CARDIOVASCULAR FITNESS OF FOURTH GRADE BOYS AND GIRLS DUE TO AN AEROBIC TRAINING PROGRAM

By

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ABSTRACT

The purpose of this study was to determine whether an aerobic fitness program will increase cardiovascular fitness in fourth grade boys and girls. A secondary purpose was to determine if there is a relationship between data obtained from a submaximal bicycle test, a nine minute walk/run test, and a maximal treadmill test. Of the 61 fourth grade boys and girls included in this study, 32 had three additional aerobic training periods per week, for 20 minutes. The treatment program was 12 weeks in length. The bicycle ergometer test and the nine-minute walk/run were used for assessing cardiovascular fitness. The results indicated that an aerobic training program significantly increased the scores on the experimental group's nine-minute walk/run test scores. The results also showed that males had significantly better recovery heart rates in the first minute of recovery and faster time scores in the nine minute walk/run test than females. There were no significant changes in submaximal heart rates and resting heart rates due to an aerobic training program.

To determine if there was a relationship between testing measures, a sample of students were involved in a maximal treadmill test. Following the treadmill test, the nine minute walk/run and bicycle ergometer tests were administered. The results did not show a significant correlation between scores from the maximal treadmill test, nine minute walk/run and the bicycle ergometer test.

Conclusions from this study were; 1) that a twelve week aerobic training program, three times a week, will increase cardiovascular fitness of fourth graders as measured by a nine minute endurance run. 2) Although the nine minute walk/run did not correlate with maximal oxygen consumption in this study, that does not mean it is not a good measure for improvement from an aerobic training program. Motivation could be the key to any error in testing using the nine minute walk/run. 3) Aerobic training programs for children are necessary not only to increase cardiovascular fitness, but also to start good life-time physical fitness habits and to help with keeping the body trim and fit.

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A.M.L.

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CHAPTER I

INTRODUCTION

Cardiovascular diseases are the cause of more than 50 percent of the deaths in the United States (34, 44, 55,). Within the last ten years a concerned effort by the allied medical profession to control this epidemic has led to various studies on "risk factors" (5, 15, 20, 23, 29, 38, 44). These risk factors assist in identifying individuals who are susceptible to premature development of coronary heart disease. Risk factors include: Hypertension, elevated blood lipids, cigarette smoking, obesity, electrocardiographic abnormalities during rest and exercise, family history of heart disease, diabetes, and inadequate physical activity (5, 15, 20, 23, 29, 28, 44).

While most of these risk factors are associated with the adult population, reports from recent research has indicated that risk factors and habits which are involved in the development of atherosclerosis are also identifiable in early childhood (5, 15, 20, 23, 29, 44). Of the above risk factors, inadequate physical activity would most likely be the one least associated with the elementary school child. Yet, it has been reported, as a result of research, that the North American elementary school child is lacking in overall physical fitness (10, 11, 52). Since important therapies exist for the control of these risk factors, particularly the prevention of cardiovascular disease through physical fitness, it may well be time for physical educators to examine our elementary physical education programs.

Research findings concerning the role of elementary physical education programs in improving fitness are controversial. A few studies have attempted to measure changes in cardiovascular fitness in children following an aerobic training program. Studies have shown that an aerobic training program does not improve maximal oxygen consumption (indicator of cardiovascular fitness) in children (14, 55). Yet other studies, also involving elementary school children, have shown improvements of maximal oxygen consumption with intensive aerobic training (8, 17, 18, 41, 43). In research where submaximal heart rates and running field tests have been used as indicators, it was found there were improvements in the fitness level of elementary and junior high school students due to an aerobic training (11, 14, 24, 26, 55).

One of the many possibilities for improving fitness in young children is to augment the physical activity of students during the school year. While data obtained through research indicate that additional physical education classes do not elicit gains in fitness (6, 46), the Trois Riveres experiment did improve the overall fitness of the school children by adding additional physical education classes (52). The Sunflower project, which concluded in the Spring of 1980, was designed to improve the cardiovascular fitness of elementary school children through additional physical fitness classes, an extended human physiology health program, and a nutritional program. General conclusions show an increase in the cardiovascular fitness of first through fifth grades as measured by distance runs (25).

Purpose of the Study

The purpose of this study was to determine if an aerobic fitness program will increase cardiovascular fitness in fourth grade boys and girls. A secondary purpose was to determine if a relationship existed between a submaximal bicycle test, a nine minute walk/run, and a maximal treadmill test.

Scope of the Study

The subjects who participated in this study consisted of 32 fourth grade boys and girls from Trailwood Elementary School and 29 fourth grade boys and girls from Brookwood Elementary School. Both school are located in the Shawnee Mission, Kansas Public Schools (USD 512).

The experimental school was Trailwood Elementary and the treatment program was conducted during three regularly scheduled recess periods, per week, for 20 minutes. The treatment program was 12 weeks in length and consisted of selected aerobic activities (Appendix A). The bicycle ergometer test and the nine minute walk/run were used for assessing cardiovascular fitness. These tests ar indirect measurements of cardiovascular fitness.

A sample, consisting of 22 fourth grade students, from both schools were also involved in a maximal treadmill test at the University of Kansas Exercise Physiology Laboratory. Following the treadmill test the nine minute walk/run and bicycle ergometer tests were administered to the 22 students at their respective elementary schools.

Assumptions

The following assumptions were made for this investigation:

1. All graduate students trained to administer the tests took accurate measurements.
2. All subjects were functioning at maximum health levels on the dates that the testing was conducted.
3. All subjects did not eat a large meal or participate in vigorous activity prior to the bicycle ergometer, nine minute walk/run, and maximal treadmill tests.

Limitations

The following factors were limiting to this study:

1. There was no control over the physical activities of the subjects outside of the experimental program.
2. Two different testing environments were used since the subjects attended two different elementary schools.
3. Trailwood school had been involved with aerobic conditioning programs, two years prior to this study.

Functional Definitions

The following defined terms are pertinent only to this study:

1. Aerobic training: Variety of exercises that stimulate heart and lung activity for a period of time, long enough to produce beneficial changes in the body.
2. Physical fitness: The degree of health required of a child to meet the daily requirements of living.

3. Maximal oxygen consumption: The amount of oxygen that an individual can utilize per unit time.

Abbreviations

1. R.H.R. -- Resting Heart Rate, measured in beats per minute. assesed right before submaximal bicycle test.
2. W.H.R. -- Working Heart Rate, measured in beats per minute. average of last two minutes of the submaximal bicycle ergometer test.
3. Rec. 1 -- Recovery Heart Rate of the first minute, measured in beats per minute. Formula for determining Rec. 1:

$$\frac{\text{Mean submaximal heart rate - recovery 1 heart rate}}{\text{mean submaximal heart rate}}$$

3. Rec. 2 -- Recovery Heart Rate of the second minute after exercise, measured in beats per minute. Formula for determining Rec. 2:

$$\frac{\text{Mean submaximal heart rate - recovery 2 heart rate}}{\text{mean submaximal heart rate}}$$

4. 9 min. -- Nine Minute walk/run, measured in miles.

Hypotheses

The following hypotheses were tested in this study and were accepted or rejected at the .05 level of significance:

1. There is a significant difference in the cardiovascular fitness levels of fourth grade boys and girls at Trail-

wood elementary School after an aerobic training program as compared with the fourth grade boys and girls at Brookwood Elementary School.

2. There is a significant correlation between the data from the nine minute walk/run test with the data obtained from the maximal treadmill test.
3. There is a significant correlation between the data from the bicycle ergometer test with the data obtained from the maximal treadmill test.

Significance of the Study

Consideration for cardiovascular fitness has generally been neglected by those teaching elementary physical education. Realizing that cardiovascular disease is a pediatric disease (5, 10, 25, 20, 23, 29, 34, 44, 47, 52), if additional aerobic fitness periods can increase cardiovascular fitness, then physical education teachers need to be aware of this finding. In addition, information is needed in elementary physical education programs on the implementation of fitness programs and functional methods for assessing cardiovascular fitness (5, 10, 55).

Sutdents also need to be made aware of the role physical activity may have in reducing risk factors. As a child grows and leaves the school system he must have a desire to continue physical activity. As a result, the elementary physical education curriculum should contain a wide range of sports and leisure time activities which stress the cardiovascular system and can be carried

over into adult life (20, 23, 52).

CHAPTER II

REVIEW OF LITERATURE

The purpose of this study was to determine of an aerobic training program will increase cardiovascular fitness in fourth grade boys and girls. A secondary purpose is to determine if there is a correlation among data obtained from a submaximal bicycle test, a nine minute walk/run test, and a maximal treadmill test.

This review of literature section is divided into the following topics: Cardiovascular disease, methods of increasing cardiovascular fitness, aerobic training programs for children, testing measures for chariovascular fitness, and summary. The time period covered in this review of literature is from 1961 - 1984. The reason for the literature search starting in 1961 is that before 1960, research in the area of cardiovascular fitness dealt mainly with adults.

Cardiovascular Disease

Cardiovascular disease accounts for approximately 85 percent of all deaths in the American population. This cardiovascular disease of adulthood has its origins in infancy and childhood. There are several reasons supporting this belief. The most severe manifestations of ischemic heart disease, acute myocardial infraction or sudden unexpected death, are now occurring with greater frequency in younger people. Also, blood cholesterol levels in children from countries with frequent ischemic heart disease are higher than in countries where the condition is rare (20). Experimental programs

developed to control this disease among adults over 40 years of age have not been very successful, since changing health habits at this age are difficult (15). Therefore, the recommendation by which many epxerts concur is that prevention must start early (5, 15, 20, 23, 29, 34, 47, 58).

Research for the prevention of cardiovascular disease has led to the establishment and employment of risk factors. Risk factors include: Hypertension, elevated blood lipids (serum cholesterol and triglycerides), cigarette smoking, obesity, family history of heart disease, diabetes, and inadequate physical activity (5, 15, 23).

Research has shown that these risk factors are evident in elementary school children. The Chicago Health Department has reported that approximately six percent of Chicago elementary school children have at least two of the above mentioned risk factors (15). Likewise, Gilliam et al. (23) reported that of 47 active boys and girls, seven to 12 years of age, 62 percent, had at least one risk factor. Furthermore, 17 had two or more risk factors and one subject had five risk factors.

