1976

The Effects of a Calisthenic Exercise Program on Fourth Grade Elementary School Children

Toby Bedford
Eastern Illinois University

THE EFFECTS OF A CALISTHENIC EXERCISE PROGRAM ON FOURTH GRADE ELEMENTARY SCHOOL CHILDREN

(TITLE)

BY

TOBY BEDFORD

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Science

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1976
YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

7/28/76
DATE

7/28/76
DATE

PAPER CERTIFICATE #2

TO: Graduate Degree Candidates who have written formal theses.

SUBJECT: Permission to reproduce theses.

The University Library is receiving a number of requests from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow theses to be copied.

Please sign one of the following statements:

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

1/29/16
Date

I respectfully request Booth Library of Eastern Illinois University not allow my thesis be reproduced because _____

_____

_____

_____ _____

Date Author

pdm

ACKNOWLEDGEMENTS

The author wishes to thank Mrs. Marylou Replogle and Mrs. Paula Wright of Hawthorne Elementary School in Mattoon, Illinois, for their invaluable assistance in suggesting ideas for the handling of their students who were the subjects of this study. Cooperation and flexibility by these two teachers allowed the successful conclusion of the exercise program.

The author is grateful for the learning experience that Dr. Thomas Woodall provided for in the design of the study, and for constantly stressing accuracy and clarity in the writing of the investigation.

The author also wishes to thank Dr. William Buckellew and Dr. Robert Carey for their proofreading and suggestions for the format of the thesis.

Lastly the author wishes to acknowledge the help his wife Sheila provided in the 9-minute run test and the step test during the exercise program, and her constant encouragement during the course of the study.

TABLE OF CONTENTS

	Page
LIST OF TABLES	v
LIST OF FIGURES	vi
Chapter	
1. INTRODUCTION	1
NEED FOR THE STUDY	3
THE PROBLEM	4
NULL HYPOTHESIS	4
LIMITATIONS OF THE STUDY	4
2. REVIEW OF RELATED LITERATURE	6
CARDIO-VASCULAR FITNESS	6
Exercise Studies: Frequency, Duration, Intensity, for Adults and Adolescents	8
Exercise Studies: Frequency, Duration, Intensity for Children	13
BODY COMPOSITION	17
SUMMARY	19
3. PROCEDURES	21
SUBJECTS	21
DESIGN OF THE STUDY	22
TESTING PROCEDURES	22

Pilot Experiments 22
Heartrate 23
Step Test 23
Distance Running 24
Tests 26
Step Test 26
9-minute Run 27
Height 28
Weight 28
Skinfold 29
The Exercise Program 29
Control Group 29
Experimental Group 30
4. ANALYSIS OF DATA 31
DATA CONVERSION. 31
STATISTICAL TREATMENT 31
FINDINGS 32
Experimental and Control Groups at T_1 32
Experimental and Control Groups at T_2 33
Within the Group Comparisons at T_2 33
Heartrate Recovery Pattern 37
Within the Group Changes. 37
Between Group Changes 40

Correlations between the Step Test and 9-minute Run 40

DISCUSSION OF THE FINDINGS 40

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 44

CONCLUSIONS. 45

RECOMMENDATIONS 46

REFERENCES. 47

APPENDICES

A. Copy of the Parental Information Letter 51

B. Descriptions of the Calisthenics Used in the Exercise Program 52

C. *t*-Ratios Needed for Statistical Significance at the .05 Level of Confidence 54

D. Raw Data Scores and Measurements of All Participants 55

LIST OF TABLES

Table		Page
1.	A Descriptive Profile of the Experimental and Control Groups at T_1.	34
2.	A Descriptive Profile of the Experimental and Control Groups at T_2.	35
3.	Differences Within the Groups on all Variables at T_2 Control Group	36
4.	Differences Within the Groups on all Variables at T_2 Experimental Group	38
5.	Correlations of the Step Test and Running Distances for Pre-Training and Post-Training Scores.	41

LIST OF FIGURES

Figure		Page
1.	Recovery Heartrate Pattern for the Control and Experimental Groups at T_1 and T_2	39

Chapter 1

INTRODUCTION

The myriad of cardio-vascular health problems that has arisen in recent years can probably be attributed to a change in the cultural standards of our society. While this implies many causes, there is an area in which physical education could make a greater impact, that is the development and maintenance of life-long fitness habits.

The lack of physical fitness has caused numerous problems for individuals, their families, employers, and friends. Poor diet, chronic tension, smoking, overweight, with a lack of exercise, have been pointed out as major contributors to an individual's ailments (17:14). Financially, heart disease alone, cost the nation $24.5 billion or 4 per cent of the gross national product in 1962 (17:9).

Ten years later, the American adult was continuing in his inactive ways. The National Adult Physical Fitness Survey (25) found that 45 per cent of all adult Americans (age 22 or older) did not engage in physical activity for the purpose of exercise. This meant that 49 million out of 109 million adults were inactive. Paradoxically, 63 per cent of those who did not exercise were more inclined to believe that

they received enough exercise, while 53 per cent of the exercisers said the same.

The Educational Testing Service (9:20-21) conducted a survey of New Jersey policemen. The study concluded:

> A substantial portion of this diminishing health status appears age-related but much of it may also be due to the largely sedentary features of the job. We have evidence that this decline is somewhat less severe for those who are more active either on the job or because of a self-imposed routine of physical exercise.

These same results (29) were found in a demographic study conducted in Europe, with implications that exercise was a better preventive measure than a cure for arteriosclerosis.

Prevention begins in the youth of the population, at a time when habits are forming and life-long attitudes can be instilled. Those dealing with physical education in the Soviet Union feel that properly organized physical education for the school child is the basis for a healthy life and success in any sphere of social activity (27; 35). This same feeling has existed in the United States for several years (12). Cureton (7:2) stated the idea more specifically, "The persons least likely to be exercising now are those who did not have physical education in school or college." He believes that it is possible to postpone some physiological aspects of aging and degeneration during the period of middle age, 26 to 65 years, by sufficient endurance training.

Not only does a successful exercise program increase good health, it results in a possible improvement of behavior and self-

attitude. Collingwood (6) matched 25 residents at the Arkansas Rehabilitation Research and Training Center on behavioral and emotional difficulties and the need for a physical training program. They exercised one hour per day, five days per week for four weeks. The workouts consisted of jogging, sprints, calisthenics, and agility drills. A step test, situps, pushups, the Kraus-Weber test, plus psychological tests were used as the measuring devices. The results showed a statistically significant improvement on self concept and self acceptance scales as well as a significant improvement on the physical tests.

The growth and development years are seen as extremely influential on later outcomes in life. Activities that stress individual participation should be engaged for the continuing improvement of fitness. Astrand (2:32) summed the situation by stating that, "There is evidence that neglect of regular physical activity during adolescence cannot fully be compensated later on in life."

NEED FOR THE STUDY

This study arose from the consideration that fitness programs have to be constructed so as to complement and/or supplement the physical education programs of the individual schools. Each school physical education program is built around different circumstances.

The lack of facilities and time for meaningful physical fitness activity in a small east-central Illinois elementary school prompted

this investigation. The physical education for students in this school consisted of two, 25-minute periods per week. Facilities consisted of one or two small classrooms, depending upon the daily schedule of the classroom teachers. Equipment was limited to a minimal number of balls, ropes, beanbags, etc.

THE PROBLEM

This study was conducted to determine what changes, if any, could be effected in the cardio-vascular responses of male and female elementary school children as the result of a planned six week circuit calisthenic exercise program. In addition, height, weight, and skin-fold parameters were studied.

NULL HYPOTHESIS

Short periods of calisthenic type exercise does not affect the cardio-vascular fitness of grade school children as determined by a step test and a 9-minute run, nor does it affect height, weight and skinfold measurements.

LIMITATIONS OF THE STUDY

The nature of the subjects imposed several limitations on the study. Children in this particular school were basically unfamiliar with any type of distance running, and motivation was a constant

source of variability. One could not be certain the subjects were extending themselves during the tests or training. Also, hot weather during the final testing period might have influenced the results.

Chapter 2

REVIEW OF RELATED LITERATURE

This investigation concerned the effects of a cardio-vascular fitness program on elementary school children. The three parameters measured as possible indicators of change were the heartrate response to a step test, the distance covered in a distance run and body composition as reflected by skinfold measurements.

