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The Effects of Various Exercise Programs Involving Different Amounts of Exercise on the Development of Certain Components of Physical Fitness.

Ronald F. Kirby
Louisiana State University and Agricultural & Mechanical College

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THE EFFECTS OF VARIOUS EXERCISE PROGRAMS
INVOLVING DIFFERENT AMOUNTS OF EXERCISE ON THE
DEVELOPMENT OF CERTAIN COMPONENTS OF PHYSICAL FITNESS

A Dissertation

Presented to the Faculty of the
Graduate School of Louisiana State University
and Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree
of Doctor of Education

in

The Department of Health, Physical and Recreation Education

by

Ronald F. Kirby
B.S. in Ed., Eastern Illinois University, 1961
M.S. in Ed., Eastern Illinois University, 1963
May 1966
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ABSTRACT

It was the purpose of this study to determine the relative effects of five exercise programs, each involving different amounts of exercise, on the development of physical fitness as measured by the Harvard Step Test and the JCR Test.

Subjects for the study were 140 male students at Louisiana State University in Baton Rouge, Louisiana. The subjects were divided into five groups and performed the following: (1) Group I, basic activity and one isometric exercise; (2) Group II, basic activity, one isometric exercise, and running in place; (3) Group III, basic activity class, one isometric exercise, running in place, and a vertical jump exercise; (4) Group IV, performed push ups in addition to the same exercises as Group III; and (5) Group V, students enrolled in classes devoted entirely to exercising.

The Harvard Step Test and the JCR Test were given at the beginning and at the conclusion of a six week training program. The classes met three times a week.

The t-test for correlated groups was used to determine the significance of the mean gains made by each group on the Harvard Step Test, the JCR Test and for each test item comprising the JCR Test.
Regression lines were studied by using covariance and orthogonal comparisons. This was done to see whether a definite pattern of relationship existed between amount of exercise and changes in physical fitness.

Findings in the study were as follows:

1. In the analysis of mean gains made in the Harvard Step Test, it was found that all of the groups, except Group V, gained significantly in step test performance.

2. When the Harvard Step Test scores were analyzed by covariance and orthogonal comparisons, a significant cubic regression line was evidenced.

3. In the analysis of the mean gains made in the composite JCR Test scores, only Groups I, II, and III made significant improvement.

4. A significant, linear regression line was found for the composite JCR Test scores, which indicated that those subjects who were given the least number of exercises made the most improvement in physical fitness.

5. When each test item of the JCR Test was analyzed, it was found that only Group II had improved significantly in vertical jump performance.

6. In chinning and shuttle run performance, the three groups who exercised the least amount (Groups I, II, and III) made significant gains, whereas Groups IV and V
The following conclusions resulted from this study:

1. Within the limits of this investigation, it appears that cardiovascular efficiency, as measured by the Harvard Step Test, can be significantly improved by engaging in a very few brief, vigorous exercises performed in addition to regular physical education class activities.

2. Cardiovascular fitness may be developed by performing one isometric exercise, in addition to regular physical education class activity, equally as well as by engaging in a physical education activity composed entirely of calisthenics, weight training, and isometric exercises.

3. There is an indication that physical fitness, as measured by the JCR Test, may be improved most effectively by performing a minimum number of very brief, vigorous supplementary exercises, in conjunction with regular physical education class activity, providing those exercises involve total body movement and that maximum effort is exerted while performing them. Furthermore, it may be that it is the intensity of effort applied while exercising, even if it is only a single exercise of but a few seconds duration, that is the major factor in conditioning rather than time spent or number of repetitions and/or number of exercises involved in the exercise program.
CHAPTER I

STATEMENT OF THE PROBLEM

I. INTRODUCTION

Physical fitness has been an objective of physical education since the days of the early Greeks. It was the principle purpose for the birth of the profession in the United States.\(^1\) Despite the fact that there has been considerable debate within the physical education profession as to the degree of emphasis that should be accorded physical fitness, it has always been accepted as one of the major goals of the profession. As would be expected, the degree of interest in physical fitness exhibited by the physical education profession has corresponded quite closely with the interest shown by the general public. The amount of attention given fitness has been somewhat cyclic in nature, being influenced by wars and draft statistics and other social phenomena.

The current interest in physical fitness has been said to have been initiated by the Kraus-Weber report and the subsequent establishment of the President's Council on Youth Fitness by President Eisenhower in 1956.\(^2\)

Similar concern was demonstrated by President Kennedy and carried on by President Johnson by continuing to support the work of the agency and expanding its scope to encompass adult fitness as well. The name of the Council is now the President's Council on Physical Fitness.

However, regardless of the cause for the present interest in physical fitness, many persons are engaging in exercise programs in schools, colleges and universities, health studios, clubs, and in their homes.

Youth has been the pace setter for physical fitness gains, but older Americans are also beginning to flex their muscles. Private business has increased spending for employee recreation programs to more than one billion dollars a year; the Armed Forces have strengthened their physical fitness programs, the exercise books and equipment are enjoying unprecedented popularity.3 Therefore, with this climate of concern for improved physical fitness which has evolved, a logical question arises as to how much exercise is needed in order to produce and maintain an adequate degree of physical fitness. Such a question may seem ludicrous when it is readily apparent, to even the most casual observer, that the physical


education literature is abounding with information in the area of physical fitness. There have been numerous studies reported on constructing tests of physical fitness, and on the contribution of various sports activities, strength building programs, and calisthenics on the development of physical fitness. Nevertheless, very little scientific evidence has been reported on the problem of how much time needs to be spent in exercising and what kinds of exercises are needed to produce significant improvement in physical fitness.

A recent study by Campney and Wehr investigated the claims made in the manual on adult physical fitness, produced by the President's Council on Physical Fitness, wherein it was alleged that by following the recommended program of calisthenics such benefits as increased strength, endurance, coordination, and flexibility would result. On the basis of the findings of their study, Campney and Wehr seriously questioned the effectiveness of the recommended length and intensity of the program of exercise.

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A very important problem thus exists as to the means by which improvement in physical fitness can be realized within certain limitations imposed by available time, equipment and facilities. It is common knowledge that extensive, prolonged training programs, such as those engaged in by varsity athletes and by persons in the armed forces, will produce a high state of physical fitness. But it is also generally recognized that it is beyond the purpose and scope of most physical education programs to achieve this level of fitness, nor is a high degree of fitness necessarily needed for the average person. A popular definition of the general term physical fitness is that it is "a reflection of the person's ability to work with vigor and pleasure, without undue fatigue, with energy left for enjoying hobbies and recreational activities and for meeting unforeseen emergencies." 

This investigation was concerned with the problem of developing physical fitness when limited time, equipment and facilities are factors both in regard to physical education programs and for individuals out of school who take part in unsupervised exercise programs.

In the school situation, the problem of time available for actual teaching and participation in the

\[6\text{Ibid.}\]
skills and activities in a class period is often encountered. Time must be allotted for going to and from class, dressing, showering, roll taking, moving equipment, warm-up and explanations and demonstrations. All these and other factors, regardless of how expeditiously they are accomplished, consume valuable class time. Then, in addition, in order to achieve the objective of physical fitness development, more time must be spent in some type of exercise program. It is recognized by physical educators, that some games and activities are not sufficiently vigorous, in themselves, to make any great contribution toward physical fitness, while others may involve only certain parts of the body, or contribute toward the development of only one phase of fitness. Consequently, supplementary exercises frequently are included. It is therefore vital that the most effective exercises be employed.

Research on the most effective exercises which consume minimal time and yet involve little equipment and space is also urgently needed in the area of adult fitness. Although a program of daily, vigorous exercise for persons in all walks of life would perhaps be ideal, it is simply unrealistic. Some problems of a material nature that are involved include scarcity of space available for sports activities in urban areas, lack of facilities, and high cost of equipment. But even if these formidable problems
could be solved, there exists the human element which looms even larger as an obstacle to regular, rigorous exercise. The human element referred to here includes the feeling by many of the people that work should come before play and in the confines of the normal day's busy schedule, there is the tendency to feel that one does not have the time to set aside regularly for the purpose of exercise. Contributing to the feeling of not having the time to space is the reluctance to force oneself to voluntarily seek exercise during or after a day's work. As a part of this reluctance is the inconvenience involved in having to travel to an exercise area, having to change into clothes for exercising, then showering and changing clothes again and other minor, yet time consuming details that act as deterrants to voluntary participation.

It would be far too ambitious for one study to attempt to solve all the many problems that are involved in the area of physical fitness development in the schools and in the home. However, if it can be shown through scientific investigations that physical fitness can be significantly improved in a relatively small amount of time, entailing little equipment and limited space in which to perform the exercises, then a significant contribution will have been made toward the well-being of the American people.
II. STATEMENT OF THE PROBLEM

The problem was to try to shed more light on the relative effectiveness of various exercises upon the development of selected components of physical fitness. The problem was compounded in that the total time allotted for performing any exercise program would be held to approximately five minutes. This five minute time limit was set up in order to make the data obtained from this study more closely related to the school situations where supplementary exercises are often given in an attempt to accomplish the objective of physical fitness.

Another aspect of the problem was concerned with the writer's intention to have the information also be of conceivable benefit to individuals who desire to improve their physical fitness on their own initiative. With this thought in mind, it was deemed practical to impose further limitations on the methods employed. Thus, in addition to the time factor, exercises had to be of a nature which, while involving as much of the total body as feasible, the exercises would require minimum equipment and need only a very small amount of space in which to perform the exercises.

III. PURPOSE OF THE STUDY

The purpose of the study was to determine the comparative effects of five exercise programs, each
involving different amounts of exercise, on the development of physical fitness as measured by the JCR physical fitness test and the Harvard Step Test.

IV. PLAN OF THE STUDY

The design of the study was as follows: One group of subjects trained by practicing only one exercise, which required the minimum amount of time (ten seconds) to perform; another group performed the same exercise plus an additional one; a third group was given one more exercise in addition to the same exercises given in the second group; and a fourth group performed all of the exercises of the third group, plus one more. A fifth group of subjects was utilized and their program of exercises will be explained later in this section.

The investigator believed that this design for the exercise programs would offer a rather precise and controlled arrangement for analyzing the effects of progressively increasing (or decreasing) the amount of exercises. The four exercises employed were: an isometric exercise; ten-second bouts of running in place; a vertical jumping exercise; and ten-second bouts of push ups. It was not the intent of this study to establish the best exercise, or exercises, for physical fitness development, but merely to employ exercises which would be rigorous and involve as much total body exercise as practical within
the limitations of time, equipment, and space. The rationale for selecting these exercises, as well as their descriptions, is presented in Chapter III.

The aforementioned fifth exercise group was comprised of subjects enrolled in a conditioning exercise class. Their total class participation time, approximately thirty minutes, was spent in exercising—calisthenics, running, weight training, and isometric exercises. It was felt that this group would represent a near maximum proportion of time, devoted to the development of physical fitness, as would be found in a physical education program, or in an individual exercise regime. Therefore, although it was not taught by the investigator, it was included for comparative purposes.