Inadequate physical activity is usually associated with the overweight adult. Surprisingly, research has indicated that the United States elementary school child is lacking in overall physical fitness (10, 11, 52). Conrad (10) concluded that one out of every six children in elementary school is so weak, uncoordinated, or generally inept that he or she is physically unable to handle everyday problems that may arise.

Presently there is a concern that our elementary school physical

education programs are inadequate and partially responsible for poor cardiovascular fitness of North American children (5). One means of increasing the physical activity through school physical education programs is to increase the duration or frequency of physical education class. Conflicting results have originated from research conducted in this area. Bar-Oz and Zwiren (6) found no gains in maximal oxygen consumption when children were given two additional physical education classes per week for nine weeks.

Likewise, Mocellin and Wasmund (46) required their students to carry out one or two 1,000 meter runs each week for six weeks but s saw no training response. Taddonio (56) compared the physical fitness of two fifth grade classes, one with no physical education curriculum and the other with a curriculum of 15 minute daily periods of calisthenics. Physical fitness was determined by the American Association for Health, Physical Education and Recreation (AAHPER) Youth Fitness test. Aerobic conditioning as measured by the 600 yard walk/run showed no significant difference between groups.

An extensive study by Cumming et al. (13) worked with sixth and tenth graders from three school systems for a school year. Of the three schools in the study, one private school offered a full program of physical education, the other private school had no formal program of physical education but the boys participated in snowshoeing and canoe trips and worked at farming, and the public school boys had less than 90 minutes of physical education every six days. It was concluded that the maximal oxyten consumption of fairly fit boys was unlikely to change over a school year, no matter how many

hours were allotted or how many facilities were available for physical education, without the institution of a training program specifically designed to improve endurance fitness.

However, the Trois Riveres Regional Experiment did result in an increased level of cardiovascular fitness in subjects, ages six-21. This was accomplished by adding five additional hours of required physical education each week (52). Johnson (33) had similar results when comparing two groups of seventh grade students over a two year period. One group had a physical education class every day, the other group had a physical education class two or three times during the week. Near the end of the second school year a physical fitness test battery was given. The results indicated that the five day subjects were superior in physical fitness to the two and three day a week subjects. Hanson (28) also did a study comparing the effects of a five day versus a three day physical education on achievement scores (in the youth fitness battery) of sixth grade children. Scores were collected from 1300 children in 20 Minneapolis public schools. The five day program was more effective than the three day program for each sex in developing a higher degree of fitness.

The Sunflower Project under the auspices of the Department of Health, Physical Education, Recreation and Dance, University of Kansas, Lawrence, Kansas; Shawnee Mission School District, Shawnee Mission, Kansas; University of Kansas Medical Center, the American Heart Association; and the Northeast Kansas Lung Association also attempted to elicit mental as well as physical changes in elementary

school children concerning cardiovascular fitness. Three additional physical fitness classes per week, an extended human physiology health program, and a nutritional program were included in the treatment program. Programs were designed especially for the individual grade levels and were administered to children in kindergarten through grade six (25).

Conclusions from the Sunflower Project that are pertinent to this study were: 1) The resting heart rates of fourth graders were considerably lower than the control students. The resting heart rates of all the children decreased with increasing age, the experimental children more than the control. 2) The twelve minute run for fourth graders indicated better performances for experimental children.

Methods of Increasing Cardiovascular Fitness

To improve cardiovascular fitness, aerobic activities are essential (4, 42, 58). For improvement, oxygen demands must be great enough and long enough to produce a good training effect on the heart,lungs, and blood vessels. The effects of training are influenced by many factors, including: (1) the intensity of the training sessions; (2) the frequency per week of the training sessions; and (3) the duration of the training program.

With children, specific guidelines are yet to be formalized in order to maximize cardiovascular fitness. However, beneficial results have been shown in studies with children eight to 15 years old, using the following guidelines. (1) Intensity of the training program

must be higher than with adults. Working heart rates of 170 to 190 beats per minute, or 85 percent of the maximal heart rate has been found to elicit higher gains of cardiovascular fitness (41, 55). In addition, this heart rate must be maintained anywhere from 12 to 20 minutes. (2) Frequency per week of a training program in children must be three times to five times per week to show improvement (11, 41, 55). (3) The duration of the training program varies with different studies, however, improvement has been verified with programs ranging from six weeks to 16 weeks (11, 18, 38, 41, 43, 55).

With children there may be another factor to consider, age (35, 37, 49). Katch (35) hypothesized that exercise-induced changes in muscular and cardiovascular function in children is dependent on hormonal regulation. Katch's Trigger Hypothesis states that there is one critical time period in a child's life which usually coincides with puberty. Before that time the effects of physical conditioning, not skill development, will be minimal or will not occur at all.

Rutenfranz et al. (49) supported this theory in their longitudinal study of 56 boys and 56 girls. The study examined the development of maximal aerobic power as a function of maturation. The age at which they observed the greatest height velocity was used as a reference of biological age and maturation. The findings suggest that the increase in maximal oxygen consumption prior to an approximate age of 14 is brought about by growth in body size with only negligible effect of other factors e.g., physical activity. Kobayashi et al. (37) studied junior athletes and found similar

results. From nine years of age to an age of 13 to 14 no significant changes in maximal oxygen consumption were observed. At maturation and in the years following to 16 years of age, an average increase of 30 percent in maximal aerobic power was noted.

Aerobic Training Programs for Children

Several studies have measured changes in cardiovascular fitness in children following participation in aerobic training programs. Realizing that maximal oxygen consumption is perhaps the best indicator of cardiovascular fitness with adults, several studies have attempted to increase maximal oxygen consumption with aerobic training in children (8, 13, 14, 17, 18, 37, 41, 43, 51, 55). Other studies have used indirect measurements of cardiovascular fitness to show an improvement in fitness (11, 14, 22, 28, 33, 40, 41, 48, 51, 55, 56).

Steward and Gutin (55) found no increase in maximal oxygen consumption for boys ten to 12 years of age following an eight week training program. Their subjects trained four times per week for 75 minutes at an average intensity level of 187 beats/per minute. Likewise, Cumming et al. (14) found no increase following a six day, intense training program averaging 35 miles per subject/per day. The subjects consisted of boys and girls, 13 to 16 years of age. Cumming and Goulding (13) also showed no significant change in maximal oxygen consumption, with three groups of various training intensities, following a ten month training program.

Shasby and Hagerman (51) studied 19 boys (aged 12-13) assigned to either distance, interval or control groups prior and following a 12 week conditioning program. No significant differences occured between any of the groups for maximal oxygen consumption variables. Kobayashi et al. (37) measured maximal oxygen consumption for six successive years in seven Japanese schoolboys starting at age nine and lasting until age 16. The subjects' training program consisted of activities such as endurance running, soccer and swimming for one to one and a half hours a day, four to five times a week. No significant changes in maximal oxygen consumption were found for the first three years.

On the other hand, there has been research showig increases in maximal oxygen consumption following a prescribed aerobic training program. Kobayashi et al. (37) did find that training did effectively increase maximal oxygen consumption after age 13 above the normal increase attributable to age and growth. Dobeln and Eriksson (16) measured an increase in maximal oxygen consumption of 12-14 percent more than could be ascribed to growth. They trained 12 boys 11 to 13 years of age, three times a week for four months. Each session was an hour long. Massicotte and Machab (41), following a six week training program, found that 36 boys, aged 11 to 13, increased their maximal oxygen consumption level by training three times per week, 12 minutes per session at a heart rate of 170 to 180 beats per minute. Brown et al. (8), trained pre-adolescent girls for 12 weeks, four to five times per week for at least 15 minutes, and showed an improvement in maximal oxygen consumption. And Ekblom (17),

with adolescent boys training twice a week, for 45 to 60 minutes each session also showed an increase.

Lussier and Buskirk (40), trained boys and girls, aged eight to 12 for 12 weeks, four times per week at an average of 30 minutes per workout. They showed a significant increase in distance on the 10 minute run and a significant decrease of their submaximal working heart rates. Cumming et al. (14) and Steward and Gutin (55) did not show a significant increase in maximal oxygen consumption with training, but a significant decrease in submaximal heart rates was noted. Likewise, Shasby and Hagerman (51) noted significant improvement in submaximal heart rates of 19 boys, aged 12 to 13, in both the interval and distance training groups. The conditioning program lasted 12 weeks. The submaximal heart rates differed significantly from the control group, which showed no change, yet there was no significant change in maximal oxygen consumption in any of the groups. Gatch (22), following an eight week training program with boys nine and ten years of age, five times per week for 25 minutes each session at an in intensity level of 80-90 percent of maximum heart rate, reported a decrease in submaximal heart rates. Mayers and Gutin (43) with approximately the same population and same training regime also noted a decrease in submaximal heart rates.

Testing Measures for Cardiovascular Fitness

Research using the 600 yard walk/run as a running field test, to show improvement in cardiovascular fitness, has shown conflicting results (11, 28, 33, 48, 56). Rothermel et al. (48) tested 87 boys

between the ages of seven and 13 inclusively in the 600 yard walk/run test. The group was broken down into two subgroups, with 65 experimental subjects and 22 control subjects. The conditioning program lasted eight weeks and consisted of 30 minutes of endurance running, four days a week. The changes which took place in items which purport to measure cardiorespiratory endurance were significantly greater for the boys in the experimental group. Johnson (33) with eighth graders and Hanson (28) with sixth graders showed similar results in the 600 yard walk/run, when increasing the number of physical education classes to greater than three times a week.

Cooper et al. (11) studied 778 high school boys after a 15 week endurance training program. The exercise program was five days a week, 20 minutes a session and consisted of exercises and progressive endurance running. The control group participated in their normal activity. The Cooper 12 minute walk/run test was administered at the beginning and at the end of the study. The results showed that the 12 minute walk/run improved significantly for the students who performed endurance training in addition to their standard physical education program. Taddonio (56) on the other hand, studied two fifth grade self-contained classes for four months, one with no physical education curriculum and the other with 15 minute daily periods of calisthenics. Results indicated that 15 minutes daily periods of calisthenics has little or no effect upon their performance on the 600 yard walk/run.

