A STUDY OF THE EFFECTS OF A SELECTED PROGRESSIVE EXERCISE PROGRAM ON THE MUSCULAR ENDURANCE AND CIRCULO-RESPIRATORY FITNESS OF EIGHTH GRADE BOYS

Thesis for the Degree of M. A.

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Douglas Craig Wolf

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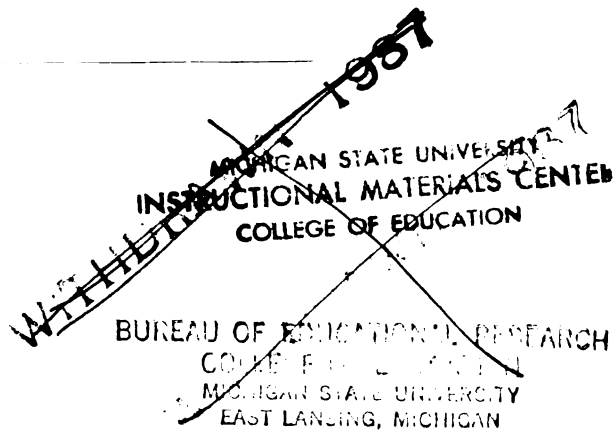

A STUDY OF THE EFFECTS OF A SELECTED PROGRESSIVE EXERCISE PROGRAM ON THE MUSCULAR ENDURANCE AND CIRCULO-RESPIRATORY FITNESS OF EIGHTH GRADE BOYS

By

Douglas Craig Wolf

AN ABSTRACT OF A THESIS

Submitted to
Michigan State University
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ABSTRACT

A STUDY OF THE EFFECTS OF A SELECTED PROGRESSIVE EXERCISE PROGRAM ON THE MUSCULAR ENDURANCE AND CIRCULO-RESPIRATORY FITNESS OF EIGHTH GRADE BOYS

by Douglas Craig Wolf

Statement of the Problem

It was the author's intent in this study to show the effects of a selected progressive exercise program on the muscular endurance and circulo-respiratory fitness of eighth grade boys. The problem included three objectives:

1. To determine if a series of selected progressive exercises would significantly increase the muscular endurance of the arms, abdomen, and legs.

2. To determine if the circulo-respiratory fitness would be significantly increased.

3. To determine if a progressive exercise program consisting of six minutes of exercise, four days a week, for a period of eight weeks would be sufficient to significantly change the muscular endurance and circulo-respiratory fitness of the eighth grade boys tested.

Methodology

The subjects used in the research were members of two physical education classes at East Lansing Junior High School, East Lansing, Michigan. One class of thirty-five

members served as the experimental group while the other class of thirty-five members served as the control group. The experimental group participated in the progressive exercise program for a period of eight weeks. The control group received no regular exercise program in the physical education classes.

A ten man testing team selected by the author administered a set of five physical tests to both groups before the exercise program began and also at the end of the training program. The five test items used were: (1) post-exercise pulse rate as found through a modified step test, (2) pull-ups, (3) sit-ups, (4) push-ups, and (5) leg changes. These tests were selected because they were easy to conduct and, when properly administered, they suceeded in measuring the endurance and circulo-respiratory fitness of the muscles being gauged.

Results

The data accumulated from the pre and post tests were analyzed using the student "t" test. Significance at the .05 level served as a basis for acceptance or rejection in the analysis of each test item. The following results were derived from the analysis:

1. The experimental group showed a significant increase in the push-up test over the control group. This increase was shown to be significant at the .01 level.

2. The subjects who participated in the experimental group showed a significant increase over the control group in

the pull-up test. The mean change between the two groups was significant at the .01 level.

3. The analysis of the mean change between the experimental and the control group in the leg change test indicated that the experimental group's mean change was significant at the .01 level.

4. The mean change between the experimental and control group in the sit-up test did not prove significant at the .05 level, although the experimental group did show more of a change than did the control group.

5. The mean change between the experimental group and the control group in the resting pulse rate showed that the change was not statistically significant.

6. The mean change between both groups based upon their pre and post test results of the post exercise pulse rate taken from one to one and one-half minutes after the step test showed no significance.

Conclusions

The following conclusions have been drawn as a result of the analysis of data:

1. The experimental group showed significant mean changes on the push-up, pull-up, and leg change tests.

2. The mean changes recorded by the experimental group on the sit-up test and the resting and post exercise pulse rates recorded on the step test did not prove to be significant.

3. The selected progressive exercise program did

significantly increase the muscular endurance of the arms and legs.

4. Although the experimental group did improve more than the control group on the sit-up test, this improvement was not significant at the .05 level.

5. The circulo-respiratory fitness of the subjects, as measured by the step test, was not significantly increased.

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To Mr. James Oestriech and to my faculty advisor, Dr. John A. Friedrich, I give special thanks for their unerring guidance that helped so much to make this research study possible.

DEDICATION

To my parents who made my education possible.

D.C.W.

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CHAPTER I

THE PROBLEM

Introduction to the Problem

The development of a strong, healthy body is one of the basic objectives of a good physical education program. This has been the primary goal of physical education since it entered the school curriculum in the United States.

Fifty years ago nearly all the work done in industry and at home was accomplished by hand; the intricate machinery and modern appliances found in factories and homes today had not yet been invented. Even the automobile was considered a luxury by most families. Farmers, without the benefit of harvesters and combines, spent long hours in the fields harvesting crops by hand. People were able to build and maintain the musculature of their bodies by the very nature of their daily routine.

Automation has gradually reduced many of the manual tasks in the home and in industry. As machinery has taken over the jobs once done by hand, the working week has shrunk from sixty to forty hours.

With an increase in leisure time, radio, television, and motion pictures have more and more provided the American public with entertainment. Vigorous activities to keep the body strong and healthy have faded into the background.

Despite the increase in leisure time, the United States is gradually becoming a nation of spectators and passive observers instead of participants in vigorous recreational pursuits.[1] Because of this sedentary living, the physical fitness of Americans is beginning to suffer.

Physical educators are becoming aware of this apparent decrease in the over-all physical fitness of the nation. The alarming number of physically unfit men discovered by the draft during World War II and the Korean Conflict influenced physical educators to emphasize programs involving physical conditioning. The results of the Kraus-Weber Minimum Fitness Tests showed that the American youth who took the tests did not compare favorably to similar groups of European children.[2] Although subsequent investigations disproved many of these findings, the results of these tests still caused concern among both public and professional people alike.

President Kennedy and former President Eisenhower were aware of the need for developing the physical fitness of our youth. During their terms in office they both endorsed physical fitness programs aimed at the development of the strength and endurance and over-all fitness of the

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[1]William Kvaraceus, The Community and the Delinquent (New York: World Book Company, 1954), p. 321.

[2]Hans Kraus and Ruth P. Hirschland, "Minimum Muscular Fitness Tests in School Children," Research Quarterly, XXV (May, 1954), p. 178.

nation's youth.[3] These testing programs have usually been administered to the school children twice during the school term. By conducting the fitness tests at the beginning and at the end of the school year, the physical education instructor is able to determine how well his program is contributing to the physical development of his students.

Recently the Royal Canadian Air Force released an exercise program for its personnel entitled 5BX Plan for Physical Fitness.[4] The program proposed the use of progressive exercises as a means of achieving physical well-being for optimum living. This plan consists of five exercises, each done in the same order and within a total maximum time limit of eleven minutes. After experimenting with several hundred men over a two year period, the Royal Canadian Air Force announced the 5BX Plan was an effective plan for improving levels of physical fitness.

In this study the author has attempted to adapt the 5BX Plan For Physical Fitness to meet the needs of eighth grade boys from the East Lansing Junior High School in East Lansing, Michigan. It is this writer's hope that the results of this study will aid in gaining insight into the use of progressive exercises as a method for developing the muscular endurance and circulo-respiratory fitness of all

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[3]President's Council on Youth Fitness, Youth Physical Fitness (Washington, D.C.: Government Printing Office, July, 1961).

[4]Royal Canadian Air Force, 5BX Plan For Physical Fitness (Ottawa: Queen's Printer and Controller of Stationary, 1962).

male students from grade school through high school.

Statement of the Problem

An attempt has been made through this study to show the effects of selected progressive exercises on the muscular endurance and the circulo-respiratory fitness of eighth grade boys from East Lansing Junior High School. The problem consists of three objectives: (1) to determine if a series of regular progressive exercises would significantly increase the muscular endurance of the arms, abdomen, and legs; (2) to determine if the circulo-respiratory fitness would be significantly increased; and (3) to determine if a progressive exercise program consisting of six minutes of exercise four days a week for a period of eight weeks would be sufficient to significantly change the muscular endurance and circulo-respiratory fitness of the eighth grade boys tested.

Scope of the Problem

All of the members used in this study were members of the eighth grade in the East Lansing Junior High School, East Lansing, Michigan. They were members of two physical education classes that met four times weekly. One class represented the experimental group, while the other class represented the control group. The experimental group received the battery of progressive exercises four times weekly over the eight-week training period, whereas the control group received no specific set of exercises. The

two groups were matched only by grade level. They were not matched according to height, weight and age. (Further information concerning grouping can be found in Chapter III.)

Significance of the Study

The relationship found between muscular strength and endurance and physical fitness has shown the need for the development of strength and endurance in the youth of our nation. Due to recent advances in medical and nutritional technology, our youth appear to be healthier than at any other time in history. But because of their failure to engage in energetic physical activities, the youth of today do not seem to be as physically fit as were generations of American boys and girls before them.

Very little research has been concerned with the development of muscular endurance and circulo-respiratory fitness at the junior high, or even high school, level. Many researchers have been loath to conduct such studies because it is extremely difficult to impose controls on human subjects during experimental studies. It is this investigator's view that this type of study is needed if physical education is to progress satisfactorily. The author chose the eighth grade as the grade level in which to conduct his study.

It is hoped that the results of this study will demonstrate the benefits to be derived from progressive exercises insofar as the development of muscular endurance and circulo-respiratory fitness are concerned. If these

results prove to be significant, it is the author's hope that physical educators will employ a progressive exercise program in their classes as a training program for improving physical fitness.

Limitations of the Study

The investigator has recognized several limitations while preparing and conducting this study.

1. The children in this study lived only in the East Lansing, Michigan area. It cannot be said with absolute certainty that the results of the study would have been the same throughout all the areas of the United States. It is assumed that the results would have been somewhat similar in any eighth grade unless no physical education was provided in the seventh grade.
2. This study was concerned with eighth grade boys only. It cannot be implied that the study would have achieved the same results with seventh or ninth grade boys or girls.
3. This research project was designed to study only the muscular endurance and circulo-respiratory fitness of the subjects. No attempt was made to study the mental and social growth and development or any other physical measures of these boys.
4. No account was made for the participation of the subjects involved in physical activities outside

of the physical education class. Therefore, it cannot be assumed that both groups were involved similarly and to the same extent in outside activities.

Definitions of Terms

Progressive exercise.--As used in this study, a progressive exercise consisted of a simple exercise made increasingly more difficult either by increasing the number of repetitions performed or by increasing the difficulty of the performance of the exercise through the execution of more complicated movements. This progression was performed within a time limit which remained constant throughout the entire training program.

Muscular endurance.--Muscular endurance, as defined by Clarke, means the ability to continue muscular exertions of sub-maximal magnitude.[5] In this study the number of repetitions in a designated time limit measured the endurance of the muscles being tested. Muscular strength, a single maximum contraction of the muscle being tested,[6] is not considered in this study.

