

A STUDY OF THE EFFECTS OF TWO FORMS OF
SUPPLEMENTARY EXERCISES UPON THE
CARDIOVASCULAR EFFICIENCY OF
JUNIOR HIGH SCHOOL MALES

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CHAPTER I

INTRODUCTION

Physical fitness has been stressed greatly in the past few years, especially in the schools. Physical education instructors and athletic coaches have placed more emphasis on the well rounded physical fitness program.

Experiments have been conducted concerning the various types of exercises and their particular benefits. In recent years, a form of exercise known as isometrics has come into common use in physical education classes and as an addition to athletic training. Some controversy exists about its value as compared to calisthenics.

Cardiovascular efficiency is a most important aspect of physical fitness and an evaluation of this efficiency during the performance of isometrics and of calisthenics would appear to be extremely important and useful in comparing the two types of exercises.

STATEMENT OF THE PROBLEM

The purpose of this study was to determine the comparative effects of isometrics and calisthenics upon cardiovascular efficiency in male junior high school students.

LIMITATIONS OF THE STUDY

This study included 300 junior high school boys with ages ranging from 12 years to 15 years. There was no control over the subjects outside of class in terms of outside activities and diet. This study was designed to ascertain the level of cardiovascular efficiency attained in each of the two types of exercises and not to test dexterity, agility, strength or speed.

DEFINITION OF TERMS

Isometrics. The word comes from the Latin 'iso' meaning same and 'metric' meaning measurement. It is holding a muscle in static contraction against some immovable resistance.¹

Calisthenics. Systematic bodily exercises without apparatus.²

Buddy plan. A method using one subject as the resistance position and the other subject as the contractor.

Cardiovascular efficiency. The adaptive response of the heart, blood vessels and lungs to exercise.³

¹Hal Higdon, "Let's Tell the Truth About Isometrics," Today's Health, June, 1965, p. 59.

²"Calisthenics," Webster's New Students Dictionary (New York: American Book Company, 1964), p. 115.

³"Man in the Gray Flannel Physique," Saturday Review, October 24, 1964, p. 60.

CHAPTER II

REVIEW OF LITERATURE

The usefulness of the isometric contraction has been established unquestionably by some of the fundamental research that has been conducted in isometrics. The same is true of the calisthenic form of exercise.

Numerous investigations have been made into both types of exercises concerning the increasing of strength. Few, however, have dealt with the effects of isometrics and calisthenics on cardiovascular efficiency.

The chapter on the review of literature will be divided into two basic sections. The first section was concerned with calisthenics and their effects on fitness and cardiovascular efficiency, and the second section dealt with isometrics and their effects on fitness and cardiovascular efficiency.

I. CALISTHENICS AND THEIR EFFECTS ON CARDIOVASCULAR EFFICIENCY

Calisthenics. The history of calisthenics probably goes back as far as the fourth or fifth century before Christ, when the Greeks employed directors, coaches, trainers, masseurs and supervisors to develop athletes. About a century ago the present definition of calisthenics came into existence. The definition is "the

art or practice of exercising the muscles for the purpose of gaining health, strength or grace of form and movement; a kind of light gymnastics."¹

According to Staley, calisthenics are performed to attain four objectives:

1. The development and maintenance of body health.
2. The development and maintenance of good body mechanics.
3. The development and maintenance of body suppleness.
4. The development and maintenance of body control.²

Free exercises, or exercises performed by an individual without equipment, are called calisthenics. Scientific research has proven that calisthenics correctly executed will improve flexibility, strength and endurance.³

White stated that three conditions add to the benefits of calisthenics:

1. They should be done rhythmically, with a lilt and a dash.
2. They should be performed continuously, at varying tempos, but continuously from start to finish.

¹S. C. Staley, Calisthenics (New York: A. S. Barnes and Company, 1928), p. 1.

²Ibid.

³Paul Dudley White, M. D. and Curtis Mitchell, Fitness For The Whole Family (Garden City, New York: Doubleday and Company, Inc., 1964), p. 116.

3. Their severity should be slowly and gradually increased, either by adding to the time taken for them or by increasing the number of repetitions, or by crowding⁴ the set number of repetitions into a shorter period.

Physical fitness improvement has become the desire of many people at the present time. Physical educators have for many years had the objective of fitness in their programs.

A renewed interest in calisthenics prompted a study by Campney and Wehr on the calisthenic exercise program advocated for adults by the President's Council on Physical Fitness.

Nineteen subjects participated in the exercise program for ten weeks. Before and after the training, measurements were taken relative to the Council's objectives for the program: strength, flexibility, improved general appearance, endurance, coordination, and efficiency. The results showed the flexibility in males and some endurance in females were significantly improved, but the other components of fitness did not appear to be significantly improved.⁵

Physical fitness is not limited to calisthenics, of course. Any physical activity, from walking to competitive sports, is classified as exercise.

⁴Ibid.

⁵Harry K. Campney and Richard W. Wehr, "Effects of Calisthenics on Selected Components of Physical Fitness," Research Quarterly, 34:393-402 (1965).

Hilsendager conducted an investigation comparing the calisthenic and non-calisthenic physical education program. The study was designed to determine whether the usual 10 minutes of physical education class time allocated to calisthenics were of more or less motor fitness developmental value than a ten minute period spent in a skill activity. The skill activities compared with calisthenics were touch football, volleyball, handball and basketball.

Examination of the data showed that calisthenics affected performance on the standing broad jump and squat thrusts tests more than touch football did. Volleyball or basketball did not have as much effect on the performance of the sit-up test as did calisthenics. No statistically significant differences were found among the test item performances when calisthenics were compared to handball.⁶

The effects of calisthenics on cardiovascular efficiency. All types of training programs have been found to have varying effects on the improvement of cardiovascular efficiency. These range from sports such as wrestling, swimming, golf, volleyball, cycling, basketball, rope skipping, etc. to isometric, isotonic and calisthenic exercise programs.

Many studies have been conducted concerning the relation of the various sports to improved cardiovascular efficiency, but few

⁶Donald Hilsendager, "Comparison of a Calisthenic and a Non-Calisthenic Physical Education Program," Research Quarterly, 37:148-50 (1966).

are known to have been made concerning the relationship of calisthenic exercises to improved cardiovascular efficiency.