Lowered resting heart rates and submaximal heart rates have been shown to be good indicators of fitness (24, 26). One method of

measuring submaximal heart rates is using a bicycle ergometer. A modified Astrand Rhyming Bicycle Test has been used (35, 50). Subjects bicycle for six minutes with heart rate recorded the last 15 seconds of each minute. A workload of 300 kpm/minute at a speed of 50 revolutions per minute is used for elementary school children. The fifth and sixth minute reading must be within five beats of each other or the test is continued until leveling off has occured. The average of the last two minutes are used for data as the submaximal working heart rate. Research has indicated a lowered submaximal heart rate due to an aerobic training program is usually an indication of an increase in cardiovascular fitness (3, 42). Resting heart rates are taken before the testing begins and two recovery heart rates are taken at the first and second minute after the subject finished bicycling. The recovery heart rates are also taken the last 15 seconds of each minute (3, 36, 50, 55). It is hypothesized that the quicker the heart rate returns to normal the better the condition of the cardiovascular system (4, 42, 50). The formula used to determine recovery heart rate data was: exercise heart rate-recovery rate/exercise heart rate (50).

Running field tests, which are easy to administer and use little or no equipment, have been shown to be excellent indicators of cardiovascular improvements (11, 19, 26, 30, 31, 45). According to other research the nine-minute walk/run is most appropriate and accurate for fourth grade students (19, 31, 45). The 12 minute walk/run is used with fifth and sixth grade students (19).

These indirect measures of cardiovascular fitness; prediction

of maximal oxygen consumption, running field tests, submaximal and resting heart rates have been used with adults successfully and have a high correlation with maximal oxygen consumption (4, 42). Yet with children these indirect measurements have been used to indicate changes in cardiovascular fitness but do not always correlate highly with maximal oxygen consumption (12, 14, 39, 55).

Krahenbuhl et al. (40) found a correlation of .918 with maximal osygen consumption expressed in ms/kg/minute with a 1600 meter run time in third graders. Mayers and Gutin (43) with boys eight to 11 years of age found a correlation of .80 with maximal oxygen consumption and mile run time. Metz and Alexander (45) studied 60 boys, 12 to 13 years of age, and found maximal oxygen consumption significantly related to the 600 yeard walk/run. Similarly, Jackson and Coleman (30) with 22 boys and girls from fourth, fifth and sixth grades found the nine minute and 12 minute walk runs were significantly correlated with maximal oxygen consumption.

Cummings and Keynes (12) did not find maximal oxygen consumption significantly related to the 300 yard walk/run with 500 children, 6 to 17 years of age. Likewise, Lariviere et al. (39) studies the relationship of the 50 yard, 300 yard, 880 yard, five minute and 12 minute runs with maximal oxygen consumption and found them largely unrelated. Steward and Gutin (55) with males 10-12 years of age and Cumming et al. (14) with males and females 13-16 years of age compared submaximal heart rates and maximal oxygen consumption. Both investigators reported low correlations between submaximal heart rates and maximal oxygen consumption.

Summary

Cardiovascular disease is a pediatric disease, therefore, therapy should start in childhood (5, 15, 20, 23, 29, 34, 41, 58). Some elementary schools have tried to increase cardiovascular and over-all fitness by implementing additional physical fitness classes to their physical education program (6, 13, 25, 28, 33, 52, 56). The research is controversial about the minimum amount of physical education needed to improve cardiovascular fitness. Yet results have been seen in children with as little as 15 minutes of aerobic activity, three times per week, for a period of six weeks (11, 41, 45). The test testing measures may be indirect measurements, since they are easy to administer and usually show improvements in short term physical training (14, 22, 40, 43, 51, 55). Yet these improvements do not always correlate with an increase in maximal oxygen consumption (12, 14, 39, 55).

Research using maximal oxygen consumption assessment with children after an aerobic training program has also yielded conflicting results (8, 13, 14, 17, 18, 37, 41, 43, 51, 55). Conflicting results may have something to do with the age of the children involved in the study (35, 37, 49). Researchers are hypothesizing that there may be a time, usually around puberty, that before this time there will be only small training-induced biological alterations because of the lack of hormonal control (35, 37, 49). Hopefully these findings will help the elementary physical education teacher better decide what type of training program is necessary to increase cardiovascular fitness and what is the best way to measure the changes.

CHAPTER III

PROCEDURES

Design

This study was designed to determine if three, 20-minute aerobic fitness periods, in addition to the regular physical education program, would increase cardiovascular fitness in fourth grade boys and girls. In addition, an examination of the intercorrelations among the nine minute walk/run, the bicycle ergometer test, and the maximal treadmill run as indicators of cardiovascular fitness was conducted.

A review of the related literature was conducted by first examining the material on cardiovascular diseases in children. Other areas examined were; (1) ways of assessing children's cardiovascular fitness, and (2) design and implementation techniques for cardiovascular fitness programs for children.

The experimental group consisted of 32 fourth-grade boys and girls at Trailwood Elementary School. The control group consisted of 29 fourth-grade boys and girls from Brookwood Elementary School. Subjects were selected due to accessibility and availability of students, equipment and personnel. Both schools are in the Shawnee Mission, Kansas School District (USD 512).

Selection of Tests

The measurement techniques identified in the discussion on pre-testing and post-testing procedures were utilized to obtain the necessary data. These tests are described as follows:

1. Nine Minute Walk/Run: A running field test most suitable for fourth grade students (19, 21). It was conducted on a pre-measured course. Students were paired, with one-half of the class running while a partner counted the number of laps the other partner completed in the nine minute period. Distance was recorded to the nearest yard. Following the testing of the first group, the other group ran.
2. Modified Astrand Rhyming Bicycle Test: This test was used to assess the heart rates before, during, and after sub-maximal exercise. Each subject was first asked to sit on the bicycle ergometer to determine the proper saddle height. The most effective saddle height is when the subject has the front part of his/her foot on the pedal and gives a slight bend of the knee joint in the lower position (36). With the subject's hands on the handle bars and his/her feet on the rests, a resting heart rate was taken by placing a stethoscope on the chest over the heart. A stopwatch was used to time the count of 20 pulse beats for determining heart rate. Using the table in Appendix B the time recorded for 20 beats was converted to heart rate per minute. Each subject then pedaled for six min-minutes at a speed of 50 revolutions per minute (r.p.m.) as determined by a calibrated metronome. After the subject had started to pedal, the ergometer was adjusted to a workload of 300 kpm/minute. The heart rate was counted and recorded the last 15 seconds of every minute. Submaximal working heart rates were determined by taking the mean of the last two working

heart rates. If the difference between the fifth and sixth minute heart rates exceeded five beats per minute, the working time was prolonged until a constant level was reached. When a constant level was reached the subject was asked to place his/her feet on the rest and to keep his/her hands on the bars. A recovery heart rate was taken for each minute interval following the workout for two minutes. All heart rates were taken during the last 15 seconds of each minute (3, 36, 50, 55). Values used in the data analysis for recovery heart rates were determined by the following formula: mean submaximal heart rate - recovery heart rate/mean submaximal heart rate (50).

3. Maximal Oxygen Consumption Test: This test was conducted in the exercise physiology laboratory at the University of Kansas. Twenty-two volunteer subjects from the fourth grades of both schools were tested. All subjects and parents were sent a letter to advise them of the risks and benefits of the tests and testing procedures (Appendix C). Consent forms (Appendix D) were signed before entering the laboratory, allowing participation and understanding of the implications of the test.

Maximal Oxygen Consumption (max Vo_2) was determined by using the Astrand maximal treadmill test procedure. The subjects performed a maximal run on the treadmill with the length of the run varying for each individual subject. The speed of the run varied for each individual to allow the subjects to reach a max within four to eight minutes. The subjects were prepared for this test by first being hooked up to a standard three

lead electrocardiogram (EKG) which monitored the subject's heart rate throughout the test. The subjects were given a sufficient warm-up period to adjust themselves to running on the treadmill. At the end of the warm-up period, the subject was at the speed and grade that the test was conducted. The speed varied from 4.8 miles/hour to 6.2 miles/hour, depending upon the fitness level of the subject. Once the test was started the speed of the treadmill remained the same throughout the test. The grade, however, was increased every three minutes by 2.67 degrees. The subject ran on the treadmill until he/she could not keep up with the treadmill. At the conclusion of the run, the maximal heart rate was determined by an EKG read-out. The EKG readout was taken immediately after the subject stopped running.

Expired air was collected during the test in meteorological balloons. The last three full bags collected during the test were analyzed for O_2 and CO_2 content as well as volume of air in the bags. The expired air was analyzed by a Bechman Oxygen analyzer OM-14. The analyzers were calibrated between each subject using a previously known gas supplied by the Puritan Bennett Corporation. The total volume in the bags was measured by a Collins Tesot tank.

All subjects were given a sufficient cool down period after the run which consisted of a brisk walk on the treadmill. after the subjects had reached a heart rate of 120 beats per minute, and felt allright, the test was terminated.

Data for this study was analyzed only if the subjects reached a maximal oxygen consumption. Cirteria used to determine whether maximal oxygen consumption was achieved is: Respiratory quotient greater than 1.1, less than 2.2 mil difference in oxygen consumption between the last three bags collected, and heart rate near predicted maximal heart rate at the conclusion of the test.

Test Administration

All pre-testing was conducted during the month of September, 1979 at both elementary schools. Volunteer graduate students assisted in administering the bicycle ergometer test. They were trained at the University of Kansas Exercise physiology laboratory. Undergraduate students from the Health, Physical Education and Recreation Department, University of Kansas were used as recorders for the above tests. At Trailwood Elementary School the student teacher, in physical education at the time, was trained to help with the treatment program and to administer and record the nine minute walk/run scores.

After the pre-testing phase, the subjects at Trailwood Elementary School participated in a 12 week aerobic training program (Appendix A) Students met for 20 minute periods, three times per week. Activities varied due to seasonal weather changes and motivational needs. Every fitness period included a warm-up, an aerobic activity, and a cool down. The objective of each lesson was to keep the students moving continuously for 20 minutes.