Circulo-respiratory fitness.--Moderate contractions of large muscle groups over a relatively long period of time require an adjustment of the circulo-respiratory system to the activity. Circulo-respiratory fitness is determined by

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[5]H. Harrison Clarke, Application of Measurement to Health and Physical Education (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959), p. 222.

[6]Ibid.

how quickly the heart rate returns to normal at the cessation of exercise or exercises. In this study the circulo-respiratory fitness is measured by the post-exercise recovery pulse rate following a modified Harvard Step Test.[7]

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[7] L. Brouha, "The Step Test: A Simple Method of Measuring Physical Fitness for Muscular Work in Young Men," Research Quarterly, XIV (March, 1943), pp. 31-36.

CHAPTER II

REVIEW OF RELATED LITERATURE

"Mechanization has largely replaced human brawn and automation is supplementing human brain. We are experiencing a degree of leisure unknown to any human culture."[1] This statement by Morehouse sums up the life of the American family today. The over-all physical fitness of our youth is gradually declining. In their physical education classes children should be participating in activities which, when properly administered, are capable of improving their physical fitness.

This chapter has been organized into three sections: (1) literature related to physical fitness and conditioning programs, (2) literature related to the measurement of endurance, and (3) literature related to tests of circulo-respiratory fitness.

Literature Related to Physical Fitness and Conditioning Programs

"Exercise is one of the important factors contributing to total fitness. Its contribution to fitness includes

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[1]Lawrence Morehouse, "A Threat to Fitness," Journal of Health, Physical Education, and Recreation, XXVII (September, 1958), p. 20.

the development of strength, endurance, and agility."[2] The preceding statement, released jointly by the American Medical Association and by the American Association for Health, Physical Education, and Recreation, reflects the attitude of both of these organizations toward the value of exercise. When defining fitness, the American Association for Health, Physical Education and Recreation states:

> Fitness is that state which characterizes the degree to which the person is able to function. It implies the ability of each person to live most effectively within his potentialities. Fitness is a dynamic, constantly changing quality, the development of which should be continuous and satisfying from early infancy through maturity so that the inherent potentialities of each person can be realized.[3]

The effects of training and non-training on the physical efficiency of twenty-three college women were studied by Walters.[4] She found that after eleven consecutive days of short bouts (7-1/2 to 12-1/2 minutes) of strenuous exercises, the physical efficiency as measured by the physiological responses of the body was improved in all the subjects. She also found that the subjects lost this

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[2]A statement by a Joint Committee of the American Medical Association and the American Association of Health, Physical Education, and Recreation, "Exercise and Fitness," Journal of Health, Physical Education, and Recreation, XXIX (April, 1958), pp. 40-43.

[3]Statement prepared and approved by the 100 delegates to the Am. Assoc. of Health, Physical Education, and Recreation Fitness Conference, September 12-15, 1956, Washington, D.C. Journal of Health, Physical Education, and Recreation, XXVII (December, 1958), pp. 7-9.

[4]Etta Walters, "Effects of Prescribed Exercise on Physical Efficiency of Women," Research Quarterly, XXIV (March, 1953), p. 102.

efficiency after two weeks of nontraining.

Howell and Morford conducted an exercise program in which the students moved to different exercise stations which were set up in the gymnasium.[5] The students were allowed ten minutes to complete the circuit of exercises. The time that they spent at each exercise program remained constant. They were allowed to progress at a work rate compatible to their individual capacities. The exercises used in this program were squat-jumps, sit-ups, squat-thrusts, step-ups, push-ups, straight arm pullovers. Also chinning and wrist rolling exercises were used. When a student was able to complete the circuit within the ten-minute period, his training dose at each exercise station was increased. The results of this program were not listed, although the authors stated that the physical fitness levels of the students were raised.

Kistler's study at Louisiana State University showed the benefits to be derived from a physical fitness training program.[6] The 1,650 men in the study participated in a training program which was of eight days duration. During this period the men met three times each week for a thirty-minute workout. The training program consisted of bending and stretching calisthenics, sit-ups, push-ups, deep-knee

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[5]Maxwell L. Howell and W. R. Morford, "Circuit Training," Journal of Health, Physical Education, and Recreation, XXXII (November, 1961), pp. 33-34.

[6]J. W. Kistler, "A Study of the Results of Eight Weeks of Participation in a University Physical Fitness Program for Men," Research Quarterly, XV (January, 1944), pp. 23-28.

bends, and personal combat activities. It included all-out chinning, long distance running, and obstacle course running also. The results showed that the subjects improved the most on the sit-up and push-up tests. The tester found also that the cardio-respiratory fitness of the subjects was the most difficult to improve even though his exercise program contained an abundance of cardio-respiratory exercises.

Lowell conducted a fifteen-day exercise program at Michigan State University.[7] This study involved fifty-three subjects in the experimental group and thirty-five in the control group. Both groups performed various physical tests at the beginning of the study. The experimental group performed the training program for thirty minutes on five days within the fifteen-day period. At the conclusion of the exercise program, all of the subjects in the study were retested. The test items used were a three-minute step test, an agility run, and a measurement of body weight. Sit-ups and push-ups were included, as was a testing of trunk flexion and extension.

Lowell's results showed that the subjects who participated in the limited exercise program had a significantly lower pulse rate on the retest than they had experienced on the pre-test. The subjects performed more push-ups on the

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[7]Walter Smith Lowell, "The Effects of a Limited Exercise Program on the Post exercise Pulse Rate of Male College Freshmen" (unpublished Ph.D. dissertation, Department of Health, Physical Education, and Recreation, Michigan State University, 1961).

retest than they did on the initial test, and their scores on the trunk flexion and agility run were significantly increased. It was interesting to note that the control group which participated in no exercise program at all also improved significantly on the push-up test.

Durnin, Brockway, and Whitcher conducted an experiment in which they attempted to measure whether or not there was an improvement in physical fitness through varying degrees of exercise which lasted only ten days.[8] One group acted as the control group and did only a minimum of exercise. There were three experimental groups. Each day of the training program the first experimental group walked ten kilometers; the second group, twenty kilometers; and the third, thirty kilometers. Their fitness was assessed by measurements of pulmonary ventilation, oxygen extraction, oxygen consumption, and recovery heart rate during a standardized physical test on the treadmill. The test was administered before, during, and at the conclusion of the training period. The results showed that the control group did not improve on any of the tests. The three exercise groups did improve on all the measurements taken, with the second group showing the most improvement.

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[8] J. U. G. A. Durnin, J. M. Brockway, and H. W. Whitcher, "Effects of a Short Period of Training of Varying Severity on Some Measurements of Physical Fitness," Journal of Applied Physiology, XV (January, 1960), pp. 161-165.

Literature Related to the Measurement of Muscular Endurance

In order to determine the fitness status of Navy personnel, a five item motor fitness test was developed by the Department of the Navy. The items contained in the test battery were squat-thrusts, sit-ups, push-ups, squat-jumps, and pull-ups.[9]

The Army constructed a test battery similar to the test battery of the Navy to measure the basic elements of strength, endurance, agility, and coordination.[10] The five item battery consisted of pull-ups, squat-jumps, push-ups, sit-ups, and a 300-yard run. If the test was administered indoors, a one-minute squat thrust or a 250-yard shuttle run was substituted for the 300-yard run.

Bookwalter constructed a practical test of motor fitness for men of high school and college age. Known as the Inidana Motor Fitness Test, the battery included chin-ups, straddle chinning, push-ups, and the vertical and standing broad jumps.[11]

Under the chairmanship of Paul A. Hunsicker, a committee of the American Association for Health, Physical

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[9]Bureau of Naval Personnel, Training Division, Physical Section, Physical Fitness Manual for the United States Navy (Washington, D.C.: Government Printing Office, 1943).

[10]Department of the Army, Department of the Army Field Manual FM 21-20, Physical Training (Washington, D.C.: Government Printing Office, 1957).

[11]Karl W. Bookwalter, "Further Studies of Indiana University Motor Fitness Index," Bulletin of the School of Education, Indiana University, XIX, No. 5 (September, 1943).

Education, and Recreation formed the American Association of Health, Physical Education, and Recreation youth fitness test battery.[12] The test battery consists of pull-ups, sit-ups, a 40-yard shuttle run, the standing broad jump, 50-yard dash, softball throw for distance, and 600-yard run-walk. This test battery is currently being used by many physical educators to measure the success of their physical education programs.

Mohr found that the push-up test was not an accurate test of arm and shoulder girdle strength when administered en masse.[13] She said that the tests must be given individually if the data are to be valid. Miss Mohr also found the sit-up test to be valid and highly reliable for the purpose of measuring abdominal strength and endurance. In a similar test using two hundred college women, Phillips noted that abdominal strength and endurance were best measured by the dynamic test represented by sit-ups as compared to the static type represented by V-sits and half-sit holds.[14]

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[12]American Association for Health, Physical Education, and Recreation, American Association of Health, Physical Education, and Recreation Youth Fitness Test Manual (1201 Sixteenth Street N.W., Washington 6, D.C., 1958)

[13]Dorothy Mohr, "The Measurement of Certain Aspects of the Physical Fitness of College Women," Research Quarterly, XV (December, 1944), pp. 340-349.

[14]Marjorie Phillips, "Study of a Series of Physical Education Tests by Factor Analysis," Research Quarterly, XX (March, 1949), pp. 60-71.

Wedmeyer attempted to analyze the two-minute and the unlimited sit-ups as to their values as measures of strength and endurance of the muscles used in the exercise.[15] Forty-seven senior high school boys were used as subjects. They were tested to see how many sit-ups they could do in two minutes. In addition they were tested to see how many sit-ups they could do in rhythm to a metronome with no time limit. After a two-month training period the boys were tested again. Wedmeyer concluded that after strength reached a certain level, further improvement in the number of sit-ups was accompanied by no significant increase in strength. The endurance factor seemed to improve more than did the strength factor. In this analysis of the sit-up test, Wedmeyer used the Martin Breaking Strength Method to record sit-up strength.[16]

When speaking of the sit-up test for abdominal strength and endurance, Lowendahl said,

> With hands on the head in a back-lying position and with knees bent, the individual gets a maximal pull on the rectus abdominals in coming to a sitting position. This is a better exercise than the traditional hooking of the feet under the bars with legs straight and the arms at the side. In this latter position the weight of the arms eliminates some of the pull of the abdominals in the initial phase of sitting up, and the balance of the sit-up is accomplished mainly by the hip flexor muscles so that one actually gets very little abdominal exercise.[17]

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[15] R. A. Wedmeyer, "A Differential Analysis of Sit-ups for Strength and Muscular Endurance," Research Quarterly, XVII (March, 1946), p. 40.

[16] Ibid., p. 42.

[17] Evelyn Lowendahl, "Muscle Development in Athletic Training," American Association for Health, Physical Education, and Recreation Journal, XXI (June, 1950), pp. 331-332.

Literature Related to Circulo-Respiratory Tests

Researchers have spent considerable time in devising a single test which would best measure physical fitness. Many experiments have been conducted which show certain cardiovascular factors to be related to good physical condition. The author of this study has limited his review of literature on circulo-respiratory tests to those directly related to measurements of post exercise pulse rate. It has been found that many significant physiological changes result from athletic training and that simple tests of recovery pulse rates are indicative of circulo-respiratory adjustments.