The JCR physical fitness test, composed of a vertical jump, chinning, and shuttle run, and the Harvard Step Test were administered before and after the training program. These measures were used as the criteria of physical fitness. The description and discussion of each measure is presented in Chapter III. The performance in the initial and final tests in each of the test items was analyzed for each group in order to establish whether gains in physical fitness were attained.

V. DELIMITATIONS OF THE STUDY

The scope of the investigation was limited to 140
male students enrolled in physical education activity classes at Louisiana State University during the spring semester of 1965.

Varsity athletes and other students who were currently participating in any type of training program were not included in the study. The subjects were asked to refrain from taking part in any strenuous activities outside of class time, but the writer was not able to directly control this factor. Although efforts were made to provide motivation in order to secure maximum efforts, it was recognized that all subjects were probably not equally motivated.

The training period was limited to an exercise program three days per week for six weeks. A longer period of time, and more frequent exercise bouts, may well have produced different results.

As mentioned previously, the investigation involved only a few conditioning exercises. Since there are so many conditioning exercises and so many variations in the way in which they can be performed, no attempt was made to establish that the exercises used in this study were the best means of conditioning.

The test items used to measure physical fitness are, of course, subject to debate. Many components have been listed as comprising physical fitness. It was not considered to be within the realm of this study to include tests which
purport to measure all of the components, nor to construct and validate a comprehensive physical fitness test. A review of the literature did not reveal any test which claimed to measure all aspects of physical fitness. Therefore, the items used as criteria for physical fitness were recognized, standard tests that had been demonstrated through research as being valid measures of general physical fitness.

The test items employed in the study were considered to represent measures of muscular strength and endurance, cardiovascular efficiency, speed and agility, explosive power and coordination. All of these components have been frequently cited as major components comprising physical fitness.7

VI. DEFINITION OF TERMS

Definitions of terms as they were used in this study are presented below:

Agility is the ability of the body or parts of the body to make quick and accurate changes in direction.8

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Cardiovascular endurance is the ability of an individual's cardiovascular system to adjust and recover from stress exercise. 9

Isometric contraction is the development of tension in a muscle without any change resulting in the length of the muscle. 10

Iso-Kit is an exercise kit comprised of a nylon web belt and two aluminum bars that can be used for a variety of isometric exercises. 11

Iso-Scale is a scale which can be attached to the belt of the Iso-Kit that is unmobilized at one or two ends to be used for measuring the amount of force exerted in an isometric contraction. 12

Muscular endurance is the ability of an individual to continue to make successive muscular movements over an extended period of time. 13

Muscular power is the ability of an individual to

9Ibid.


11Coaches Sporting Goods Corp., Marion, Indiana.

12Ibid.

13Barrow and McGee, loc. cit., p. 117.
make maximum muscle contractions at a very fast pace.\textsuperscript{14}

Muscular strength is the ability of an individual to exert a muscular force against a resistance.\textsuperscript{15}

Speed is the ability of an individual to perform repetitive movements at a rapid pace.\textsuperscript{16}

\textsuperscript{14}Ibid., p. 116.
\textsuperscript{15}Ibid., p. 115.
\textsuperscript{16}Ibid., p. 116.
CHAPTER II

REVIEW OF RELATED LITERATURE

The related literature was divided into two categories: (I) studies reported on the development of physical fitness through certain physical education activities; and (II) studies reported on the development of physical fitness through specific physical fitness exercise programs.

I. STUDIES RELATED TO THE DEVELOPMENT OF PHYSICAL FITNESS THROUGH CERTAIN PHYSICAL EDUCATION ACTIVITIES

Landiss\(^1\) conducted a study designed to compare eight selected physical education activities as to their potential in developing physical fitness and motor ability of students participating in these activities. Elementary courses in swimming, boxing, weight training, tennis, wrestling, volleyball, tumbling-gymnastics, and a basic conditioning program were compared in the study. The physical fitness test consisted of a 300 yard shuttle run, pull ups, and sit ups. The results of the comparisons

indicated that the combined activities of tumbling and gymnastics were most effective in developing motor fitness and motor ability. Tennis, swimming, and boxing ranked the lowest of the other activities.

A study reported by Campbell\(^2\) attempted to determine the effects of supplementing several varsity squads' conditioning programs with weight training in the development of physical fitness. The basketball, football, and track squads were used in this study. Each squad was divided into two matched groups: one group engaged in weight training during the first half of the season and the other group had weight training during the last half of the season. Both groups continued their regular training programs all season. It was concluded that the addition of weight training to the regular training program produced a significantly greater increase in physical fitness than did their regular training program.

In a study by Davis\(^3\), an attempt was made to analyze the effects of training and conditioning for the 200 yard crawl stroke event upon the physical condition of non-


varsity swimmers. Selected measures of cardiovascular condition, general physical fitness, gross strength, motor fitness, strength of muscle groups used primarily in the crawl stroke, and the strength measures of the involved muscles were taken. It was found that the scores on the test batteries used to measure physical fitness, motor fitness, and gross strength improved significantly. There was no significant difference found in the cardiovascular measures.

Estes^4 conducted a study to determine the effects of a program of creative activities performed on selected play equipment on the development of muscular fitness of third grade children. The equipment included an improvised horizontal ladder, modified parallel bars, balance beams, balance poles, doorway gym bars, a rope, and a Swedish vaulting box. The creative play program consisted of basic stunts and activities which were presented and then followed by opportunities and encouragement for the subjects to invent and improvise their own new activities. The following conclusions were drawn from the study: (1) a creative activity program can cause a significant increase in muscular fitness; (2) arm and shoulder strength was

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^Mary M. Estes, "The Role of Creative Play Equipment in Developing Muscular Fitness," Microcarded doctoral dissertation, State University of Iowa, 1959, pp. 73-84.
improved; (3) static balance, as measured by the Stork Test was improved; and (4) flexibility of the girls was better than that of the boys.

Knuttgen and Steendahl\(^5\) studied the effects of the Danish physical education program on the development of physical fitness. The AAHPER Youth Fitness Test and a test of circulo-respiratory fitness were employed as measuring devices in the study. It was concluded that: (1) Danish school physical education programs had definite positive effects on fitness and (2) the outdoor parts of the program were effective in the development of circulo-respiratory fitness.

The purpose of a study conducted by Keough\(^6\), was to investigate the effects of a daily program and the effects of a two-day-a-week program upon the motor fitness of third and fifth grade children. The daily program lasted four weeks and the two-day-a-week program lasted ten weeks so that both groups actually spent the same amount of time in class. The Iowa Test of Motor Fitness was used as the measure of motor fitness. The


\(^6\)Betty J. Keough, "The Effects of a Daily and Two Day Per Week Physical Education Program Upon Motor Fitness of Children," Microcarded doctoral dissertation, State University of Iowa, 1962, pp. 130-140.
conclusions of the study were: (1) a well planned and balanced physical education program resulted in a significant increase in the motor fitness level of both grades; and (2) the two-day-a-week program was found to be equal to the daily program in developing physical fitness.

In a study by Wilbur, a comparison of the effects of two programs of activities on developing physical fitness was made. One of the programs consisted of work on gymnastic apparatus and the other program consisted of instruction and participation in a variety of sports. A test battery of chins, dips, baseball throw for distance, jump and reach, bar snap for distance, a 440 yard run, and a dodging run was used as the measure of physical fitness. The conclusions of the study were as follows: (1) the sports program was superior to the apparatus method for developing physical fitness; (2) the sports program was better for developing arm and shoulder girdle strength, body coordination, agility, and control; (3) the two programs were found to be equal for improving leg speed and leg strength; and (4) there was no significant difference between the two programs in the development of

endurance.

Fabricius conducted a study to determine if there was any significant difference in the development of physical fitness in students who participated in a normal physical education curriculum and a normal physical education curriculum with added emphasis on calisthenic activities. The subjects were eighty boys and eighty-two girls who met in physical education classes four times a week for thirty minute periods. The Oregon Motor Fitness Test was used to measure physical fitness in this study. The conclusions of the study were: (1) fourth grade girls and boys improve in physical fitness as a result of participation in this elementary school physical education program; and (2) fourth grade boys and girls improve in fitness, as measured by the Oregon Motor Fitness Test, to a greater degree when five or six calisthenics are added to the program than a program without the extra calisthenics.

Wrightstone, in another study similar to Wilbur's, tried to discover the differences between the sports type

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program and the formal drill program in developing physical fitness. The Roger's battery of physical capacity tests was used and it was found that the sports type program was significantly superior.

Wireman\textsuperscript{10} attempted to study the relative effectiveness of four different approaches to increasing physical fitness as measured by the Indiana Motor Fitness Test. The different groups followed one of the following programs throughout the training period: (1) calisthenics, games and sports with a periodic knowledge of results; (2) calisthenics, games and sports without a knowledge of results; (3) games and sports with a periodic knowledge of results; and (4) games and sports without a knowledge of results. It was concluded that knowledge of results have more effect on the development of physical fitness than does fifteen minutes of calisthenics at the beginning of each class.

Black\textsuperscript{11} investigated that effects of weight training on the development of physical fitness as measured by the Roger's Physical Fitness Battery. High school boys were


used as subjects and it was found that progressive weight training increases physical fitness index scores significantly.

In a study by Harkness, the contributions of the physical education program and the Air Force ROTC program were investigated. Phillips' JCR Test was used as the measure of physical fitness in the study. It was concluded that physical education activity courses contributed significantly more to the development and maintenance of physical fitness in college students than did the Air Force ROTC program at this same college.

A study by Magnusson was conducted in order to determine the effects of a specific stunts activity program on muscular fitness of third and fourth grade children of low muscular fitness status. The conclusions of the study were: (1) boys are superior to girls in the measures except for flexibility; (2) a stunt type program over a short period of time can increase muscular fitness; and (3) a stunt type program can be significantly effective in increasing arm and abdominal strength.

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Beyer\textsuperscript{14} investigated the effects of rhythmic gymnastics on the development of physical fitness of college women. The program involved a total of twenty lesson-periods for each of two groups. Group I met twice a week for ten weeks and Group II met four times a week for five weeks. It was found that significantly greater gains in physical fitness status resulted from the five week program over those of the ten week program.

MacKenzie\textsuperscript{15} studied the effects of several programs of physical activities on the development of physical fitness. The activities studied were: abdominal class, low physical fitness class, gym class, swimming, wrestling, track, cross-country, football, hockey, and basketball. It was concluded that the cross-country group seems to be the best part for all around development and the individual programs low physical fitness group are the best type of exercise for strength development.

Carter\textsuperscript{16}, also studied the effect of various

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activities on the development of physical fitness. The subjects were 263 students who were chosen from classes of badminton, general basic activity, basketball, body conditioning, bowling, fencing, folk dance, and swimming. It was found that all of the classes contributed to the improvement of some physical fitness elements. None of the classes contributed to the development of speed of a dodging nature as measured in an agility test. The general basic activity class was ranked highest among the classes.

Ball\textsuperscript{17} studied the relative effect of participation in modern dance, basketball, and skiing on physical fitness development and on a strength index. It was found that skiing made the greatest contribution to physical fitness and strength development. Modern dance was second and basketball was third.