CARDIO-VASCULAR FITNESS

The general effects of cardio-vascular training on post-pubescent males are well known. The heartrate response to exercise and the physical working capacity of an individual are intimately associated with many of the physiological mechanisms of the body. Significant improvement of these mechanisms usually results in a better heartrate response to exercise and an improved physical working capacity.

Rowell (31), in a review of cardio-vascular adjustments to exercise found that the range of adjustment of maximum oxygen consumption (Max $\dot{V}_{O_2}$) depended upon the initial fitness level of the subjects. Young performers gained in cardiac output by an increase in

the stroke volume (SV) and the arterio-venous oxygen difference ($A\text{-}\dot{V}_{O_2}$) as opposed to a SV increase in older subjects.

Saltin (32) found a difference in the adjustments to training according to the length of training. Long term training, one year or more, increases red blood cell (RBC) volume, heart size, and perhaps the size of red muscle fibers. Short term training, less than one year, produced a better distribution of the cardiac output to the working muscle, and possibly more efficient use of the muscle.

Shepard (34:116) discussed the various changes that occur throughout the body due to training. There is an increase of Max $\dot{V}_{O_2}$ (ml/kg/min) and in the duration of a performance after sufficient amounts of training. Heartrate decreases in submaximal work as well as at rest. Maximal tests still elicit maximal heartrates but the stroke-volume increases. The weight of the heart and skeletal muscles increases with more capillarization of the muscle. Hemoglobin per unit of blood and the total blood volume increases with training.

Shepard also pointed out that there is some evidence that training produces a secretion of insulin and the growth hormone of the anterior pituitary gland. He believes that if the growth hormone is responsible for increases in heart weight and skeletal muscle then this increased production would seem to be more effective in children during the growing years than in mature adults. Grown men have improved because of training while the response of children to very vigorous training programs has not been exceptional.

The effect of exercise on cardio-vascular fitness in children is more difficult to assess because the growth mechanisms confound the results. In evaluating work capacity, the most important factors according to Adams (1) and Knuttgen (22) are those related to body size, such as weight, height, surface area, lean body weight and active tissue. Children of the same chronological age vary considerably so that body size and not age is more important when evaluating physical working capacity.

According to Adams (1) sex also determines the physical working capacity (PWC). Males generally have a greater PWC when compared with females of a similar body size, though the explanation for these differences is unknown. Trained children have a greater PWC than untrained children, while shorter periods of training alter the cardio-vascular system differently than longer training periods.

Exercise Studies: Frequency, Duration, Intensity, for Adults and Adolescents

Hill et al. (18) tested the effect of exercise frequency on adults, using 24 males in two groups working at three and five times per week for 40 sessions. The five times per week group experienced a higher Max $\dot{V}_{O_2}$ in l/m and ml/kg/min. Both groups increased the length of time they could ride a bicycle ergometer and they decreased their resting heartrate. The three times per week group was more effective at reducing their heartrate at a submaximal load. After the

same number of sessions, both groups had equal improvement on Max $\dot{V}_{O_2}$ in l/min and in ml/kg/min and in the resting heartrate.

Another study, by Pollock et al. (28) used two and four days per week of training as the frequencies. Measurements were taken at the beginning, middle, and end (20 weeks) of the training period. Both frequency groups improved significantly at each measurement period, though there was no significant difference between the groups on measures of Max $\dot{V}_{O_2}$, Max $\dot{V}_E$, heartrate, and oxygen pulse. The higher frequency group experienced a more significant improvement in treadmill endurance running times than the two/week workout group. Pollock concluded that both groups did make significant gains though larger between group differences were noted as the program continued into the second ten weeks.

The length of the daily exercise period and the age of the individual were the two factors studied by Wilmore et al. (40). Using adult males as subjects, exercise durations of 12 minutes and 24 minutes, three days per week were continued for 10 weeks, with subjects jogging at a rate of their own choosing. Both groups significantly increased in vital capacity, Max $\dot{V}_{O_2}$, oxygen pulse, and showed significant decreases in resting blood pressure, resting heartrate, though the 24 minute group showed greater changes. There appears to be a somewhat linear relationship between the age of the subjects and the rate at which they chose to jog. Because of the varying initial fitness

levels in the different age groups, any age related improvement was nullified. Most differences between the 12 and 24 minute groups were not statistically significant, but the magnitude of changes was usually greater for the 24 minute group.

Sharkey (33) controlled the intensity and the duration of exercise in college males, three days per week for six weeks. The analysis failed to show any significant treatment or interaction effects for any of the test conditions when Max $\dot{V}_{O_2}$ and physical working capacity were measured. The higher intensity group made greater improvement but because of individual variation, improvements were not significant.

Four different approaches to cardio-vascular fitness were used by Garrett et al. (16) during regular volleyball instruction. The subjects, male college students, were placed in one of four treatment groups: in-place running, rope skipping, bench skipping, and continued volleyball instruction. Each exercise period lasted 40 minutes, two days per week for three weeks. The Harvard Step Test was used as the measuring criterion initially and at three weeks. Though cardio-vascular fitness was improved, no treatment group showed superiority. The greatest improvements were made by the in-place running, rope skipping, bench stepping and volleyball instruction groups in that order.

The determination of the relative effect of different intensities of training upon a young adult's capacity to do a given amount of

work, was the problem Faria (14) studied. Forty untrained males, 18-24 years of age, were used as the subjects. The three groups trained at bench stepping for five days per week for four weeks. The duration of the stepping bout in training was sufficient to elicit a heart-rate of 120-130, 140-150, or 160-170, depending upon which experimental group was training. Work was stopped when the preassigned heartrate was reached during the first exercise bout and this amount of time used for subsequent exercise periods. The controls played volleyball during the training period. The results obtained showed that the groups who worked at the heartrates of 145 and 165, performed significantly better on a bicycle ergometer. The group working at 125 beats per minute did not show this improvement. Faria held that the threshold for training may be related to initial fitness and that a submaximal stimulus might elicit a training effect.

Vrigens (39) inserted an interval circuit exercise program in a regular physical education class and noted whether it was possible to improve physical fitness levels. Eleven adolescents whose average age was 16.7 years volunteered to serve as the experimental group while nine others, whose average age was 17.1 years, were the control group. Five endurance type exercises and five strength exercises were given to the experimental group during regular physical education classes while the controls only took part in the regular physical education class activities. The extra exercises were used three times

per week for six weeks. The experimental group had significant gains in weight, surface area of thigh, arm and chest, and in a physical working capacity test. The controls did not experience any of these significant changes. Vrigens concluded that the physical fitness of adolescents could be improved after just a few weeks of intensive training.

Franks and Moore (15) compared calisthenics alone, in combination with volleyball, and volleyball alone in a attempt to determine their contribution to physical fitness. Three groups of 16 year old boys participated for five weeks, exercising five days per week in one of the three groups. The calisthenics and volleyball groups had fitness improvements as large as the calisthenics only group. Volleyball was the least effective in producing changes on a fitness test.

Hilsendager (19) had his subjects perform calisthenics for 10 minutes two and three times weekly for two four-week periods interspaced with activity units of touch football, volleyball, basketball, and handball. The exercises given were nonstop for 10 minutes. Calisthenics affected performance on the standing long jump and squat thrust more than touch football. When considering the sit-ups test, calisthenics had a greater effect than either the volleyball or basketball units. There was no difference between the effects of the calisthenics and handball programs.

Exercise Studies: Frequency, Duration, Intensity for Children

Daniels and Oldridge (8) investigated changes in Max $\dot{V}_{O_2}$ and $\dot{V}_{O_2}$ at submaximal running speeds among growing boys. During their 22 month study they found increases in height, weight, and Max $\dot{V}_{O_2}$, though there was no change in ml/kg/min of oxygen because of the concurrent change in body weight. There was also a drop in submaximal $\dot{V}_{O_2}$ because of an increased efficiency of the circulatory system. A group of "hard" runners were smaller, younger, and showed a greater increase in Max $\dot{V}_{O_2}$ than the "easy" runners who showed a significant drop in the submaximal $\dot{V}_{O_2}$. Through an analysis of the improved running times the investigators concluded that growing boys show significant increases in Max $\dot{V}_{O_2}$ but not in the ratio of oxygen consumption to body weight. Efficiency increases were felt to be more a function of growth rather than training. For example the older individual may possess an increased ability to withstand the discomfort of anaerobic activity.