The Schneider Test was one of the earliest of the cardiovascular tests.[18] It was devised during World War I to test whether or not aviators were functionally fit to fly. After the pulse rate and systolic pressure were taken in a standing and a reclining position, the subject stepped up and down on a chair 18-1/2 inches high five times in fifteen seconds. At the end of the fifteen-second exercise period the subject continued to stand during the post exercise pulse count. A rating table was devised. A perfect record, the sum total of the values for all six tests, was a score of eighteen while a score of nine or less indicated that the subject was not physically fit to fly. When the

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[18] E. C. Schneider, "A Cardiovascular Rating as a Measure of Physical Fitness and Efficiency," Journal of the American Medical Association, LXXIV, No. 5 (May 29, 1920), p. 1507.

test was given with extreme care, the reliability was found to be as high as .89.

To measure physical efficiency, Tuttle devised a pulse-ratio test in 1931.[19] In Tuttle's test the subject's pulse rate was counted for thirty seconds and doubled after his resting pulse count remained constant. The result was recorded as the normal pulse for one minute. Then the subject stepped on a thirteen-inch stool with his right foot and then with his left foot. He participated in this exercise for one minute at the rate of twenty steps (up with both feet and down with both feet) a minute for boys and fifteen steps per minute for the girls. Immediately after the exercise, the subject's pulse rate was taken for a total of two minutes. The result of the post exercise pulse count was divided by the normal pulse rate for one minute. This was the first pulse-ratio. Again the exercise was done for one minute at the rate of thirty-five steps for girls and forty steps for boys. As before, the pulse rate for two minutes was recorded and a second pulse rate computed. After the subject's two pulse-ratios had been plotted on a chart, he repeated the one-minute exercise at a stepping rate which represented the 2.5 pulse-ratio on his chart. In order to determine whether or not the subject had a defective heart, Tuttle computed his pulse-ratio in the usual

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[19] W. W. Tuttle, "The Use of the Pulse-Ratio Test for Rating Physical Efficiency," Research Quarterly, II (May, 1931), p. 5.

manner. If this ratio was more than .07 above or below 2.5, Tuttle suspected a heart condition and referred the subject to a physician.

Brouha devised perhaps the best known step test, the Harvard Step Test.[20] This test was originally constructed for college men. Brouha formulated a set of norms after she had tested eight thousand male college students. Using a four-count step as was used by Tuttle, the subject stepped up and down thirty times a minute on a bench twenty inches high. Unless physical exhaustion occurred, he continued the exercise for five minutes. Immediately after completing the stepping exercise, the subject sat on a chair and took his pulse rate, one to one and a half, two to two and a half, three to three and a half minutes after the exercise. A Physical Efficiency Index was computed using the following formula:

$$\text{P. E. I.} = \frac{\text{Duration of exercise in seconds} \times 100}{2 \times \text{sum of pulse counts in recovery}}$$

On the basis of eight thousand tests carried out on college students, the following norms based on the Physical Efficiency Index were prepared:

Below 55 = Poor physical condition
From 55 to 64 = Low average
From 65 to 79 = High average
From 80 to 89 = Good
Over 90 = Excellent

Concerning her Harvard Step Test, Brouha said,

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[20]Brouha, op. cit., pp. 31-36.

> What this test measures is the general capacity of the body--the cardiovascular system in particular--to adapt itself to hard work and to recover from what it had done.[21]

Cogswell, Henderson, and Berryman explored the effects of training on the pulse rate of seven young men.[22] They conducted a twelve-week training program. The subjects performed the Harvard Step Test, ten per cent grade treadmill at six miles per hour for two and four minute periods, and a sixty-second bicycle ergometer test. Each subject participated in the program three times per week. The investigators found that in sub-maximal exercises the post exercise pulse rate showed a decrease with training whereas the maximal tests failed to produce a similar response.

To ascertain the effects of physical training on young women, Sloan subjected female students to a modified Harvard Step Test at the beginning of the academic year and again four and nine months later.[23] The group which specialized in physical education had higher physical fitness indexes than the others, and they improved with training. Whereas two groups which engaged in limited physical activity showed no significant increase in fitness index. The fourth

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[21] Ibid., p. 31.

[22] R. C. Cogswell, C. R. Henderson, and G. H. Berryman, "Effects of Training on Pulse Rate, Blood Pressure, and Exercise in Humans Using the Step Test," American Journal of Physiology, CXLVI (February, 1946), pp. 422-430.

[23] A. W. Sloan, "Effect of Training on Physical Fitness of Women Students," Journal of Applied Physiology, XVI (January, 1961), pp. 167-169.

group which had no physical training displayed a tendency to deteriorate rapidly. Changes in the resting pulse rate were less consistent, and resting pulse rates showed little correlation with fitness indexes. In a similar study involving varsity athletes, Montoye found a correlation of the maximum pulse rate and recovery index before and after a twelve-week training period to be significant at the .02 level.[24]

A one-minute step test at thirty-six steps per minute on a seventeen-inch bench was administered to seventeen varsity basketball players every three weeks during sixteen weeks of training by Michael and Galleon.[25] After taking a resting pulse count, they took the step test. At the conclusion of the test five post exercise pulse counts were taken on all the subjects. The pulse counts, each fifteen seconds in duration, were taken at one-minute intervals during a five-minute recovery period. The results indicated that the recovery pulse rate count decreased significantly during the training for the basketball season.

Summary

The investigator was unable to find any studies

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[24]H. Montoye, "Inter-Relation of Maximum Pulse Rate During Moderate Exercise, Recovery Pulse Rate, and Post Exercise Blood Lactate," Research Quarterly, XXIV (December, 1953), pp. 453-458.

[25]Ernest D. Michael and Arthur Galleon, "Periodic Changes in the Circulation During Athletic Training as Reflected by a Step Test," Research Quarterly, XXX (October, 1959), pp. 303-311.

related to training programs among junior high school students. The scientific periodicals are filled with studies concerned with physical fitness among college students and adults. Invariably these studies have shown the positive effects on physical fitness brought about by some type of training program. Beneficial results attributed to training were noted by Walters,[26] Kistler,[27] and Lowell,[28] as well as by other investigators.

Many different types of exercises have been used by investigators to study muscular endurance. Mohr,[29] Phillips,[30] Wedmeyer,[31] and Lowendahl[32] conducted studies which proved the sit-up test to be a reliable test of abdominal strength and endurance. Miss Mohr also studied the validity of the push-up test as a test of arm and shoulder girdle strength and endurance.[33]

The test most often used to measure circulo-respiratory fitness is Brouha's Harvard Step Test or modifications of this test.[34] This test is most often used because it is simple to administer. Modifications of the Harvard Step

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[26]Walters, loc. cit.

[27]Kistler, loc. cit.

[28]Lowell, loc. cit.

[29]Mohr, loc. cit.

[30]Phillips, loc. cit.

[31]Wedmeyer, loc. cit.

[32]Lowendahl, loc. cit.

[33]Mohr, loc. cit.

[34]Brouha, op. cit., pp. 31-36.

Test were used in studies conducted by Tuttle,[35] Sloan,[36] Michael and Galleon,[37] and Cogswell, Henderson, and Berryman.[38] Many researchers, if conducting laboratory tests with humans, will use a treadmill run followed by a pulse count to determine circulo-respiratory fitness.

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[35]Tuttle, loc. cit.

[36]Sloan, loc. cit.

[37]Michael and Galleon, loc. cit.

[38]Cogswell, Henderson, and Berryman, loc. cit.

CHAPTER III

METHODOLOGY

This study was experimental in design. The project attempted to study the effects of a selected progressive exercise program on the muscular endurance and circulo-respiratory fitness of eighth grade boys. The subjects used in the research were members of two eighth grade physical education classes at East Lansing Junior High School, East Lansing, Michigan. One class of thirty-five members served as the experimental group while the other class of thirty-five members served as the control group. The experimental group participated in the progressive exercise program for a period of eight weeks. The control group did not participate in a progressive exercise program. Both groups were given a set of five physical tests before the exercise program began and were retested at the conclusion of the training program using the same set of physical tests.

Chapter III has been divided into four sections: (1) selection of the groups, (2) testing procedure, (3) exercise program, and (4) data analysis procedure.

Selection of the Groups

All of the subjects in this study were male members of two physical education classes at the East Lansing Junior High School, East Lansing, Michigan. These classes met four

times a week. There were seventy subjects in the research design, thirty-five members in each group.

After receiving permission from the school authorities at the East Lansing Junior High School to conduct a research program with students from their school, the investigator was able to utilize the services of two classes. Since the project was conducted during the school day, the author selected one class as the experimental group and the other class as the control group. The groups were not matched according to height, weight or age.

The author visited both groups several times before the pre-tests were administered. The purpose of this study was explained to all of the subjects prior to their initial tests and the subjects were assured that the results of the tests would have no bearing on their grade in physical education. To motivate the subjects to do their best on the pre-test and on the retest, the author spoke to both groups and encouraged them to perform with maximum efficiency so that one group's performance would not eclipse that of the other group.

Testing Procedure

Five tests were administered to all of the subjects; their results were measured and analyzed in this study. A testing team, composed of ten college students familiar with the tests, aided in conducting the pre-test and the retest. The five test items used were: (1) post-exercise pulse rate as found through a modified step test, (2) pull-ups, (3) sit-

ups, (4) push-ups, and (5) leg changes. These tests were selected because they were easy to conduct, and because, when properly administered, they succeeded in measuring the endurance and the circulo-respiratory fitness of the muscles being gauged.

Post exercise pulse rate.--A two-minute step test was used to measure the post-exercise pulse rate of the subjects. The test was pre-recorded on tape. All of the instructions were recorded on tape and a metronome was used to set the cadence at 120 beats per minute. This cadence was used by Brouha when she conducted her Harvard Step Test.[1] When the students came to the testing station, they were instructed to sit down on the benches and to rest for two minutes. Then the resting pulse rate was taken either at the wrist or at the carotid artery for a period of thirty seconds. Because of the age of the students, the author assigned a member of the testing team to each subject. The tester took the pulse count and recorded it on the pupil's recording sheet. The subjects stood up, faced the benches, and awaited the command to start the test. A "step" consisted of stepping up on the seventeen inch bench with the left foot, stepping up with the right foot, and then stepping down with the left foot followed by the right foot. The metronome established the cadence for all of the four movements (see Figure 1).

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[1]Brouha, op. cit., p. 31.

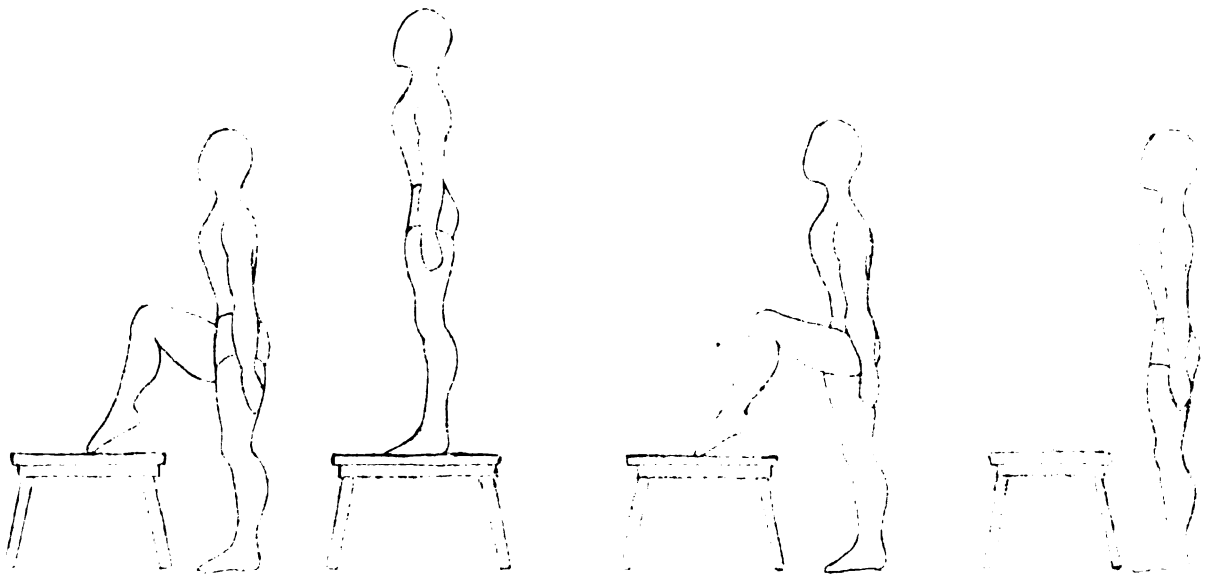

Fig. 1.--Step test.