Bogard quoted Taylor's study involving 42 business men from the Vancouver Y.M.C.A. Taylor equated the men into three groups; one group used a calisthenics program, one used a circuit training program and the third acted as the control group. Taylor concluded that both the calisthenics and the circuit training programs created some improvement in the cardiovascular efficiency and the muscular tone of the business men.⁷

A study by Harper, Billings and Mathews on the comparative effects of two physical conditioning programs on cardiovascular fitness used three matched groups of college men. Of the 25 men, eight took part in a modified army conditioning program of calisthenics and marching, nine participated in an interval training program involving running, and the third group of eight men acted as the control group and participated in recreational activities. After meeting five days a week for seven weeks, pre- and post-conditioning maximum oxygen consumption and Harvard Step Test indexes were recorded to evaluate differences. The results were that those in the calisthenics group showed no significant improvement in maximum oxygen consumption, but did show significant improvement

⁷Gale Wayne Bogard, "The Effects of Four Running Programs on the Development of Cardiovascular Efficiency," (unpublished Field Study, Kansas State Teachers College of Emporia, Emporia, Kansas, 1967), p. 16.

in the Harvard Step Test. The interval-trained group showed improvement on the two fitness tests, and the control group did not significantly improve.⁸

Franks and Moore conducted a study with the purpose of determining the effects of different amounts of calisthenics and volleyball in tenth grade physical education classes on the AAHPER fitness test and volleyball skill.

The classes were divided into three groups: (a) combination of calisthenics and volleyball, (b) calisthenics, and (c) volleyball.

Training lasted for five weeks and the results showed significant fitness improvement in the combination group and in the calisthenics group. The volleyball group did not improve as much as the other two groups.⁹

In a study comparing the physical fitness of two fifth grade self-contained classes, one without physical education in the curriculum and the other with a program of 15 minute daily periods of calisthenics, Taddonio concluded that 15 minute daily periods of calisthenics in the intensity cited had little or no effect upon the physical fitness of fifth grade boys and girls as measured by the

⁸Donald D. Harper, Charles E. Billings, and Donald K. Mathews, "Comparative Effects of Two Physical Conditioning Programs on Cardiovascular Fitness in Man," Research Quarterly, Vol. 40, No. 2, pp. 293-298.

⁹B. Don Franks and George C. Moore, "Effects of Calisthenics and Volleyball on the AAHPER Fitness Test and Volleyball Skill," Research Quarterly, Vol. 40, No. 2, pp. 288-292.

AAHPER Youth Fitness Test. The explanation for this was that the 15 minute periods of calisthenics do not tax fifth graders sufficiently to contribute significantly to physical fitness.¹⁰

Weber and Knowlton conducted a study assessing the cardio-respiratory fitness of 95 randomly selected young college males enrolled in three physical fitness sections and one tennis course, each lasting eight weeks. The physical fitness sections included interval running, distance running, rhythmic calisthenics, and flexibility exercises. Results showed eight weeks of physical fitness training can produce significant improvements in physique and circulorespiratory characteristics.¹¹

II. ISOMETRICS AND THEIR EFFECTS ON CARDIOVASCULAR EFFICIENCY

Isometrics. Isometric exercises, according to Cooper, contract muscles without producing movement or demanding much oxygen. They tense one set of muscles against another or against an immovable object.¹²

¹⁰Dominick A. Taddonio, "Effect of Daily Fifteen-Minute Periods of Calisthenics upon the Physical Fitness of Fifth-Grade Boys and Girls," Research Quarterly, Vol. 37, No. 2, pp. 276-281.

¹¹Herbert Weber and Ronald G. Knowlton, "A Comparative Study of Physique and Performance Measures Resulting from a Short-Term Physical Fitness Course," Research Quarterly, 39:1107-14, (1968).

¹²Kenneth H. Cooper, Aerobics (New York: M. Evans and Company), p. 17.

Though isometrics have received a great deal of publicity in recent years, they are not new. Their history goes back to the 1920's when they were used by therapists to maintain strength in patients who had limbs enclosed in casts. An English translation of some German experiments published in 1952 concluded that isometric contractions could increase the size and strength of muscles by as much as five per cent a week. This brought about a great amount of enthusiasm for isometrics, but the conclusions were later modified or disproved.¹³

The two German researchers, Hettinger and Mueller, published in 1952 the results of experiments which indicated the five per cent a week strength gains.

Higdon stated that Steinhaus and other physiologists realized of course that isometrics had a certain legitimate, but limited place in physical fitness programs. Their efforts to say so were lost, however, for the public interest in instant exercise that promised fitness without the fuss of sweaty exercise rapidly grew out of control.¹⁴

Bender, Kaplan and Johnson agree that great popular emphasis has recently been placed on the use of isometric exercises for the development of strength. They state that due either to commercialism

¹³ Ibid.

¹⁴ Hal Higdon, "Let's Tell the Truth About Isometrics," Today's Health, June, 1965, p. 59.

or to an attempt to get on the publicity bandwagon, many persons have produced methods, gadgets, and exercises to add to the benefits that can be derived from isometrics.¹⁵

The feelings of Bender, Kaplan and Johnson were that isometric exercises can be capitalized upon as a highly desirable procedure through proper use, but that it should be recognized that no exercise or exercise method can necessarily solve all exercise problems.¹⁶

Studies undertaken at the Southern Illinois University Laboratory of Applied Physiology and the Laboratory of Physical Education (Men) by Bender, Kaplan, and Johnson led to the following conclusions:

1. The greatest value found so far in the use of isometrics has been in the elaboration of a method to evaluate the strength of various movements surrounding joints.

2. An isometric contraction can develop muscular strength at any given point of stimulation throughout a range of motion.

3. The isometric contraction must be highly controlled if proper strength development is to be achieved.

4. Evaluation of the effect of isometric exercises is necessary if strength gains are to be realized.

5. Isometric exercises are not the whole answer to the conditioning needs of most individuals.

¹⁵Jay A. Bender, Harold M. Kaplan and Alex J. Johnson, "Isometrics, A Critique of Faddism versus Facts," Journal of Health, Physical Education and Recreation, 34:21-24, May, 1963.

¹⁶Ibid.

6. An isometric conditioning program using gross exercises is often more detrimental than beneficial.¹⁷

The same study by Bender, Kaplan and Johnson brought about the following recommendations for isometrics in physical education classes:

1. Isometric testing in strengthening can be beneficially applied to children and adults who need a corrective program, as well as to those who have insufficient strength to handle their body weight in such activities as chinning, dipping, and pushups.

2. Isometric testing and strengthening can be used appropriately in activities such as postural work, sports, and dance if the students cannot properly perform the activities.

3. In general, isometric exercises can be used if the development of strength is necessary or desired.

4. An isometric exercise program should be individual rather than general in nature.¹⁸

The recommendations for isometrics in athletics were:

1. All members and prospective members of a team should be tested by isometric methods to determine what muscle groups of their body need strengthening.

2. A muscle strengthening program should be designed for each athlete on the basis of testing. This program should include

¹⁷Ibid., pp. 21-22.

¹⁸Ibid.

isometric, isotonic, and stretching exercises.