Ekblom (11) completed a longitudinal study of 11 year old boys that lasted 32 months. Interval training, sprinting and distance running were used in combination with strength activities and ball games. The experimental and control groups were compared with a normal growth pattern to partial out any abnormal growth. Height, weight, vital capacity, and Max $\dot{V}_{O_2}$ changes during the first six months were negligible. Though the training group's gains were

larger, both groups increased their scores on these variables during the six to 32 month period. Ekblom concluded that if the aim is to develop large anthropometric measurements and better physiological functions then hard physical training must occur during the growing years.

Eisenman et al. (10) used two groups of girls age 12-13 and two groups of 18-21 year old females to compare the effects of endurance training on their Max $\dot{V}_{O_2}$ and to compare the magnitude and rate of change in Max $\dot{V}_{O_2}$ between the two age groups. Two experimental groups of women and girls were formed while the controls were the other two groups of women and girls. There were no significant differences between the groups at the start of the experiment. The workouts for the experimental groups consisted of jogging and bench stepping 30 minutes per day, three times per week for 14 weeks. Height, Max $\dot{V}_{O_2}$ (ml/kg/min), pulmonary ventilation and maximum heartrate were taken at the beginning, two weeks, six weeks, and 14 weeks into the program. The experimental groups experienced significant increases in Max $\dot{V}_{O_2}$ expressed in l/m and ml/kg/min, pulmonary ventilation and height for girls. Eisenman noted in the discussion that while other studies showed gains, there was no evidence that girls consistently achieved greater improvements than young women in training on Max $\dot{V}_{O_2}$.

Brown et al. (5) observed the effects of a cross-country season

on pre-adolescent girls. Twelve girls with varying ability levels volunteered to serve as the experimental group and eight non-endurance track girls were used as controls. The girls, whose ages ranged from 8-13 years old, were measured on height, weight, heartrate at submaximal and maximal treadmill work loads, Max $\dot{V}_{O_2}$ and pulmonary ventilation. These measurements took place at the beginning, six weeks and 12 weeks during the study. The training varied among the three track clubs that participated. Most of the girls gained in bodyweight by the end of the season. Maximal heartrates dropped for both groups as well as the heartrate on a submaximal test. The majority of improvement in aerobic capacity occurred during the first six weeks in the experimental group but they still improved during the course of the season. There was no increase in the aerobic capacity of the control group.

Rothermal et al. (30) recorded the changes, using an AAHPER test, resulting from an eight week sport and physical fitness program. The subjects were 87 boys in the age range of 7-13 years old. The boys were matched on age, weight and height and participated in a three hour, four days per week program of aquatics, gymnastics, track and field, conditioning and an endurance program for eight weeks. There were significant changes for the experimental group in pull-ups, sit-ups, standing long jump, and the 600 yard run, with no significant improvement for the controls. They concluded that this program signifi-

cantly increased endurance and strength, while there was no change in speed, agility or coordination.

Johnson (20) compared the effects of five days per week of physical education classes versus a two and three days per week regimen. Physical fitness, activity skills, subcutaneous adipose tissue and physical growth were measured. Boys and girls in the 8th grade, of which there were 754, were measured after some had experienced physical education classes five days per week for two years, while the others had physical education for two or three days per week for two years. The physical fitness test given was similar to the AAHPER test. Among the boys, the five days per week group made significant improvements in the long jump, and pull-ups, while both boys groups were almost equal in the jump-reach, 160 yard block race and the 600 yard run. The more frequently meeting girls group showed a significant improvement in the standing long jump. Skinfolds were significantly smaller for the five days per week boys but not the girls. Also there was no difference in the growth curve in height or weight between the two groups.

Taddonio (36) found no significant changes between his control and experimental groups. The experimental group of 5th grade boys and girls exercised 15 minutes for five days per week while the control group did not do any form of activity. The total program lasted 16 weeks during which time both groups experienced gains on the fitness

test items but no group showed a superiority. Taddonio concluded the 15 minutes of daily calisthenics had little or no effect on physical fitness.

Fabricius (13) gave an extra three minutes of calisthenics to a 4th grade class that met four times weekly for seven months. The control group participated in the same physical education program but did not have extra calisthenics. There was significant improvement for both groups at the post-training period but the experimental group was significantly better than the control group. Fabricius concluded that the increase was due to the extra calisthenics.

BODY COMPOSITION

The studies that are included represent an overview of the type of body composition studies in the literature. Very little work had been reported on children.

Boileau (4) found that exercise made a difference in body composition and physical fitness. Young adult males participated in a 500 to 600 kilocalorie per hour exercise program for five days a week that lasted nine weeks. The program was sufficient to improve physical performance and alter the body composition of all subjects. An obese group decreased significantly in bodyweight as well as skinfold thickness while the body density increased significantly. The lean group also experienced an increase in body density and a decrease in skinfold thickness.

Jokl (21) measured the effect of training on bodyweight, lean tissue and excess fat in adolescent girls. The girls trained for five months with exercises such as calisthenics, gymnastics, weightlifting, dancing games and track and field activities. There was no significant change in bodyweight after five months between the groups. The experimental group gained four pounds of lean bodyweight while the controls lost .25 pounds of the same. There were significantly smaller differences in excess bodyfat in the experimental group.

Vann (38) measured the effect of exercise on selected skinfold and girth measurements of high school girls. The various measurements, taken at the beginning of the exercise program, the end, and eight weeks later, showed mixed results in that the skinfold thicknesses of the wrist and the thigh were significantly smaller while the skinfold measurement of the hips was not changed.

Moody et al. (24) measured the effects of a moderate exercise program on body weight and skinfold thickness in overweight college women. After a jogging/walking program of 500 kilocalories each session, that met six times weekly for eight weeks, bodyweight, skinfolds, percent of body fat, total fat, and fat-free bodyweight were measured. Significant losses were found in all of the measures with an increase in fat-free bodyweight.

Body composition was one of the parameters that Pollock et al. (28) studied, in determining the effects of frequency of training on

working capacity, and cardio-vascular function in adult men. The most frequently exercising group lost a significant amount of fat over the other groups during the second ten weeks of a jogging program, though there was no differences the first ten weeks.

One of the few child studies found in the literature was a longitudinal observation by Parizhova (26). The study claimed that exercise can change the body composition in boys and girls. The highest activity group had a slight tendency to be taller but the skeletal measurements did not differ. Lean body mass and the absolute amount of fat remained the same for the first year but the lean body mass increased significantly in the highest activity group for the next three years. The high activity group also kept the same proportion of body fat while the lowest group increased the absolute amount of fat over the high group in the fourth and last year of the study. Parizhova also tested girl swimmers, gymnasts, and obese adolescents on the same parameters. She found that swimming did not affect their growth toward normal levels of bodyfat while they were participating in their activity, but the gymnasts experienced a decrease in skinfolds over a control group. Obese subjects lost an average of ten percent bodyweight exercising in combination with a 1700 kilocalorie diet.

SUMMARY

Though it is relatively easy to determine the cause of change

in fitness levels for exercising adults, the assessment is extremely difficult in children because of the growth factor. Individual variations in efficiency, and ability to use the anaerobic system can also affect the results of exercise programs. Those children who tend to be athletic or obese will probably show the greatest gains.

Increases in fitness seem to be related to increases in the frequency and duration of exercise. Exercising every two days, adults show meaningful improvements, although they are greatly affected by the original level of fitness and age of the subjects. Increases in fitness are seen following the initial phase of an exercise program and this increase continues until the limits of ability are reached.

Adult body composition is greatly affected by exercise, and these changes may be observed early in the exercise program. Changes in the body composition of children may also be observed as the result of an exercise program, however exercise should probably continue for a year or more to notice changes in children.

Chapter 3

PROCEDURES

This study concerns the effects of an interval calisthenic fitness program on elementary school children. The three variables measured as possible indicators of change were the heartrate response to a step test, the yardage covered in a nine minute run-walk test and body composition as reflected by skinfold measurements.

SUBJECTS

The study was conducted during the spring of 1975, using 36 children (19 males and 17 females) as subjects. The students were in the fourth grade physical education class at Hawthorne Elementary School, Mattoon, Illinois. The ages of the subjects ranged from nine to ten years old. The weights ranged from 26 kg to 54 kg, while the mean weight was 34 kg. The range of heights was from 128.9 cm to 148.5 cm with the mean height at 138 cm. Not all of the pupils in the class were able to participate due to illness or permanent disabilities.