At the completion of the two-minute step test the subjects sat down and rested for one minute. A pulse count was taken for thirty seconds and recorded on the testing sheet of each individual. The thirty second pulse count was found one, two, three, four, and five minutes after the completion of the step test. Only the first post exercise pulse count was used in the analysis of the data; however, the means for all five pulse counts were computed. These computations are found in Figure 2, (page 28) showing the rate of decrease in the recovery pulse count.

Pull-ups.--The pull-ups were performed on two overhead ladders. Six boys simultaneously performed the test on each ladder. The subjects were given one minute to do all the pull-ups they were capable of completing. Credit was

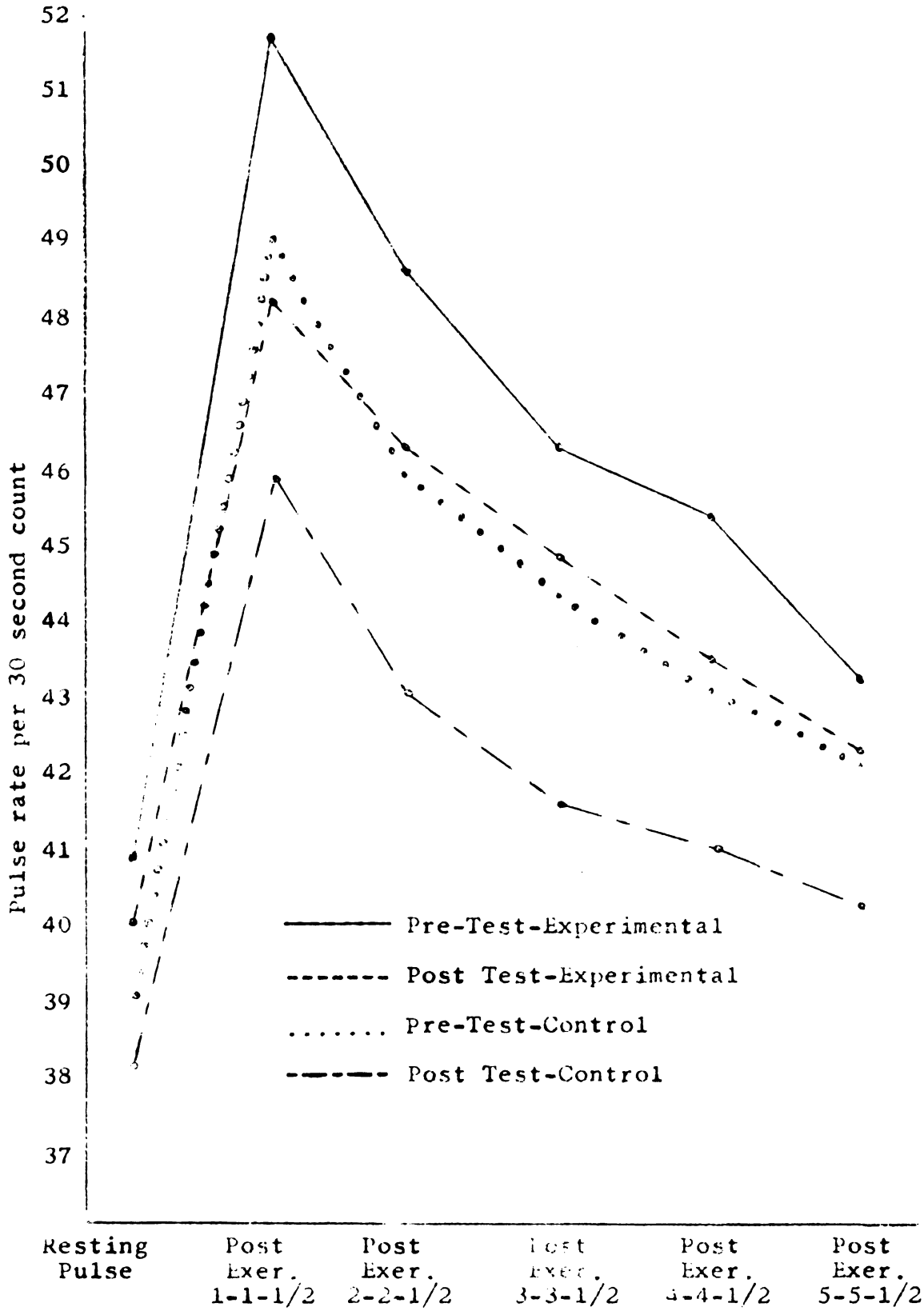

Fig. 2.--Graph indicating pre and post test records of group means on step test.

given for one complete pull-up each time the subject placed his chin over the bar. The starting position for this test consisted of grasping the bar with palms facing forward and hanging with arms and legs fully extended (see Figure 3). The feet were free of the floor. A partner stood to one side of the pupil and counted each successful pull-up. Knees were not permitted to be raised nor legs to be kicked, and the body was not allowed to swing. If a subject started to swing, one of the members of the testing team stopped the motion by holding an extended arm across the front of the subject's thighs. The subject's score was recorded on his testing sheet.

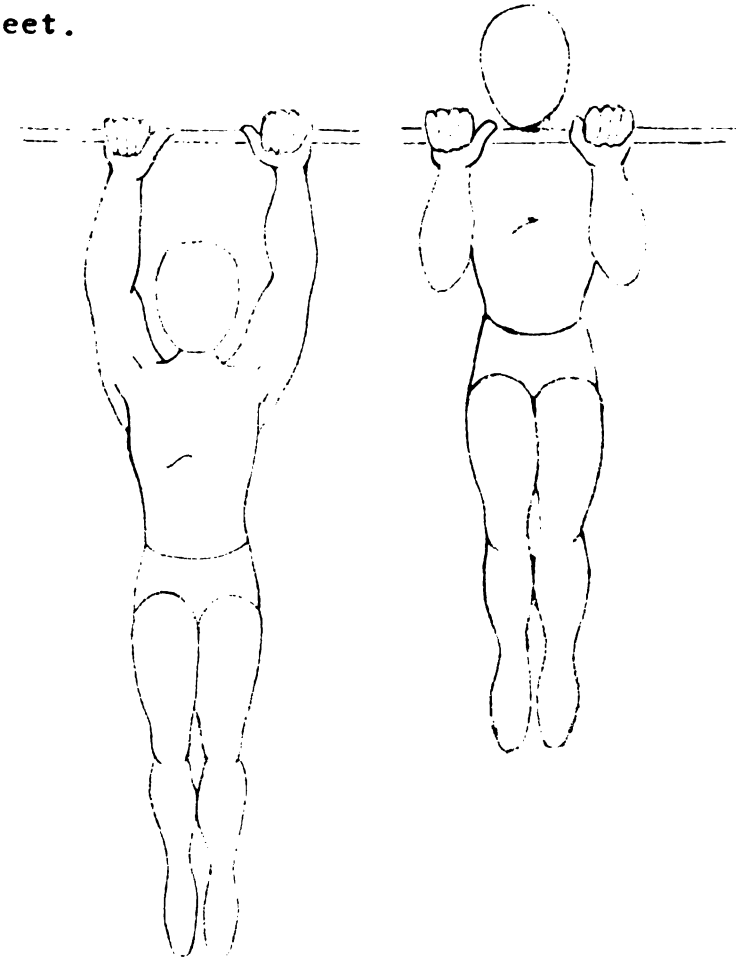

Fig. 3.--Pull-up.

Sit-ups.--The sit-ups were done in a group by the subjects. Each subject had a partner who held his heels to the floor and counted the number of successful sit-ups. The sit-ups were performed in a bent-knee position with the fingers interlaced behind the head. The knees were bent in order to eliminate the hip flexors from the pull of the abdominals.

A sit-up consisted of two movements: a movement from a supine position to a sitting position and one from a sitting position to a supine position. The subject was to perform as many sit-ups as he could in a one-minute time limit, touching both elbows to his knees each time he came up to a sitting position (see Figure 4). This score was recorded on the testing sheet of the subject. The partners exchanged positions and the sit-up test was repeated.

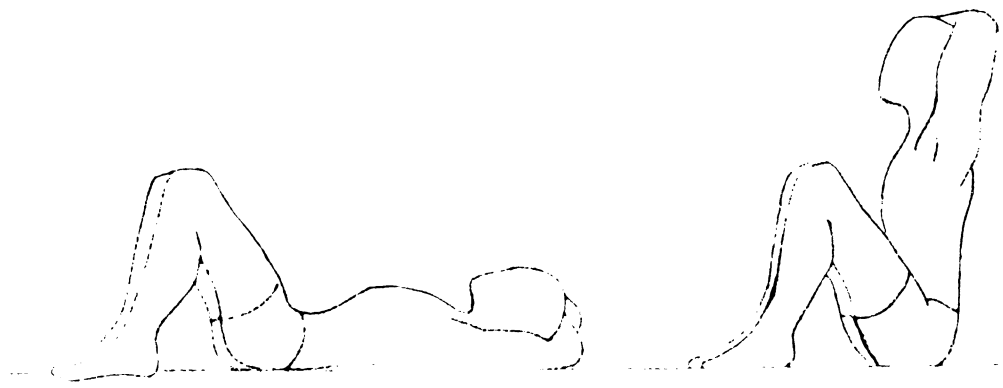

Fig. 4.--Sit-up.

Push-ups.--The push-ups were performed in a group. Each subject was assigned a partner who would count the correct number of push-ups done in one minute. The push-ups

were performed in a two-count cycle. The subject started from a prone position on the floor with the fingers of his hands pointing forward. The push-up was executed with a straight back and with the knees locked. The subject rose to a position of elbow-locking and then returned to touch his chin to the floor (see Figure 5). The testing team ascertained that the subjects were looking straight ahead and not tilting their chins downward. The students were instructed to stop the push-ups whenever any part of their body, other than the chin, hands, and feet, touched the floor. At the completion of the test, the scores were recorded on the testing sheets. The partners changed places and the test was repeated.