Post-testing included the nine minute walk/run and the bicycle

ergometer test at both schools. Testing was administered in December, 1979, after the 12 week treatment program was concluded at Trailwood Elementary School. The same procedures used for pretest were used for the post-test. A maximal treadmill test was administered in March, 1980, on a total of 22 students from both schools, at the University of Kansas Exercise Physiology Laboratory, by trained graduate students.

Reliability and Validity

Reliability for the submaximal bicycle test and maximal treadmill test was determined by a pilot study. The pilot study was conducted in August, 1979 and March, 1980 and consisted of a small sample of students being tested in the Exercise Physiology Laboratory at Kansas University and at Trailwood Elementary School. Based upon the work of Astrand (3, 4), AAHPER's Youth Fitness Tests (19), Jackson and Coleman (30) and Boileau (7), validity was accepted for all testing measures.

Data Analysis

Miltiple repeated measures analysis of variance and covariances were used to analyze the bicycle ergometer and the nine minute walk/run data. To see if there was a correlation between the bicycle ergometer and the nine minute walk/run tests to the maximal treadmill test, correlation coefficients were determined. The data used in the anslyses were resting heart rates, submaximal heart rates, recovery heart rates, nine minute walk/run scores and maximal oxygen

consumption scores. Significant differences were accepted at the .05 level of significance, however, ratios below the .05 level were also noted.

CHAPTER IV

RESULTS AND DISCUSSION

Analysis of Data

A sample of fourth grade students (n=32) from the Shawnee Mission School District in Overland Park, Kansas, were subjects of a 12 week aerobic training program. The purpose of the study was to determine if an aerobic fitness program will increase cardiovascular fitness in fourth grade boys and girls. Secondly, relationships between a submaximal bicycle test, a nine minute wakl/run, and a maximal treadmill test were also studied.

The treatment program was conducted at Trailwood Elementary School during three regularly scheduled recess periods, per week, for 20 minutes. The treatment program lasted 12 weeks and each session consisted of a warm-up, selected aerobic activities (Appendix A), and a cool down period. The bicycle ergometer test and the nine minute walk/run were used for assessing cardiovascular fitness, pre and post treatment. A sample of fourth grade students (n=20) at Brookwood Elementary School served as the control group, participating only in the pre- and post-testing phase of the study.

To determine if there was a relationship between data obtained from a submaximal bicycle test, a nine minute walk/run, and a maximal treadmill test; a sub study was performed on a sample (n=22) of volunteer students from both schools. Maximal oxygen consumption was determined by a maximal treadmill test at the University of Kansas Exercise Physiology Laboratory. Following the treadmill test, the

nine minute walk/run and bicycle ergometer tests were administered to the 22 students at their respective schools.

Graphs One through Five illustrate the pre- and post-test means of the data from the nine minute walk/run and the submaximal bicycle test. (See pages 30-35.)

Table 1 shows an analysis of the variance of results of resting heart changes due possibly to an aerobic training program. The aerobic training program did not significantly affect resting heart rates since the F-ratio of .15 did not exceed the critical values required at the .05 level of significance.

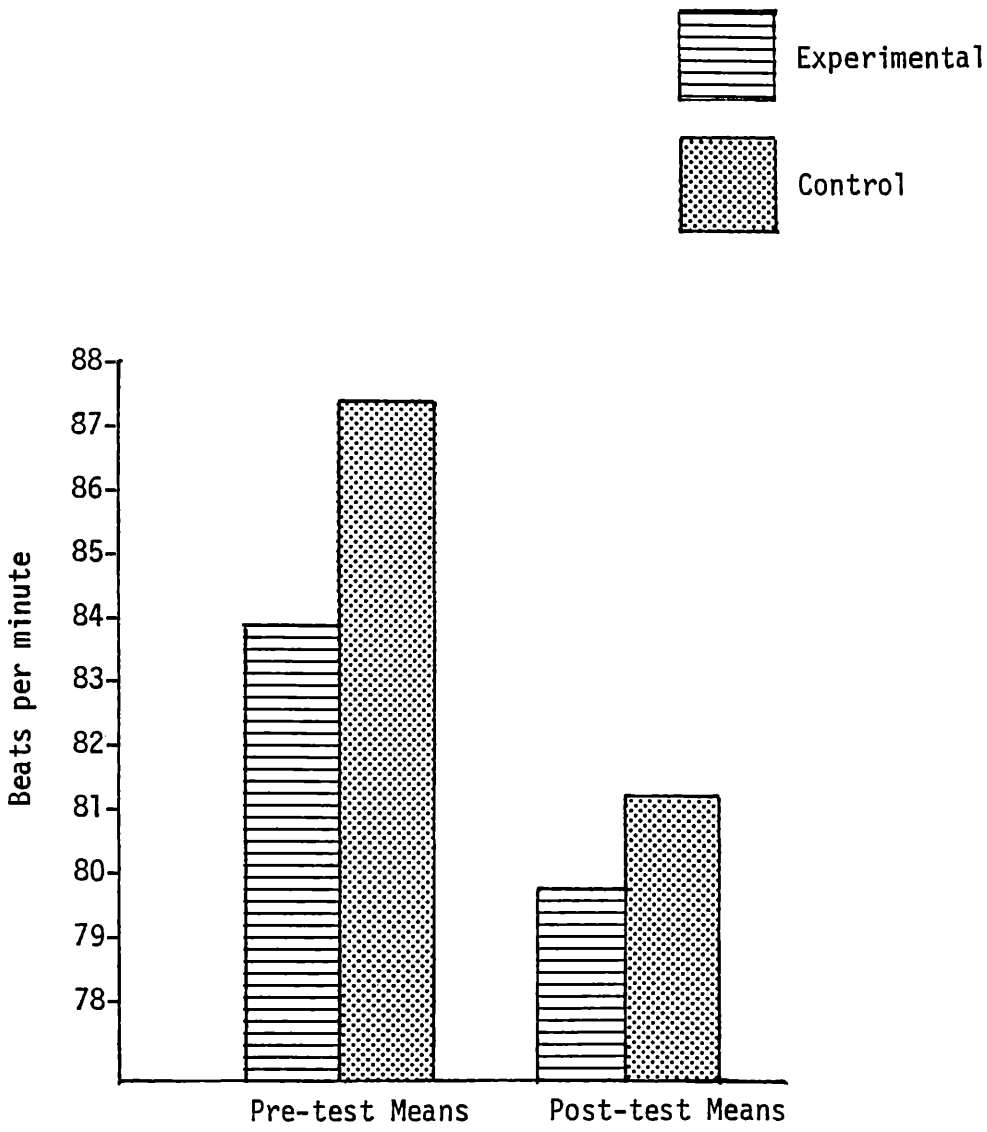
Table 1

Analysis of Variance for Resting Heart Rate Changes due to an Aerobic Training Program

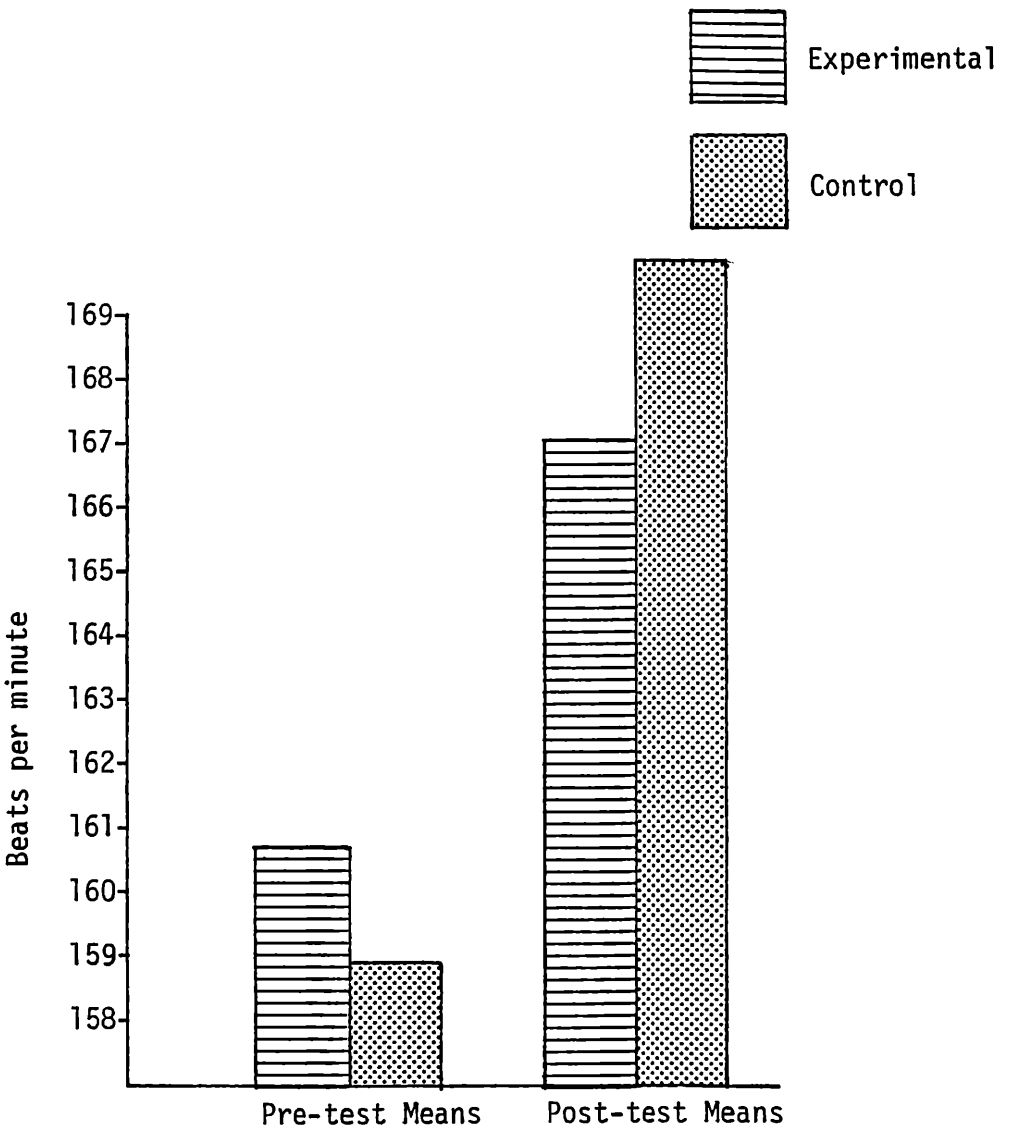
Source	SS	DF	MS	F	Prob.
Groups (X-C)	191.63	1	191.63	.83	.37
Sex (FM-M)	227.40	1	227.40	1.20	.28
Pre X Post X Group	21.20	1	21.20	.15	.70
Pre X Post X Sex	36.68	1	36.68	.27	.61