In a study by Carr\textsuperscript{18}, three programs were compared in the development of physical fitness and in badminton achievement. The three programs were as follows: a five minute isometric program and the rest of the period of badminton; a fifteen minute progressive conditioning

\textsuperscript{17}Ann E. Ball, "The Effect of Participation in Certain Physical Education Activities upon the Strength Index and Physical Fitness Index of College Girls," (unpublished Master's Thesis, Syracuse University, Syracuse, 1946), p. 16.

programs and the rest of the period in badminton; and the third program consisted of badminton only. The elements of physical fitness studied were: endurance, flexibility, agility, arm-shoulder strength, and abdominal strength. It was concluded that the addition of isometrics and conditioning exercises will aid in maintaining and increasing the physical fitness level but not necessarily more than a regular badminton class.

Lee\(^9\) conducted a study on the effects of certain programs of exercise upon performance in the Tuttle Pulse Ratio Test. The results failed to reveal any significant gain in the cardiovascular measure. The following exercises were included in the study: swimming, badminton-tennis, modern dance or Danish gymnastics.

II. STUDIES RELATED TO THE DEVELOPMENT OF PHYSICAL FITNESS THROUGH SPECIFIC PHYSICAL FITNESS EXERCISE PROGRAMS

In this section of related literature, the writer attempted to discuss only those studies which dealt

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specifically with physical fitness exercise programs.

Hughes\textsuperscript{20} reported the test results of the University of Michigan conditioning program for three months of 1942. The purpose of the study was to determine the benefits of the program as measured by: grip strength, pull ups, push ups, vertical jump, standing broad jump, 60 yard sprint, and a 440 yard run. There were 1041 subjects tested and the following conclusions were reported: (1) that a well planned conditioning program produced an acceptable degree of physical condition in a period involving four and one-half hours per week for sixteen weeks; (2) that a program of three hours per week for sixteen weeks produced only sixty-nine percent as much gain as the four and one-half hours per week; (3) that a total average gain of about twenty percent was directly attributable to the program of conditioning.

Kusinitz and Keeney\textsuperscript{21} studied the effects of weight training on the health and physical fitness of adolescent boys. The subjects were divided into two groups of twenty-


three boys each. One group, known as the experimental group, participated in an eight week progressive resistance training program. The other group, the control group, took part only in a regular physical education activity program. At the completion of the eight weeks, it was found that the experimental group had increased their ability to do pull ups, push ups, the Harvard Step Test, dodge run, burpee test and trunk extension and flexion. The control group improved in the dodge run, burpee test, push ups, and trunk extension, however, the experimental group's gains exceeded those of the control group in all areas.

In a study by Kistler\textsuperscript{22} involving 1650 men, the effects of eight weeks participation in a physical fitness program were investigated. The class periods were thirty minutes in length and were composed of eight minutes of calisthenics, and five minute bouts of exercise devoted to all-out chinning, obstacle course running, personal combat activities, and running. The physical fitness test items used in the study were: (1) a five minute run for distance; (2) an obstacle course run for time; (3) push ups; (4) chin ups; and (5) sit ups. It was concluded that a significant improvement in certain physical fitness

elements can be achieved through a specific training program devoted to the physical fitness elements.

Sills\textsuperscript{23} conducted a study concerning the effects of special conditioning exercises on students with low physical fitness scores. Thirty-three male freshmen who had made low scores on physical fitness tests when they entered the University of Iowa were placed in a special conditioning exercise class. Their progress was tabulated for one semester and compared with the progress made by another thirty-three students who took part in the regular activity program. It was found that greater gains in physical fitness level can be achieved by the low level student if he is provided an opportunity to take part in a special program of conditioning exercises.

Cureton\textsuperscript{24} reported a study on the improvement in chinning, dipping, vertical jumping, and a composite weighted score as a result of physical education and physical fitness clinic work. In the first and second semesters of 1940-1941, 2600 subjects were tested and the students (154) who were in the lower 20th percentile were


\textsuperscript{24}T. K. Cureton, "Improvement in Motor Fitness Associated with Physical Education and Physical Fitness Clinic Work," Research Quarterly, 14:154-157, May, 1943.
placed in a physical fitness clinic. The other students remained in the regular physical education classes. The retest was given in 1941-1942 and it was found that the students in the regular physical education classes had:

- increased chinning ability 27.95 percent;
- vertical jumping ability increased 2.75 percent;
- dipping ability increased 49.30 percent;
- and the composite score increased 6.78 percent as compared to 33.96 percent by the group in the physical fitness clinic.

Weiman\(^25\) reported some results of the Army Specialized Training Program. The program consisted of six hours per week for two weeks under conditions providing for regularity in food and sleep. The activities stressed were aquatics, gymnastics, military track, combatives, and team sports. The test items used in the study were push ups, sit ups, squat jumps, pull ups, squat thrust, 300 yard shuttle run, and a 100 yard run. It was found that the training program produced a reasonably uniform average improvement in physical fitness as measured by these selected test items.

In a study by Johnson\(^26\) the effectiveness of a


military athletic course was investigated. The military athletic course was designed to provide vigorous conditioning activities to better prepare students for the armed forces during World War II. The course included two or three different exercises for each of the following main divisions: (1) jumping; (2) throwing; (3) climbing; and (4) running. Johnson stated that, "It was difficult to evaluate statistically the full effect of a military athletic program because the percentages of withdrawals was great. However, statistical analysis indicated considerable improvement in physical condition for those who completed the course."

Watt\textsuperscript{27} conducted a study in which the purpose was to determine the effects of two different methods of instruction on the development of physical fitness of low fitness men. One group participated in a circuit training program and the other group was in the regular developmental exercise program at the University of Oregon. The conclusions of the study were: (1) significant gains in physical fitness can be made by both methods of training; (2) the most significant gain was made in cardio-respiratory improvement as measured by a 300 yard shuttle run; and (3)

\textsuperscript{27}Norman S. Watt, "The Comparison of Two Methods of Physical Fitness Training in Low Fitness Males at the University of Oregon," (microcarded Master's Thesis, University of Oregon, Eugene, 1961), pp. 41-45.
the least improvement as a result of either program of exercise was found in pull ups.

In a study by Bilik a developmental program was investigated to determine its value with substandard physical fitness students. The program consisted of isometrics and isotonic exercises and were held for a period of five weeks. The Roger's Physical Fitness Index was used as the measure of physical fitness. It was found that both isometrics and isotonics caused significant increases and that there was no significant difference between the two methods of exercise.

Wright studied the effects of an exercise class on the physical fitness status of adult women. The class met once a week for two hours for fourteen weeks and performed general bodily exercises. The case study method of research was used in the study. There were ten subjects in the experimental group and five in the control group. The exercise program consisted of an hour of calisthenics and running and an hour of voluntary swimming. Significant


gains were found in the eighteen item motor fitness test as a result of the exercise program.

The purpose of a study by Banister was to investigate some of the current fitness training methods. Four groups of boys fourteen to sixteen years of age were equated on the basis of their scores on McCloy's Classification Index, Larson's Strength Test, and the Harvard Step Test. The training programs were as follows: (1) interval circuit training with emphasized maximum resistances and endurance running; (2) conventional circuit training with endurance running; (3) conventional circuit with games and activity; and (4) playing games only. Gains were made by each group when retested two months later. It was concluded that the group which had performed the maximum resistance exercises and endurance running superior over the other three groups.

Campney and Wehn studied the effects of calisthenics which were advocated by the President's Council on Physical Fitness. There was a ten week training period for nineteen subjects. It was concluded that the Council's Program is

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not likely to produce significant improvements in any physical fitness component except flexibility. No significant improvements were made in strength, endurance, coordination, efficiency of men or general appearance as measured by total body weight and segmental girths.

III. SUMMARY OF RELATED LITERATURE

A review of the related literature revealed that sport's activity programs do contribute significantly in physical fitness development. Some studies did conclude that certain activities are better than others in developing physical fitness. Sports programs were found superior to a gymnastic apparatus program and a formal drill program.

The related literature concerned with weight training and isometrics were also in general agreement. It was concluded in several studies that weight training and isometric programs do develop physical fitness.

The reviewed literature related to specific physical fitness programs produced about the same results. It was found that specific fitness programs such as a Physical Fitness Clinic, calisthenics, military programs, and circuit training do bring about significant increases in physical fitness.
CHAPTER III
DESCRIPTION OF PROCEDURE

I. OUTLINE OF THE STUDY

This study was conducted at Louisiana State University in Baton Rouge, Louisiana during the spring semester of 1965. A total of 140 male students were placed in five equal groups. Each group followed their own exercise program during a six week training period. The JCR Fitness Test and the Harvard Step Test were used as measures for determining physical fitness. The significance of the difference between the means and the analysis of co-variance techniques were used in analyzing the data.

II. SELECTION AND ORGANIZATION
OF THE SUBJECTS

Subjects for the study were drawn from the men's physical education activity classes at Louisiana State University. The subjects were divided into five groups as follows: Group I contained students who were participating in regular activity classes but were given one isometric exercise; Group II was comprised of students who were participating in regular activity
classes, performed one isometric exercise, and also exercised by running in place; the subjects in Group III had the isometric exercise, running in place and also performed a vertical jump exercise in addition to participation in the regular activity classes; Group IV was composed of students participating in regular activity classes and performed push ups in addition to the same exercises as Group I, II, and III; and Group V was composed of those students who were enrolled in the conditioning exercise classes.

The subjects were assigned to the five groups stated above in the following manner. The first four groups were randomly selected from the basic activity classes. The investigator assigned the subjects to the groups in such a manner that an approximately equal number of subjects from each of the different physical education activities were placed in each experimental group in order to counteract any conditioning effects that any activity might produce. The fifth group was composed of students from special conditioning exercise classes. The students for these classes were not necessarily of low fitness nor were they assigned to the classes on the basis of any examination.

The subjects in the conditioning exercise classes numbered thirty-five at the time of initial testing, but due to resignations and various other reasons there were
only twenty-eight at the end of the training program. Each of the other groups started out with approximately forty subjects per group and at the conclusion of the testing there were thirty, thirty-one, thirty-one, and thirty-two subjects left in Groups I, II, III, and IV respectively. For the purpose of statistical analyses some subjects in each of these four groups were eliminated by use of a table of random numbers, resulting in a total of twenty-eight subjects in each group.

Those students who were members of any of the intercollegiate athletic teams or those students who had any physical disabilities were automatically eliminated from taking part in the study.

III. FACILITIES AND EQUIPMENT

The gymnasium of Louisiana State University served as the center for this study. The main floor of the gymnasium was used as the testing center. A special room in the gymnasium was used to conduct the training program.

The equipment used in this study consisted of a stop watch, four iso-scales, eight iso-belts, four iso-platforms, two bankboards 2" x 12" x 6', two vertical jump scales, a horizontal bar and benches for the step test.
IV. CRITERIA FOR THE SELECTION OF THE TEST ITEMS AND CONDITIONING EXERCISES

The following criteria were used in selecting the test items for this study:

1. The tests must have been validated and have had their reliability coefficients established.
2. The test items must not require a great amount of time to perform.
3. The test items should not involve a great deal of equipment.
4. The test items should not be too difficult to administer in order to avoid the need of extensive training of testers.
5. The tests should be accompanied by standardized scoring tables.