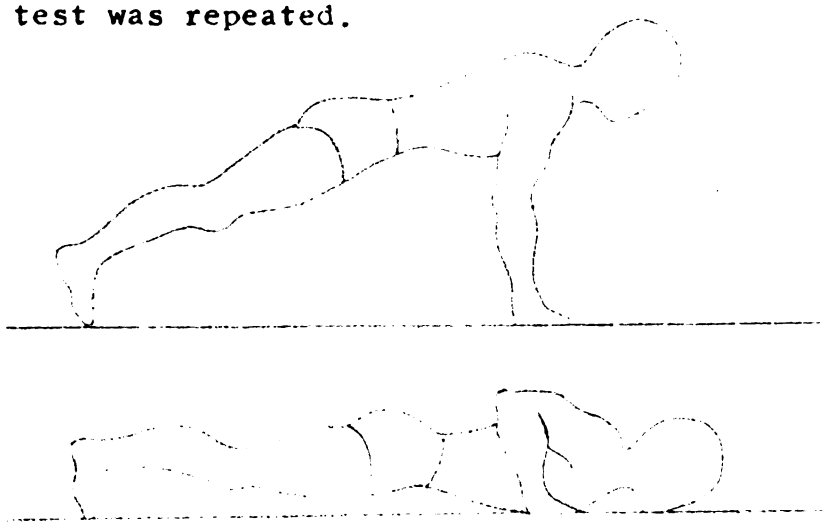

Fig. 5.--Push-up.

Leg changes.--This test was administered to the subjects in a group. Each subject had a partner who counted the number of leg changes the subject could do in one minute. The student assumed a squatting position, hands on the floor, fingers pointed forward, and left leg fully extended to the

rear. The subject was credited with one leg change every time he reversed the position of his feet by bringing the left foot under his chest and extending his right leg backward all in one motion. He would then reverse his feet and return to the starting position (see Figure 6). To be certain that the subjects brought their knees under their chests, the author instructed them to touch their knees to the insides of their upper arms. When the test was concluded, the subjects recorded their scores and changed positions with their partners. The partners changed positions and the test was repeated.

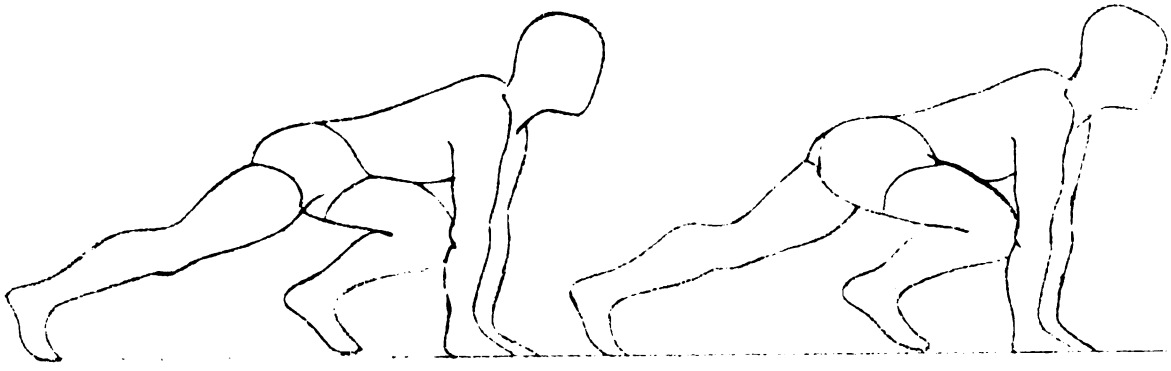

Fig. 6.--Leg changes.

Description of Exercise Program

Experimental group.--The experimental group was given a battery of five exercises during the eight week conditioning program. The program contained three different levels of difficulty. Each level was composed of exercises which were performed in the same order each time and in the

same maximum time limit; but as the subjects progressed from level to level, there were slight changes in each basic exercise with a gradual demand for more effort to be expended. The entire exercise program was allotted a maximum time limit of six minutes. The six minute time limit was established in order that the training program would not impinge upon the time allotted for the class period.

Each class period the program began with a general stretching and loosening exercise which limbered up the large muscles of the body. Following this exercise the subjects performed exercises which were chosen to develop the muscular endurance of the abdominal region, the back, the upper arm and shoulder girdle, and the legs as well as the circulo-respiratory fitness of the entire body.

The five exercises are listed below in the order in which they were given each class period:

1. Toe touch
2. Sit-ups
3. Back-lifts
4. Push-ups
5. Run-jump.

The time limit for each of the first four exercises was one minute while the time limit imposed on the run-jump exercise was two minutes. It was thought that an arbitrary time limit of two minutes on this exercise would be sufficient for the grade level involved in this study. A description of the complete progressive exercise program can be found

in Appendix A, pages 56-58.

The subjects were instructed to begin each exercise at a level which was comfortable to them and to work up progressively to the highest level they could attain. They were instructed not to hurry their progression, to take their time and to be certain they were doing the exercises correctly. As soon as a subject was able to perform the maximum number of repetitions for any exercise at a particular level, he proceeded to the next level of that exercise. Thus, a subject may have been working on the push-up exercise at the first level while working on the other four exercises at the second level. It is interesting to note that at the conclusion of the training program almost all the subjects were working on the third level of progression on all five exercises.

Each subject maintained a daily chart which he filled in every time the training program was conducted. On this chart he would record the number of repetitions which he had completed that day in each exercise. The scores for the first level were recorded in black pencil; the second level scores were recorded in blue pencil; and the scores of the third level were recorded in red pencil (see Appendix A, page 55.

Control group.--The control group was not given a battery of progressive exercises. This group received no selected exercise program at all. The exercises which they received were merely bending and stretching routines. These

exercises were given at the beginning of the period to offer a proper warm-up. When the warm-up calisthenics were completed, the control group would participate in the physical education unit which was scheduled at that time.

Data Analysis Procedures

The analysis of the data in this study was based upon the results of the test scores of the subjects who participated in the control group. The statistical tool used to analyze the mean difference between the experimental and control groups, based upon their pre-test and post test scores, was the student "t" test.[2] Because of the small number of subjects, the investigator accepted significance at the .05 level as the basis for acceptance or rejection in the analysis of each test item. The results of the analysis can be found in Chapter IV.

Summary

This study was an experiment which included seventy eighth grade students. The thirty-five members in the experimental group participated in an eight-week training program. The control group, consisting of thirty-five students, received no selected progressive exercise program. Instead the subjects received only bending and stretching exercises. The five selected progressive exercises performed by the experimental group were the toe-touch, sit-ups, back-lifts,

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[2]Paul G. Hoel, Introduction to Mathematical Statistics (New York: John Wiley & Sons, Inc., 1954), pp. 227-228.

push-ups, and the run-jump. Both groups performed a five-item test battery of physical tests before the training program began and were retested on these same five tests after the progressive exercise program was completed.

CHAPTER IV

ANALYSIS OF THE DATA

In this investigation the analysis of the data was based upon the results of the test scores of the subjects who participated in a selected progressive exercise program and those subjects who participated in no exercise program (see Appendix B, Tables II, III, IV, and V). The seventy subjects involved in the study were tested on five selected physical tests before the progressive exercise program was begun with the experimental group. After the conclusion of the exercise program, all of the subjects involved in the study were retested on the five tests.

The statistical tool used to analyze the mean difference between the experimental group and the control group based upon their pre and post test results was the student "t" test.[1]

$$t = \frac{M^1 - M^2}{\sqrt{\sigma M^2_1 + \sigma M^2_2}}$$

Significance at the .05 level was used by the investigator as a basis for acceptance or rejection in the analysis of each test item.

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[1]Hoel, loc cit.

Analysis of the Five Selected Tests

Step test.--In order to investigate the effects of the selected progressive exercise program on the circulo-respiratory fitness of the subjects involved in this study, the author used a modification of the Harvard Step Test.[2] The Harvard Step Test has been validated with significant findings by several other investigators (Cogswell,[3] Montoye[4]), and it has been subjected to modifications which also produced significant results (Sloan,[5] Michael and Galleon,[6] Lowell[7]). In this study the Harvard Step Test was modified from a twenty-inch bench to a seventeen-inch bench. The age of the participants and the availability of a seventeen-inch bench at the junior high school instigated this modification. Another modification in the administration of the Harvard Step Test was to take five thirty-second pulse counts in five minutes after the exercise.

In this study the mean resting pulse rate of the subjects in the experimental group was found to be 40.82 at the pre-test and a mean pulse rate of 40.12 at the post test. There was a mean loss of 0.70 pulse counts for the resting pulse rate. This represented a 1.71 per cent change. The mean resting pulse rate of the control group was 39.12 at the retest. There was a mean reduction of 0.94 pulse

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[2]Brouha, op. cit, pp. 31-36 [3]Cogswell, loc cit.

[4]Montoye, loc. cit. [5]Sloan, loc. cit.

[6]Michael and Galleon, loc. cit.

[7]Lowell, loc. cit.

counts for the resting pulse count of thirty seconds prior to the step test. This represented a decrease in the resting pulse rate of 2.40 per cent (see Figure 7). The student "t" test of the mean difference between the experimental group and the control group showed that this change was not statistically significant (see Table I, page 40).

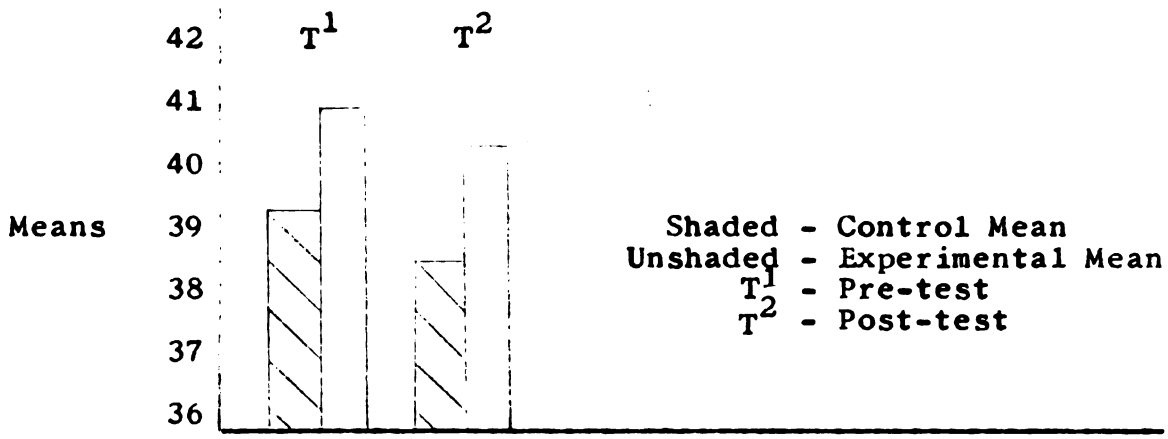

Fig. 7.--Graph indicating pre and post test recordings of group means on resting pulse count preceeding step test.

The investigator also conducted a student "t" test on the mean change between both groups based upon their pre and post test results of the post exercise pulse rate taken from one to one and a half minutes after the step test. The mean post exercise pulse rate of the experimental group at the initial test was found to be 51.88 pulse counts for the thirty second period. The results of the retest showed the mean pulse rate taken from one to one and a half minutes after the step test to be 48.33 pulse counts. A mean difference of -3.54 pulse counts was indicated. The mean

difference represented a 6.83 per cent change. The mean post exercise pulse rate of the control group at the pre-test was 48.94 pulse counts during the one to one and a half minute recording period following the step-test. The findings of the retest revealed a mean pulse rate of 45.76 pulse counts. There was a mean loss of 3.18 pulse counts for the thirty second period from one to one and a half minutes after exercise. This represented a 6.94 per cent change (see Figure 8). The student "t" test analysis of the mean change between groups showed no significance (see Table I).