Table 2 shows an analysis of variance of submaximal heart rate changes due possibly to an aerobic training program. Apparently, the aerobic training program did not significantly affect submaximal

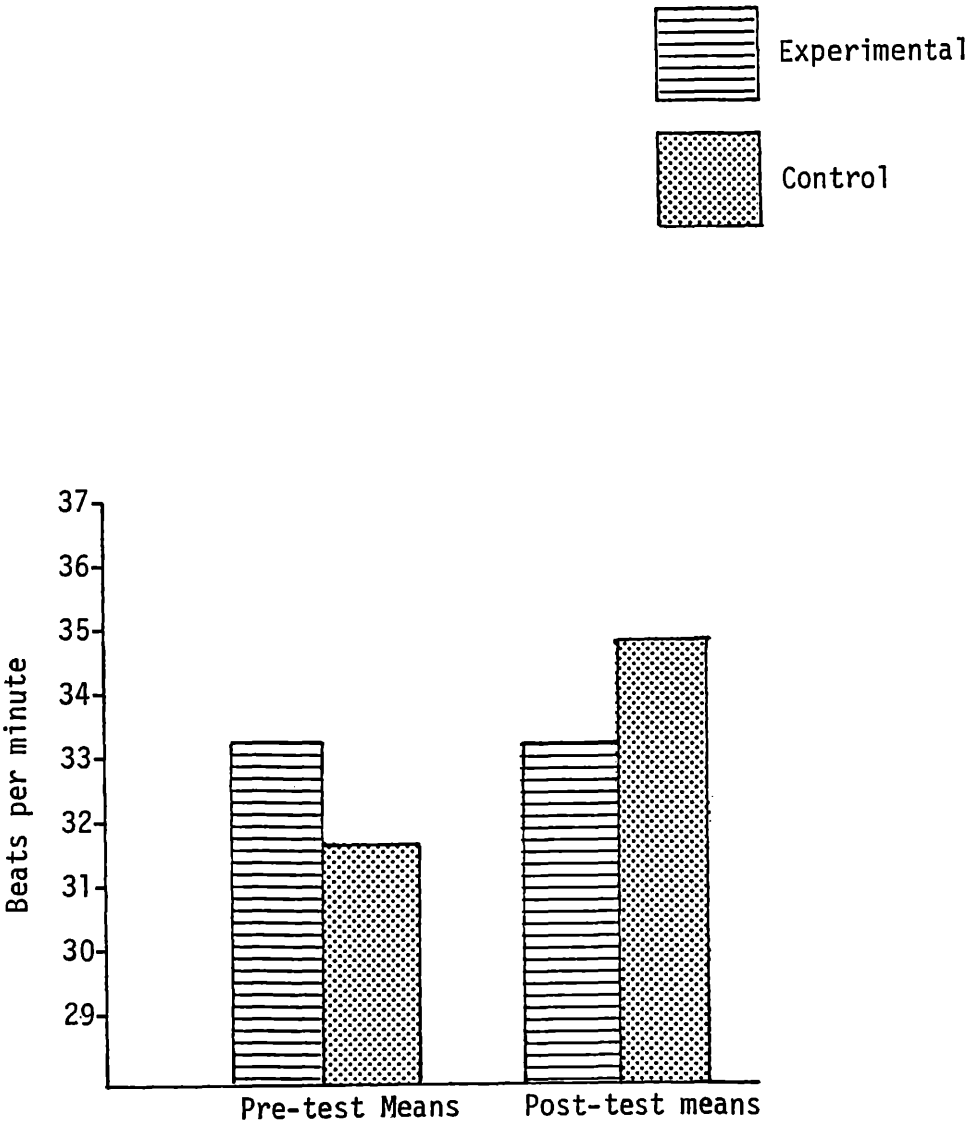
Graph 1. Pre and Post Test Means of the Resting Heart Rate Data



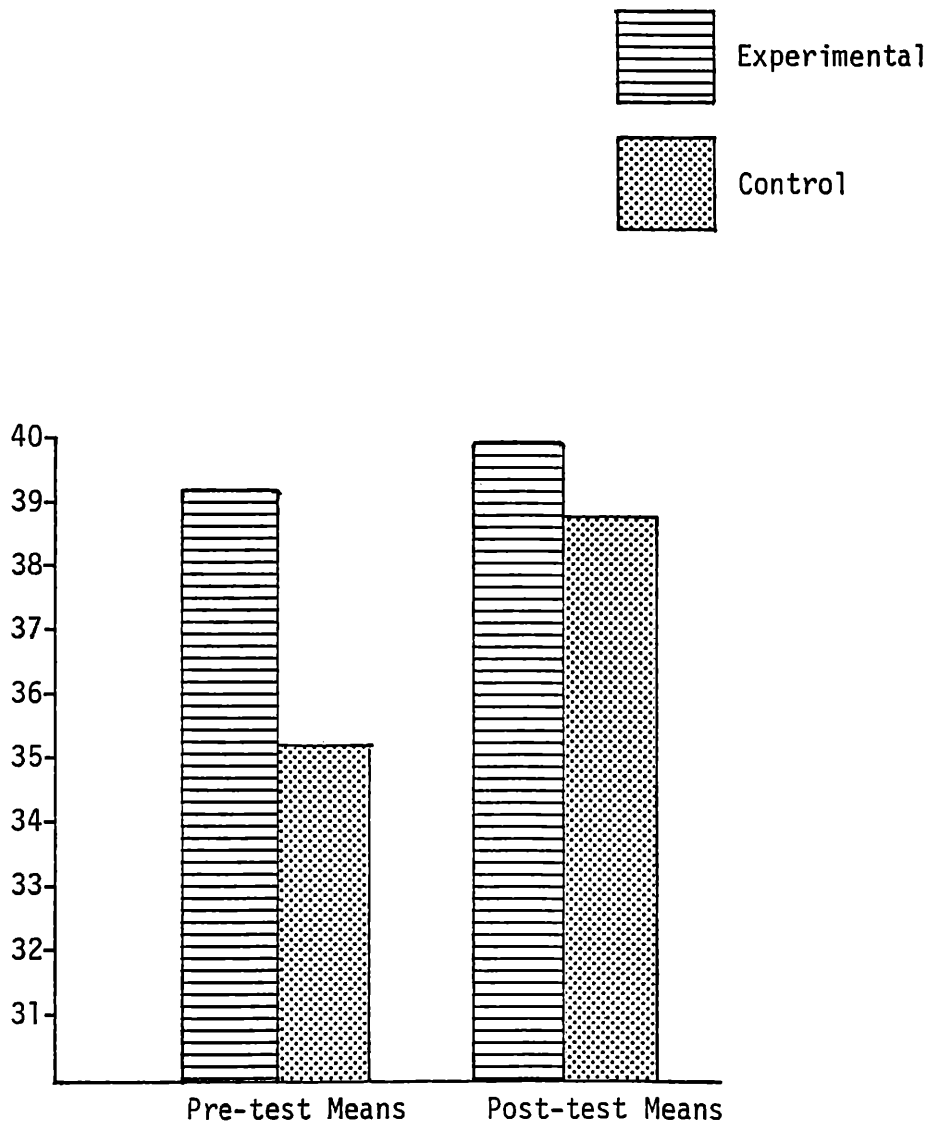
Graph 2. Pre and Post Test Means of the Working Heart Rate Data



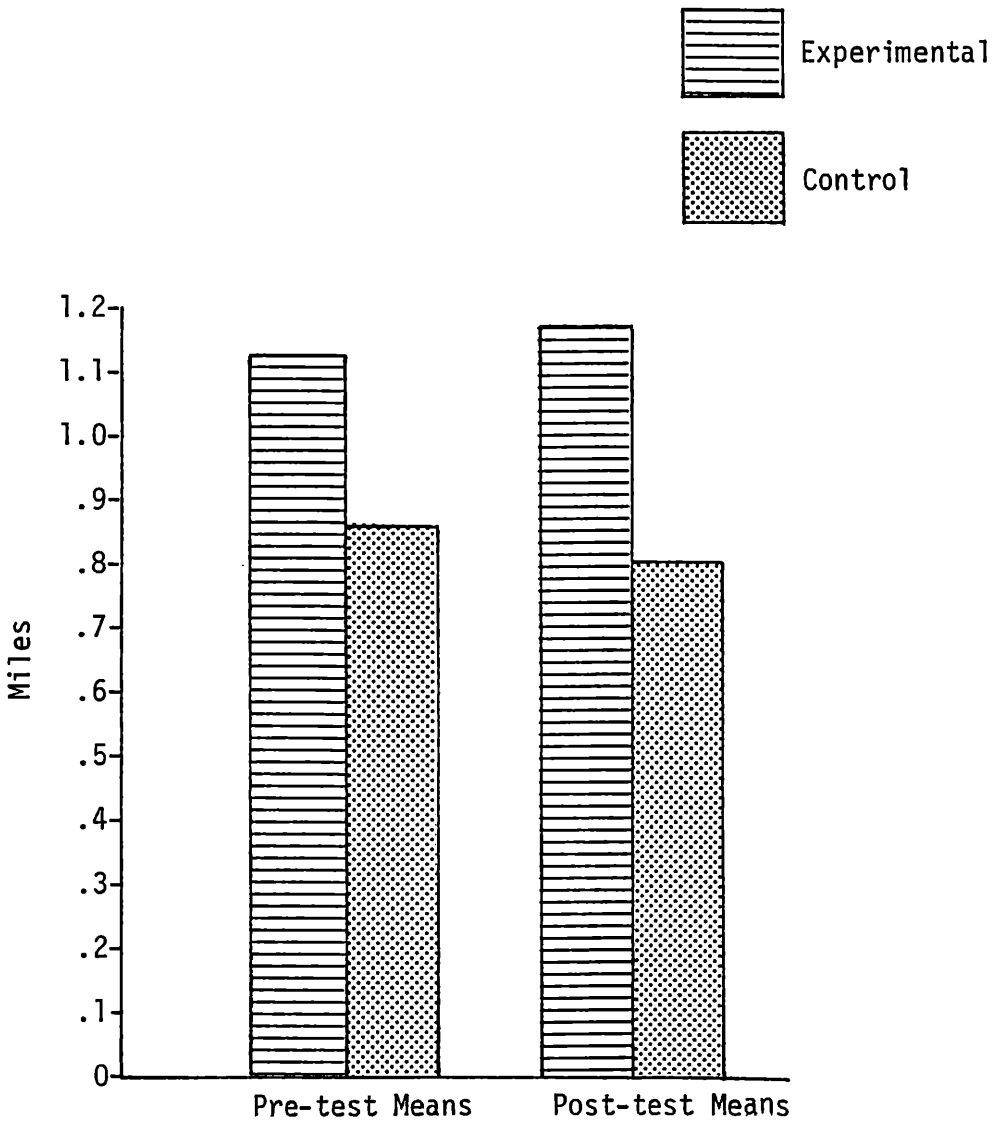
Graph 3. Pre and Post Test Means of the First Minute Recovery Heart Rate Data