A note was sent to the parents of the participants explaining the study and asking them to respond if there were any objections. A copy of the note is in Appendix A. All of the available students received the approval of their parents.

DESIGN OF THE STUDY

The basic design used a control group and an experimental group that were equated on the basis of the pre-training 9-minute run test. Other variables were measured in pre and post-training tests that were administered prior to (T_1) and following (T_2) a six week training program.

The two groups (a control and an experimental) of 18 subjects each, also performed a step test that would serve as an alternate indicator of fitness levels. Height, weight, and skinfolds were taken to measure any anthropometric changes that may have occurred during the period of the study.

The control group did not participate in the exercise program but spent their time using the Nelson Reaction Timer stick, a passive activity.

The experimental group met every Monday, Wednesday, and Friday (three days per week) for six weeks. Each exercise period consisted of eight exercises of 20 seconds each, alternating with rest periods of 20 seconds, until five minutes elapsed. The exercises are described in Appendix B.

TESTING PROCEDURES

Pilot Experiments

The step test was given to four students while all students

practiced the 9-minute run. The purpose of the pilot tests was to determine the best procedures for the pre-training tests.

Heartrate. Four boys were chosen to help determine the validity of post exercise heartrate determinations by fourth grade children. After the subjects were seated for ten minutes, the test was explained and each subject was allowed to listen to his own heartbeat through a stethoscope. This procedure attempted to acquaint the subjects with the test method. Each boy then exercised by jumping up and down for 15 seconds in order to raise his heartrate. After 15 seconds the subject was told to sit on a chair and to begin counting his heartrate by himself at the carotid artery in the neck using the first and second fingers. Concurrently the investigator placed the stethoscope over the apex of the heart and counted the pulsations. At the end of one minute the subject told the investigator his count and it was recorded. This procedure was repeated for each subject. The conclusion drawn from this experiment was that the boys were unreliable in accurately counting their own heartrate, meaning the investigator would take the heartrates during the actual testing.

Step Test. Three girls and one boy were chosen as subjects to enable the investigator to determine the difficulty and discrimination ability of the modified Harvard step-test for grade school children (23). Two subjects were thought to be low fitness subjects while the other two

were high fitness subjects. The complete test, including instructions, was put on an audio tape to insure reliable and consistent testing procedures.

The test consisted of the subject stepping up on a 14-inch bench and then down, at the rate of 30 round trips per minute for three minutes. Heartrates were taken for 30 seconds at 1, 2, and 3 minutes following the termination of the stepping portion of the test. Each student had previous knowledge of bench stepping but had to practice keeping rhythm to the beat of the metronome recorded on the audio tape. When each child felt comfortable with the procedure, the test was begun. The subject was continuously observed by the investigator for signs of fatigue that would indicate the end of the test if three minutes had not been reached. If the subject could not keep the pace during any 15 second period, the test was terminated. Because of fatigue, two of the subjects were unable to complete the test.

When the subjects stopped stepping, heartrates were taken by the investigator at the appropriate times as well as a 15 second count, 15 seconds after the cessation of stepping. This count provided an approximation of the heartrate during the exercise bout. The recovery heartrates were entered into a physical fitness index formula and evaluated.

Distance Running. The 9-minute run test has been used by the Texas Governor's Commission for Physical Fitness to test cardio-vascular

endurance of children in the fourth through the sixth grades (37). Three practice runs of varying time length were given to the class to familiarize students with the test procedures and to help condition the students.

Nine days prior to the actual experiment, the class was divided into two groups for the pilot runs of four, six and three minutes, taken in that order on different days. Individuals in one group were to count laps for their partners in the running group. The group that was to run was told to slow their normal pace during the running for best results. The course consisted of running around two poles, 110 yards apart. Each time the runner went around a pole the counters were told to add one lap to the runner's score. The elapsed time was read every 30 seconds with the final 10 seconds being counted out loud. A whistle was blown at four minutes indicating the end of the first practice run. The same procedure was repeated for the next group, the individuals who had already run now counted laps for their partners in the other group.

The same test was run three days later except that the duration was six minutes. At this point the counters for the runners were deemed to be incapable of accurate recordings because of the variable number of laps each gave for his runner.

The last practice test was given three days before the actual pre-training test. This practice was held indoors because of inclement

weather. Each subject was told to run until he thought three minutes had elapsed.

Tests

Step Test. The modified Harvard step test for grade school children was given two weeks in advance of the actual exercise program. Testing took one week because there was only one investigator and the limited availability of the subjects.

Each child had previously practiced stepping onto a bench but did not know the particulars of the Harvard test. The subject was brought to the testing room by himself, and he listened to a tape recording. The recording related his previous experience of bench stepping to the test of that day, explained and provided practice for stepping to the rhythm of a metronome, and told him to sit for the recovery period so that his heartrate could be taken.

The commands of "get ready," "get set," and "begin" started the child stepping on and off the bench, continuing to use the same leg throughout the test. Encouragement was frequently given to maintain the pace, while every 30 seconds the elapsed time was read. If the subject finished the three minutes of stepping, he then sat on the bench, and the investigator took the carotid pulse at the predetermined times in accordance with the recording. Occasionally a subject would not finish the test; if this happened he was stopped and the elapsed time recorded from a stopwatch that had been started simultaneously when

the stepping began. Regardless of the duration of the subject's effort, the 30 second recovery heartrates were taken at 1, 2, and 3 minutes following the termination of the test. An additional recovery count was taken from 15 to 30 seconds following the cessation of stepping. This helped reveal the approximate pulse rate during the test.

During the post-training period the modified Harvard step-test was given using two investigators. Students were tested two at a time for purposes of efficiency and motivation. The other investigator was a nurse's aid and was capable of obtaining valid heartrates.

9-Minute Run. The method of counting and recording the number of laps was changed because of the observed unreliability of the student counters during the pilot testing. Twenty small wooden sticks were given to each subject on which he wrote his name. The child was to hold this bundle of sticks (which were held together by a rubber band) while he ran during the test. Each time the student rounded a pole he was instructed to throw one stick into the basket to insure that the distance he ran was properly documented. Helpers watched to insure only one stick was thrown at a time.

The group being tested started running the course on the command "go". Every time a subject completed one lap he had added 110 yards to his score. The elapsed time was announced every 30 seconds during which time the runners were constantly encouraged to maintain their pace.

At nine minutes a whistle was blown. The runners stopped and stood in place until the investigator measured the total distance run, including yardage beyond the laps recorded by the wooden sticks method. The measuring device was a bicycle wheel of a known circumference. The revolutions were counted and the extra distance determined to the nearest five yards. The number of sticks in the baskets were counted and tallied for each student and their total distance calculated. When runners in the first group finished, the second group began, using the same procedure.

Because of hot weather during the post-training tests, the 9-minute run course was rerouted into the shade which made each lap 145 yards long.

Height. One week before the exercise program commenced each subject reported to the testing room individually where height, weight and skinfolds were measured.

The subject was instructed to remove his shoes but not his socks. Then he was told to stand with his heels and his shoulders against the wall while looking forward, thus keeping the head level. A book was placed on the subject's head parallel to the floor and extending perpendicular to the meter stick on the wall. Height was read to the nearest millimeter after the subject stepped out from under the book.

Weight. While the subject's shoes were off he was instructed to step

onto the center portion of a floor scale, making sure not to bounce on the scale. Body weight was then recorded to the nearest pound.

Skinfold. The scapula skinfold was not taken on the female subjects for reasons of modesty. Each male subject pulled his shirt up on his back and stood in a relaxed manner with both arms to the side so that an oblique skinfold on the vertebral border of the scapula could be taken. A vertical skinfold was taken on all subjects at the midpoint of the back of the upper arm, as the forearm was held at a 90^{o} angle. The skinfold thicknesses were measured in millimeters using a Lange Skinfold caliper. The investigator pinched the maximum skinfold thickness between his thumb and forefinger and then the calipers were applied approximately one centimeter from the fingers. The reading was made after two or three seconds to allow the calipers time to adjust.

The Exercise Program

Control Group. The control group met with the investigator two days per week and was at recess the other day. An assistant tested the control group using the Nelson Reaction Timer stick during the five minutes that the experimental group was exercising. The children were encouraged to better their performance each trial and each session.

