203	246	+43
11	8.6	8.3	- .30	6.9	8.1	+1.20	222	269	+47
12	7.5	8.1	+ .60	6.8	7.1	+ .30	220	249	+29
13	7.0	7.5	+ .50	6.8	6.8	.00	205	207	+ 2
14	8.0	7.5	- .50	6.7	6.9	+ .20	241	267	+26
15	6.1	7.7	+1.60	6.5	7.2	+ .70	256	294	+38
16	5.6	7.3	+1.70	6.1	7.7	+1.60	240	302	+62
17	5.4	6.6	+1.20	5.9	6.6	+ .70	196	230	+40
18	3.8	5.2	+1.40	5.3	6.2	+ .90	228	224	- 4
19	4.9	4.5	- .40	5.0	5.0	.00	240	268	+28
20	5.3	5.0	- .30	4.8	6.0	+1.20	220	285	+15
21	4.5	5.3	+ .80	4.7	5.5	+ .80	232	288	+56

EXPERIMENTAL GROUP - GIRLS

Subject	Gates			Metro.			Wash. Fitness		
	Fall	Spring		Fall	Spring		Fall	Spring	
1	11.1	10.7	- .40	10.6	9.9	- .70	250	315	+65
2	10.1	10.6	+ .50	9.5	10.2	+ .70	265	296	+31
3	11.4	11.4	.00	9.2	10.2	+ .10	199	289	+90
4	10.0	9.9	- .10	8.9	8.3	- .60	293	299	+ 6
5	9.8	10.6	+ .80	8.6	9.4	+ .80	259	333	+74
6	9.9	11.5	+1.60	8.5	9.6	+1.10	248	267	+19
7	10.5	8.8	-1.70	7.5	8.5	+1.00	259	325	+66
8	9.2	9.7	+ .50	7.3	8.0	+ .70	187	263	+76
9	6.6	7.5	+ .90	7.0	7.3	+ .30	297	301	+ 4
10	7.4	7.6	+ .20	6.6	7.1	+ .50	274	348	+74
11	6.5	7.7	+1.20	6.4	7.8	+1.40	284	281	- 3
12	7.2	7.6	+ .40	6.3	7.1	+ .80	103	208	+105
13	7.7	5.5	-2.20	5.9	5.9	.00	232	274	+42
14	5.9	5.1	- .80	5.2	6.0	+ .80	206	294	+88
15	4.0	4.3	+ .30	4.7	5.8	+1.10	254	285	+31
16	5.5	4.6	- .90	4.0	5.1	+1.10	234	284	+50

CONTROL GROUP - GIRLS

Subject	Gates			Metro.			Wash. Fitness		
	Fall	Spring		Fall	Spring		Fall	Spring	
1	11.4	11.7	+ .30	9.5	10.3	+ .80	192	231	+80
2	11.1	10.9	- .20	9.5	10.0	+ .50	220	253	+33
3	10.9	11.2	+ .30	9.3	10.2	+ .90	235	246	+11
4	11.1	10.4	- .70	9.2	10.0	+ .80	239	283	+44
5	10.2	10.2	.00	8.6	9.1	+ .50	248	280	+32
6	8.9	8.6	- .30	7.7	9.1	+1.40	234	294	+60
7	9.9	10.5	+ .60	7.5	8.0	+ .50	143	222	+79
8	10.1	10.9	+ .80	7.2	8.1	+ .90	254	307	+53
9	9.0	9.7	+ .70	7.2	8.1	+ .90	241	268	+27
10	8.1	8.0	- .10	6.7	8.5	+1.80	223	266	+43
11	6.4	5.9	- .50	6.5	6.4	- .10	290	328	+38
12	6.8	6.3	- .50	6.3	6.8	+ .50	280	291	+11
13	6.7	8.7	+2.00	6.1	6.9	+ .80	251	261	+10
14	5.8	8.4	+2.60	5.6	7.3	+1.70	251	276	+25
15	4.3	4.6	+ .30	4.7	5.5	+ .80	221	266	+45
16	3.5	4.3	+ .80	4.4	4.2	- .20	234	246	+12

Test No. 1: Standing Broad Jump

Purpose: To measure power.
Equipment: A measuring tape and a yardstick. . . .

Starting Position: The pupil assumes a squat position with his arms extended backward and with the toes of both feet parallel to and back of the starting tape. . . .

Movement: The pupil starts the jump by shifting his arms forward and upward. As soon as his feet leave the floor . . . he flexes his legs and continues to swing his arms forward. The pupil lands with feet parallel, trunk flexed and his arms extended in a forward direction. . . .

Scoring: Allow one practice jump. The second jump is recorded. A tape measure is used to measure the distance to the nearest inch from the take-off line to the nearest heel position. An accurate reading can be taken if the recorder places a yardstick behind the heels of the jumper . . . at right angles to the measuring tape. If the pupil steps with one foot and then jumps, or touches the floor with his hands before landing, or falls backward after landing, the jump is repeated.