Graph 4. Pre and Post Test Means of the Second Minute Recovery Heart Rate Data



Graph 5. Pre and Post Test Means of the Nine Minute Walk Run Data



heart rates since the F-ratio of .45 did not exceed the critical values required at a .05 level of significance.

Table 2

Analysis of Variance for Submaximal Heart Rate Changes due to an Aerobic Training Program

Source	SS	DF	MS	F	Prob.
Groups (X-C)	3.01	1	3.01	.01	.93
Sex (FM-M)	1403.42	1	1403.42	3.26	.08
Pre X Post X Group	147.42	1	147.42	.45	.50
Pre X Post X Sex	44.19	1	44.19	.14	.71

Table 3 shows an analysis of variance of first minute recovery heart rate changes due possibly to an aerobic training program. The aerobic training program did not significantly affect first minute recovery heart rates since the F-ratio of 2.01 did not exceed the critical values of a .05 level of significance. The combined female first minute recovery heart rates and the combined male first minute recovery heart rages with an F-ratio of 5.66 was great enough to produce a significant difference between the means at the .02 level.

Table 3

Analysis of Variance for the First Minute Recovery Heart Rate Changes due to an Aerobic Training Program

Source	SS	DF	MS	F	Prob.
Groups (X-C)	.00	1	.00	.00	1.00
Sex (FM-M)	538.71	1	538.71	5.66	.02*
Pre X Post X Group	86.41	1	86.41	2.01	.16
Pre X Post X Sex	1.44	1	1.44	.03	.86

*Significant at the .02 level of significance

In Table 4 the data are listed for the analysis of variance of second minute recovery heart rates due possibly to an aerobic training program. The aerobic training program did not significantly affect second minute recovery heart rates since the F-ratio of 1.27 did not exceed the critical values required of a .05 level of significance.

Table 5 shows an analysis of variance of the nine minute walk/run performance scores. A significant difference in the nine minute walk/run scores was found. The F-ratio of 6.2 was great enough to produce a significant difference at the .02 level of significance. The combined female performance score means were significantly different than the males' performance scores because the F-ratio of 13.31 exceeded critical values required for the ,001 level of

significance.

Table 4

Analysis of Variance for Second Minute Recovery Heart Rate Changes Due to an Aerobic Training Program

Source	SS	DF	MS	F	Prob.
Groups (X-C)	233.78	1	233.78	2.95	.09
Sex (FM-M)	90.31	1	90.31	1.14	.29
Pre X Post X Group	57.39	1	57.39	1.27	.26
Pre X Post X Sex	11.66	1	11.66	.26	.61

Table 5

Analysis of Variance on the Nine Minute Walk/Run Scores

Source	SS	DF	MS	F	Prob.
Groups (X-C)	1.48	1	1.48	71.83	0.001*
Sex (X-C)	.27	1	.27	13.31	.001**
Pre X Post X Group	.04	1	.04	6.2	.02***
Pre X Post X Sex	.001	1	.001	.20	.66

*Significant at the .001 level of significance

**Significant at the .001 level of significance

***Significant at the .02 level of significance

In Table 6 the correlation coefficients between testing measures are presented. There was no significant correlation between maximal oxygen consumption scores and the other scores. The recovery heart rate score of the first minute did have correlation of .86 with the recovery heart rate scores of the second minute but it was not a significant correlation.

Table 6

Correlation Coefficients Between Testing Measures

	Group	Sex	9 min	Max VO_2	RHR	WHR	R1	R2
Group	--							
Sex	.07	--						
9 min	-.74	-.41	--					
Max VO_2	.20	-.54	.36	--				
RHR	.05	-.33	.20	.25	--			
WHR	.15	.60	-.34	-.42	.10	--		
R1	-.01	.24	-.10	-.07	-.53	-.09	--	
R2	0.04	.19	-.12	-.14	-.49	-.08	.86	--

Based upon the results of this study, the hypotheses were rejected or accepted accordingly. The first hypothesis indicated that there would be a significant difference in the cardiovascular fitness levels of fourth grade boys and girls at Trailwood Elementary School as compared with the fourth grade boys and girls at Brookwood Elementary School. The first hypothesis was accepted since a

significant difference was found between the nine-minute walk/run scores at Trailwood Elementary School compared to Brookwood Elementary School.

The second hypothesis proposed that there would be a significant correlation between the data from the nine-minute walk/run test with the data obtained from the maximal treadmill test. The second hypothesis was rejected since a significant correlation was not found between scores from the maximal treadmill test and the nine minute walk/run.

The third hypothesis stated that there would be a significant correlation between the data from the bicycle ergometer test with the data obtained from the maximal treadmill test. This hypothesis was rejected since a significant correlation was not found between the data from the bicycle ergometer test and the data from the maximal treadmill test.

Discussion

There were no significant changes in resting heart rates, submaximal heart rates, and first and second minute recovery heart rates due to the aerobic training program. The analysis conducted on the data obtained from the bicycle ergometer test showed a significant difference comparing all males to females in the ability of the heart rate to recover after the first minute of exercise. The males showed a significantly higher percentage in the ability of their heart rates to recover from exercise than the females. There was also a significant difference between the male and female subjects

in the nine-minute walk/run scores. The males showed a significantly higher distance in the nine minutes as compared with the females. There were no positive correlations between maximal oxygen consumption and the other testing procedures scores.

The results of this study indicated some similarities as well as differences to other studies performed in the field of cardiovascular fitness and elementary school children. Lussier and Buskirk (40), trained boys and girls, aged eight to 12 for 12 weeks, four times a week at an average of 45 minutes per work out. The age of the children, frequency and duration of the program were very similar to this study. Also both studies showed a significant increase in distance on their test runs. Rothermel et al. (48), Johnson (33) and Hanson (28) had similar results in using running field tests. All three studies showed significant improvements in the 600 yeard walk/run scores with students from seven to 13 years of age. Lussier and Buskirk (40) also found a significant decrease in submaximal working heart rates which was not shown in this study. Likewise, Shasby and Hagerman (51) noted significant improvement of submaximal heart rates due to an exercise program.

Mayers and Gutin (43) and Krahenbuhl et al. (38) conducted simi similar studies in comparison of field tests with maximal oxygen consumption. Krahenbuhl et al. (38) found a correlation of .80 with msximal oxygen consumption and a mile run time. Both of these studies were similar to this study in design but this study did not find a positive correlation between maximal oxygen consumption and the nine minute walk/run. One possible reason for the difference could

be the motivation levels of children when performing distance runs and the lack of control administrators of tests have in this area. A study by Steward and Gutin (55) and Cumming et al. (14) concerned with the correlation of submaximal heart rates and maximal oxygen consumption, produced results similar to this study. These studies reported low correlations between maximal oxygen consumption and submaximal heart rates.

The studies that did not find a significant correlation between maximal oxygen consumption and other indirect cardiovascular fitness measurements (12, 14, 39, 55), as did this study, along with the research that showed no increase in maximal oxygen consumption due to training programs in children (13, 14, 37, 49, 51, 55), help support Katch's (35) hypotheses. Katch hypothesizes that children under approximately 14 years of age will only see minimal effects from physical training on their maximal oxygen comsumption scores. Katch's (35) trigger hypotheses explains that changes in hormonal regulation after puberty allows for increases in maximal oxygen consumption scores after aerobic conditioning.

There may be some explanations for the different outcomes in training programs. I feel that the intensity at which the program is designed has a great deal to do with the children's cardiovascular improvement. Also, the initial fitness level of the child has to be looked at (the same as with adults). The lower the initial fitness level, the greater the percentage of improvement that will be shown. And finally what type of effort the children put into the fitness programs.

These three statements may have something to do with the results of this study. Ideally I would say the children should be at an intensity level of 85-90 percent of their maximum heart rate for at least 30 minutes, three times per week. Also, I feel the Trailwood students started at a higher level of fitness than most elementary school children, because they had been involved in the Sunflower Project for two years prior to this study. Finally, it is hard to determine whether their motivation would be higher or lower than students at amother school.

Even if cardiovascular assessments do not find a significant increase in scores, aerobic training programs with children are still a necessity for later on in life. Also the increase in physical activity may help in our fight of obesity.

The difference in males having better performances on the nine minute walk/run tests could be because; 1) I feel the males were physically stronger than the females and 2) there seemed to be more competitive peer pressure to perform well on the test.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to determine if an aerobic fitness program would increase cardiovascular fitness in fourth grade boys and girls. A secondary purpose was to determine if there was a relationship between a submaximal bicycle test, a nine minute walk/run, and a maximal treadmill test.