3. A muscle testing is necessary after athletic injury to determine the optimal time when the athlete can return to competition without a high susceptibility to injury. An athlete with a severe knee injury one season will start the next season with the same injury unless specific remedial exercises have been applied to the injured areas.¹⁹

A cooperative study between the Laboratory of Applied Physiology at Southern Illinois University and the United States Military Academy at West Point was conducted to investigate fully the problem of knee injury and the effectiveness of isometric exercises. The entire Plebe class entering the Academy in July, 1963 was the basis for the gathering of the data.

Each cadet filled out a questionnaire which included questions pertaining to any injuries of the lower extremities suffered before coming to the Academy. The study consisted of testing by a multiple-angle method the strength of knee extension at two specific points in the total range of motion by isometric contractions. The muscles used in this movement appear to be specifically involved where injury to the knee is concerned. The result of this study points up clearly that knee injuries in persons actively participating in sports can be reduced greatly by instituting a careful testing and strengthening

¹⁹Ibid., pp. 22-23.

program in isometrics.²⁰

An investigation conducted by Lindeburg, Edwards and Heath was to determine if a maximum isometric exercise program would improve standing broad jumping ability, a skill demanding coordination, flexibility, body balance and strength. Seventy-six male eighth grade junior high school students were tested in a standing broad jump. The subjects were then paired according to broad jumping ability into two groups. The experimental group participated in an isometric program consisting of a 15 second maximum contraction in an inverted leg press once a day, five days a week for six weeks. Both groups were retested at the end of the six week program. The data were treated statistically and neither the experimental group nor the control group improved significantly in standing broad jumping ability.²¹

Howell, Kimoto and Morford conducted a study to determine the relative effects of an isometric exercise program, (the Commander Set, a series of static exercises developed by the late Commander Giaucque, USN, and Arthur H. Steinhaus) and a regular isotonic exercise program of weight training upon muscular endurance as measured by two-minute and all-out work on a bicycle ergometer at 14 kg. resistance. Three groups of 11 subjects enrolled in required physical

²⁰Jay A. Bender, Frank J. Kobes, Jr., Harold M. Kaplan, and Joe K. Pierson, "Strengthening Muscles and Preventing Injury with A Controlled Program of Isometric Exercises," Journal of Health, Physical Education and Recreation, 35:57-58 (January, 1964).

²¹Franklin A. Lindeburg, Donald K. Edwards and William D. Heath, "Effect of Isometric Exercise on Standing Broad Jumping Ability," Research Quarterly, 34:478-83 (December, 1963).

education were equated on this basis. Group I did weight training, Group II used the Commander Set series of isometric contractions, and Group III participated in normal activities. After the eight week testing period, all subjects were retested on the bicycle ergometer under the original conditions. The two experimental groups showed significant improvements and the hypothesis was that increases in muscular endurance may be effected by certain programs of isometric exercises as well as by isotonic exercises.²²

According to Bender, Kaplan and Johnson, the following are essentially the situations in which isometric strength is most evident in athletic skills: (1) posture stabilization, (2) initiating movements, (3) recovery movements, (4) changing direction, and (5) ballistic movements.²³

Suggestions were given by Bender, Kaplan and Johnson in improving wrist strength for shooting basketball by application of isometric flexion exercises. Weak shoulders, arms and wrists of tennis players can also be corrected by isometric exercises.²⁴

²²Maxwell L. Howell, Ray Kimoto and W. R. Morford, "Effect of Isometric and Isotonic Exercise Programs upon Muscular Endurance," Research Quarterly, Vol. 33, No. 4, pp. 536-39.

²³Jay A. Bender, Harold M. Kaplan and Alex J. Johnson, "Isometric Strength Needs in Athletic Skills," Journal of Health, Physical Education and Recreation, XXXIV (September, 1963), pp. 36-74.

²⁴Ibid.

The effects of isometrics on cardiovascular efficiency. In any area of athletics and in physical education classes, properly used isometric exercises appear to contribute a great deal.

It should be noted that in both physical education and athletic programs, there are four distinct types of conditioning needs. They are:

1. Cardiovascular efficiency, or the adaptive response of the heart to exercise.

2. Muscular strength, or the ability to accomplish an activity at peak performance without injury. Strength is the ability to work against a specified resistance.

3. Muscular endurance, or the ability of the muscle to respond repetitively for a relatively long period of time.

4. Flexibility, defined both as the elasticity of a muscle group and the effective use of the muscle group throughout its maximum range of motion.²⁵

Each of these four areas of response must be developed in accordance with an individual's needs, according to Bender, Kaplan, and Johnson.²⁶

Determining the fitness of an athlete or a physical education student cannot be limited to the physical aspect. Physiological fitness, or the amount of work the athlete or student can

²⁵Op. Cit., Bender, Kaplan and Johnson, p. 36.

²⁶Op. Cit., p. 36.

do without a strain on his cardiovascular mechanism, must be taken into consideration.

Homola stated:

In most cases, physical and physiological endurance will automatically result from regular and prolonged physical training, and the amount of endurance acquired will accrue in proportion to the amount and type of training. But if an athlete has a heart defect or a respiratory disorder, his physiological development may not keep pace with his physical development, and there may be excessive strain on his heart and lungs. For this reason, it is sometimes not enough to test physical fitness by physical performance alone.²⁷

All body cells are nourished by the heart and blood vessels (the cardiovascular system). Changes in all these millions of cells are created by any type of physical exercise, from simple walking to the most strenuous of sports activities. The cells have an ever-increasing demand for oxygen and since oxygen is transported by the blood, the heart serves as the most important instrument in pumping the blood throughout the body. This pumping is done at a speed and pressure required by muscular demands or by the changing environment of the individual.²⁸

Bender and Shea stated that the heart is often thought of as being the strongest and toughest muscle in the body. This muscle will respond to the same training and conditioning as other muscles of the body and persons who have regular periods of physical activity

²⁷ Samuel Homola, "Testing Athletic Fitness," Athletic Journal, 46:56-59 (January, 1966).

²⁸ Jay Bender and Edward J. Shea, Physical Fitness: Tests and Exercises (New York: The Ronald Press Company, 1964), p. 143.

possess hearts that are much more efficient in circulatory and pulmonary functioning than do those who lead sedentary lives.²⁹

Much controversy appears to exist concerning the effects of isometric exercises on the efficiency of the cardiovascular system.

Cooper is not an advocate of the use of isometrics except in therapeutics. His opinion was:

Isometric exercises are capable of increasing the size and strength of individual skeletal muscles, but they have no significant effect on overall health, especially on the pulmonary and cardiovascular systems. There is no increase in oxygen consumption and, consequently, minimal if any training effect.