Precautions: Encourage the subject to flex his knees in the starting position to assure maximum thrust from the leg muscles (33:5).

Test No. 2: Bench Push-Ups

Purpose: To measure the strength and endurance of the forearm, the arm, and the shoulder girdle muscles.

Equipment: A chair (the seat of the chair should be approximately 14 to 17 inches above the mat) and a mat. Place chair on the mat.

Starting Position: The pupil grasps the nearest corners of the chair and assumes a front leaning rest position with legs together and both feet on the mat. The body should form a straight line and be at right angles with the arms. . . .

Movement: The pupil lowers his body and flexes at the elbows until his chest touches the nearer edge of the chair. . . . The arms are then extended to the starting position. . . .

Scoring: The score is the number of push-ups performed. Stop the pupil at the end of the 50th push-up.

Precautions: Place one hand on the nearer edge of the chair to make certain the chest touches on every downward movement (33:6).

Test No. 3: Curl-Ups

Purpose: To measure the strength and endurance of the trunk flexor muscles.

Equipment: A mat.

Starting Position: The pupil assumes a back lying position with knees bent, soles of the feet flat on the floor and the fingers laced behind the head. The tester places his right hand on the pupil's feet, holding them down and close to the buttocks, while the left hand is placed across the top of the pupil's knees. . . .

Movement: The pupil sits up, touches the tester's hand . . . and returns to the starting position. . . . It should be noted that a child's physique will determine whether he is able to touch the tester's hand with his head, chin or chest. Touching with the head should be considered as an acceptable performance for all children.

Scoring: The score is the number of times the pupil sits up and touches the tester's hand. Stop the pupil at the 50th curl-up.

Precautions: Prevent the pupil from using his elbows in bracing or pushing against the floor as he rises up. Keep the pupil's heels close to his buttocks throughout the exercise (33:7).

Test No. 4: Squat Jump

Purpose: To measure the strength and endurance of the trunk and leg extensor muscles.

Starting Position: The pupil assumes a crouched position with the arms at the sides of the legs and the fingers resting on the mat. . . .

Movement: The pupil jumps to a height at which his feet are approximately four inches above the mat. The arms remain at the pupil's sides to maintain balance. . . . The pupil returns to the starting position and continues the exercise (33:8).

Test No. 5: Thirty-Yard Dash

Purpose: To measure speed.

Equipment: A stop watch, measuring tape and a finish tape. An indoor area such as the gymnasium floor or an outdoor area such as the playing field may be used for the thirty-yard dash.

Starting Position: The pupil assumes a standing starting position immediately behind the starting mark.

Movement: At the command "go" the pupil runs as fast as possible through the thirty-yard distance passing through the finish tape at the thirty-yard mark.

Scoring: The score is the number of seconds required to run thirty yards. Record to the nearest tenth of a second.

Precautions: Explain the purpose of the test. In order to maintain maximum speed, encourage the pupil to run at top speed for a short distance beyond the finish line (33:9).

EXERCISES

ARMS

1. Wheel-barrow
2. Push-ups
3. Diamond Push-ups
4. Reverse Push-ups
5. Squat Thrust
6. One Arm Push Down
7. Straddle Chin-up

UPPER CHEST AND BACK AREA

1. Bench Push-ups
2. Arm Circle
3. Seal Walk
4. Knee Push-ups
5. Seal Clap
6. Circle Pull-ups
7. Crab Walk

ABDOMINAL AREA

1. Curl-ups
2. Sit-ups - Straight
3. "V" Sit
4. Back Bridge
5. Leg-lifts
6. Flutter Kicks
7. Sitting Tucks

LEGS

1. Jumping on Wall
2. Standing Broad Jump
3. Squat Jumps
4. Knee Bends
5. Toe Toucher
6. Heel Raises
7. One Foot Hop

AGILITY

1. 20 Yard Dash
2. Potato Race
3. Cherry Pickers
4. Backward Run
5. Rope Skipping
6. Run Around Through Chairs
7. Running Sumersault

WORK, REST CYCLES OF CIRCUIT-INTERVAL TRAINING PROGRAM

NOVEMBER	WEEK	WORK	REST	DECEMBER	WEEK	WORK	REST
	1	5	15		1	15	15
	2	10	15		2	15	10
	3	15	10		3	20	10
	4	20	15				
JANUARY	1	10	15	FEBRUARY	1	15	15
	2	10	10		2	15	10
	3	15	15		3	20	15
	4	15	10		4	20	10
MARCH	1	15	10	APRIL	1	20	15
	2	20	15		2	20	10
	3	20	10		3	25	15
	4	25	10		4	30	10