The reaction test was considered an activity that would have no possible training effect, yet give equal attention to the control group. This test consisted of the timer holding the stick vertically so

that the student's thumb and forefinger were parallel with the bottom starting line on the stick. The tester then dropped the stick at varying time intervals, with the student trying to squeeze and consequently stop the stick as it fell. The reaction time was then read from the markings at the point where the student stopped the stick. Each student performed as many trials as he wanted during the experimental group's exercise period.

Experimental Group. The experimental group met with the investigator three times weekly. Each exercise was demonstrated and the subjects were allowed a short practice period prior to the first meeting. The exercises were the grasshopper, side-straddle-hop, squat-jumps, squat-thrust, rope jumping, in-place running, crab kicking, and partner pull-over. These exercises are described in Appendix B. The subjects were told that each exercise would last 20 seconds and to try to perform as many repetitions as possible in that time. After each exercise bout the subjects were allowed 20 seconds to rest. Using all eight exercises, the total time of exercise and rest was five minutes.

Chapter 4

ANALYSIS OF DATA

A control and experimental group of fourth grade elementary school children was initially measured on the parameters of heartrate recovery from a step test, total distance run in nine minutes, height, weight, and skinfold thickness. An exercise program that consisted of interval calisthenics was instigated with the experimental group and continued for six weeks. All of the parameters were remeasured for any significant changes at T_2.

DATA CONVERSION

Certain groups of data were converted to more workable scores for statistical purposes. The weight, originally measured in pounds, was converted to kilograms by dividing by 2.2. Scores for the physical fitness index (P.F.I.) were determined by using the formula given by Meyers and Blesch (23):

$$\text{P.F.I.} = \frac{\text{exercise duration in seconds x 100}}{\text{2 x the sum of the 3 recovery heartrates}}$$

STATISTICAL TREATMENT

A correlated t test was used to determine whether there were

significant changes between pre and post training variables for each group.

An uncorrelated *t* test was used to determine if any significant differences existed between the groups.

The final statistical procedure used was the product-moment method of determining correlations. Correlations were determined between the pre-training step and 9-minute run tests, and the post-training step and 9-minute run tests.

All of the previously mentioned statistical procedures were verified by using the statistical program in the Plato IV computer (3).

The .05 level of confidence was chosen in order to avoid a Type II error. The large number of influences on the children's performance during the testing increased the likelihood of accepting the null hypotheses, when in fact there may have been actual significant increases in their fitness. Appendix C reports the *t*-ratios needed to attain the .05 level of confidence and reject the null hypothesis.

FINDINGS

Experimental and Control Groups at T_1

Originally the groups were matched according to the distance run in nine minutes. The matching process consisted of alternately assigning individuals to the control and the experimental group from a list of 9-minute run scores ranked from largest to smallest. An exception to this process concerned the three largest scores in that the

largest score was assigned to the control group and the second and third scores to the experimental group.

Table 1 shows that there was no statistically significant difference between the groups of the remaining variables at T_1.

Experimental and Control Groups at T_2

Larger, but still insignificant differences were observed between the groups at the post-training testing period as shown in Table 2. A large difference occurred in the skinfold measurements for the boys, in that the experimental group's mean skinfold was 5.2 millimeters larger than the control's. Also the mean height for the experimental group was three centimeters greater than the control group at T_2. Differences in the remaining variables were very insignificant.

Within the Group Comparisons at T_2

The control group experienced significant changes in two areas as shown in Table 3. During the six weeks of the program members of the control group had an average height gain of 2.3 cm. This increase was significant at the .01 level of confidence. The same group also gained .63 kg in the same time period, this difference also being significant at the .01 level of confidence. Another large change, though insignificant, was the 1.15 mm increase in the girls' triceps measurement. The remaining variables were only slightly different from the T_1 scores and measurements.

Table 1

A Descriptive Profile of the Experimental and Control Groups at T_1

		Control	Experimental	Mean Difference	t-Ratio
Step Test (PFI)	$\overline{X}$	56.65	53.20	3.45	0.98*
	S. D.	10.55	10.60	0.05	
9-minute run (yd)	$\overline{X}$	1483.90	1482.20	1.70	0.02*
	S. D.	225.90	229.30	3.40	
Height (cm)	$\overline{X}$	137.40	138.70	1.30	0.71*
	S. D.	5.50	5.45	0.05	
Weight (kg)	$\overline{X}$	33.27	24.40	1.13	0.46*
	S. D.	5.32	8.90	3.58	
Triceps--Girls (mm)	$\overline{X}$	13.75	13.20	0.55	0.25*
	S. D.	4.50	4.30	0.20	
Sum of Skinfolds--Boys (mm)	$\overline{X}$	17.00	19.40	2.40	0.66*
	S. D.	3.97	10.20	6.23	

* None of the differences between the means of the control and experimental groups were statistically significant.

Table 2

A Descriptive Profile of the Experimental and Control Groups at T_2

		Control	Experimental	Mean Difference	t-Ratio
Step Test (PFI)	$\overline{X}$	58.45	58.40	0.05	0.02*
	S.D.	6.80	9.60	2.80	
9-minute run (yd)	$\overline{X}$	1512.90	1465.00	47.90	0.37*
	S.D.	382.00	342.70	39.30	
Height (cm)	$\overline{X}$	139.70	142.70	3.00	1.47*
	S.D.	6.40	5.80	0.60	
Weight (kg)	$\overline{X}$	33.40	34.60	1.20	0.29*
	S.D.	5.46	8.70	3.24	
Triceps--Girls (mm)	$\overline{X}$	14.90	13.40	1.50	0.71*
	S.D.	4.50	4.20	0.30	
Sum of Skinfolds--Boys (mm)	$\overline{X}$	16.60	21.80	5.20	1.16*
	S.D.	4.40	12.70	8.30	

* None of the mean differences between the control and experimental groups were statistically significant.

Table 3

Differences Within the Groups on all Variables at T_2

Control Group

		T_1	T_2	Mean Differences	t-Ratio
Step Test (PFI)	$\overline{X}$	56.65	58.45	1.80	0.72
	S. D.	10.55	6.80	3.75	
9-minute run	$\overline{X}$	1483.90	1512.90	29.00	0.08
	S. D.	225.90	382.00	156.10	
Height (cm)	$\overline{X}$	137.40	139.70	2.30	3.76*
	S. D.	5.50	6.40	0.90	
Weight (kg)	$\overline{X}$	33.27	33.90	0.63	2.94*
	S. D.	5.32	5.46	0.14	
Triceps--Girls (mm)	$\overline{X}$	13.75	14.90	1.15	2.23
	S. D.	4.50	4.50	0.00	
Sum of Skinfolds--Boys (mm)	$\overline{X}$	17.00	16.60	0.40	0.51
	S. D.	3.97	4.40	0.43	

* Significant at the .01 level of confidence.

The experimental group also showed two areas of significant change as revealed in Table 4. During the six week period the group experienced a 4.0 cm height increase which was significant at the .001 level of confidence. The other measurement that changed significantly was the step test scores. The experimental group improved 5.3 points on the physical fitness index scale which was significant to the .02 level of confidence. A noticeable increase of 2.4 mm occurred in the skin-fold measurements of the boys. On the other hand, the experimental groups averaged 17.2 yards less during the final 9-minute run test.

Heartrate Recovery Pattern

Within the Group Changes. Heartrates were counted at the post-exercise times of 15-30 seconds, 1-1:30, 2-2:30, and 3-3:30 minutes. Figure 1 shows the average recovery pattern for the control group. The recovery rates at T_1 and T_2 remained essentially the same, though at T_2 the heartrates were faster after the 3 minute count. The heartrates dropped from approximately 148 beats per minute (bpm) at the 15 second count to 102 bpm at 3-3:30 minutes.

Figure 1 also shows the average recovery rates for the experimental group. A trend was set at T_2 in that the average recovery heartrates were smaller than at T_1. The first heartrate count at T_1 was 162 bpm while it was 147 bpm at T_2. The final count at T_1 was 105 bpm which was reduced to 100 bpm at T_2.