At best, isometrics have some effect on body building, chiefly the limbs, if that is your goal. They are more valuable, however, in therapeutics. . . But since isometrics affect only the skeletal muscles, they do not strengthen the heart, the lungs or the blood system.³⁰

Another opinion voiced was by Shvartz who conducted a study using twelve subjects to determine the effect of isotonic and isometric exercises on heart rate using a military press in a sitting position. The isotonic exercise was performed for 45 seconds with one half of maximum resistance, and the isometric exercises were performed for 45 seconds with one half, two thirds and maximum resistance. The results indicated that isometric exercise performed for 45 seconds with one half of maximum resistance could stimulate heart rate to the same extent that isotonic exercise could, using the same intensity and duration. The results also showed that

²⁹Ibid.

³⁰Op. Cit., Cooper, p. 17.

increasing the load in isometric contraction resulted in a proportional increase in heart rate and that increasing the load to maximum isometric contraction resulted in a near twofold increase in heart rate.³¹

Milton conducted a study to determine the effectiveness of three programs of distance running and a program of isometric exercises upon the development of cardiovascular efficiency.

At Kansas State Teachers College, 463 male students were given the Harvard Step Test as an initial measure of cardiovascular efficiency. They were divided into four groups who trained four days a week for seven weeks, and the Harvard Step Test was again administered at the completion of the training period.

Group I ran ten minutes each session; Group II ran twenty minutes; Group III ran thirty minutes; and Group IV participated in isometric exercises each session.

For each group, mean gain significance between initial and final Harvard Step Test scores was established. Analysis of variance and orthogonal comparisons were used to compare the effectiveness of the four programs on cardiovascular efficiency improvement. Regression was used to find relationship between the amount of running and cardiovascular fitness among the running groups and an analysis of the effects of the training programs for subjects of high and low initial cardiovascular condition was made.

³¹Esar Shvartz, "Effect of Isotonic and Isometric Exercises on Heart Rate," Research Quarterly, Vol. 37, No. 1.

Milton's findings were that all four training programs produced gains in cardiovascular efficiency and though there were no significant differences among the running groups, all three running groups proved to be more effective than the isometric exercise group in cardiovascular improvement.

For subjects of highest initial cardiovascular efficiency, the groups who ran ten and twenty minutes a day made more gains in cardiovascular fitness than the group who ran thirty minutes a day and the isometric exercise group.

Isometrics were found to be superior in improving cardiovascular efficiency for subjects having low initial test scores.

The conclusions of Milton's study were that cardiovascular efficiency may be improved significantly by participating in running programs and by participation in isometrics, but generally, distance running proved to be more effective in improvement of cardiovascular efficiency than isometrics.

All four programs were equally effective in improving cardiovascular efficiency in subjects of low initial cardiovascular fitness. The isometric program proved to develop greater cardiovascular efficiency in subjects of low initial fitness than in subjects of high initial cardiovascular fitness.³²

³²George Cohle Milton, "The Effects of Three Programs of Long Distance Running and an Isometric Exercise Program on the Development of Cardiovascular Efficiency," (unpublished Doctoral dissertation, Louisiana State University and Agricultural and Mechanical College, 1966).

Graham pointed out that while there might be some basis for the use of isometric exercises in muscle building for strength, there is no doubt that they accomplish little or nothing in the battle for survival against heart disease because they require so little of the heart and lungs.³³

SUMMARY

A review of the available literature seemed to indicate that isometric exercises have less effect on cardiovascular efficiency than do calisthenic exercises. The pros and cons of both isometrics and calisthenics were explored to complete the review.

³³M. F. Graham, M. D., Prescription for Life (New York: David McKay Company, Inc., 1966), p. 109.

CHAPTER III

PROCEDURE OF STUDY

Introduction

The purpose of this study was to determine the comparative efficiency of isometrics and calisthenics upon cardiovascular efficiency in male junior high school students.

Nature of the physical education program. The male physical education department at Ervin Junior High School, Hickman Mills, Missouri was comprised of three instructors teaching a total of twelve sections of physical education daily.

The yearly program of physical education was divided into eight sections: (1) flag football, (2) indoor games, (3) basketball, (4) volleyball, (5) physical fitness tests, (6) archery, (7) softball, and (8) track and field. The first eight minutes of each class period were devoted to warming up type of exercises for all students.

Groups used. Subjects used for this study were 300 male students at Ervin Junior High School who were enrolled in six sections of required physical education classes. Each of the six sections met three days one week and two days the following week for nine weeks, making a total of twenty-three one hour sessions for each group.

At the first class meeting of the third nine week quarter of the school year, the subjects of each of the six male physical education sections were divided into two groups. The random selection was made by having the students line up and count off. The even numbered subjects were assigned to the isometric group and the odd numbered subjects were assigned to the calisthenic group.

Training Procedure

Both the isometric group and the calisthenic group performed their particular exercises at the same time during the class period. The school gymnasium was used for the training program and was divided into two sections, one for each group.

Isometrics. The eight isometric exercises chosen were for the large muscle groups of the leg, back, abdomen, neck, arm and shoulders. The exercises were performed for one minute each, making each session eight minutes in length. The one minute allotted to a specific exercise was divided into alternate six second contractions and ten second rest periods.

The eight isometric exercises were:

1. Fingertip-arm-shoulder contraction.
2. Hand clasp-arm pressure contraction.
3. Hand and arm-head and neck contraction.
4. Full body muscle contraction.
5. Arm wrestle.
6. Arm pulling-feet pushing contraction.

7. Arm and neck-arm and leg contraction.
8. Leg-arm contraction.

Pictures and descriptions of the isometric contractions may be found in the appendix.

Calisthenics. The calisthenic group performed eight different calisthenic exercises for one minute each during a session. The calisthenic exercises used were:

1. Fingertip pushups.
2. Sit ups.
3. Shoot the cannon.
4. Leg lifts.
5. Side-straddle hop.
6. Leg stretchers.
7. Toe-stomach-sky.
8. Running in place.

Pictures and descriptions of the calisthenic exercises may also be found in the appendix.

Test materials and methods used. At the first class meeting of the quarter, the investigator explained to the subjects the importance of their cooperation and its effect on the outcome of the study.

The next three class sessions were used for the initial administration of the Harvard Step Test. The students were randomly divided into groups of three and were given two cards. The

person sitting in the middle of each group was the testee and the two students on either side of him were testors. The two testors recorded the testee's name and 30 second resting pulse before each testing program began. After reviewing the test procedure the testee stood, faced an 18 inch bench and followed the test directions from a tape recorder. The commands were: "Ready, Up, Two, Three, Four, Up, Two, Three, Four, etc." The command "up" was called out every two seconds. On that command the testee stepped up on the bench with one foot. On the command "two" he stepped up with the other foot to an erect position. On the command "three" he stepped down with the lead foot, and on the command "four" he stepped down with the other foot to the original starting position. The four counts were one complete cycle and the testee repeated the cycle at the rate of thirty cycles per minute for a maximum of five minutes.