The following criteria were used in the selection of the conditioning exercises:

1. The exercises could not require a great deal of time to perform due to the fact that the subjects were from activity classes.
2. The exercises must not require a great deal of equipment for each performer due to the large number of subjects.
3. The exercises should be strenuous and still be capable of being performed in a few minutes.
4. The exercises should involve as much of the total body in exercise rather than a concentration on specific parts of the body.

5. The exercises must be able to be performed simultaneously by several subjects, and at the same time, be of a nature which allows the subjects to keep a personal record of their progress.

V. TEST ITEMS AND TESTING PROCEDURES

The physical fitness test items were administered during the last four days of the first grading period and again during the last four days of the second grading period. There was a six week training interval between the pre-test and the post-test.

The Harvard Step Test and the JCR Test were given on separate days. The Harvard Step Test was given the first two days of testing and the JCR Test was given during the next two days.

JCR Test

The JCR Test is composed of three items: vertical jump, chinning, and a shuttle run. The test was developed by Phillips\(^1\) in 1946 as a measure of the basic elements

of power, strength, speed, agility, and endurance. The reliability of the test is high. The reliability coefficients reported by Mathews\(^2\) are .91 and .94 in two separate studies involving 135 men each. The validity of the test was originally determined by a multiple correlation with 25-variable criterion which resulted in a coefficient of .81. In another study between the JCR and a 19-variable criterion of physical fitness, a coefficient of .90 was reported. One other study has reported a corrected r of .78 between it and the AAF motor fitness test.

The JCR test was administered according to the directions provided by Phillips.\(^3\) An introductory statement about the nature of the JCR Test was given. Then an explanation and demonstration of the correct form and scoring methods for each of the individual test items was given. Score cards were also given to each subject before the testing began.

As another aid in the administration of the JCR Test, the subjects were divided into three subgroups: one group started at the vertical jump test station; one group at the chinning test station; and the other group


\(^3\)Phillips, loc. cit.
at the shuttle run test station. Each group rotated in a prescribed manner. The same procedure was followed for each subgroup in the post-test so that the order of test items would not affect any individual's test results.

**Vertical Jump Test**

A graduate assistant from Louisiana State University's basic physical education program served as the tester for the vertical jump test. A reliability study, by the test-retest method was performed before the initial test was given. The reliability coefficient for the vertical jump test was .95.

For the vertical jump, the subject stood with one side against the wall and then reached as high as he could with the hand nearest the wall. This height was recorded on the score card. The subject powdered his fingers and jumped, trying to touch as high up on the wall scale as he could. This height was marked on the scale by the powder. The score for the vertical jump was the difference between his standing reach height and the highest point on the wall that he touched when jumping. The best jump of three trials was used as the subject's vertical jump score. The score was recorded in inches and then converted to standard scores by use of the tables provided.

**Chinning Test**

A faculty member from Louisiana State's basic
activity program administered the chinning test. A test-retest reliability study revealed a reliability coefficient of .94.

For the chinning test, the subject jumped up and hung from a horizontal bar with the palms-forward grip. He then pulled himself up until his chin was above the level of the bar. The subject then lowered himself so that his arms were fully extended. He continued in this manner as many times as he could until he was no longer able to raise his chin above the level of the bar. Swinging, kicking, or resting was not permitted. The score for chinning, was the number of complete chins performed. Partial chins or faulty chins were not counted. The scores were converted to standard scores by use of the tables provided.

**Shuttle Run Test**

The writer was in charge of administering the shuttle run test. A reliability coefficient of .90 was found by the test-retest method on the shuttle run tester.

The subject began the shuttle run with one foot against the bankboard and ran straight ahead for ten yards to touch the other bankboard. The subject continued in this manner until he had completed five round trips for a total of 100 yards. The subject was required to touch the
bankboards at both ends at all times except during the last round when the subject ran through the starting line. Bankboards 2" x 12" x 6' were stationed at each end at an angle of 40 degrees with the floor to aid the subjects in making the 180 degree turn. The score for the shuttle run was the time it required the subject to complete the five rounds. The score was recorded to the nearest tenth of a second and then converted to standard scores according to the tables provided.

**Harvard Step Test**

The Harvard Step Test was developed by Brouha during World War II. The test was devised for measuring cardiovascular condition. Brouha, Fadd, and Savage tested 2200 male college students for endurance in treadmill running, blood lactate level, maximum heart rate per minute, and the Harvard Step Test. It was found that: athletes out-performed nonathletes; that with additional training their scores increased; and with a termination of training the scores decreased. Taddonic and Karpovich

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conducted another validity study on the Harvard Step Test and found a coefficient of .63 between the test and the order in which they finished a cross-country race. McCloy states that "The type of physical condition measured by the Harvard Step Test is significantly related to a type of physical condition that might be held highly desirable for the average citizen."

The Harvard Step Test was administered according to the directions provided by Weiss and Phillips in their textbook Administration of Tests in Physical Education. An introductory statement was given about the nature of the Harvard Step Test. An explanation was provided next, followed by a demonstration of the correct test procedure. The students were each given their own score card and a pencil. The group was then divided into two or three subgroups depending upon the size of the group to be tested during that session. The test was administered to one group at a time. The writer called out the proper cadence


during each test. Two other faculty members with stop
watches stood by in case a subject was forced to stop
before the five minutes were completed.

The subjects stood facing a twenty inch high bench
with both feet on the floor. At the signal to begin, the
subjects placed one foot on the bench and then the other
foot. They stepped down in the same manner, one foot at
a time, and continued to a cadence of thirty steps per
minute for five minutes, or until they could continue
no longer.

The pulse counters for the step test were composed
of faculty members, graduate assistants, graduate students,
and the participants. Preceding each testing session, the
pulse counters were given an explanation and a demonstration
of the correct methods involved in taking the pulse. This
explanation and demonstration was followed by practice
sessions in taking the pulse. A test-retest study resulted
in a reliability coefficient of .95 for a randomly selected
group of pulse counters. Two individual pulse counts were
taken for each subject: one count at the wrists and one
count at the neck by the subject himself. The pulse counts
were taken and recorded during the following periods:
one minute to one and one-half minutes after cessation of
stepping; two to two and one-half minutes after cessation
of stepping; and from three to three and one-half minutes
after cessation of stepping. The two separate counts were then summed up for the three periods during which they were taken. The average of the two separate counts were computed next and recorded as the subject's score. This recorded score was then converted by utilizing the formula:

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\text{Score} = \frac{\text{Duration of Stepping in Seconds} \times 100}{2 \times \text{Sum of Pulse Counts in Recovery}}
\]

VI. TRAINING PROCEDURE

The training period consisted of exercises three days per week for six weeks. The only interruption in the period of training was for the Easter holidays when classes were dismissed on Thursday, Friday, Saturday, and Monday of the following week. This meant that each person missed two work outs during the Easter holidays. Each subject performed the supplementary exercises either before or after each class period. In all but a few cases, the subjects reported to the exercise room about ten minutes before class time. The time required to perform the exercises ranged from approximately thirty seconds to five minutes depending upon the exercise group to which the subject was assigned. The subjects were required to chart their progress everyday by marking their scores on a large worksheet posted on the wall of the exercise room.
VII. DESCRIPTION OF EXERCISES

Groups I, II, III, and IV performed the following exercises according to the system explained at the beginning of this chapter.

**Isometric Exercise**

This exercise utilized the following pieces of equipment: a wooden platform, two aluminum bars, two nylon iso-belts, and an iso-scale. The last three items are components of the iso-kit. The platform, constructed by the investigator, measured 17" x 12" in surface area and was elevated off the floor by 3" boards nailed to each side. In the middle of each side support, a notch 2" x 2" was cut to allow one of the bars to be inserted under the platform. In addition, the side supports were extended five inches in front and uprights were nailed to these to serve as a support for the bar used in the curl exercise when not in use. The equipment is pictured in Appendix A.

In performing the exercise the subject stood on the platform with his feet placed about shoulder width apart. The knees were bent at an angle of approximately 120 degrees; the back was kept straight and parallel to the floor; the subject's arms were held close to his sides with forearms

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9Iso Kit, Coaches Sporting Goods Corporation, Marion, Indiana.
extended forward, thus making an angle of about 90 degrees at the elbow. His hands were turned palms-upward in order to grasp the second bar for the curl exercise.

For the leg-lift part of the exercise, one iso-belt was attached at both ends of the belt to the bar that was placed under the platform. A loop was thus formed which was positioned across the back of the subject's hips. It should be pointed out that the belts consisted of a series of loops in which the aluminum bars could be inserted. Consequently, adjustments could be made for variations in the subject's height by inserting the bottom bar through a higher or lower loop on the belt. The iso-scale which measures pounds of force exerted, was attached to this belt to provide a measure of progress for the subjects throughout the training program. Each subject recorded his score on the worksheet after every training session.

The curl position of the exercise was accomplished in the following manner. One end of the second belt was attached to the bar under the platform. The belt ran up the front of the platform and the second bar was inserted in a loop of the belt at a height best suited for the size of the subject.

The actual exercise entailed the subject attempting to straighten his legs and at the same time forcibly trying to curl the bar in his hands up toward his chest. Although this exercise has been described as a combination
leg lift and arm curl, it actually involved the muscles of the wrists, forearms and back extensors as well as the leg extensors and the shoulder and arm flexor muscles. Therefore, it was felt that this represented a total body exercise, inasmuch as any single static type exercise is able to do.

The duration of the exercise was for ten seconds. The investigator continually stressed to the subjects that they must exert as hard as possible in order for the exercise to be of value. Actually the exertion was not maximum for the full ten seconds; the first two or three seconds were spent in a gradual build up to maximum effort, then greatest exertion was held for approximately five or six seconds and the remaining seconds were allotted for a gradual release of contraction.

Four of these isometric stations were set up in the exercise room. Each person was assigned to a specific station at which he exercised during the entire study. This was done for two reasons: one, the subjects were assigned to a specific isometric exercise station according to height which greatly reduced the amount of individual adjustments of the belts; a second reason was for greater reliability of scores, since each person used only one scale, the possible variability among different scale readings was avoided.

One further procedure was involved which proved to be time-saving. The nylon beltloops were numbered and
and each subject was instructed to record the particular loop number, best suited for his stature, for the leg lift belt and the arm curl belt in order to eliminate the trial-and-error method of obtaining the correct adjustment each time.

An illustration of a subject performing the isometric exercise is provided in Appendix B.

Running in Place Exercise

The running in place exercise consisted of three ten-second bouts of running. A ten-second rest period was given between each bout. The subject was instructed to just barely lift his feet off the floor while running. This was done to avoid variations in height of leg lift, and the inevitable slowing down toward the end of a bout. It was believed that the person could move his feet much faster with this procedure, thereby giving the subject a more vigorous workout. The subject counted the total number of times his right foot hit the ground, as accurately as possible, and this score was recorded on the worksheet after every workout.