Table 4

Differences Within the Groups on all Variables at T_2

Experimental Group

		T_1	T_2	Mean Differences	t-Ratio
Step Test (PFI)	$\overline{X}$	53.20	58.50	5.30	2.78**
	S.D.	10.60	9.60	1.00	
9-minute run (yd)	$\overline{X}$	1482.20	1465.00	17.2	0.86
	S.D.	229.30	342.70	113.40	
Height (cm)	$\overline{X}$	138.70	142.70	4.00	6.66*
	S.D.	5.45	5.80	0.35	
Weight (kg)	$\overline{X}$	34.40	34.60	0.20	1.23
	S.D.	8.90	8.70	0.20	
Triceps--Girls (mm)	$\overline{X}$	13.20	13.40	0.20	0.37
	S.D.	4.30	4.20	0.10	
Sum of Skinfolds--Boys (mm)	$\overline{X}$	19.40	21.80	2.40	1.47
	S.D.	10.20	12.70	2.50	

* Significant to the .001 level of confidence.
** Significant at the .02 level of confidence.

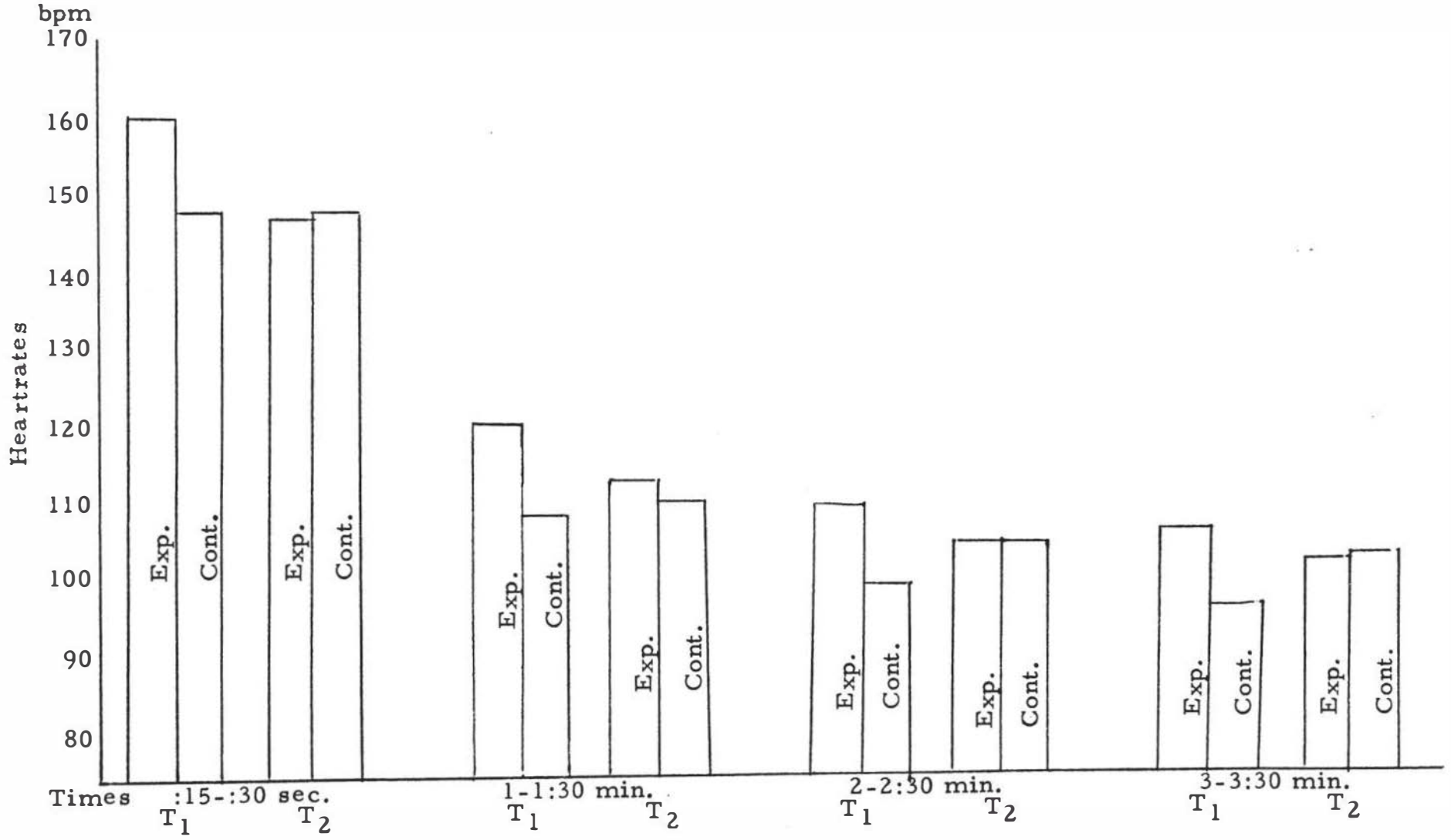

Figure 1

Recovery Heartrate Pattern for the Control and Experimental Groups at T_1 and T_2

Between Group Changes. Direct comparison of the average recovery heartrates between the control and experimental groups can be made in Figure 1. The results of the step test at T_1 show that the control group was consistently lower in beats per minute throughout the recovery period. The difference at the 15 second count was 14 bpm, which was narrowed to 10 bpm at the 3 minute count. The recovery pattern for both groups at T_2 was essentially the same.

Correlations Between the Step Test and 9-minute Run

The relationship between these two measures of fitness was measured at T_1 and T_2. Table 5 shows that at T_1 the correlation between the step test and the 9-minute run was +0.3718. The correlation at the post-training period was +0.1246.

DISCUSSION OF THE FINDINGS

The experimental group's significant increase in the P. F. I. scores might have been a true reflection of the exercise program. The fact that the control group's step test scores did not change significantly may support the experimental group's improvement.

As was expected, the growth of the children during the six week program provided increases in the height and weight variables. Height increases were significant in both groups, though more so with the experimental group. The gain in body weight of the control group was statistically significant while the experimental group gains were

Table 5

Correlations of the Step Test and Running Distances for Pre-Training and Post-Training Scores

	Correlation
Pre-Training Step Test versus Pre-Training 9-minute run	+0.3718
Post-Training Step Test versus Post-Training 9-minute run	+0.1246

not significant. To suggest that the caloric cost of the exercises caused the lack of weight gains would probably be incorrect. The total caloric expenditure of the exercises added to the daily expenditures of the children would be negligible. Researchers have suggested that the growth hormone might be released during extended periods of exercise, thus providing a possible reason for the extra height increase but this seems to conflict with the fact that subjects in the experimental group gained very little weight. The most probable explanation lies in the sampling.

The thickness of the triceps skinfold on the girls showed perhaps the start of the differentiation between the fat content of boys and girls, though none of the girls had reached puberty. The experimental group did not show the same increase that was present in the control group. Once again it was probably not the caloric expenditure of exercises, but sampling.

Contrary to what might have been expected, the sum of the skinfolds for the boys in the experimental group increased while the controls did not experience any increase. Though the investigator was experienced in taking skinfold measurements, the reliability of these measurements is still low. Several variables enter into the skinfold measurement such as the state of hydration of the subject, the amount of skin held for the measurement and the positioning of the calipers when measuring. It is possible that some of the increase in

the measurements was due to the low reliability of the skinfold measurements.

Because young children are very active, it is difficult to attribute changes in anthropometric measurements to an exercise program, even though control groups are employed. Most anthropometric changes that occur are due to maturational growth.

Other investigators have suggested that in a field study using the step test another measure should supplement the step test (34:63-69). The 9-minute run was thought to be a valid indicator of fitness when given under ideal conditions. This means that the step test should be highly related to the 9-minute run test in order to show changes in fitness. Whether or not the two tests measure the same physiological, biomechanical, psychological etc., functions of the subjects is not the purpose of this study. The result in this study showed that though children had practiced the 9-minute run, there was no meaningful relationship between the distance run in nine minutes and the step test scores. Conditions for the 9-minute run were less than ideal in that the motivation of the children varied tremendously from day to day. Hot weather during the period of the post training tests may have influenced some of the running and P. F. I. scores. A more strenuous step test might have shown more dramatically the fitness improvements of the experimental group.

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The introduction of physical fitness programs into the lives of elementary school children is a necessity for future growth and health. Problems arise as individual school situations dictate the need for exercise regimens that can produce fitness with limited facilities and time.

The purpose of this study was to measure the effects of a fitness program, modified to meet a particular elementary school situation. The heartrate recovery after exercise and the distance run in nine minutes were the main parameters measured in a group of 36, fourth grade school children who participated in the study. The control and experimental groups were also measured on height, weight, and skinfold thicknesses prior to (T_1) and following (T_2) a six week time period in which the experimental group participated in an interval calisthenics program. The program consisted of eight 20 second bouts of calisthenics with 20 seconds of rest between bouts. The total time of the program was five minutes, three days per week. The control group worked with the Nelson Finger Reaction Timer stick, a sedentary activity, while the experimental group exercised.