At the end of the exercise period the recording gave the command, "stop! sit down." The testee sat down on the bench immediately and remained quiet. The testors found the testee's pulse, using the radial artery, during the one minute rest period. At the end of the first minute the command to start counting was given. One and one-half minutes after the exercise, the students were told to stop and record. Two minutes after exercising, the testors were instructed to start counting and at two and one-half minutes after the exercise the testors were told to stop and record.

At three minutes after the exercise the testors were instructed to start counting and after thirty seconds the testors were told to stop and record their scores.

After each counting period the testors recorded the number of pulse beats on the score card, and when all three counts had been taken, the total pulse count was figured.

After the cards had been handed to the testee and collected, the subjects changed positions allowing another member of the group to become the testee and the other two the testors. This changing was done until all subjects had been tested.

The results of the test were recorded and later transferred to an IBM sheet.

CHAPTER IV

PRESENTATION OF DATA

I. INTRODUCTION

The purpose of this study was to determine the comparative efficiency of isometrics and calisthenics upon cardiovascular efficiency in male junior high school students. There was one statistical analysis computed in studying the two supplementary training programs on the development of cardiovascular efficiency of the subjects. This statistical method was the significance of the correlated means for all groups between the initial and final Harvard Step Test performance.

The data used in this study were gains made between the initial and final scores on the Harvard Step Test.

To establish the significance of the mean gains in Harvard Step Test performance, t tests were computed comparing the initial and final cardiovascular efficiency scores for each group.

II. SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE INITIAL AND FINAL HARVARD STEP TEST FOR EACH GROUP BY GRADE LEVELS

To gain greater insight into the influence which the different exercises have upon cardiovascular efficiency, both

experimental groups were further subdivided by academic grade levels in order that isometric and calisthenic exercises were used by the same age group. The levels were seventh grade, representing students between the ages of 12 and 13; eighth grade, representing students between the ages of 13 and 14; the ninth grade, representing students between the ages of 14 and 15.

The initial and final Harvard Step Test scores and the differences between them can be seen in Table I. It can be noted that not one grade level was able to show a significant improvement. It is interesting to note that the seventh and ninth grades of the calisthenic group had a decrease of -3.47 and $-.32$ respectively in the cardiovascular efficiency as tested by the Harvard Step Test.

This decrease by the calisthenic group can be compared to the overall improvement of the isometric group. This improvement of the isometric group was also non-significant. To be significant with 50 degrees of freedom, a t of 2.01 and 2.68 at the .05 and .01 levels of significance is necessary. Not one of the six sub groups approached significance.

III. SIGNIFICANCE OF THE DIFFERENCE ON THE FINAL HARVARD STEP TEST PERFORMANCE BETWEEN THE CALISTHENIC AND ISOMETRIC GROUPS BY GRADE

To further investigate the effectiveness of the two forms of cardiovascular efficiency training, the investigator compared

TABLE I

SIGNIFICANCE OF THE DIFFERENCE BETWEEN INITIAL
AND FINAL HARVARD STEP TEST PERFORMANCE
OF BOTH GROUPS BY GRADE LEVEL

Group	N	H.S.T. 1	H.S.T. 2	Diff.	t	P
I (Cal)						
7	49	162.67	166.14	-3.47	.937	-
8	67	165.00	163.55	1.45	.467	-
9	34	158.65	158.97	.32	.056	-
II (Iso)						
7	50	163.76	161.72	2.04	.920	-
8	63	163.60	163.17	.43	.122	-
9	37	159.32	157.16	2.16	.467	-

\bar{t} necessary for significance at .05 level of confidence with 50 df = 2.01

\bar{t} necessary for significance at .01 level of confidence with 50 df = 2.68

the two experimental groups. Again, the two groups were further subdivided into grade levels.

The full results can be found in Table II. As can be seen, the difference of the two groups on the Harvard Step Test and in all grade levels is non significant. The largest difference was found at the seventh grade level with a mean difference of 4.42 resulting. A t of 1.31 was not significant as a t of 1.98 was necessary with 100 degrees of freedom. The difference found at the eighth grade level was a mean difference of .38 and the t of .11 was not significant. The mean difference of 1.81 was found at the ninth grade level. A t of .34 was not significant.

IV. SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE INITIAL AND FINAL HARVARD STEP TEST FOR THE TWO GROUPS

The next step was to find the difference when all the subjects in the various grade levels were placed in a total group under the title of either calisthenic or isometric exercises and compare the initial to the final Harvard Step Test.

As shown in Table III, the mean difference found in the calisthenic group between the initial and final Harvard Step Test was -.56. The t of .248 was not significant as a t of 1.98 at the .05 level was necessary with 150 degrees of freedom, and a t of 2.11 at the .01 level was necessary with 150 degrees of freedom.

TABLE II

SIGNIFICANCE OF THE DIFFERENCE OF MEAN SCORES
OF THE FINAL HARVARD STEP TEST BETWEEN
GROUP I (CALISTHENIC) AND GROUP II
(ISOMETRIC) GRADE LEVEL STUDENTS

Group	N	H.S.T. 2	Mean Diff.	t	P
I 7	49	166.14	4.42	1.31	-
II	50	161.72			
I 8	67	163.55	.38	.11	-
II	63	163.17			
I 9	34	158.97	1.81	.34	-
II	37	157.16			

t necessary for significance = 1.98 with 100 degrees of freedom

TABLE III

SIGNIFICANCE OF THE DIFFERENCE FOR BOTH GROUPS
ON CARDIOVASCULAR EFFICIENCY IMPROVEMENT

Group	N	Initial Mean Score	Final Mean Score	Diff.	t	P
I (Cal)	150	162.80	163.36	-.56	.248	-
II (Iso)	150	162.60	161.21	1.39	.598	-

\underline{t} needed for significance at the .05 level of confidence with
150 df = 1.98

\underline{t} needed for significance at the .01 level of confidence with
150 df = 2.11

The mean difference in the isometric group between the initial and final Harvard Step Test was 1.39. As with the calisthenic group, the mean difference of the isometric group was not significant at the .05 level or the .01 level.

V. SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE
TWO TOTAL GROUPS ON THE FINAL HARVARD
STEP TEST PERFORMANCE

As the main purpose of this study was to ascertain the difference, if any, which the two forms of exercise would cause on cardiovascular efficiency as measured by the Harvard Step Test, this section deals with such a comparison.

Table IV shows that the mean score of the calisthenic group on the final Harvard Step Test was 163.44. The mean score of the isometric group on the final Harvard Step Test was 161.03 indicating a mean difference between the two groups of 2.41. A \underline{t} of 1.08 was not significant because a \underline{t} of 1.97 at the .05 level with 300 degrees of freedom was necessary and a \underline{t} of 2.59 at the .01 level with 300 degrees of freedom was necessary to be significant.