Vertical Jump Exercise

The vertical jump exercise consisted of jumping approximately twelve inches higher than the subject could reach. The subject faced a wall, reached as high as he could, then jumped, touching a point on the wall about
twelve inches above his reach with one hand. The exercise was performed as rapidly as possible for thirty seconds. The subject counted the number of times he touched the wall during the thirty second exercise period. This score was recorded every session.

**Push Up Exercise**

The push up exercise was performed during two ten-second bouts. A ten-second rest was given between bouts. The writer did not try to enforce a rigidly prescribed form while doing the push ups. This was done in an attempt to provide as vigorous a workout as possible and to take into account the fact that some subjects would not be able to perform push ups in the correct manner for the full time and would therefore spend some of the allotted time lying prone. The score was the number of up movements accomplished in the two ten-second bouts. As with the previous exercises, this number was recorded each day to serve as a progress measure.

Group V, which consisted of students from the conditioning exercise classes, followed a planned program of calisthenics, weight lifting, isometrics, and running. This group met approximately thirty minutes each session three times a week for six weeks. This was the only group which was not under the direct control of the writer.
VIII. STATISTICAL PROCEDURES

The Computer Research Center of Louisiana State University was used for most of the computations involved in analyzing the data for this study.

For each group, the significance of the difference between the initial and final means was computed for each of the different variables in order to establish whether significant gains had been made in the various measures of physical fitness.

Analysis of covariance with orthogonal comparisons was then employed to determine whether any significant regression could be found, and if so, the nature of the regression line, between amount of exercise assigned to the different training groups and amount of improvement in physical fitness, as measured by the Harvard Step Test and the JCR Physical Fitness Test.
CHAPTER IV

ANALYSIS AND PRESENTATION OF THE DATA

I. ANALYSIS OF GAINS MADE FROM INITIAL TO FINAL TESTS FOR EACH EXERCISE GROUP

The data were first analyzed to determine the differences between the initial and final means for each group on the Harvard Step Test and the three items and composite score of the JCR Test. The t tests were computed by using the formula for the significance of the difference between correlated groups. The results of these comparisons are shown in Tables I through V.

**Harvard Step Test**

For each group of twenty-eight subjects, a t of 2.05 was needed to be statistically significant at the .05 level and 2.77 at the .01 level of probability.

Groups III and IV, the students who performed the isometric exercise, running in place and the vertical jump, plus push ups for the latter, showed significant improvement. Group III had a difference between the initial and final Harvard Step Test means of 5.93, and Group IV's difference between the initial and final means was 6.46. The t's were computed and found to be 3.69 for Group III and 4.38 for Group IV and therefore both were significant at the
.01 level.

Two other groups improved significantly at the .05 level of probability. Group I, who performed the isometric exercise only, and Group II, who performed running in place in addition to the isometric exercise, had observed differences of 5.32 and 3.32, respectively. The t for Group I was 2.27 and for Group II, 2.28.

As shown above by the t's for Groups I through IV, it was indicated that these exercise programs produced significant improvement in physical fitness as measured by the Harvard Step Test.

Group V, those students who performed conditioning exercises during the whole class period, showed only very slight improvement in their test scores, which was not statistically significant. The data for the Harvard Step Test scores are presented in Table I.

JCR Composite Score

Group I (isometric exercise), Group II (isometric exercise and running in place), and Group III (isometric exercise, running in place, and a vertical jump exercise) all improved significantly in their composite scores at the .01 level of probability. The differences between the initial and final means for these three groups were 10.68, 12.61, and 9.64, respectively. The resulting t's were 3.72 for Group I, 6.05 for Group II, and 5.16 for Group III.
## Table I

**Comparison of Initial and Final Mean Standard Scores on the Harvard Step Test for 140 College Men Who Participated in the Five Exercise Programs**

<table>
<thead>
<tr>
<th>Item and Group</th>
<th>Initial Mean</th>
<th>Final Mean</th>
<th>Diff</th>
<th>SE Diff</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I</strong></td>
<td>28</td>
<td>81.75</td>
<td>87.07</td>
<td>5.32</td>
<td>2.34</td>
<td>2.27</td>
</tr>
<tr>
<td><strong>II</strong></td>
<td>28</td>
<td>79.00</td>
<td>82.32</td>
<td>3.32</td>
<td>1.46</td>
<td>2.28</td>
</tr>
<tr>
<td><strong>III</strong></td>
<td>28</td>
<td>80.36</td>
<td>86.29</td>
<td>5.93</td>
<td>1.61</td>
<td>3.96</td>
</tr>
<tr>
<td><strong>IV</strong></td>
<td>28</td>
<td>81.04</td>
<td>87.50</td>
<td>6.46</td>
<td>1.48</td>
<td>4.38</td>
</tr>
<tr>
<td><strong>V</strong></td>
<td>28</td>
<td>82.96</td>
<td>83.43</td>
<td>0.46</td>
<td>2.54</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Group I: Isometric exercise
Group II: Isometric exercise and running in place
Group III: Isometric exercise, running in place, and a vertical jump exercise
Group IV: Isometric exercise, running in place, a vertical jump exercise, and push ups
Group V: Conditioning exercises whole period

$t$ needed for significance at .05 level, 2.05; for .01 level, 2.77.
Group IV (isometric exercise, running in place, a vertical jump exercise, and push ups) and Group V (conditioning exercises for whole class period) showed some improvement in their composite test scores as evidenced by observed differences between the means of 4.57 for Group IV and 1.82 for Group V. However, the resulting $t$-ratios of 1.51 and 0.66 for Groups IV and V, respectively, did not reach significance at the .05 level of probability. The data for the JCR Composite Test Scores are presented in Table II. The gains for each group in each of the three tests making up the composite score were then analyzed separately.

**Vertical Jump Test**

In the vertical jump test, only one group improved their test scores significantly. Group II (isometric exercise and running in place) had a $t$ of 2.33 for the mean gain of 4.50 and this was significant at the .01 level of probability. The $t$ needed for the .05 level was 2.05 and it can be seen that the gains for Group I (isometric exercise only) almost reached significance with a $t$ of 2.00.

For Groups II, IV, and V, the $t$'s were 0.17, 0.20, and 1.23, respectively. The difference between the initial and final means for the above three groups in order were 0.21, 0.25, and 1.50. The data for the Vertical Jump
TABLE II
COMPARISON OF INITIAL AND FINAL MEAN STANDARD SCORES OF THE JCR COMPOSITE SCORE FOR 140 COLLEGE MEN WHO PARTICIPATED IN THE FIVE EXERCISE PROGRAMS

<table>
<thead>
<tr>
<th>Item and Group</th>
<th>N</th>
<th>Initial Mean</th>
<th>Final Mean</th>
<th>Diff</th>
<th>SE Diff</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>28</td>
<td>168.71</td>
<td>179.39</td>
<td>10.68</td>
<td>2.87</td>
<td>3.72</td>
<td>.01</td>
</tr>
<tr>
<td>II</td>
<td>28</td>
<td>167.75</td>
<td>180.36</td>
<td>12.61</td>
<td>2.08</td>
<td>6.05</td>
<td>.01</td>
</tr>
<tr>
<td>III</td>
<td>28</td>
<td>173.79</td>
<td>183.43</td>
<td>9.64</td>
<td>1.87</td>
<td>5.16</td>
<td>.01</td>
</tr>
<tr>
<td>IV</td>
<td>28</td>
<td>187.21</td>
<td>191.79</td>
<td>4.57</td>
<td>3.02</td>
<td>1.51</td>
<td>---</td>
</tr>
<tr>
<td>V</td>
<td>28</td>
<td>181.07</td>
<td>182.89</td>
<td>1.82</td>
<td>2.76</td>
<td>0.66</td>
<td>---</td>
</tr>
</tbody>
</table>

Group I Isometric exercise
Group II Isometric exercise and running in place
Group III Isometric exercise, running in place, and a vertical jump exercise
Group IV Isometric exercise, running in place, a vertical jump exercise, and push ups
Group V Conditioning exercises whole period

* t needed for significance at .05 level, 2.05; for .01 level, 2.77.*
Test Scores are presented in Table III.

**TABLE III**

**COMPARISON OF INITIAL AND FINAL MEAN STANDARD SCORES ON THE VERTICAL JUMP TEST FOR 140 COLLEGE MEN WHO PARTICIPATED IN THE FIVE EXERCISE PROGRAMS**

<table>
<thead>
<tr>
<th>Item and Group</th>
<th>N</th>
<th>Initial Mean</th>
<th>Final Mean</th>
<th>Diff</th>
<th>SE Diff</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>28</td>
<td>53.62</td>
<td>56.36</td>
<td>3.04</td>
<td>1.52</td>
<td>2.00</td>
<td>---</td>
</tr>
<tr>
<td>II</td>
<td>28</td>
<td>58.32</td>
<td>63.46</td>
<td>4.50</td>
<td>1.56</td>
<td>2.88</td>
<td>.01</td>
</tr>
<tr>
<td>III</td>
<td>28</td>
<td>58.14</td>
<td>58.36</td>
<td>0.21</td>
<td>1.29</td>
<td>0.17</td>
<td>---</td>
</tr>
<tr>
<td>IV</td>
<td>28</td>
<td>64.36</td>
<td>64.61</td>
<td>0.25</td>
<td>1.27</td>
<td>0.20</td>
<td>---</td>
</tr>
<tr>
<td>V</td>
<td>28</td>
<td>60.71</td>
<td>59.21</td>
<td>1.50</td>
<td>1.22</td>
<td>1.23</td>
<td>---</td>
</tr>
</tbody>
</table>

Group I: Isometric exercise
Group II: Isometric exercise and running in place
Group III: Isometric exercise, running in place, and a vertical jump exercise
Group IV: Isometric exercise, running in place, a vertical jump exercise, and push ups
Group V: Conditioning exercises whole period

t needed for significance at .05 level, 2.05; for .01 level, 2.77.
Chinning Test

In the chinning test, only Group III (isometric exercise, running in place, and a vertical jump exercise) improved their test scores significantly at the .01 level of probability. The t for Group III was 3.32 for the observed difference between the means of 4.86.

Group I (isometric exercise) and Group II (isometric exercise and running in place) improved their chinning test scores at the .05 level of significance. The difference between the means for Group I was 4.07 which resulted in a t of 2.33. For Group II, the t was 2.73 and the difference between the means was 3.21.

Group IV (isometric exercise, running in place, a vertical jump exercise, and push ups) and Group V (conditioning exercises all period) did not improve their chinning scores significantly at the .05 level. The t's for the two groups were 1.56 and 0.67, respectively. The data for the Chinning Test Scores are presented in Table IV.

