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COMPARISON OF A SPECIALLY DESIGNED CIRCUIT TRAINING PROGRAM WITH THE TRADITIONAL CALISTHENICS TRAINING PROGRAM ON THE PHYSICAL FITNESS LEVELS OF THE OFFICER CANDIDATES AT THE KUWAIT POLICE ACADEMY

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Jawad Askar Saud

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ABSTRACT

COMPARISON OF A SPECIALLY DESIGNED CIRCUIT TRAINING PROGRAM WITH THE TRADITIONAL CALISTHENICS TRAINING PROGRAM ON THE PHYSICAL FITNESS LEVELS OF THE OFFICER CANDIDATES AT THE KUWAIT POLICE ACADEMY

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This study was designed to compare a specially designed circuit training program with the calisthenics training program on the physical fitness levels of the police officer candidates at the Kuwait Police Academy.

Fifty-nine freshmen police officer candidates who served as subjects in this study were randomly assigned into two groups. The experimental group (30 subjects) used the circuit training program while the traditional group (29 subjects) used the academy's traditional calisthenics training program. All subjects were non-athletic and all training sessions were conducted at the Kuwait Police Academy.

Both training programs for the experimental group and the traditional group were conducted over a ten-week time period. All officer candidates exercised 40 minutes a day, four days per week.

There were two test sessions during the study. A pre-test was given at the beginning of the study, and a post-test was given at the end.

The statistical treatment used in testing the eleven hypotheses was the t-test. The level of significance was set at .05.

The findings were as follows:

1. Body composition changes (i.e., body weight and body fat) were similar for the two groups.

2. Cardiovascular changes (i.e., heart rate and blood pressure) were significantly better in the experimental group.

3. Muscular endurance changes (as measured by pull-ups and sit-ups) were significantly better in the experimental group.

4. Power changes (as measured by the vertical jump) were similar for the two groups.

5. Flexibility changes (as measured by the sit and reach test) were similar for the two groups.

6. The changes in the agility run were similar for the two groups.

7. The endurance run changes (i.e., 1.5 mile run) were significantly better in the experimental group.

The circuit training program produced significant improvements in all variables tested except body weight. The traditional group also resulted in significant training improvements in all variables except heart rate and sit-ups. The circuit program is clearly superior in producing improvement in the cardiovascular variables, muscular endurance, and endurance capacity. These improvements are greatly significant to the health and fitness of police officers.

DEDICATED TO:

The Kuwait Interior Ministry

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TABLE OF CONTENTS

TABLE OF CONTENTS, CONT'D.

TABLE OF CONTENTS, CONT'D.

LIST OF TABLES

TABLE OF TABLES, CONT'D

LIST OF FIGURES

LIST OF FIGURES, CONT'D.

LIST OF PLATES

CHAPTER I

INTRODUCTION

The majority of Kuwait's population leads a sedentary lifestyle due to current technological advances. More than half do not engage in any exercise or sport activities. Inactivity is closely associated with the risk of heart attack, high blood pressure, obesity, lower back pain, emotional stress, and anxiety. The majority of Kuwaitis work in office settings which require very little activity. The law enforcement occupations, however, require strenuous activity particularly in emergency situations. The police officer who is not physically fit may fail to protect his own life as well as the lives of others, thus failing to correctly carry out his assignments. Unconditioned officers are more susceptible to exercise-induced injury and many of the stress-related illnesses. Poor physical fitness thus increases the probability of injury, forced early retirement, and chronic absenteeism in the workplace.

The Kuwait Police Academy recognizes this as a serious problem for its officers. One of the academy's prime objectives is to utilize a well-constructed fitness program for its future officers to become involved in a

professional as well as on a personal level. The traditional calisthenics program at the academy has been the only physical conditioning program used for 28 years. This arbitrary physical fitness method has generated the problems of promoting poor physical fitness levels, injuries (due to improper warm-ups), resignations, and a general disinterest in exercise.

Bonney (1978) reported that the most frequent cause of early police officer retirement in the U.S. has been heart-related -- heart attacks, high blood pressure, and circulatory disease. The second cause has been back trouble, and the third has been some type of permanent injury received while on duty.