TABLE IV

SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE TWO
GROUPS FOR MEAN SCORE ON THE FINAL
HARVARD STEP TEST

Group	N	Mean H.S.T. 2	Mean Diff.	t	P
I (Cal)	150	163.44			
II (Iso)	150	161.03	2.41	1.08	-

t necessary for significance at .05 level of confidence with
300 df = 1.97

t necessary for significance at the .01 level of confidence with
300 df = 2.59

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

I. SUMMARY

It was the purpose of this study to analyze and compare the effectiveness of isometrics and calisthenics upon the development of cardiovascular efficiency in junior high school males.

The subjects for this study were 300 junior high school males enrolled in the required physical education program during the third nine week quarter of the 1968 school year at Ervin Junior High School, Hickman Mills, Missouri.

The Harvard Step Test was given to all subjects in the first three class periods of the nine week quarter, and it served as the initial measure of cardiovascular efficiency. Subjects were randomly assigned to two training groups: Group I trained by calisthenic exercises for eight minutes each class period; Group II trained by isometric contractions for eight minutes each class period. Both of the groups trained two days one week and three days the next for a period of seven weeks. At the end of that period, the Harvard Step Test was again administered to all subjects.

The t test was used to determine the significance of the gains made for each group and for significance between the groups.

II. FINDINGS OF THE STUDY

The findings of the study were as follows:

1. The seventh, eighth, and ninth grade isometric training program and calisthenic training program brought about no significant improvement in cardiovascular efficiency between the initial and final Harvard Step Test at the .05 level or the .01 level of confidence.
2. When the two exercise programs were compared, no significant difference in cardiovascular efficiency was found.

III. CONCLUSIONS

Within the limitations of the study, the following conclusions were made:

1. Although it was not significant, the seventh grade calisthenic training group showed a decrease in cardiovascular efficiency between the initial and final Harvard Step Tests.
2. The eighth grade calisthenic training group showed an improvement in cardiovascular efficiency after the training program, but it was not a significant improvement.
3. The ninth grade calisthenic training group showed a slight decrease in cardiovascular efficiency after the training program. This, too, was not a significant decrease.

4. The seventh grade isometric training group showed a non-significant increase in cardiovascular efficiency between the initial and final Harvard Step Tests.

5. The eighth grade isometric training group showed a non-significant increase in cardiovascular efficiency after the training program.

6. The ninth grade isometric training group showed a non-significant increase also in cardiovascular efficiency after the training program.

7. In the findings of the total calisthenic training group, there was a slight, but non-significant decrease in cardiovascular efficiency.

8. In the total isometric training group, there was a slight, but non-significant increase in cardiovascular efficiency.

IV. DISCUSSION

The subjects were greatly enthused about the training programs, and a competitive spirit developed between the two different groups. Absenteeism was kept at a minimum and some subjects expressed a desire to make up absences.

It appeared that the subjects possessing higher test scores enjoyed the program more and showed leadership qualities. It also appeared that the isometric training group was motivated more throughout the program than was the calisthenic training group.

V. RECOMMENDATIONS

The recommendations for further study are as follows:

- 1 Continued study of this type using female junior high students in comparison to male junior high students.
2. Conduct a similar study comparing junior high male athletes to junior high male non-athletes.
3. Conduct a similar study comparing male junior high special education students and average academic male junior high students.
4. Further investigation comparing motivated junior high males and non-motivated junior high males.
5. More time for the introduction to and preparation for the training program.

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APPENDICES

APPENDIX A

DESCRIPTIONS OF ISOMETRIC AND CALISTHENIC EXERCISES

I. ISOMETRICS



1. Finger-arm-shoulder contraction. Each subject stood facing the gym wall, placed the fingertips of each hand against the wall a shoulder's width apart. On the command "contract", the subjects contracted all their force against the resistance of the wall.



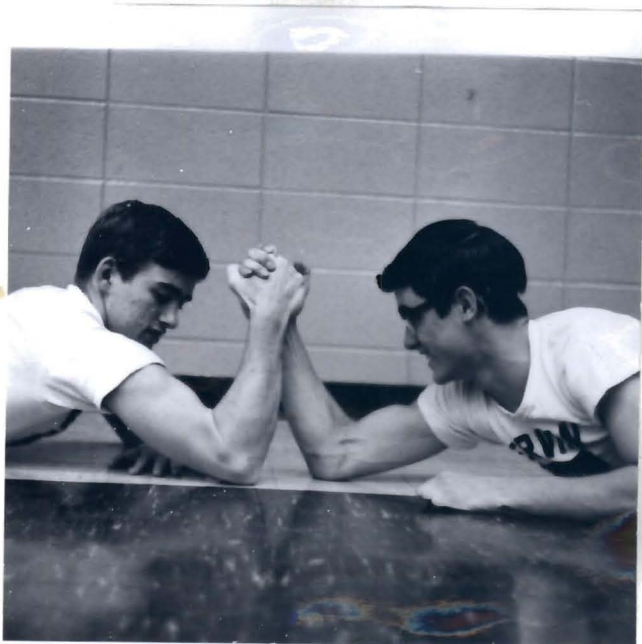
2. Hand clasp - arm pressure contraction. Each subject stood with hands clasped in front of his chest, with elbows raised to chest level and extended outward. On the command "contract," each hand contracted against the resistance of the opposite hand.



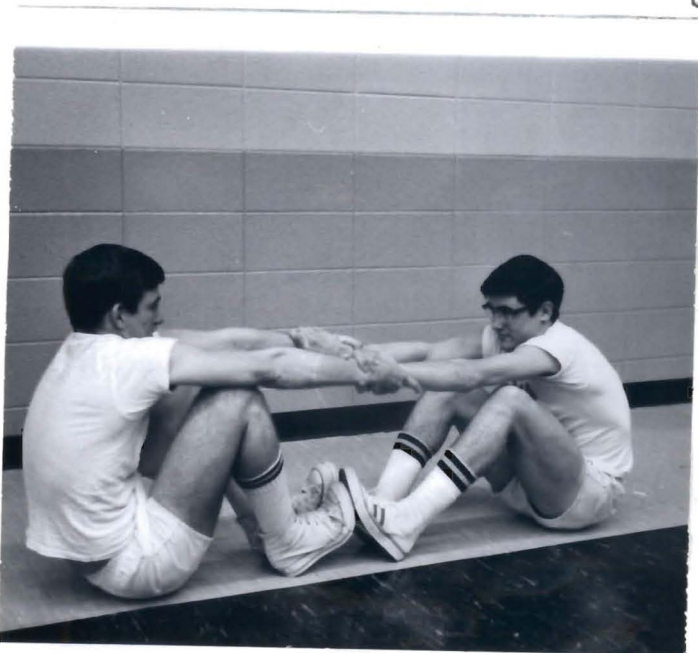
3. Hand and arm - head and neck contraction. The subjects pressed the palms of both hands against the forehead. On the command "contract," pressure was exerted by the hands and arms against the resistance of the head and neck.