Shuttle Run Test

In the shuttle run test, Group II (isometric exercise and running in place) and Group III (isometric exercise, running in place, and a vertical jump exercise) improved significantly at the .01 level of probability. The difference between the initial and final means was 4.75 for Group II and 5.29 for Group III. The t for Group II was 4.56 and for Group III, it was 4.98.
**TABLE IV**

**COMPARISON OF INITIAL AND FINAL MEAN STANDARD SCORES ON THE CHINNING TEST FOR 140 COLLEGE MEN WHO PARTICIPATED IN THE FIVE EXERCISE PROGRAMS**

<table>
<thead>
<tr>
<th>Item and Group</th>
<th>N</th>
<th>Initial Mean</th>
<th>Final Mean</th>
<th>Diff</th>
<th>SE Diff</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>28</td>
<td>52.25</td>
<td>63.32</td>
<td>4.07</td>
<td>1.74</td>
<td>2.33</td>
<td>.05</td>
</tr>
<tr>
<td>II</td>
<td>28</td>
<td>56.71</td>
<td>59.93</td>
<td>3.21</td>
<td>1.13</td>
<td>2.73</td>
<td>.05</td>
</tr>
<tr>
<td>III</td>
<td>28</td>
<td>56.18</td>
<td>61.04</td>
<td>4.86</td>
<td>1.46</td>
<td>3.34</td>
<td>.01</td>
</tr>
<tr>
<td>IV</td>
<td>28</td>
<td>61.11</td>
<td>63.89</td>
<td>2.79</td>
<td>1.79</td>
<td>1.56</td>
<td>---</td>
</tr>
<tr>
<td>V</td>
<td>28</td>
<td>59.25</td>
<td>60.43</td>
<td>1.18</td>
<td>1.76</td>
<td>0.67</td>
<td>---</td>
</tr>
</tbody>
</table>

Group I  Isometric exercise  
Group II Isometric exercise and running in place  
Group III Isometric exercise, running in place, and a vertical jump exercise  
Group IV Isometric exercise, running in place, a vertical jump exercise, and push ups  
Group V  Conditioning exercises whole period  

t needed for significance at .05 level, 2.05; for .01 level, 2.77.
Group I (isometric exercise) improved their shuttle run test scores at the .05 level. The t was 2.20 for the difference between the initial and final means of 3.57.

Group IV had a t of 1.54 and Group V had a t of 1.78 which were not significant at the .05 level of significance. The data for the Shuttle Run Test Scores are presented in Table V.

**TABLE V**

COMPARISON OF INITIAL AND FINAL MEAN STANDARD SCORES ON THE SHUTTLE RUN TEST FOR 140 COLLEGE MEN WHO PARTICIPATED IN THE FIVE EXERCISE PROGRAMS

<table>
<thead>
<tr>
<th>Item and Group</th>
<th>Initial Mean</th>
<th>Final Mean</th>
<th>Diff</th>
<th>SE Diff</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>56.64</td>
<td>60.21</td>
<td>3.57</td>
<td>1.63</td>
<td>2.20</td>
<td>.05</td>
</tr>
<tr>
<td>II</td>
<td>52.07</td>
<td>56.82</td>
<td>4.75</td>
<td>1.04</td>
<td>4.56</td>
<td>.01</td>
</tr>
<tr>
<td>III</td>
<td>59.11</td>
<td>64.39</td>
<td>5.29</td>
<td>1.06</td>
<td>4.98</td>
<td>.01</td>
</tr>
<tr>
<td>IV</td>
<td>61.39</td>
<td>63.64</td>
<td>2.25</td>
<td>1.46</td>
<td>1.54</td>
<td>---</td>
</tr>
<tr>
<td>V</td>
<td>61.46</td>
<td>64.32</td>
<td>2.86</td>
<td>1.60</td>
<td>1.78</td>
<td>---</td>
</tr>
</tbody>
</table>

Group I Isometric exercise
Group II Isometric exercise and running in place
Group III Isometric exercise, running in place, and a vertical jump exercise
Group IV Isometric exercise, running in place, a vertical jump exercise, and push ups
Group V Conditioning exercises whole period

t needed for significance at .05 level, 2.05; for .01 level, 2.77.
Summary of Analyses of Mean Gains

In the foregoing discussion it was seen that not all of the exercise programs brought about significant gains in the selected measures of physical fitness employed in this study.

In the Harvard Step Test, all of the groups who engaged in supplementary exercises, in addition to their regular activities, improved significantly. The group in the physical conditioning class whose class periods were entirely devoted to exercising did not gain significantly in cardiovascular efficiency as measured by this test.

When physical fitness as indicated by the composite score of the JCR test battery was analyzed, only the three groups who exercised the least amount of time showed significant improvement. The group performing four supplementary exercises (Group IV) and the conditioning exercise subjects failed to gain significantly.

In analyzing the gains in each of the test items in the JCR test battery, it was found that only one group, the subjects who performed one isometric exercise and ran in place, realized significant improvement in the vertical jump test. The first group who did only the isometric exercise had a mean gain which was almost significant at the .05 level. All of the other groups' gains were not
In the chinning test performance, the first three groups (Groups I, II, and III) which represented the least amount of exercise, had significant gains from initial to final tests. Groups IV and V did not gain significantly in chinning performance.

The analysis of the shuttle run scores resulted in the same findings as in the chinning test, which were that Groups I, II, and III gained significantly while Groups IV and V did not. The findings for the chinning and the shuttle run tests undoubtedly were the explanation for the Composite Score findings.

Therefore, from the analyses of mean gains for each of the tests on physical fitness in this study, the results would indicate that the amount of time spent exercising and improvement in physical fitness status are inversely proportional. If conclusions were to be drawn from these findings alone, it could be hypothesized that perhaps it is not the amount of exercise but rather brief intensity of exercise which is the most important factor in improving physical fitness.

II. ANALYSIS OF COVARIANCE AND REGRESSION

Since there were significant gains made by some of the groups in each of the variables of physical fitness
studied, the next step was to determine whether a significant relationship existed between the amount of exercise performed in training and the amount of physical fitness improvement. This step was accomplished through analysis of covariance.

In covariance, an adjustment is made for any correlation that exists between initial and final scores, and an adjustment of the final means is then made accordingly for differences among initial means. Analyses were made for the Harvard Step Test Scores and the JCR Composite Test Scores. In addition, each test making up the JCR battery, the vertical jump, chinning, and shuttle run scores, were also analyzed in an attempt to discover as much information as possible concerning the effects of different exercise programs on these measures of physical fitness.

Following each analysis of covariance, the nature of the regression line between amount of exercise performed in training and the amount of improvement in physical fitness was determined by means of orthogonal comparisons. It should be pointed out that ordinarily it is not statistically permissible to make any further comparisons if a significant F ratio is not obtained in the analyses of variance (or covariance). However, an exception to this is when specific comparisons were planned in advance.
as a part of the study's design.¹

In this investigation, the experiment was designed so that each successive group was purposely assigned an increased amount of exercise in order to analyze whether there would be found a proportional change in physical fitness. Therefore, orthogonal comparisons were made for each set of test scores regardless of whether a significant F-ratio was obtained in the analysis of covariance for the particular physical fitness variable.

With five groups there are four allotted comparisons (N-1) one can make. The pattern for orthogonal polynomials for each comparison have been predetermined and are as follows:²

<table>
<thead>
<tr>
<th>Comparisons</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Group IV</th>
<th>Group V</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁ Linear</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>C₂ Quadratic</td>
<td>+2</td>
<td>-1</td>
<td>-2</td>
<td>-1</td>
<td>+2</td>
</tr>
<tr>
<td>C₃ Cubic</td>
<td>-1</td>
<td>+2</td>
<td>0</td>
<td>-2</td>
<td>+1</td>
</tr>
<tr>
<td>C₄ Quartic</td>
<td>+1</td>
<td>-4</td>
<td>+6</td>
<td>-4</td>
<td>+1</td>
</tr>
</tbody>
</table>

FIGURE 1

PATTERN FOR ORTHOGONAL COMPARISONS


Each comparison yields a sum of squares and had one degree of freedom. The resulting mean square is then tested for significance by means of the F-ratio. If a significant F is obtained in any comparison it indicates that the regression line possesses that characteristic. For example, the first comparison determines whether there is a straight-line relationship (linear) between the two components. In this study, it was hypothesized that an increase in the amount of exercise would probably increase physical fitness.

A significant quadratic comparison would mean that there was a definite rise and/or fall between the variables of amount of exercise and performance. A significant cubic regression pattern indicates that there are more than one rise and fall. It is frequently found that a regression line may possess two or more significant characteristic patterns. However, usually the experimenter is only interested in whether the line is linear or possibly linear and quadratic. Cubic and quartic regression lines are meaningless insofar as any practical relationship of variables is concerned.

Therefore, in this study the primary purpose was to determine whether a linear effect, or possibly a consistent quadratic effect, was present. A consistent quadratic effect would point to a particular exercise program as being the best.
Following each covariance table, the final adjusted means for the five groups on that particular variable have been plotted on graphs. This was done to better enable the reader to interpret the orthogonal comparisons in order to see the effects of the amount of exercise on improvement in physical fitness.

Harvard Step Test

In Table VI it can be seen that the F-ratio of 1.70 for the analysis of covariance for the Harvard Step Test Scores was not significant. It was shown in Table I, page 53, that Groups I through IV made significant gains in the step test scores but the conditioning exercise subjects did not.

Orthogonal comparisons were computed for any significant regression effects and it was found that the F-ratio for linearity was .70 and not significant. The quadratic comparison yielded an F of .58 which was also not significant. The only significant comparison was for the cubic comparison which had an F-ratio of 5.21, which was significant at the .05 level of probability.

Therefore, it was found that although all of the groups except the conditioning exercise group improved significantly, the differences among the five training programs in cardiovascular fitness improvement followed no definite pattern of regression. Consequently, one
type of exercise program was about as effective as any other in developing cardiovascular efficiency. The importance of this finding as far as this study was concerned, was that it appears that one supplementary isometric exercise in addition to regular activity is as effective, and maybe more so, than a program devoted entirely to exercises in regard to cardiovascular fitness. The final adjusted means for each group on this test are shown in Figure 2.

**JCR Composite Scores**

The application of the covariance technique to the JCR Composite Test Scores resulted in an F-ratio of 1.33 which was not significant at the .05 level. The data for the covariance analysis is shown in Table VII.

When tested for linearity, the F of 8.04 for this comparison was significant at the .01 level of probability. This indicates that there was a straight-line relationship between the amount of exercise and performance in the JCR test battery. Upon examination of the adjusted final means shown in Figure 3, this relationship is strikingly revealed, but it is an inverse relationship. Thus, the more exercises performed in training, the smaller the amount of improvement that was made in the JCR test of physical fitness.

The regression line was also tested for quadratic
TABLE VI
ANALYSIS OF COVARIANCE FOR THE HARVARD STEP TEST

<table>
<thead>
<tr>
<th>Item</th>
<th>Source of Variation</th>
<th>Corrected SS</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvard Step Test</td>
<td>Among Groups</td>
<td>577.47</td>
<td>4</td>
<td>144.37</td>
<td></td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>11,383.55</td>
<td>134</td>
<td>84.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>11,961.02</td>
<td>138</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F needed for significance at .05 level, 2.44; for .01, 3.46.