TABLE I.--Student "t" analysis of the mean difference between the experimental and control group based upon their pre and post test scores

Test	Exp. Group Mean Difference of Pre and Post Test	Control Group Mean Difference of Pre and Post Test	"t" of Mean Difference Between Groups
Sit-up	3.87	1.94	1.83
Push-up	5.12	1.55	2.64**
Pull-up	0.48	-1.29	15.12**
Leg change	5.90	-0.76	3.05**
Step test Rest. pulse	-0.70	-0.94	-0.20
30 sec. pulse count after one min. rest	-3.54	-3.18	-0.25

*Significance at the .05 level.

**Significance at the .01 level.

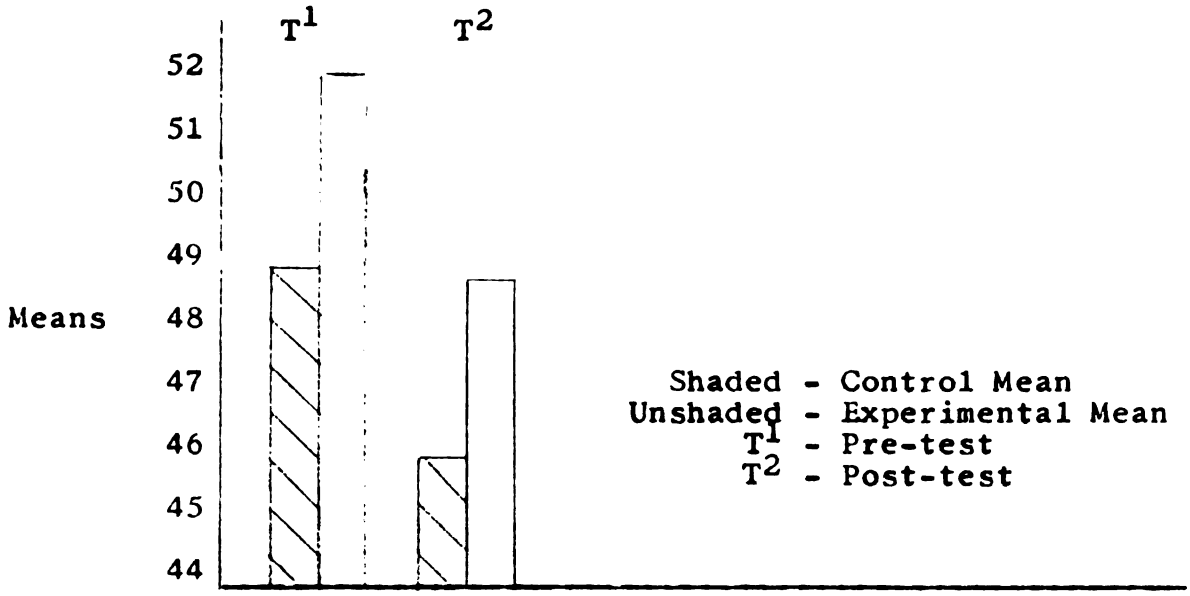

Fig. 8.--Graph indicating pre and post test recordings of group means on recovery pulse rate following step test.

This result was in agreement with Lowell,[8] who conducted a training program with college men in 1961. He did find though that the subjects who participated in the limited exercise program had a significantly lower pulse rate on the post test than they had experienced on the pre-test.

Pull-ups.--The mean number of pull-ups for the experimental group increased from 3.69 on the pre-test to 4.17 on the retest, a mean gain of 0.48 pull-ups. This mean gain resulted in a mean positive change of 13.18 per cent. The mean number of pull-ups for the control group decreased from 5.26 pull-ups on the pre-test to 3.97 pull-ups on the retest, which is a mean loss of 1.29 pull-ups or a negative change of 24.46 per cent (see Figure 9). The author could cite no apparent reason for this decrease. The mean difference

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[8]Lowell, loc. cit.

between the experimental and control group was significant at the .01 level (see Table I, page 40).

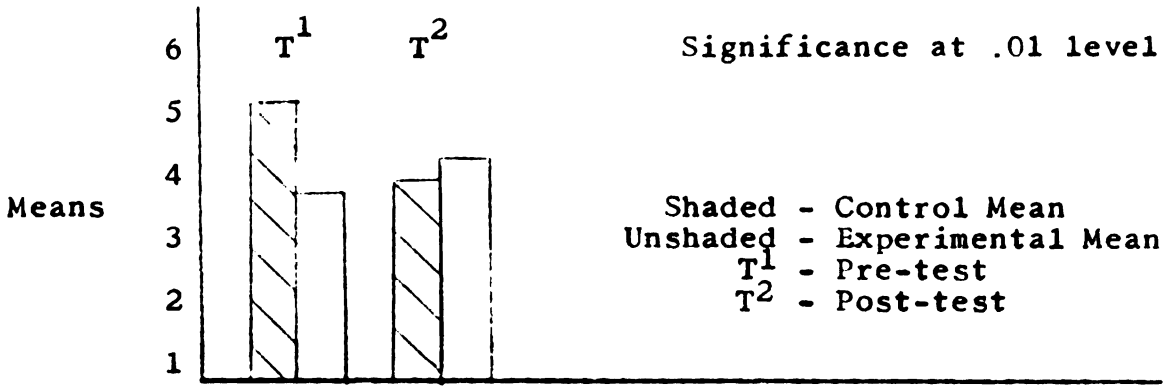

Fig. 9.--Graph indicating pre and post test recordings of group means on pull-up test.

Sit-ups.--The mean number of sit-ups for the experimental group increased from 39.88 sit-ups on the pre-test to 43.75 sit-ups on the retest. This was a gain of 3.87 sit-ups or a mean positive change of 9.72 per cent. The mean number of sit-ups for the control group went from 42.12 to 44.06, which is a mean gain of 1.94 sit-ups. This was a mean positive change of 4.60 per cent (see Figure 10). The mean difference between the experimental group and the control group did not prove significant at the .05 level (see Table I, page 40). This investigator's results are not in agreement with Kistler.[9] In a training program he set up over an eight week period, Kistler found a significant change in the number of sit-ups performed at the close of the training program. Perhaps the difference between the investigator's findings and those of Kistler can be

[9]Kistler, loc. cit.

attributed to the difference in intensity of the two training programs.

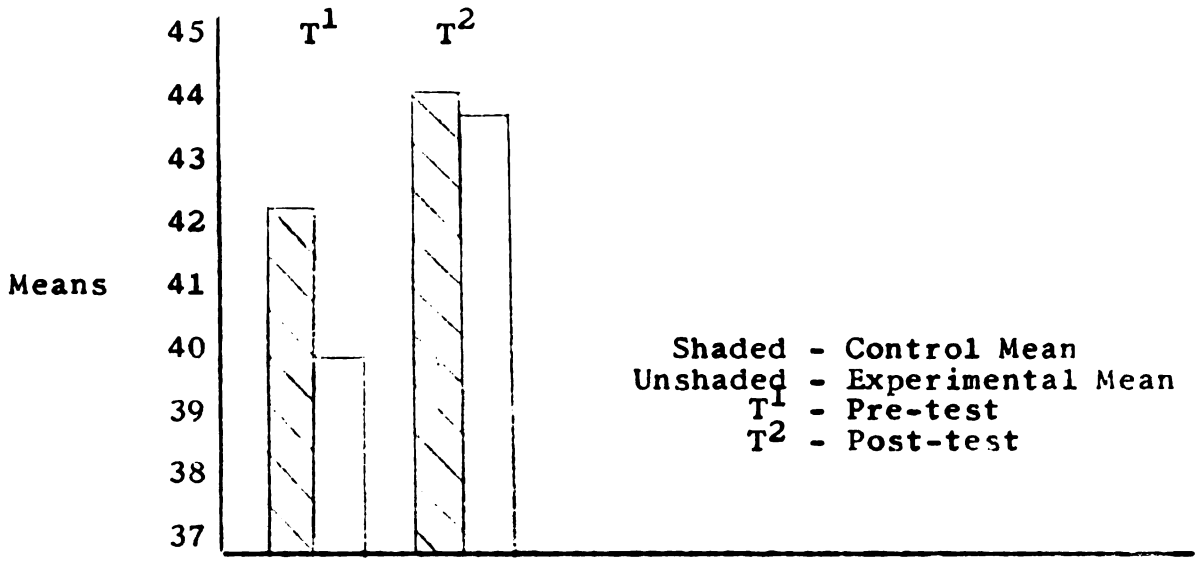

Fig. 10.--Graph indicating pre and post test recordings of group means on sit-up test.

Push-ups.--The experimental group improved from a mean score of 17.00 push-ups on the initial test to 22.12 push-ups on the retest. This was a mean gain of 5.12 push-ups, or a mean positive change of 30.12 per cent. The control group changed from a mean of 23.06 on the pre-test to a mean of 24.60 push-ups on the retest. This was a mean positive change of 6.70 per cent and a mean gain of 1.55 push-ups (see Figure 11). The mean difference between the groups was shown to be significant at the .01 level (see Table I, page 40).

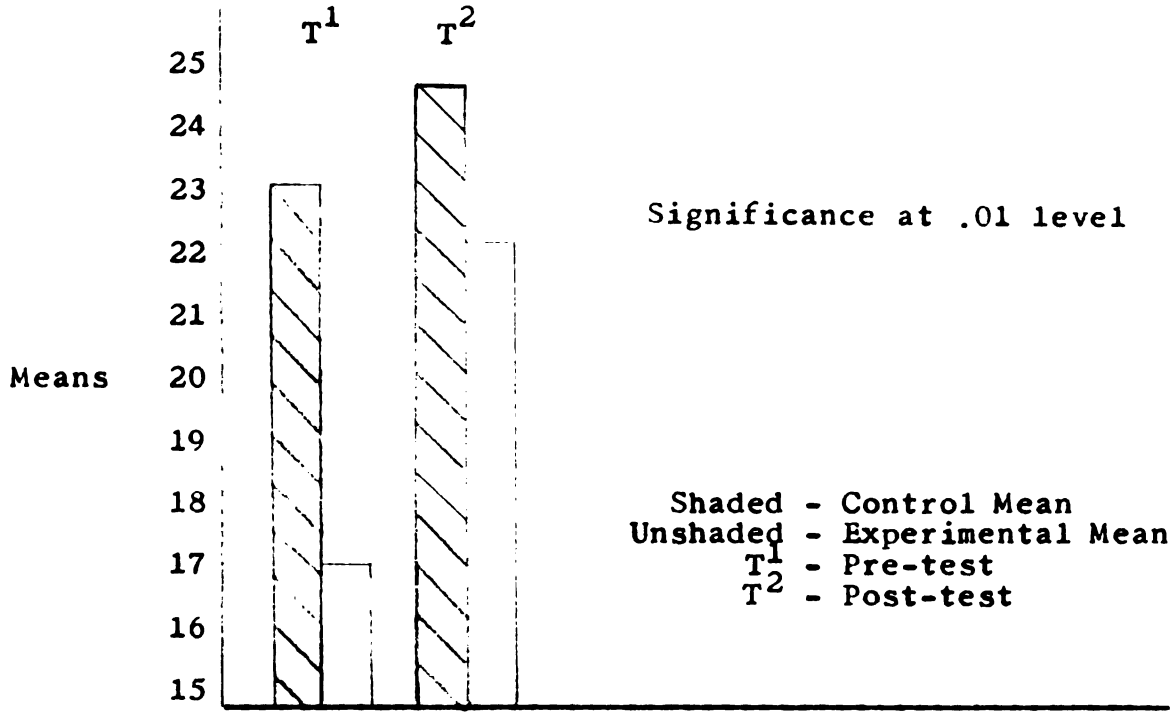

Fig. 11.--Graph indicating pre and post test recordings of group means on push-up test.