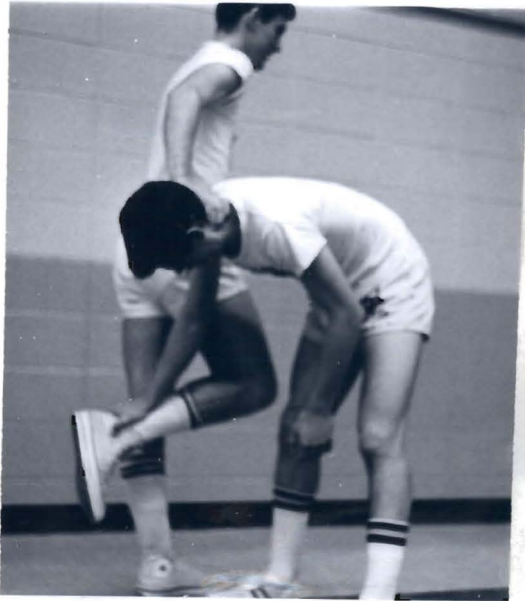
4. Full body muscle contraction. Each subject lay on his back on the floor with his head and heels raised two inches off the floor. On the command "contract," the subjects would contract all body muscles. At the end of 30 seconds, the subjects turned over to their stomachs, raised the chin and toes two inches off the floor, and repeated the full body muscle contraction.



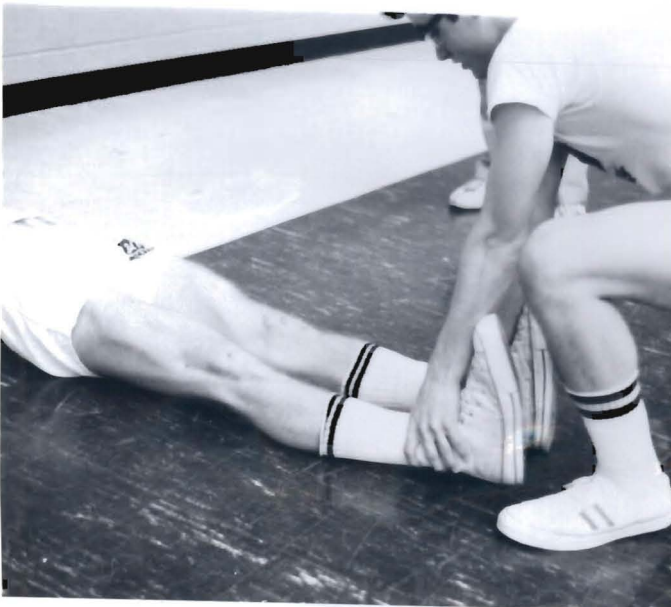
5. Arm wrestle. The buddy system was employed in this exercise. The two subjects lay on their stomachs on the gym floor facing each other. With elbows on the floor and arms upward, they grasped right hands. The left arms were at the sides of their bodies. On the command "contract," each subject's right hand applied pressure against the buddy's right hand. At the end of 30 seconds, the subjects changed from right hand to left and repeated the exercise.



6. Arm pulling - feet pushing contraction. Two subjects sat facing each other on the gym floor with legs drawn up toward the body, feet pressed flat against the feet of the buddy, and grasped both wrists of the buddy with the hands. On the command "contract," each pushed the feet and pulled the arms of the buddy.



7. Arm and neck - arm and leg contraction. Two subjects stood side by side to begin this exercise. One subject bent over forward while the other stood erect. The standing subject raised the right leg behind him at a 90 degree angle while placing his right arm against the back of the neck of his buddy. At the same time, the subject who was bending placed his left hand on the ankle of the raised leg of the other subject. On the command "contract," the standing subject pushed down on the neck of his buddy while trying to raise his own right leg. The subject who was bending pushed down on the ankle of his buddy's raised right leg while trying to raise his own head.

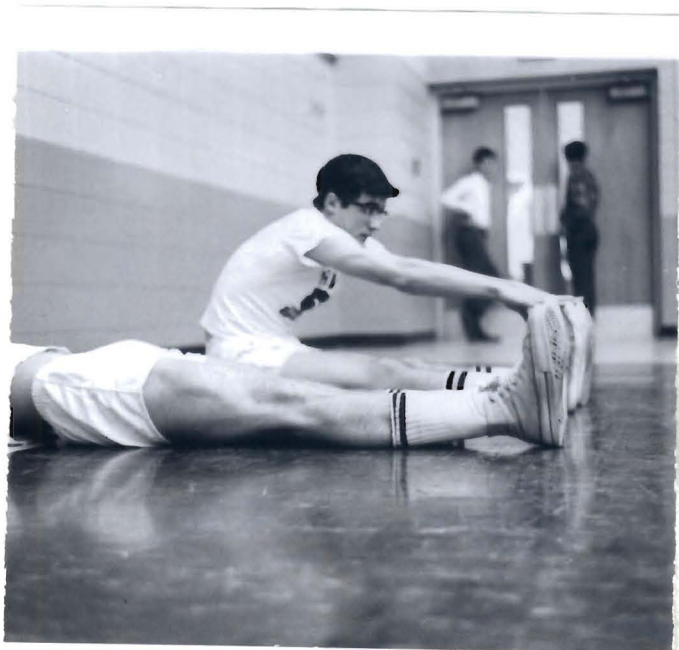


8. Leg - arm contraction. One subject lay flat on his back on the floor while the other subject (who was on his knees) held the ankles with his hands. On the command "contract," the subject lying on the floor tried to raise his legs as the other subject held them down with his hands.

II. CALISTHENICS



1. Fingertip pushups. The subjects lay in a prone position, elbows bent, arms extended straight down from the shoulders. A four-count repetition was used; "up," "two," "three," "four." On the command "up," the subject straightened the arms to raise the trunk from the floor; on "two," the trunk was lowered; on "three," the trunk was raised; and on "four," it was again lowered.



2. Sit ups. The subject lay flat on his back. On the count of "one," the trunk was raised and the subject touched his toes with his hands. On the count of "two," the trunk was lowered to the floor. Four count repetitions were used.