FIGURE 2
FINAL ADJUSTED STANDARD SCORE MEANS FOR THE FIVE EXERCISE GROUPS ON HARVARD STEP TEST
### TABLE VII
ANALYSIS OF COVARIANCE FOR THE JCR COMPOSITE SCORES

<table>
<thead>
<tr>
<th>Item</th>
<th>Source of Variation</th>
<th>Corrected SS</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>JCR Composite</td>
<td>Among Groups</td>
<td>1,023.78</td>
<td>4</td>
<td>255.94</td>
<td>1.33</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>25,690.50</td>
<td>134</td>
<td>191.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>26,714.28</td>
<td>138</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F needed for significance at .05 level, 2.44; for .01, 3.46.

![Figure 3](chart.png)

**FIGURE 3**
FINAL ADJUSTED STANDARD SCORE MEANS FOR THE FIVE EXERCISE GROUPS ON JCR COMPOSITE SCORES
characteristics, but the F of 1.16 was not significant. Therefore, even though the graph shows a slight rise from Group I to Group II, this was not significant. The cubic and quartic comparisons were not made because the first two comparisons accounted for all of the treatment sum of squares, and therefore no further significant F-ratios could possibly be found.

Each of the three test items comprising the JCR Test was then analyzed separately.

**Vertical Jump Test**

Table VIII shows that an F of 2.77 was found by use of analysis of covariance for the vertical jump test scores. This F was significant at the .05 level of probability. Orthogonal comparisons were made as in the Harvard Step Test and the JCR Composite Score analysis.

In comparison one, for linearity, an F-ratio of 7.44 was obtained which was significant at the .01 level of confidence. This indicates a definite, straight-line relationship of performance in vertical jumping ability with amount of exercise. However, when the adjusted means are viewed in Figure 4, it can be seen that an inverse relationship is evidence. The groups exercising the least amount showed better performance in the vertical jump than the subjects participating in more prolonged exercise programs. Or, to state it another way, the improvement
TABLE VIII
ANALYSIS OF COVARIANCE FOR
THE VERTICAL JUMP TEST

<table>
<thead>
<tr>
<th>Item</th>
<th>Source of Variation</th>
<th>Corrected SS</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Jump</td>
<td>Among Groups</td>
<td>576.44</td>
<td>4</td>
<td>144.11</td>
<td>2.77</td>
<td>.05</td>
</tr>
<tr>
<td>Test</td>
<td>Within Groups</td>
<td>6,968.13</td>
<td>134</td>
<td>52.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>7,544.57</td>
<td>138</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F needed for significance at .05 level, 2.44; for .01, 3.46.

FIGURE 4
FINAL ADJUSTED STANDARD SCORE MEANS OF THE FIVE EXERCISE GROUPS ON VERTICAL JUMP TEST
in performance on the vertical jump test was inversely proportional to the amount of exercise.

The other comparisons for other characteristics of the pattern of regression were not significant. Comparison II for quadratic tendencies revealed an F of .36, the F for cubic was 2.42, and for quartic it was 1.65.

Chinning Test

An F-ratio of only .61 was found in the covariance analysis of the chinning test data. Since 2.44 was needed at the .05 level of probability, this F was not statistically significant. These data are presented in Table IX.

The final adjusted means ranged from 62.72 for the group practicing with isometric exercise, running and vertical jump exercises (Group III) to 59.58 for the conditioning exercise group (Group V). This narrow range of scores is exemplified in the graphical presentation in Figure 5. Consequently, none of the orthogonal comparisons yielded significant F-ratios. This is interpreted as meaning that the regression line did not deviate significantly from a straight-line paralleling the abscissa, or bottom, line of the graph in Figure 5.

The F-ratios were as follows for the four allotted comparisons: for linearity, 1.55; for quadratic, .90; for
### TABLE IX
ANALYSIS OF COVARIANCE FOR THE CHINNING TEST

<table>
<thead>
<tr>
<th>Item</th>
<th>Source of Variation</th>
<th>Corrected SS</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinning Test</td>
<td>Among Groups</td>
<td>162.42</td>
<td>4</td>
<td>40.60</td>
<td>.61</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>8,888.62</td>
<td>134</td>
<td>66.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>9,051.24</td>
<td>138</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F needed for significance at .05 level, 2.44; for .01, 3.46.

---

**FIGURE 5**
FINAL ADJUSTED STANDARD SCORE MEANS FOR THE FIVE EXERCISE GROUPS ON CHINNING TEST
cubic, .10; and for quartic, .06. Therefore, no significant regression or differences were found among the five groups in chinning performance.

**Shuttle Run Test**

An insignificant F-ratio of .67 was found in the analysis of covariance for the Shuttle Run Scores. When the final adjusted means in Table X, and the subsequent plotting of these means on the graph presented in Figure 6, are studied, it can be readily seen that the groups differed hardly at all in shuttle run performance. The range of means for the five groups was only from 63.46 to 60.50, a difference of less than three.

Therefore, as would be expected, there were no significant indications of regression as a result of the orthogonal comparisons. The F-ratios were .47, .74, .58, and 1.00 for the linear, quadratic, cubic, and quartic comparisons, respectively.

It was thus concluded that no differences resulted in the shuttle run test regardless of the type of exercise program in which the subjects engaged.

**III. ANALYSIS OF CONDITIONING EXERCISE GAINS**

As stated in the chapter on procedures, measures were taken each day that the subjects performed the conditioning exercises. This was done to provide the
### TABLE X
ANALYSIS OF COVARIANCE FOR THE SHUTTLE RUN TEST

<table>
<thead>
<tr>
<th>Item</th>
<th>Source of Variation</th>
<th>Corrected SS</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shuttle Run Test</td>
<td>Among Groups</td>
<td>144.08</td>
<td>4</td>
<td>36.02</td>
<td>0.67</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>7,120.58</td>
<td>134</td>
<td>53.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7,264.66</td>
<td>138</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F needed for significance at .05 level, 2.44; for .01, 3.46.

![Figure 6](image)

**FIGURE 6**

FINAL ADJUSTED STANDARD SCORE MEANS FOR THE FIVE EXERCISE GROUPS ON THE SHUTTLE RUN TEST
subjects with a knowledge of their progress for motivational reasons. However, this information was also utilized to ascertain whether the subjects actually did make improvements in their exercises. Although this was not the purpose of the study, it was deemed necessary for the reason that if the subjects did not gain in strength, or in their running, jumping, and push ups then it could be misleading to make any statements regarding the effectiveness or ineffectiveness of the exercise programs in developing physical fitness.

In analyzing this data, the scores obtained from the third day of the training program were used as their initial scores. This was felt by the investigator to be a more accurate measure of initial status than using the first day's scores because it allowed the subjects time to become accustomed to the exercises and the techniques involved in performing them. The scores of the last day of the exercise program were used as the final scores.

The significance of the difference between correlated means was employed to determine whether each group improved significantly on their respective conditioning exercises. The data are shown in Table XI.

It is shown that all groups improved significantly on the conditioning exercises with the exception of Group II in the running in place exercise. It should be pointed
TABLE XI
SIGNIFICANCE OF THE MEAN GAINS IN THE CONDITIONING EXERCISE PERFORMANCE FOR THE FOUR EXERCISE GROUPS

<table>
<thead>
<tr>
<th>Item and Group</th>
<th>N</th>
<th>Initial Mean</th>
<th>Final Mean</th>
<th>Diff</th>
<th>SE Diff</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isometric exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>28</td>
<td>278.79</td>
<td>373.21</td>
<td>94.43</td>
<td>12.51</td>
<td>7.55</td>
<td>.01</td>
</tr>
<tr>
<td>II</td>
<td>28</td>
<td>251.36</td>
<td>343.00</td>
<td>91.64</td>
<td>13.42</td>
<td>6.83</td>
<td>.01</td>
</tr>
<tr>
<td>III</td>
<td>28</td>
<td>265.07</td>
<td>344.79</td>
<td>79.71</td>
<td>10.61</td>
<td>7.52</td>
<td>.01</td>
</tr>
<tr>
<td>IV</td>
<td>28</td>
<td>282.50</td>
<td>362.07</td>
<td>79.57</td>
<td>21.59</td>
<td>3.69</td>
<td>.01</td>
</tr>
<tr>
<td>Running in place exercise*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>24</td>
<td>139.21</td>
<td>165.63</td>
<td>26.42</td>
<td>22.58</td>
<td>1.17</td>
<td>---</td>
</tr>
<tr>
<td>III</td>
<td>26</td>
<td>140.58</td>
<td>167.12</td>
<td>26.54</td>
<td>5.39</td>
<td>4.92</td>
<td>.01</td>
</tr>
<tr>
<td>IV</td>
<td>24</td>
<td>152.50</td>
<td>173.42</td>
<td>20.92</td>
<td>7.92</td>
<td>2.64</td>
<td>.05</td>
</tr>
<tr>
<td>Jumping exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>28</td>
<td>62.04</td>
<td>83.89</td>
<td>21.86</td>
<td>3.24</td>
<td>6.75</td>
<td>.01</td>
</tr>
<tr>
<td>IV</td>
<td>28</td>
<td>59.25</td>
<td>78.07</td>
<td>18.82</td>
<td>2.23</td>
<td>8.45</td>
<td>.01</td>
</tr>
<tr>
<td>Push ups</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>28</td>
<td>25.57</td>
<td>29.11</td>
<td>3.54</td>
<td>0.77</td>
<td>4.60</td>
<td>.01</td>
</tr>
</tbody>
</table>

Group I  Isometric exercise
Group II Isometric exercise and running in place
Group III Isometric exercise, running in place, and a vertical jump exercise
Group IV  Isometric exercise, running in place, a vertical jump exercise, and push ups

*Due to the nature of the running in place exercise, some of the subjects were not able to keep an accurate record of their progress for this exercise. Therefore, the running in place data of Group II was based on 24 subjects; Group III on 26 subjects; and Group IV on 24 subjects.

23 df  t .05 = 2.07  t .01 = 2.81  27 df  t .01 = 2.77
25 df  t .05 = 2.06  t .01 = 2.79  t .05 = 2.05
out that this exercise was a difficult exercise to score because of the speed in which the subjects performed this exercise. However, this was not considered to be a serious limitation because, as stated before, these measures were primarily for motivation and for providing an indication of improvement.

IV. SUMMARY OF COVARIANCE WITH REGRESSION ANALYSES AND DISCUSSION OF FINDINGS

In the covariance and regression analysis of the Harvard Step Test scores, no significant linear regression was found in the relationship of amount of exercise performed in training with improvement in step test scores. A significant comparison was discovered in regard to cubic characteristics of the regression line. All that this meant was that the regression line did deviate significantly from the horizontal with at least two high or low points on the line. An examination of the scores showed the conditioning exercise group (Group V) to have the lowest mean and the group who performed only one exercise (Group I) and the group who performed four supplementary exercises (Group IV) to have the highest means. The only meaningful conclusion from this analysis was that the amount of exercise was not a factor in improving step test scores. Or stated another way,
subjects who performed only one isometric exercise in addition to regular physical education activities showed as much, if not more, improvement in cardiovascular efficiency as subjects who engaged in a training program consisting entirely of calisthenics, weight training, running, and isometric exercises.