Leg changes.--The experimental group performed a mean number of 43.87 leg changes on the pre-test and increased the mean score to 49.77 leg changes on the retest. This was a mean gain of 5.90 leg changes and a mean positive change of 13.46 per cent. The mean score of the control group on the initial test was 46.94 leg changes. On the retest their mean score decreased from 46.94 to 46.18, a loss of 0.76 leg changes. This represented a negative mean change of 1.61 per cent (see Figure 12). The student "t" analysis of the mean difference between the experimental and control group showed this mean difference to be significant at the .01 level (see Table I, page 40).

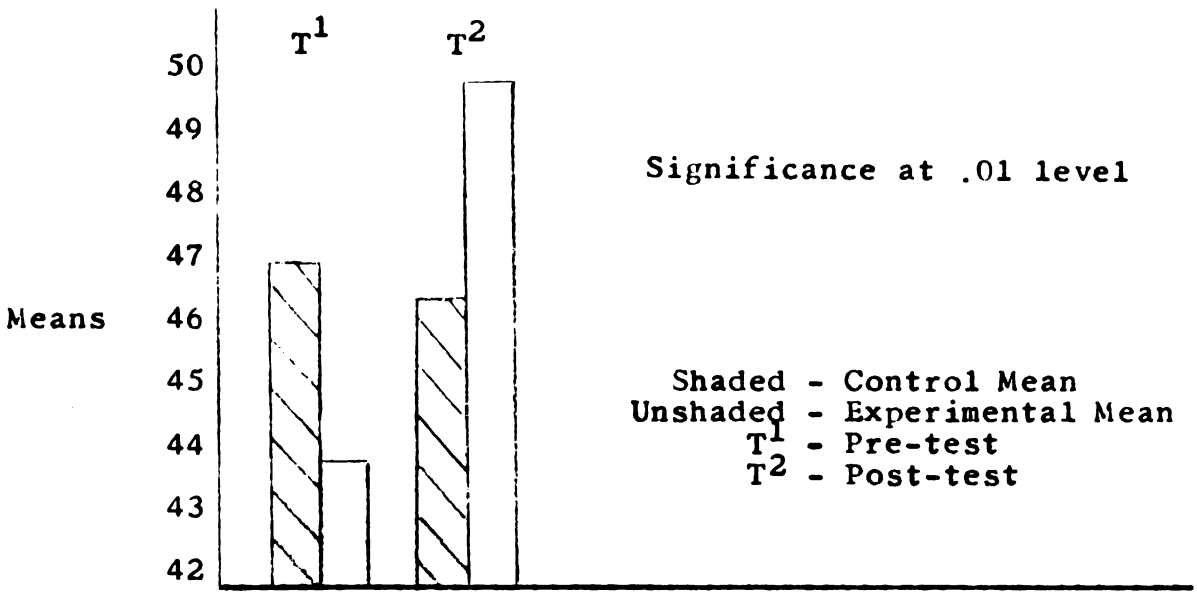

Fig. 12.--Graph indicating pre and post test recordings of group means on leg change test.

Summary

The experimental group exceeded the control group in mean change on every test except the resting and post exercise pulse rates recorded on the step test. Based on mean change, the experimental group was significant at the .01 level on the pull-ups, push-ups, and leg changes. On the sit-up test the experimental group showed a mean gain of 3.87 sit-ups, which was slightly higher than the control group mean improvement of 1.94 sit-ups. This mean change was not found to be significant at the .05 level of acceptance.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

In this study it was the author's intent to show the effects of a selected progressive exercise program on the muscular endurance and circulo-respiratory fitness of eighth grade boys from East Lansing Junior High School, East Lansing, Michigan. The problem consisted of three objectives: (1) to determine if a series of progressive exercises would significantly increase the muscular endurance of the arms, abdomen, and legs; (2) to determine if the circulo-respiratory fitness would be significantly increased; and (3) to determine if a progressive exercise program consisting of six minutes of exercise four days a week for a period of eight weeks would be sufficient to significantly change the muscular endurance and circulo-respiratory fitness of the boys tested.

The experimental group of thirty-five boys received the selected progressive exercise program. The control group, also consisting of thirty-five boys, received no exercise program. All the subjects were tested on five items before and after the training program. These five items were pull-ups, sit-ups, push-ups, leg changes and step test. The results of these tests were analyzed using

the student "t" test to determine significance.[1]

Conclusions

As a result of the statistical analysis of data, the investigator has drawn the following conclusions:

1. The experimental group showed a significant increase over the control group on the pull-up test. The mean change between the experimental and control group was significant at the .01 level.

2. The subjects who participated in the experimental group showed a significant increase on the push-up test over the control group. This increase was shown to be significant at the .01 level.

3. The analysis of the mean change between the experimental and the control group on the leg change test showed this mean change to be significant at the .01 level.

4. Although the experimental group had a mean positive change of 9.72 per cent as compared to the control group's mean positive change of 4.60 per cent on the sit-up test, this change did not prove significant at the .05 level.

5. The mean change between the experimental group and the control group on the resting pulse rate showed that the change was not statistically significant.

6. The student "t" test analysis on the mean difference between both groups based upon their pre and post test results of the post exercise pulse rate taken from one

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[1]Hoel, loc. cit.

to one and a half minutes after the step test showed no significance.

7. The experimental group showed significant mean differences on every test except the sit-ups and the resting and post exercise pulse rates recorded on the step test.

Recommendations

It is the author's opinion that the results of this study show the benefits which may be derived from this type of program. Although significance was not shown in all of the tests, it was indicated on three of the five tests employed. The following are recommendations which the author feels merit some recognition and thought on the part of anyone who may attempt a similar study.

1. The training period should extend to at least ten weeks. A longer training period should show significance on the sit-up and step tests.

2. If possible, the outside activities of the subjects should be controlled as much as possible. The author had no feasible control over this variable in the present study.

3. If possible, the two groups involved should be matched and paired off. This should be done according to previous test scores on similar exercises. If possible they should also be matched according to age, height, and weight.

4. In order to determine rate of progression and

development, additional testing periods should be established at intervals during the training program.

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APPENDIXES

APPENDIX A

DAILY EXERCISE RECORD

Name_____

Your Directions: Each day the conditioning program is administered record in the right square the number of times you did each of the five exercises. Record the first level of exercises in pencil. When you have completed all these exercises in the allotted time, change to next level. Second level should be recorded in blue pencil, third level in red pencil.

Exercises:
1. Toe Touch 2. Sit-Ups 3. Back Lifts 4. Push-Ups
5. Run

Wk. of _____ Wk. of _____ Wk. of _____ Wk. of _____

1				
2				
3				
4				
5				

1				
2				
3				
4				
5				

1				
2				
3				
4				
5				

1				
2				
3				
4				
5				

Wk. of _____ Wk. of _____ Wk. of _____ Wk. of _____

1				
2				
3				
4				
5				

1				
2				
3				
4				
5				

1				
2				
3				
4				
5				

1				
2				
3				
4				
5				

PROGRESSIVE EXERCISE PROGRAM

First Level of Difficulty

Number and Exercise	Maximum Number Performed
1. Toe Touch	20
Standing, feet apart, arms overhead. Bend forward, touch floor. Stretch upward and step back. Repeat the next time with opposite foot.	
2. Sit-ups	20
Lie on back, hands on thighs. Curl head and shoulders and look at heels. Return. Repeat.	
3. Back Lifts	25
Lie on face. Lift head and opposite arm and leg. Repeat next time with other arm and leg.	
4. Push-ups	15
Hand-knee rest. Keep body straight from knees and touch chin to floor by bending elbows. Push up to starting position.	
5. Run-jump	150
Run in place. Lift feet four inches from floor. Every fifty steps (count one step each time left foot touches floor) do 10 scissor jumps. Repeat sequence until number of steps is done.	

PROGRESSIVE EXERCISE PROGRAM

Second Level of Difficulty

Number and Exercise	Maximum Number Performed
1. Toe Touch	20
Same position. Bend forward touch floor outside left foot, between feet, outside right foot. Stretch upward and step back. Repeat the next time with opposite foot.	
2. Sit-ups	20
Lie on back, arms overhead, swing arms forward and curl up and touch toes. Return. Repeat, next time and touch left foot. Next time touch right foot. Then repeat sequence.	
3. Back Lifts	35
Lie on face, hands clasped near low back. Lift head, shoulders and both legs off floor. Thighs must clear floor.	
4. Push-ups	20
Hand-foot rest. Keep body straight and touch chin to floor. Push away from floor, anyway you can. Try to keep body straight.	
5. Run-jump	175
Same as before. But every 50 steps do 10 astride jumps with arm swing to shoulder level.	

PROGRESSIVE EXERCISE PROGRAM

Third Level of Difficulty

Number and Exercise	Maximum Number Performed
1. Toe Touch	30
Same as before. But stretch upward and back. Then stretch to left and press. Next time stretch to right and press. Repeat whole exercise.	
2. Sit-ups	60
Lie on back, arms overhead, legs straight. Swing arms and body up and same time bring knees up (feet and knees together). Touch fingers to floor on opposite side of knees. Return slowly to position.	
3. Back Lifts	75
Lie on face, arms clasped back of neck. Lift arms shoulders, legs and head off floor. Return and repeat.	
4. Push-ups	40
Same as before but keep body straight coming down and going up.	
5. Run-jump	400
Same as before but every 50 steps do 10 half squats with jump off floor.	

APPENDIX B

TABLE II

SUMMARY OF STEP TEST RESULTS ON EXPERIMENTAL GROUP

Subject	Resting Pulse			1st Post. Exer.			2nd Post. Exer.			3rd Post. Exer.			4th Post. Exer.			5th Post. Exer.		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference
1	53	54	1	66	65	-1	58	60	2	58	58	0	52	56	4	52	54	3
2	32	32	0	55	44	-11	53	41	-12	47	39	-8	46	37	-9	47	36	-11
3	43	38	-5	49	44	-5	45	42	-3	46	39	-7	45	38	-7	43	37	-7
4	44	42	-2	51	48	-3	48	46	-2	47	46	-1	45	41	-4	43	41	-2
5	39	40	1	47	42	-5	45	41	-4	42	41	-1	42	40	-2	40	40	0
6	39	40	1	44	56	12	41	55	14	43	51	8	40	49	9	38	46	8
7	46	47	1	55	51	-4	49	49	0	49	49	0	47	48	1	45	47	2
8	--	--	-	--	--	--	--	--	--	--	--	-	--	--	-	--	--	--
9	36	33	-3	45	38	-7	43	36	-7	43	36	-7	42	36	-6	42	34	-8
10	39	41	2	59	56	-3	58	53	-5	56	49	-7	57	49	-8	49	48	-1
11	44	43	-1	50	48	-2	49	47	-2	47	46	-1	46	46	0	45	45	0
12	32	33	1	53	55	2	52	54	2	47	50	3	47	48	1	45	43	-2
13	50	42	-8	60	45	-15	53	44	-9	52	44	-8	50	43	-7	49	43	-6
14	44	48	4	57	58	1	51	54	3	50	54	4	48	52	4	48	49	1
15	--	--	-	--	--	--	--	--	-	--	--	-	--	--	-	--	--	--
16	33	32	-1	51	48	-3	50	45	-5	47	44	-3	43	44	1	40	41	1
17	45	42	-3	53	45	-8	50	43	-7	48	42	-6	46	41	-5	47	41	-6
18	42	41	-1	63	62	-1	54	54	0	53	51	-2	47	51	4	46	50	4
19	47	39	-8	50	41	-9	48	40	-8	45	40	-5	45	38	-7	45	37	-8
20	37	39	2	53	60	7	52	57	5	52	54	2	50	49	-1	44	45	1