Statistical procedures consisted of correlated and uncorrelated *t* tests to determine within and between group differences respectively. A product-moment correlation was determined to note the degree of relationship between the results of the step test and the 9-minute run.

CONCLUSIONS

The conclusions are based upon the acceptance of the null hypothesis.

1. The physical fitness of fourth grade school children, as reflected by the modified Harvard step test and the 9-minute run, is not affected by this minimal calisthenic type exercise program.

2. The significant changes in height and weight are most probably brought about by natural growth patterns rather than by the exercises given in this program.

3. Skinfold measurements are not changed significantly by the exercises in this study.

The length and intensity of the exercise program was not sufficient to significantly change the fitness of the participants. Trends toward fitness improvement were observed as the program progressed. Those children who tended to be overweight showed greater gains in fitness, more than most of the other children.

RECOMMENDATIONS

To further study school fitness programs, modified because of limited time and facilities, a study should be done that would vary the length of the program, the type of exercises, and/or the intensity of the exercises. Another study could be done that would group the students according to their fitness levels and determine the minimal amount of exercise needed to improve those levels.

REFERENCES

REFERENCES

1. Adams, Forest H. Physical Activity Human Growth and Development, ed. G. Lawrence Rarick. New York: Academic Press, 1973.

2. Astrand, M. D., Per-Olaf. Sport for All, Educational Resources Information Center, ERIC Document ED 092 560, 1969.

3. Avner, R. A., "Basic Statistical Package," PLATO IV, University of Illinois 1976.

4. Boileau, Richard A., "Effects of a nine-week physical conditioning program upon the body composition of obese and lean individuals," Ph. D. dissertation, Pennsylvania State University.

5. Brown, C. Harmon, Harrower, J. R., Deeter, M. F. "The Effects of Cross-Country Running on Pre-Adolescent Girls," Medicine and Science in Sports, Volume 4, (Spring, 1972), pp. 1-5.

6. Collingwood, T. R. "The Effects of Physical Training Upon Behavior and Self-Attitudes," Journal of Clinical Psychology, XXVIII (October, 1972), 583-585.

7. Cureton, Thomas Kirk. Trends of Research on Prevention of Physiological Aging and the Value of Exercise for Fitness and Health, Educational Resources Information Center, ERIC Document ED 083237, 1973.

8. Daniels, Jack, Oldridge, Neil. "Changes in oxygen consumption of young boys during growth and running training," Medicine and Science in Sports, Volume 3 Number 4 (1971), 161-165.

9. Department of Civil Service and State Law Enforcement Planning Agency of New Jersey, The Physical Activities Survey of Police Officers in New Jersey. Final Report, Educational Resources Information Center, ERIC Document 079 410, 1973.

10. Eisenman, Patricia A., Golding, Lawrence A. "Comparison of Effects of Training on $\dot{V}O_2$ Max in Girls and Young Women," Medicine and Science in Sports, Vol. 7, (Summer, 1975), 136-138.

11. Ekblom, Bjorn. "Effect of physical training in adolescent boys," Journal of Applied Physiology, Volume 27 Number 3 (Septembet, 1969), 350-355.

12. Espenshcade, Anna. Physical Education in the Elementary Schools, What research says to the teacher series. No. 27, Educational Resources Information Center, ERIC Document ED 077 902, 1963.

13. Fabricius, Helen. "Effect of Added Calisthenics on the Physical Fitness of Fourth Grade Boys and Girls," Research Quarterly, Vol. 35, (May, 1964), 135-140.

14. Faria, Irvin E. "Cardiovascular Response to Exercise as Influenced by Training of Various Intensities," Research Quarterly, Vol. 41, (1970), 44.

15. Franks, B. Don, Moore, George. "Effects of Calisthenics and Volleyball on the AAHPER Fitness Test and Volleyball Skill," Research Quarterly, Vol. 40, (May, 1969), p. 288.

16. Garrett, Leon, Sabrie, Mohammed, Pangle, Roy. "Four Approaches to Increasing Cardiovascular Fitness During Volleyball Instruction," Research Quarterly, Vol. 36 Number 11, (1965), p. 496.

17. Graham M. D., M. F. Prescription for Life. New York: David McKay Company, Inc., 1966.

18. Hill, J. S., Wearring, G. A., Eynon, R. B. "Effect of Frequency of Exercise on Adult Fitness," Medicine and Science in Sports, Volume 3 Number 1 (1971), K.

19. Hilsendager, Donald, "Comparison of a Calisthenic and an Non-Calisthenic Physical Education Program," Research Quarterly, Vol. 37, (1966), p. 148.

20. Johnson, La Von C. "Effects of 5-days per Week versus 2 and 3 Days per Week Physical Education Class on Fitness, Skill, Adipose Tissue, and Growth," Research Quarterly, Vol. 40, (March, 1969), pp. 93-98.

21. Jokl M. D., Ernest. Nutrition, Exercise and Body Composition, Springfield, Illinois: The Charles E. Thomas Company, 1964, p. 111.

22. Knuttgen, Howard G. "Physical working capacity and physical performance," Medicine and Science in Sports, Volume 1, Number 1 (1969), 1-8.

23. Meyers, Carlton R., and T. Erwin Blesh. Measurement in Physical Education. New York: The Ronald Press Company, 1962, p. 245.

24. Moody, D. L., Kollias, J., Buskirk, E. R. "The effect of a moderate exercise program on body weight and skinfold thickness in overweight college women," Medicine and Science in Sports, Volume 1 Number 2 (June, 1969), 75-80.

25. National Adult Physical Fitness Survey, Educational Resources Information Center, ERIC Document ED 095 164, 1973.

26. Parizhova, Jana. Physical Activity Human Growth and Development, ed. G. Lawrence Rarick. New York: Academic Press, 1973.

27. Pavlov, S. "Organized Physical Education and Sports Popularized on the Mass Level," Soviet Education, Volume XVI, Number 4 (February, 1974), 4-21.

28. Pollock, Michael, Cureton, Thomas K., and Greninger, Leonard. "Effects of frequency of training on working capacity, cardiovascular function, and body composition of adult men," Medicine and Science in Sports, Volume 1, Number 2 (June, 1969), 70-74.

29. Reville, Dr. Ph. Sport for all: Physical Activity and the Prevention of Disease. Facts and Figures, Educational Resources Information Center, ERIC Document Ed 084 265, 1970.

30. Rothermal, B. L., Pollock, M. L., and Cureton, T. K., Jr. "AAHPER Physical Fitness Test Score Changes Resulting from an eight-week Sport and Physical Fitness Program," Research Quarterly, Vol. 39, (1968), p. 134.

31. Rowell, Loring B. "Human Cardiovascular Adjustments to Exercise and Thermal Stress," Physiological Reviews, Volume 54, (1974), 75-159.

32. Saltin, Bengt. "Physiological effects of physical conditioning," Medicine and Science in Sports. Volume 1 Number 1 (1969), 50-56.

33. Sharkey, Brian J. "Intensity and duration of training and the development of cardiorespiratory endurance," Medicine and Science in Sports, Volume 2 Number 4 (1970), 197-202.

34. Shepard, Roy J. Endurance Fitness, Toronto: University of Toronto Press, 1969, 246 pp.

35. Stankin, M. "The Hygiene of Physical Education," Soviet Education, Volume XVL, Number 4 (February, 1974), 97.

36. Taddonio, Diminck, "Effect of Daily Fifteen-minute Periods of Calisthenics upon the Physical Fitness of Fifth-Grade Boys and Girls," Research Quarterly, Vol. 37, (1966), pp. 276-281.

37. Texas Physical Fitness-Motor Ability Test, Governor's Commission on Physical Fitness, Austin, Texas.

38. Vann, Sudartha E., "The Effect of Exercise on Selected Skinfold and Girth Measurements and Weight of High School Women," M. S. in Physical Education, University of Tennessee, (1970).

39. Vrigens, Jacques, "The Influence of Interval Circuit Exercises on Physical Fitness of Adolescents," Research Quarterly, Vol. 40, (October, 1969), pp. 595-599.