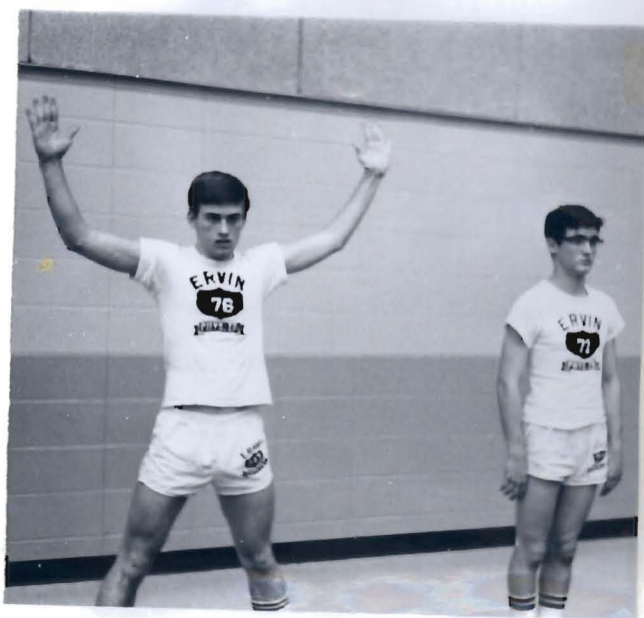
3. Shoot the cannon. The subject stood erect. On the count of "one," the palms were placed flat on the floor in front; on the count of "two," the feet were shot straight behind him; on the count of "three," the legs were brought back to normal position; and, on the count of "four," the subject stood erect.



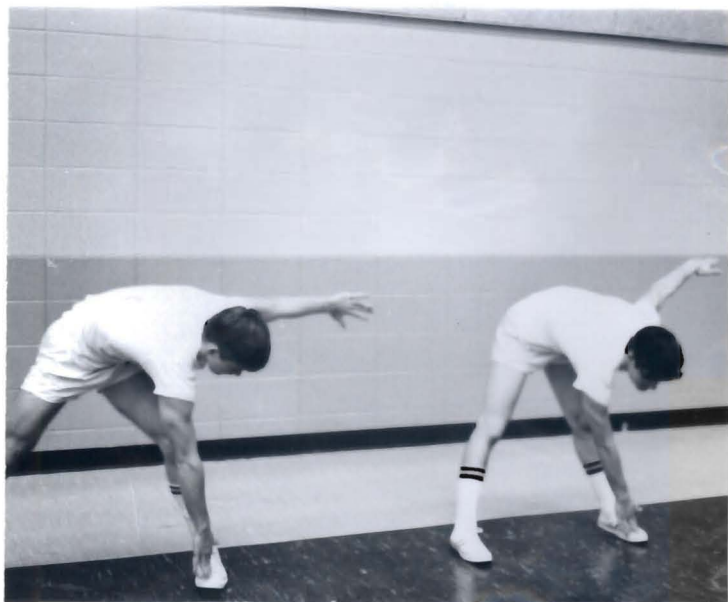
4. Leg lifts. The subject lay flat on the floor with hands underneath the hips, palms down. On the count of "one," the feet were raised six inches off the floor; on the count of "two," the legs were spread wide apart; on the count of "three," the legs were brought back together; on the count of "four," the legs were lowered to the normal resting position.

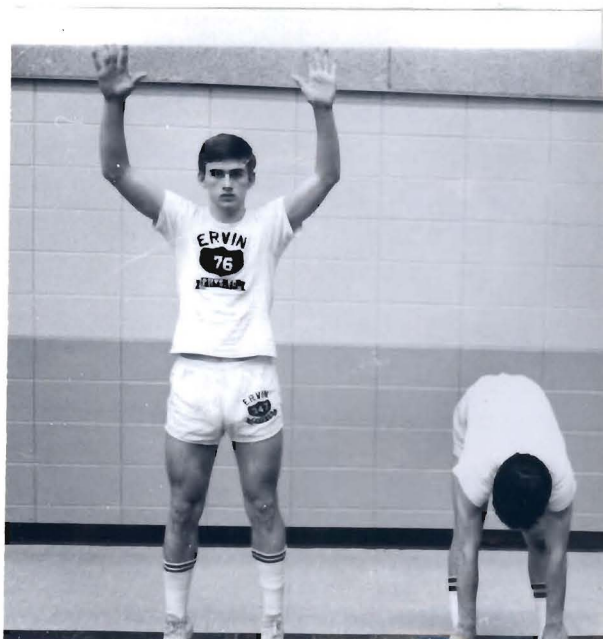


5. Side-straddle hop. The subject began in an erect standing position. On the count of "one," the feet spread a shoulder's width or more apart, arms raised fully extended above head and hands met; on "two," both arms and legs returned to erect standing position. The procedure was repeated on "three" and "four."

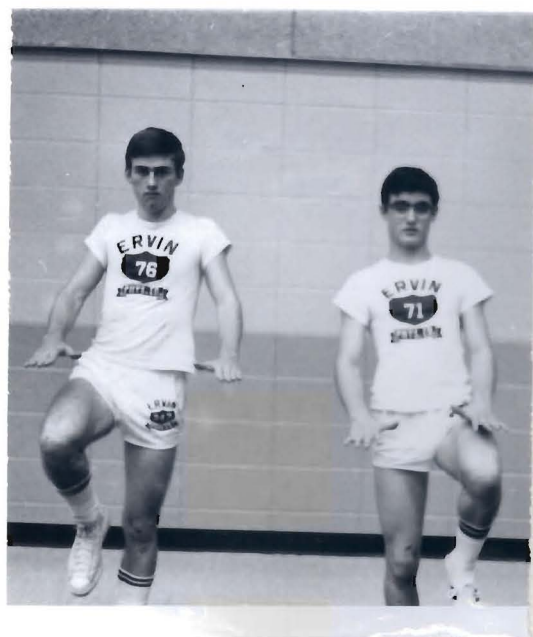


6. Leg stretchers. The subject began in a standing position with feet spread apart a shoulder's width or more, with arms extended straight out from the shoulders. On "one," the subject bent and touched the right toe with the left hand; on "two," the subject straightened to beginning position; on "three," the subject bent and touched the left toe with the right hand; on "four," the subject returned to beginning position.





7. Toe-stomach-sky. The subject stood in an erect position. On the count of "one," the legs were kept straight and the subject bent from the waist and touched the toes with his hands; on "two," the subject straightened and touched his stomach; on "three," the subject extended both arms as high as possible overhead, stood on his toes, and stretched the body; on "four," the subject returned to beginning position.



8. Running in place. The subject stood with feet a shoulder's width apart with hands waist high, palms down. On "one," the right knee was raised to meet the right palm; on "two," the right leg returned to beginning position; on "three," the left knee was raised to meet the left palm; on "four," the left leg returned to beginning position.

APPENDIX B

HARVARD STEP TEST RECORD CARD

Last Name	First Name
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Name of Tester

First H. S. T.

Second H. S. T.

1 min. _____

2 min. _____

3 min. _____

Totals _____

Length of exercise in sec. X 100

2 X Sum of pulse counts in recovery