The undertaking of this study was motivated by an apparent neglect for the development of cardiovascular fitness in the elementary school child and the growing concern of cardiovascular disease and risk factors. While most considered the elementary school child to be "healthy," research has shown risk factors for cardiovascular disease including lack of physical activity is reported in early childhood (5, 10, 11, 15, 23, 52). Therefore, young children should be exposed to a wide range of sports and recreations stressing the cardiovascular system and what type of testing procedures would be reliable to measure the improvement.

The subjects for this study attended two elementary schools in Shawnee Mission, Kansas. The treatment program at the experimental school was conducted during three regularly scheduled recess periods, per week, for 20 minutes. The treatment program was 12 weeks in length and consisted of selected aerobic activities (Appendix A).

The bicycle ergometer test and the nine minute walk/run were used for assessing cardiovascular fitness. Also a sample of students from both schools were involved in a maximal treadmill test at the

University of Kansas Exercise Physiology Laboratory. Following the treadmill test, the nine minute walk/run and bicycle ergometer tests were administered.

Analysis of variance and covariances with repeated measures were used to analyze the data obtained from the bicycle ergometer test and the nine minute walk/run. Between groups independent variables were: sex, resting heart rates, submaximal heart rates, and nine minute walk/run scores. Significant differences were accepted at the .05 level of significance; however, ratios below the .05 level were also reported.

Comparison of groups with correlation coefficients were used to analyze the stat from the sub-study involving the maximal treadmill run, bicycle ergometer and the nine minute walk/run. Within group variables included: sex, nine-minute walk/run scores, maximal oxygen consumption, resting reart rates, submaximal reart rates, first recovery heart rates and second minute recovery heart rates.

Conclusions

Within the limitations and assumptions of this study the following conclusions were made:

1. A 12 week aerobic training program, three times a week, will increase cardiovascular fitness of fourth grade students as measured by a nine minute endurance run.
2. Maximal oxygen consumption did not show a significant correlation with the nine minute walk/run or submaximal bicycle test in this study.

3. Aerobic training programs are necessary if fourth grade students are to increase cardiovascular fitness, to teach lifetime habits, and to help keep the body in good physical condition.

Recommendations

The following are considerations for further studies in the area of cardiovascular fitness in children.

1. To further substantiate these findings, a larger group of fourth grade subjects should be tested.
2. The frequency and intensity of the exercise program should be increased and monitored.
3. An effort should be made to keep testing environments the same.
4. Accuracy could be enhanced by all tests being administered by the same person.
5. Motivational techniques to keep all subjects performing at their maximul level.
6. Research in the area of hormonal regulation in children and how exercise-induced changes affect their muscular and cardiovascular function needs to be further studied.

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APPENDIX A

Twelve Week Aerobic Training Program

Twelve Week Aerobic Training Program

All sessions lasted 20 minutes and consisted of approximately three minutes of warm-up and stretching, 15 minutes of aerobic activity, and two minutes of walking and stretching.

Aerobic activity for twelve week program:

Week 1
- Continuous running
- Aerobic Games
- Continuous running

Week 2
- Circuit Station work
- Continuous running
- Circuit station work

Week 3
- Vitae Park work
- Aerobic games
- Vitae Park work

Week 4
- Interval running
- Aerobic games
- Interval running

Week 5
- Aerobic games
- Continuous running
- Aerobic games

Week 6
- Vitae Park
- Continuous running
- Vitae Park

Week 7
- Continuous running
- Aerobic games
- Aerobic games

Week 8
- Jump roping
- Indoor running to music
- Jump roping

Week 9
- Indoor running to music
- Jump roping
- Indoor running to music

Week 10
- Jump roping
- Aerobic dancing
- Jump roping

Week 11
- Indoor running to music
- Aerobic dancing
- Aerobic dancing

Week 12
- Vitae Park
- Aerobic dancing
- Indoor running to music

*Aerobic games included: Loose Caboose, Sharks and Minnows, Blob Tag, Amoeba Race, Catch the Dragon's Tail and Modified Dodge Ball.

**Vitae Park and Circuit Stations consist of a series of exercise stations that the students completed by running to a station, performing the exercise and then running to the next station.

APPENDIX B

Heart Rate Conversion Table

Table for Conversion of Time for

20 Beats to Heart Rate per Minute

Time	H.R.	Time	H.R.	Time	H.R.	Time	H.R.
20.0	60	16.3	74	12.6	95	9.0	133
19.0	60	16.2	74	12.5	96	8.9	135
19.8	61	16.1	75	12.4	97	8.8	136
19.7	61	16.0	75	12.3	98	8.7	138
19.6	61	15.9	75	12.2	98	8.6	140
19.5	62	15.8	76	12.1	99	8.5	141
19.4	62	15.7	76	12.0	100	8.4	143
19.3	62	15.6	77	11.9	101	8.3	145
19.2	63	15.5	77	11.8	102	8.2	146
19.1	63	15.4	78	11.7	103	8.1	148
19.0	63	15.3	78	11.6	103	8.0	150
18.9	63	15.2	79	11.5	104	7.9	152
18.8	64	15.1	79	11.4	105	7.8	154
18.7	64	15.0	80	11.3	106	7.7	156
18.6	65	14.9	81	11.2	107	7.6	158
18.5	65	14.8	81	11.1	108	7.5	160
18.4	65	14.7	82	11.0	109	7.4	162
18.3	66	14.6	82	10.9	110	7.3	164
18.2	66	14.5	83	10.8	111	7.2	167
18.1	66	14.4	83	10.7	112	7.1	169
18.0	67	14.3	84	10.6	113	7.0	171
17.9	67	14.2	85	10.5	114	6.9	174
17.8	67	14.1	85	10.4	115	6.8	176
17.7	68	14.0	86	10.3	116	6.7	179
17.6	68	13.9	86	10.2	117	6.6	182
17.5	69	13.8	87	10.1	118	6.5	185
17.4	69	13.7	88	10.0	120	6.4	188
17.3	69	13.6	88	9.9	121	6.3	190
17.2	70	13.5	89	9.8	122	6.2	194
17.1	70	13.4	89	9.7	124	6.1	197
17.0	71	13.3	90	9.6	125	6.0	200
16.9	71	13.2	91	9.5	126	5.9	203
16.8	71	13.1	92	9.4	128	5.8	207
16.7	72	13.0	92	9.3	129	5.7	211
16.6	72	12.9	93	9.2	130	5.6	214
16.5	73	12.8	94	9.1	132	5.5	218
16.4	73	12.7	94				

APPENDIX C

Letters To Parents

August, 1979

Dear Trailwood Parents:

This will be the third year that Trailwood Elementary School will be the site for the Sunflower Project. The goal of the Sunflower Project is to help each student gain a deep understanding of, and an appreciation for his body in general and his cardiovascular and respiratory systems in particular. He should also learn and practice ways of living which could help him to prevent heart attack and other heart and lung diseases, and to develop and maintain healthy hearts, arteries, lungs and general good health.

The design of the Sunflower Project consists of four major areas of emphasis. 1) Physiological Measurements; 2) Physical Fitness; 3) Health Knowledge; and 4) Diet.

For the past two years I have helped in all phases of the physiological and fitness testing in the Sunflower Project. This year while working on my masters program in physical education at Kansas University, I am also priviledged to be working at Trailwood on the Sunflower Project.

This fall I will be conducting a research study dealing with the fourth graders at Brookwood and Trailwood Elementray Schools. They will participate in the on-going Sunflower Project's Program. They will also be given a submaximal stationary bicycle test, and the nine minute walk/run test, to determine cardiovascular fitness, prior to and following a 12-week treamtment program. The treatment program will consist of vigorous activities for the heart and lungs, three times per week, during their normally scheduled "break for fitness" times.

Enclosed is a permission form to be completed and returned the first day of school.

The success of the Sunflower Project and this research study is dependent upon the cooperation of the Trailwood parents along with the students, faculty and staff. I am anticipating a challenging and exciting year and hope to share it with you.

If you have any additional questions, please call me at

Sincerely,

Ann Schumacher

AS:lmh

August 1979

Dear Brookwood Parents,

This will be the third year that Brookwood Elementary School will be the site for the control group of the Sunflower Project. The purpose of the Sunflower Project is to see if elementary school students can gain a deep understanding of, and an appreciation for, their body in general and their cardiovascular and respiratory systems in particular.

For the past two years I have helped in all phases of the physiological and fitness testing in the Sunflower Project. This year while working on my masters program in physical education at Kansas University, I am also priviledged to be working in Shawnee Mission on the Sunflower Project.

This fall I will be conducting a research study dealing with the fourth graders at Brookwood and Trailwood Elementary Schools. At Brookwood all that will be asked of the fourth graders is to participate in the on-going Sunflower Project tests and also a submaximal stationary bicycle test and the nine minute walk/run test to determine cardiovascular fitness. The bicycle and nine minute walk/run tests will be given in September and once again in November.

Enclosed is a permission form to be completed and returned the first day of school.

The success of the Sunflower Project and this research study depends upon the cooperation of the parents, students, faculty and staff at Trailwood and Brookwood.

I am anticipating a challenging and exciting year and hope to share it with you.

If you have any additional questions, please call me at

Sincerely,

Ann Schumacher

AS:mm

Brookwood School
103rd & Wenonga
Shawnee Mission, KS 66206

Dear Parents,

An additional testing parameter--determination of maximal oxygen consumption by treadmill testing--is to be included in the Sunflower Project this year with the 4th graders. This test will require the use of the University of Kansas Exercise Physiology Laboratory.

Maximal Oxygen Consumption

Treadmill Procedures

This involves a supramaximal run on the treadmill while expired air is collected in meterorological balloons. The grade is increased at the end of each three minutes until the subject is unable to continue. The test usually is preceded by a submaximal run to determine the starting workload on the treadmill and then a warmup and adjustment period with jogging on the treadmill. An ECG is always monitored.

Purpose

Maximal oxygen consumption is generally considered to be the single best measure of circulorespiratory fitness. The purpose is to determine the greatest amount of oxygen the subject can utilize per minute.