TABLE II.--Continued

Subject	Resting Pulse			1st Post. Exer.			2nd Post. Exer.			3rd Post. Exer.			4th Post Exer			5th Post. Exer.		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference
21	43	43	0	56	51	-5	51	49	-2	47	48	1	51	45	-6	46	44	-2
22	40	41	1	61	55	-6	53	49	-4	51	47	-4	50	45	-5	47	43	-4
23	36	36	0	44	40	-4	42	39	-3	40	40	0	37	36	-1	35	35	0
24	35	34	-1	43	41	-2	41	39	-2	37	36	-1	37	35	-2	37	35	-2
25	52	46	-6	54	47	-7	53	47	-6	53	46	-7	52	47	-5	53	46	-7
26	34	38	4	48	41	-7	42	42	0	40	41	1	40	39	-1	38	39	1
27	36	35	-1	54	51	-3	50	51	1	48	48	0	46	44	-2	43	39	-4
28	39	33	-6	44	37	-7	40	36	-4	39	34	-5	37	35	-2	37	35	-2
29	45	46	1	49	49	0	48	50	2	47	50	3	46	49	3	45	47	2
30	33	35	2	33	40	7	33	40	7	32	38	6	33	39	6	33	37	4
31	35	41	6	50	43	-7	45	41	-4	45	40	-5	40	40	0	40	39	-1
32	36	29	-7	37	36	-1	35	34	-1	35	32	-3	34	32	-2	36	31	-5
33	54	53	-1	63	62	-1	58	57	-1	57	56	-1	52	54	2	53	54	1
34	32	40	8	60	41	-19	58	40	-18	55	40	-15	50	40	-10	43	40	-3
35	52	48	-4	55	55	0	53	53	0	52	52	0	51	51	0	51	51	0

TABLE III

SUMMARY OF STEP TEST RESULTS ON CONTROL GROUP

Subject	Resting Pulse			1st Post. Exer.			2nd Post. Exer.			3rd Post. Exer.			4th Post. Exer.			5th Post. Exer.		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference
1	41	41	0	46	40	-6	44	38	-6	42	38	-4	42	37	-5	40	40	0
2	31	36	5	50	39	-11	48	39	-9	43	40	-3	39	38	-1	38	38	0
3	38	35	-3	42	37	-5	40	37	-3	42	37	-5	42	37	-5	42	36	-6
4	46	46	0	49	49	0	46	49	3	44	48	4	44	48	4	45	48	3
5	39	34	-5	54	39	-15	52	40	-12	50	35	-15	48	35	-13	46	35	-11
6	36	37	1	40	38	-2	40	37	-3	38	37	-1	40	36	-4	37	36	-1
7	39	40	1	60	54	-6	51	54	3	49	52	3	47	52	5	42	51	9
8	38	41	3	50	45	-5	45	43	-2	41	40	-1	40	41	1	38	41	3
9	46	41	-5	48	42	-6	47	42	-5	47	40	-7	46	40	-6	47	41	-6
10	35	35	0	50	47	-3	46	41	-5	46	42	-4	47	39	-8	44	39	-5
11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12	32	41	9	39	51	12	36	44	8	33	43	10	32	45	13	32	41	9
13	40	41	1	54	53	-1	40	50	0	48	48	0	48	47	-1	47	47	0
14	40	34	-6	62	50	-12	48	41	-7	47	40	-7	45	38	-7	43	35	-8
15	42	46	4	48	57	9	46	49	3	48	47	-1	44	48	4	44	46	2
16	42	38	-4	50	45	-5	44	45	1	40	45	5	42	43	1	42	40	-2
17	41	38	-3	51	46	-5	48	44	-4	46	38	-8	45	39	-6	43	39	-4
18	31	32	1	42	46	4	40	43	3	36	42	6	34	39	5	32	37	5
19	41	41	0	69	50	-19	70	50	-20	65	47	-18	60	47	-13	55	48	-7
20	40	42	2	55	52	-3	47	43	-4	47	43	-4	45	42	-3	43	43	0

TABLE III.--Continued

Subject	Resting Pulse			1st Post. Exer.			2nd Post. Exer.			3rd Post. Exer.			4th Post. Exer.			5th Post. Exer		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference
21	52	43	-9	65	58	-7	61	60	-1	57	55	-2	56	53	-3	56	48	-8
22	26	27	1	30	27	-3	28	26	-2	28	25	-3	28	24	-4	28	24	-4
23	41	44	3	49	49	0	47	47	0	45	47	2	43	46	3	41	45	4
24	35	31	-4	44	38	-6	39	34	-5	37	34	-3	35	33	-2	36	34	-2
25	39	37	-2	45	40	-5	43	40	-3	44	39	-5	44	38	-6	45	38	-7
26	39	36	-3	48	45	-3	45	42	-3	42	41	-1	41	40	-1	40	40	0
27	36	38	2	42	46	4	41	41	0	41	41	0	40	39	-1	41	42	1
28	40	34	-6	49	48	-1	44	41	-3	42	38	-4	41	38	-3	41	36	-5
29	46	40	-6	52	48	-4	49	45	-4	48	44	-4	47	44	-3	47	43	-4
30	35	39	4	41	44	3	40	43	3	41	41	0	38	40	2	37	38	1
31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
32	37	37	0	40	43	3	39	40	1	37	37	0	37	37	0	37	37	0
33	41	39	-2	60	64	4	62	57	-5	60	54	-6	58	54	-4	54	49	-5
34	46	36	-10	48	38	-10	46	37	-9	46	37	-9	46	37	-9	46	37	-9
35	40	40	0	43	42	-1	42	42	0	41	41	0	40	40	0	40	40	0

TABLE IV

SUMMARY OF SIT-UP, PUSH-UP, PULL-UP, AND LEG CHANGE TEST RESULTS ON EXPERIMENTAL GROUP

Sub-jects	Sit-ups			Push-ups			Pull-ups			Leg Changes		
	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.
1	39	40	1	12	21	1	3	3	0	44	53	9
2	38	50	12	19	29	10	13	15	2	60	62	2
3	44	40	-4	28	35	7	5	4	-1	55	60	5
4	52	45	-7	16	20	4	3	4	1	40	54	14
5	20	24	4	5	8	3	0	0	0	34	32	-2
6	38	40	2	9	15	6	0	0	0	27	33	6
7	40	45	5	30	36	6	7	7	0	35	51	16
8	25	37	12	9	15	6	2	1	-1	50	39	-11
9	60	63	3	32	28	-4	6	9	3	57	59	2
10	44	50	6	27	28	1	2	3	1	59	59	0
11	24	18	-6	10	14	4	0	1	1	27	28	1
12	21	23	2	4	7	3	0	1	1	36	41	5
13	50	51	1	31	37	6	3	5	2	55	62	7
14	43	47	4	20	22	2	0	0	0	50	52	2
15	38	40	2	9	15	6	4	3	-1	44	38	-6
16	60	64	4	28	42	14	9	9	0	57	58	1
17	37	44	7	3	9	6	2	2	0	48	48	0
18	45	49	4	27	30	3	10	9	-1	56	59	3
19	41	48	7	13	18	5	8	8	0	40	55	15
20	41	48	7	13	18	5	8	8	0	40	55	15

TABLE IV.--Continued

Subjects	Sit-ups			Push-ups			Pull-ups			Leg Changes		
	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.
21	45	50	5	4	25	21	3	4	1	59	63	4
22	46	50	4	36	34	-2	2	2	0	48	49	1
23	52	61	9	19	25	6	3	4	1	37	40	3
24	39	37	-2	14	17	3	3	4	1	46	53	7
25	40	53	13	8	14	6	0	0	0	27	35	8
26	45	50	5	20	29	9	6	8	2	50	62	12
27	44	56	12	18	25	7	3	4	1	20	44	24
28	45	50	5	43	36	-7	12	15	3	42	43	1
29	--	--	-	--	--	-	7	8	1	--	--	-
30	37	45	8	3	8	5	1	1	0	35	61	26
31	19	21	2	3	5	2	0	0	0	32	38	6
32	27	27	0	5	6	1	0	0	0	--	--	-
33	--	--	-	-	-	-	1	2	1	--	--	-
34	--	--	-	39	47	8	11	9	-2	--	--	-
35	34	31	-3	14	15	1	0	1	1	41	50	9

TABLE V

SUMMARY OF SIT-UP, PUSH-UP, PULL-UP, AND LEG CHANGE TEST RESULTS ON CONTROL GROUP

	Sit-ups			Push-ups			Pull-ups			Leg Changes		
Sub-jects	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.
1	54	52	2	23	24	1	3	3	0	55	56	1
2	42	45	3	18	25	7	2	2	0	64	63	-1
3	43	41	-2	18	21	3	3	4	1	64	62	-2
4	49	51	2	28	18	-10	5	3	-2	64	65	1
5	58	60	2	35	30	-5	1	2	1	60	67	7
6	40	41	1	30	33	3	8	5	-3	40	57	17
7	49	52	3	23	30	7	10	6	-4	55	37	-18
8	--	--	-	--	--	-	7	6	-1	--	--	-
9	33	39	6	9	9	0	2	0	-2	41	40	-1
10	34	38	4	18	20	2	5	1	-4	45	48	3
11	40	47	7	13	13	0	0	0	0	18	34	16
12	45	47	2	10	20	10	3	3	0	39	43	4
13	--	--	-	--	--	-	1	1	0	--	--	-
14	40	47	7	27	20	7	2	1	-1	35	43	8
15	38	37	-1	17	12	-5	1	3	2	47	30	-17
16	50	50	0	35	41	6	19	15	-4	74	60	-14
17	37	33	-4	10	9	-1	5	2	-3	24	35	11
18	48	49	1	29	29	0	6	5	-1	44	44	0
19	40	35	-5	20	25	5	12	8	-4	49	41	-8
20	50	45	-5	49	53	4	5	3	-2	63	63	0

TABLE V.--Continued

Subjects	Sit-ups			Push-ups			Pull-ups			Leg Changes		
	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.	Pre-Test	Post Test	Dif.
21	43	42	-1	18	9	-9	8	8	0	43	30	-13
22	45	45	0	19	30	11	2	1	-1	36	39	3
23	44	48	4	23	29	6	13	10	-3	52	61	9
24	41	45	4	14	17	3	4	4	0	23	39	16
25	43	46	3	23	25	2	10	11	1	50	55	5
26	28	30	2	2	6	4	6	8	2	26	27	1
27	36	40	4	36	36	0	7	6	-1	45	41	-4
28	36	39	3	18	19	1	6	3	-3	40	29	-11
29	40	47	7	25	26	1	4	3	-1	44	43	-1
30	46	47	1	40	34	-6	11	5	-6	50	49	-1
31	38	46	8	33	35	2	0	0	0	65	60	-5
32	45	45	0	30	42	12	4	1	-3	42	54	12
33	33	37	4	20	10	-10	2	2	0	25	31	6
34	46	47	1	28	39	11	5	3	-2	66	50	-16
35	36	41	5	20	23	3	2	1	-1	61	48	-13

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