In the analysis of regression by means of covariance for the other principal measure concerned in this study, the JCR Composite Scores, a significant linear regression line was revealed. This finding indicated that those subjects who performed the least number of exercises in training made the most improvement in their physical fitness status, as measured by the JCR test.

When the separate test scores for the vertical jump, chinning, and shuttle run tests which make up the JCR battery were analyzed, the same significant linear regression was found for the vertical jump test, but not for the chinning or shuttle run scores. There were no apparent differences among the groups in regard to performance in chinning and in the shuttle run.

Thus, it was found in the analyses of mean gains and in the regression analyses that the subjects who engaged in a relatively little amount of exercise in addition to their regular physical education sports skill classes, improved every bit as well, and in some cases
better, than subjects who were given a comparatively large number of exercises.

The fact that the conditioning exercise group did not show significant improvement in any of the measures of physical fitness employed in this study is rather difficult to explain. At the onset of this investigation it was confidently hypothesized that this group would probably make the most improvement, and the group was primarily included in the study to serve as a standard of comparison to gauge the performance of the other training programs.

There may have been several possible explanations for this finding. One may be attributed to specificity as opposed to generality. The exercises selected for the four other groups were rather similar in nature to the test items. On the other hand, the training program of the conditioning exercise group was not under the control of this writer; and their exercise regime perhaps may have been more general than specific to the particular test items. It has been established in other studies that practice in the specific exercise tested will produce the most improvement in performance, whether it is in a fitness measure or in a motor skill. However, this would not explain why Group IV failed to significantly improve in the JCR Test battery.
Another factor that may have had some influence could have been in the area of motivation. Groups I, II, III, and IV were doing these exercises in addition to their regular class activity, whereas in Group V the subjects did nothing but exercise. Also, the subjects in Groups I through IV were tested every day in the sense that they recorded their scores and thus had a continuous, daily record of progress. Of course, this does not satisfactorily account for the relatively poor performance of Group IV in relation to the first three groups, as reflected by the analysis of mean gains and regression analysis of the JCR Composite Scores, unless there may exist a general lessening of enthusiasm, or inclination to exercise vigorously, which accompanies an increase in amount of assigned exercise. Or, conceivably, motivation may have been adversely affected due to some annoyance in regard to the encroachment on their free time.

A third possible explanation may be in some actual benefits of brief, intensive activity in contrast to doing most exercises which, due to the necessity of resting and other factors, tend to be spaced more and thus required a longer time in which to perform them. This concept has not as yet been fully explored, but some evidence has been found in regard to different programs of running in relation to running performance,\(^2\) and in regard to the effects of
isometric exercises compared with running in developing cardiovascular efficiency; and as demonstrated in studies of strength gains brought about by isometric exercises performed at different frequencies. The explanation of why short, vigorous exercise bouts are comparable, or at time even superior, to the more prolonged, extensive exercise regimes was beyond the scope of this study. Although it is only conjecture on the part of the investigator, the psychological variable may play an extremely important part on the measurable physiological results. In other words, the mental act, or attitude, of the performer in regard to his willingness to exert maximum effort for a brief period of time as opposed to a conscious, or subconscious, tendency for the person to pace himself in prolonged practice sessions, may be the important factor in bringing about measured improvements in physical performance.

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Consequently, the findings from the analyses of gains made by the different experimental groups in the selected variables and the analysis of covariance with regression may have been due to several factors. Among which are specificity of practice and the inverse relationship that may exist between incentive to exert all-out effort and the amount of assigned exercise.

It was apparent to this writer after analyzing the data, that this study may have been considerably enhanced by the inclusion of a control group, and the feasibility of this was not overlooked during the planning of the experiment. However, there were certain factors which, at the time, appeared to preclude the used of a control group who would engage in only the regular physical education classes with no supplementary exercises. As was stated earlier, the main purpose of the study was to determine how much additional exercises need be given in conjunction with sports activities to produce adequate physical fitness improvement. Because of statements in the literature and some of the research reports it was hypothesized that supplementary exercises were needed. In addition, it was felt that each group would serve as a kind of control group, in that all of the groups, except the conditioning exercise group, were equally represented by the various activities in the physical education
program, and thus the effects of the activities themselves would be neutralized. Needless to say, it was incorrectly hypothesized that a group doing only physical fitness exercises would show the most improvement in physical fitness. Consequently, further research is indicated to determine the effects of the physical education activities alone on the fitness measures employed.
CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

It was the purpose of this study to determine the relative effects of five exercise programs, each involving different amounts of exercise, on the development of physical fitness as measured by the Harvard Step Test and the JCR Physical Fitness Test.

Subjects for the study were 140 male students at Louisiana State University in Baton Rouge, Louisiana. The subjects were divided into five groups: (1) Group I contained students who were participating in basic activity classes but were given one isometric exercise; (2) Group II was composed of students who were participating in basic activity classes and performed the one isometric exercise along with running in place; (3) Group III performed the isometric exercise, running in place, and a vertical jump exercise in addition to participating in the basic activity classes; (4) Group IV was comprised of students in the basic activity classes and performed push ups in addition to the same exercises as Group III; and (5) Group V was made up of those students who were enrolled in the scheduled conditioning exercise classes.

At the beginning of the study, all the subjects were
given the JCR Test and the Harvard Step Test. Following the initial testing, the groups engaged in their respective training programs three days a week for six weeks. The subjects were then retested on the JCR Physical Fitness Test and the Harvard Step Test.

The $t$-test for correlated groups was used to determine the significance of the mean gains made by each group on the Harvard Step Test and the JCR Test. The significance of the mean gains was also computed for each test item comprising the JCR test battery, namely, the vertical jump, chinning, and the shuttle run.

Analysis of covariance with orthogonal comparisons was then employed to determine whether any significant regression existed between different amounts of exercise and changes in physical fitness status.

II. FINDINGS

The major findings revealed from the data gathered in this study were as follows:

1. In the analysis of mean gains made in the Harvard Step Test, it was found that all of the groups, except the group in conditioning exercise programs, gained significantly in step test performance.

2. When analyzed by covariance and orthogonal comparisons, a significant cubic regression line was
evidenced. Therefore, no linear relationship was found between the different amounts of exercise performed in training and the amount of improvement in cardiovascular efficiency as measured by the Harvard Step Test.

3. In the analysis of the mean gains made in the Composite JCR Physical Fitness Test scores, it was found that the three training groups who were assigned the least amount of supplementary exercises, in addition to their regular physical education activities, made significant improvement. Group IV, whose subjects performed four supplementary exercises, and Group V, whose practice periods were devoted entirely to conditioning exercises, failed to show significant improvement in physical fitness as reflected by the JCR Test.

4. A significant, linear regression line was found for the JCR Physical Fitness Test, which indicated that those subjects who were given the least number of exercises made the most improvement in physical fitness.

5. When each test item in the JCR Test battery was analyzed for significant gains made by the various exercise groups, the group who practiced one isometric exercise and performed the running in place exercise (Group II) gained significantly in the vertical jump test. Group I, the group performing only the isometric exercise, had a $t$, for its mean gain in this test, of 2.00, which
just missed the $t$ of 2.05 needed for significance at the .05 level. The other three groups did not show significant improvement in the vertical jump test.

6. A highly significant linear regression was found for vertical jump performance, however. As in the Composite JCR test analysis, the regression line between amount of exercise and vertical jump performance signified that those subjects who were assigned the most exercise realized the least gain in scores.

7. In chinning performance, the three groups who exercised the least amount (Groups I, II, and III) made significant gains, whereas Groups IV and V did not.

8. No significant regression effects were revealed for the chinning scores. Thus, this meant that the subjects performing only one assigned exercise in addition to their regular physical education class activities, did as well as the subjects in any of the other groups in chinning performance.

9. The findings for the shuttle run performance were the same as for the chinning results in that Groups I, II, and III made significant gains while Group IV and V did not; and that there was no significant regression evidenced between amount of exercise and shuttle run performance.
III. CONCLUSIONS

The following conclusions were made in light of the results obtained from the analyses of the data in this study.

1. Within the limits of this investigation, it appears that cardiovascular efficiency, as measured by the Harvard Step Test, can be significantly improved by engaging in a very few brief, vigorous exercises performed in addition to regular physical education class activities.

2. Cardiovascular fitness may be developed by performing one isometric exercise, in addition to regular physical education class activity, equally as well as by engaging in a physical education activity composed entirely of calisthenics, weight training and isometric exercises.

3. There is an indication that physical fitness, as measured by the JCR Physical Fitness Test, may be improved most effectively by performing a minimum number of very brief, vigorous supplementary exercises, in conjunction with regular physical education class activity, providing those exercises involve total body movement and that maximum effort is exerted while performing them. Furthermore, it may be that it is the intensity of effort applied while exercising, even if it is only a single exercise of but a few seconds duration, that is the major
factor in conditioning, rather than time spent or number of repetitions and/or number of exercises involved in the exercise program.

IV. RECOMMENDATIONS

As a result of the findings in this study, the writer offers the following recommendations for further research in this area:

1. A study similar to this investigation which would utilize a control group who would engage in only the activities of the physical education classes to isolate the effects of these activities.

2. A study in which the subjects would engage only in the assigned exercises with no other form of physical activity involved, and in which they would be assigned from one on up to as many as eight or ten exercises.

3. A study, or studies, similar to those suggested above which would involve more physical fitness measures and perhaps more precise measurement of the effects of the training programs on certain physiological factors such as blood pressure, respiratory measures, and muscular endurance and fatigue.
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BIBLIOGRAPHY

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B. PERIODICALS


C. UNPUBLISHED MATERIALS


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Coaches Sporting Goods Corporation, Marion, Indiana.


APPENDIX
APPENDIX A

ISOMETRIC EXERCISE EQUIPMENT

The equipment needed at each of the four isometric exercise stations.
APPENDIX B

ISOMETRIC EXERCISE

The isometric exercise which the subjects in Groups I-IV performed during each exercise session. The written description of this exercise is provided on pages 45-48.
VITA

The writer was born in Pontiac, Illinois on August 6, 1939. He attended elementary and high school in the Benson Community Schools.

The writer received a Bachelor of Science in Education Degree from Eastern Illinois University in 1961 with a major in physical education and a minor in mathematics. The Master of Science in Education Degree was awarded the writer in 1963 from Eastern Illinois University.

The Doctor of Education Degree with a major in physical education and a minor in education was conferred by Louisiana State University in May, 1966.

The writer taught physical education and coached at St. Joseph Elementary School in Mattoon, Illinois 1961-1962. The writer taught physical education, mathematics, and coached at Lostant Community High School during 1962-63. In 1963, the writer entered graduate school at Louisiana State University and held a teaching assistantship in the Department of Health, Physical, and Recreation Education from September, 1963 to August, 1965. The author then accepted a position at DePaul University, Chicago, Illinois where he was an instructor in physical education for the school year 1965-66.