Testing will take place on Tuesday, April 15. Testing will be conducted in the morning and transportation will be provided by the University of Kansas. Parents and students will be contacted as tc times and the schedule for that day.

It is important that we have as many students as possible involved in this aspect of testing, due to the statistical analysis of the data that is required. Therefore, we hope that you will want to encourage your child to participate. As you may well be aware of, the Sunflower Project is getting more publicity every day and this aspect of our data will add considerable creditability to the study. Please fill out the permission slip and return it to the school by March 20. Thank you for your cooperation. If you have any questions please contact Ann Schumacher at Trailwood School - 642-9031.

Dr. Leon Greene
Project Coordinator

Ann Schumacher
Research Consultant

Trailwood School
5101 W. 95th St.
Shawnee Mission, KS 66207

February 26, 1980

Dear Parents,

An additional testing parameter--determination of maximal oxygen consumption by treadmill testing--is to be included in the Sunflower Project this year with the 4th graders. This will require the use of the University of Kansas Exercise Physiology Laboratory.

Maximal Oxygen Consumption

Treadmill Procedures

This involves a surpamaximal run on the treadmill while expired air is collected in meterorological balloons. The grade is increased at the end of each three minutes until the subject is unable to continue. The test usually is preceded by a submaximal run to determine the starting workload on the treadmill and then a warmup and adjustment period with jogging on the treadmill. An ECG is always monitored.

Purpose

Maximal oxygen consumption is generally considered to be the single best measure of circulorespiratory fitness. The purpose is to determine the greatest amount of oxygen the subject can utilize per minute.

Testing will most likely take place on Monday and Tuesday, March 10 and 11th. Testing will be conducted in the mornings and transportation will be provided by the University of Kansas. A schedule will be prepared and students and faculty will be notified and consulted concerning appropriate days for those involved.

It is important that we have as many students as possible involved in this aspect of testing, due to the statistical analysis of the data that is required. Therefore, we hope that you will want to encourage your child to participate. As you may well be aware of, the Sunflower Project is getting more publicity every day and this aspect of our data collection will add considerable creditability to the study. Please fill out the permission slip and return it to the school by March 1. Thank you for your cooperation. If you have any additional questions please contact Ann Schumacher at Trailwood School-642-9031.

Dr. Leon Greene
Project Coordinator

Ann Schumacher
Research Consultant

Trailwood School
5101 W. 95th St.
Shawnee Mission, KS 66207

Dear Parents,

Your child was randomly selected, out of the returned permission slips, to be tested on the treadmill at the University of Kansas. The students met today with Ann Schumacher (Research Consultant) at Trailwood. During the meeting the students were informed as to what the test would include and how to prepare for it. This was told to them by some students at Trailwood that were tested last week on the Treadmill. The boys will go to K.U. on March 10, Monday and the girls will go on March 11 Tuesday On your childs respective day we will all meet in the front of Trailwood at 7:00 a.m. and return to Trailwood at 1.00 p.m. Please do not feed your child a large breakfast, donuts will be provided after they have run on the treadmill. Also please pack a sack lunch for your child, we will be returning after lunch is over at Trailwood. Any homework, busy work, or sedentary games may be brought with the student to do while he/she is not on the treadmill. The two permission slips enclosed are formalities. One is a field trip form for Trailwood and the other is a form for the Laboratory at K.U., please return both to school before Friday.

If you have any questions please contact Ann Schumacher at Trailwood. If not she will meet you in front of Trailwood at 7:00 a.m. and will drive the students to K.U. Thank you for all of your help. You are all to be commended for being such exceptional parents.

Sincerely,

Dr. Leon Greene
Project Coordinator

Ann Schumacher
Research Consultant

Brookwood School
103rd & Wenonga
Shawnee Mission, KS 66206

Dear Parents,

Your child was randomly selected, out of the returned permission slips, to be tested on the treadmill at the University of Kansas. The students met today with Ann Schumacher (Research Consultant) at Brookwood. During the meeting the students were informed as to what the test would include and how to prepare for it. This was told to them by some students at Trailwood that were tested last month on the Treadmill. The students will go to K.U. on Tuesday, April 15. We will all meet in the front of Brookwood at 7:00 a.m. and return to Brookwood at 1:00 p.m. Please do not feed your child a large breakfast, donuts will be provided after they have run on the treadmill. Also please pack a sack lunch for your child, we will be returning after lunch is over at Brookwood. Any homework, busy work, or sedentary games may be brought with the student to do while he/she is not on the treadmill. There is a field trip form for Brookwood, please return it to the school before Monday, April 14.

If you have any questions please contact Ann Schumacher at Trailwood. If not she will meet you in front of Brookwood at 7:00 a.m. and will drive the students to K.U. Thank you for all of your help. You are all to be commended for being such exceptional parents.

Sincerely,

Dr. Leon Greene
Project Coordinator

Ann Schumacher 642-9031 o
Research Consultant 782-0903 h

APPENDIX D

Consent Forms

Brookwood Elementary School

Date _____

I give my permission for _____ to
(child's name)
participate in the cardiac assessment of my child as part of the Sunflower Project in Shawnee Mission Public Schools, USD512. This includes:

1. Nine Minute Walk/Run Test:—This test is a field test where the student is asked to walk or run as far as he/she can in nine minutes.
2. Submaximal Bicycle Test: This test is a stationary bicycle test used to examine heart rates before, during and after exercise.

_____
(parent or guardian)

_____
(address)

_____

_____
(phone number)

Trailwood Elementary School

Date _____

I give my permission for _____ to
(child's name)
participate in the cardiac assessment as a part of the Trailwood Sunflower Project in Shawnee Mission Public Schools, USD512.

This includes:

1. Nine Minute Walk/Run Test: student is asked to run or walk as far as they can in nine minutes.
2. Submaximal Stationary Bicycle Test: used to examine heart rates, before, during and after exercise.
3. Extended physical education program.

_____
(parent or guardian)

_____
(address)

_____

_____
(phone number)

MAXIMAL OXYGEN CONSUMPTION
(Purpose, Benefits, Risks)

Treadmill Procedures

This involves a supramaximal run on the treadmill while expired air is collected in meterorological balloons. The grade is increased at the end of each three minutes until the subject is unable to continue. The test usually is preceded by a submaximal run to determine the starting workload on the treadmill and then a warmup and adjustment period with jogging on the treadmill. An ECG is always monitored.

Purpose

Maximal oxygen consumption is generally considered to be the single best measure or circulorespiratory fitness. The purpose is to determine the greatest amount of oxygen the subject can utilize per minute.

Discomfort and/or Risks

The test is rather traumatic since it involves an all out performance. The legs usually become rubbery, breathing becomes labored, and the subject is unable to keep up with the treadmill rate. The breathing apparatus makes it difficult to swallow so the mouth becomes dry and the ears may plug up. Due to its maximal nature the test is only administered to subjects under 35 years of age unless medical clearance is obtained.

EXERCISE PHYSIOLOGY LABORATORY
Department of Health, Physical
Education and Recreation
University of Kansas

Date _____ 19__

SUBJECT INFORMED CONSENT

The Department of HPER supports the practise of protection for human subjects participating in research. Please read the accompanying procedure description entitled

MAXIMAL OXYGEN CONSUMPTION

If you have any questions, please ask them.

Your participation in this project is voluntary and you may withdraw at any time. The expected benefits associated with your participation include information regarding your personal state of fitness and the satisfaction of helping to increase physiological knowledge.

The project will be under the direction of Dr. Tom R. Thomas, but other persons may be associated or assist with the data collection. The obtained data may be used in reports or publications but your identity will not be associated with such reports.

This research should not result in physical injury to subjects. However, the following information is provided in accordance with HEW regulations.

> "In the event of physical injury resulting from the research procedures no medical treatment or monetary compensation is provided by the University. In a very limited number of cases, workers compensation could be available to University employees injured while participating as subjects. However, generally participants must look to their own health insurance policies or to the Kansas Legislature for compensation for their injuries."

Please give your consent with full knowledge of the nature and purpose of the procedures; the benefits that you maybe expect; and the discomforts and/or risks which may be encountered. We appreciate your assistance.

Sincerely,

Tom R. Thomas
Laboratory Director

_____
Signature of Subject

_____

_____
Address

_____
Phone Number

_____
Parent or Guardian's Signature

I give my permission for _____
(child's name)
to participate in the treadmill testing which will be a part of the Sunflower Project during the 1980 school year.

_____
(parent or guardian)

_____
(address)

_____

_____
(phone)

APPENDIX E

Pre and Post Test Means and Standard Deviations

Pre and Post Test Means and Standard Deviations

		Pretest						Posttest					
Variable	Group	Male	S.D.	Female	S.D.	Total Group	S.D.	Male	S.D.	Female	S.D.	Total Group	S.D.
R.H.R. Beats/ Minute	X	82.22	12.17	85.64	22.21	83.93	17.19	79.39	13.71	79.71	10.41	79.55	12.06
	C	84.87	10.57	89.71	16.03	87.29	13.30	79.47	7.15	83.00	11.87	81.24	9.51
W.H.R. beats/ minute	X	152.22	21.07	169.36	16.69	160.79	18.88	161.72	19.92	172.75	18.98	167.24	19.45
	C	159.43	20.71	158.36	23.50	158.90	22.10	169.67	19.24	169.86	12.76	169.76	16.00
Rec. 1 beats/ minute	X	35.18	8.15	31.30	7.71	33.24	7.93	35.17	10.05	31.08	10.37	33.13	10.21
	C	33.61	7.79	29.48	6.51	31.55	7.15	37.21	7.35	32.41	7.34	34.81	7.35
Rec. 2 beats/ minute	X	38.36	6.58	39.71	8.78	39.17	7.68	41.51	7.57	38.69	9.05	40.10	7.65
	C	36.65	9.15	33.36	6.05	35.05	8.31	39.64	5.68	37.75	9.31	38.70	7.50
9-Min.	X	1.11	.10	.95	.13	1.03	.12	1.13	.09	1.01	.13	1.07	.11
miles	C	.86	.12	.84	.15	.85	.14	.85	.12	.77	.09	.81	.11