40. Wilmore, Jack H., and others. "Physiological alterations resulting from a 10-week program of jogging," Medicine and Science in Sports, Volume 2, Number 1 (Spring, 1970), 7-14.

APPENDICES

Appendix A

Copy of the Parental Information Letter

Dear Parents,

The improvement of the physical education program at Hawthorne Elementary School is a continuous process. A very important area of concern in physical education is the physical fitness of your child. In order to better develop your child's physical fitness I would like to involve him or her in a trial exercise program of six weeks duration. Your child will perform various calisthenics for five minutes each exercise period. All of the children involved will then be tested to determine the effectiveness of the exercises.

If you have any questions or do not wish your child's participation please send a written note to me.

Thank you,

Toby Bedford
Physical Education Teacher

Appendix B

Descriptions of the Calisthenics Used in the Exercise Program

1. grasshopper - In order to perform the grasshopper the student assumes the push-up position except that one leg is brought forward so that the knee is under the chest. The exercise consists of alternating the feet under the chest.
2. running in place - The students were told to run as fast as possible while in place, just clearing their feet off the floor.
3. squat thrust - The exerciser starts in a standing position with his arm at his sides. On count one he squats to the floor and places his hands next to his feet. Count two consists of extending the legs backward until in the push-up position. Next the legs are brought forward until in the squating position, with the last count consisting of standing to the original position.
4. side straddle hop - From a standing position the arms and legs are completely abducted after a small hop. After the next small hop, the arms and legs are adducted to the original position.
5. squat jumps - The performer does a half-squat from the standing position and then jumps as high as possible.
6. rope jumping - The student pretends he is jumping rope using the same movements as in real rope jumping.

7. crab kicking - The body is supported on hands and feet with the back to the floor. The knees are at right angles until the legs are kicked as high as possible one at a time.
8. back pull-over - Partners lie on their backs so that their heads are almost touching and their bodies are 180^{o} from each other. After their hands are joined they pull their legs into the air until they touch their partners' feet with their own, at which time they bring them back to the floor.

Appendix C

t Ratios Needed for Statistical Significance at the .05 Level of Confidence

	Variable		N	df	t-Ratio
Uncorrelated	Step Test	pre	36	34	2.042
		post	36	34	2.042
	9-minute run	pre	36	34	2.042
		post	32	30	2.042
	Height	pre	18	16	2.120
		post	18	16	2.120
	Weight	pre	18	16	2.120
		post	18	16	2.120
	Sun of Skinfolds	pre	19	17	2.110
		post	19	17	2.110
	Triceps Skinfold	pre	17	15	2.131
		post	17	15	2.131
Correlated	Step Test	cont.	18	17	2.110
		exp.	18	17	2.110
	9-minute run	cont.	17	16	2.120
		exp.	15	14	2.145
	Height	cont.	18	17	2.110
		exp.	18	17	2.110
	Weight	cont.	18	17	2.110
		exp.	18	17	2.110
	Sum of Skinfolds	cont.	10	9	2.262
		exp.	9	8	2.306
	Triceps Skinfold	cont.	8	7	2.365
		exp.	9	8	2.306

Appendix D

Raw Data Scores and Measurements of All Participants

Post-Training Experimental Group

Name	Height (cm)	Weight (kg)	Triceps (mm)	Scapula (mm)	Sum of Skinfolds (mm)	9-minute Run (yds)	Step Test (PFI)
B.M.	138.5	31.0	12			1370	73.17
A.R.	149.5	50.0	22			1290	57.69
L.T.	149.4	36.4	14			1035	46.39
A.H.	131.0	25.5	9			1465	50.84
B.H.	136.5	27.3	12				52.63
S.B.	145.0	46.0	18				48.91
K.E.	138.1	29.5	12			1275	60.40
D.R.	137.6	27.3	9			1525	84.90
S.Y.	142.5	32.3	13			1450	50.27
T.E.	152.1	55.0	27	22	49	1070	51.72
D.L.	137.6	30.5	12	7	19	1585	58.44
B.V.	147.3	31.0	6	5	11	1150	58.06
C.M.	137.5	28.6	8	4	12	2180	62.50
B.S.	147.4	46.8	18	18	36	1300	49.18
G.P.	145.2	28.2	8	14	22	2200	59.60
G.H.	149.1	34.5	14	5	19		62.50
S.A.	143.2	33.6	11	5	14	1640	57.32
D.J.	141.1	30.0	9	5	14	1440	67.67

Appendix D

Raw Data Scores and Measurements
of All Participants

Pre-Test Experimental Group

Name	Height (cm)	Weight (kg)	Triceps (mm)	Scapula (mm)	Sum of Skinfolds (mm)	9-minute Run (yds)	Step Test (PFI)
B.M.	137.0	31.0	12			1515	63.38
A.R.	148.5	51.0	21			1430	41.28
L.T.	143.0	36.7	11			1355	48.64
A.H.	130.4	26.4	9			1660	46.39
B.H.	135.6	27.3	10			1105	51.72
S.B.	145.0	46.4	20			1125	45.00
K.E.	130.5	29.5	12			1540	61.64
D.R.	137.2	26.4	11			1555	68.18
S.Y.	141.7	32.3	13			1660	48.64
T.E.	145.3	53.6	20	18	38	1260	39.70
D.L.	131.5	29.5	11	5	16	1580	66.14
B.V.	141.9	29.1	8	5	13	1715	55.90
C.M.	133.1	27.7	6	4	10	1730	72.00
B.S.	140.8	46.8	18	18	36	1040	31.25
G.P.	138.6	27.3	9	4	13	1855	57.69
G.H.	144.5	34.5	11	5	16	1585	55.55
S.A.	137.0	32.3	11	5	16	1565	52.32
D.J.	135.1	31.0	12	5	17	1405	52.94

Appendix D

Raw Data Scores and Measurements of All Participants

Post-Test Control Group

Name	Height (cm)	Weight (kg)	Triceps (mm)	Scapula (mm)	Sum of Skinfolds (mm)	9-minute Run (yds)	Step Test (PFI)
C.B.	140.9	34.5	15			1295	62.07
B.P.	135.0	41.0	23			1165	50.56
B.G.	143.7	45.5	20			1140	55.90
A.B.	149.0	37.7	11			1595	56.25
T.P.	142.6	36.0	10			1615	66.66
D.M.	131.0	27.7	13			1165	65.21
A.L.	142.8	34.1	14			1440	47.87
L.G.	129.9	26.8	13			1420	57.32
D.S.	154.7	41.0	11	7	18	1005	67.67
E.R.	133.4	28.2	7	5	12	1295	58.82
D.S.	135.0	31.0	13	6	19	2265	62.38
G.W.	139.0	31.4	9	4	13	2040	50.84
G.R.	141.6	31.4	10	6	16	1780	63.38
S.H.	143.0	29.1	8	5	13	2105	68.18
D.F.	138.4	29.5	11	5	16	1090	58.06
S.C.	141.6	39.5	14	11	25		52.94
B.W.	131.3	28.6	8	4	12	1860	45.91
M.K.	142.2	36.8	15	7	22	1445	62.07

Appendix D

Raw Data Scores and Measurements
of All Participants

Pre-Test Control Group

Name	Height (cm)	Weight (kg)	Triceps (mm)	Scapula (mm)	Sum of Skinfolds (mm)	9-minute Run (yds)	Step Test (PFI)
C. B.	139.0	34.5	16			1435	59.60
B. P.	133.4	40.0	20			1105	44.41
B. G.	142.0	45.5	20			1380	59.60
A. B.	148.1	36.4	8			1710	60.00
T. P.	142.0	33.2	10			1740	63.38
D. M.	130.4	27.3	12			1375	77.58
A. L.	142.0	34.1	13			1215	46.15
L. G.	128.9	26.4	11			1135	70.31
D. S.	147.2	40.5	13	7	20	1625	58.67
E. R.	133.5	28.2	8	6	14	1575	69.23
D. S.	134.4	30.5	13	6	19	1575	52.63
G. W.	138.9	31.8	8	4	12	1550	56.60
G. R.	135.9	30.0	10	6	16	1660	49.18
S. H.	136.4	28.2	8	5	13	1650	40.26
D. F.	132.9	29.5	9	5	14	1545	67.67
S. C.	140.8	39.1	14	11	25	1100	42.72
B. W.	131.3	29.1	14	4	18	1855	55.55
M. K.	136.2	34.5	12	6	10	1480	45.90