Craig (1976) reported there is a growing number of job-related injuries and illnesses which affect officer performance. Based on these problems, four conclusions were made by the California Department of Justice:

1. State traffic officers may be required to conform to standards of physical fitness which were not in effect at the time the officers were appointed.

2. Standards of physical condition which are not arbitrary, discriminatory, or unreasonable may be used to improve the efficiency of public service.

3. Valid standards may be enforced under provisions of the State Civil Service Act.

4. Potential liability to the department "could arise only where the officer's deficient physical

> condition created or increased the risk of injury" (pp. 13-17).

Craig concluded that the goal of the new standards was to help officers stay in top physical condition throughout their careers.

The majority of instructors at the Kuwait Police Academy have little or no background in physical education and have limited knowledge concerning physical training techniques. They were selected because they were former athletes.

Since traditional calisthenics has been the only physical fitness program at the academy, and since it has proven to be ineffective in meeting the fitness needs of the academy officers, it was felt a new approach was necessary. Upon examining various training programs, it was determined that the use of a circuit training program could meet the training needs of the officer candidates. By using a circuit training program developed specifically for these recruits, a gradual improvement in physical fitness could be obtained. It was decided that circuit training could improve the problem of poor physical fitness facing the academy at this time.

Statement of the Problem

The problem is to compare the effects of a specially developed circuit training program with the effects of the traditional calisthenics training program on the physical fitness levels of the officer candidates at the Kuwait Police Academy.

Purpose of the Study

The administrators of the Kuwait Police Academy indicated the need for establishing a well-constructed physical training program for future police officers. The purpose of this study is to determine whether the selected exercises and the total circuit training program will have a significant effect on the candidate's physical fitness performance. Physical fitness tests were given to the first group who exercised under the circuit training program and to the traditional group who exercised under the traditional program. The results for the two groups will be compared. This comparison should indicate advantages and disadvantages in the circuit training program. If it is determined that the circuit training program is ineffective in certain exercise areas, the circuit could be altered specifically to ensure improvement in that area.

Significance of the Study

This study is highly important because there has never been a study of this type conducted in the State of Kuwait. Information gathered from this study is important for police administrators, supervisors, teachers, coaches, officers, and officer candidates. The information should reveal the strengths and weaknesses in the area of physical performance of officer candidates. The information will hopefully motivate them to utilize their training sessions more effectively and efficiently because they will have a better understanding of their personal physical fitness levels as they relate to their effectiveness and efficiency on the job. The police administration should also become more aware of and show more interest in the officer candidates' performance as the candidates become stronger, more flexible, and aerobically fit. As a result, the new officers should perform their duties better and be able to continue on their jobs longer.

Need for the Study

The present traditional calisthenic training method used by the Kuwait Policy Academy has resulted in the poor development and maintenance of a reasonable degree of physical fitness in the police officer candidates.

Administrators at the academy recognize the need for a more adequate level of physical fitness for their candidates. Most of the Kuwait police officers are out of condition and overweight. They could not be regarded as "healthy" because the average police officer does not participate in a regular physical activity program. This study will help the police officers become more aware of the benefits of physical fitness that enable them to perform their jobs at the highest level of their abilities, and develop and maintain their physical fitness at this same high level.

Assumptions

This study was based on the following assumptions:

1. The circuit training program as well as the traditional calisthenics method may be effective training methods for improving muscular endurance and aerobic capacity.

2. The circuit training program (experimental) and the traditional calisthenics training method may improve resting heart rate and resting systolic and diastolic blood pressure (cardiovascular variables).

3. Both the experimental group and the traditional calisthenics group may improve in sit and reach (flexibility), agility, and vertical jump (power).

4. Both the experimental group and the traditional group may reduce in body weight and body fat (body composition).

Limitations

The limitations of the research were as follows:

1. The experimental period was limited to a 10-week duration of four days per week.

2. The data were gathered from the Kuwait Police Academy during January through March 1986, the cool part of the year. During this period, the average daily temperature was 50 to 60 degrees fahrenheit.

3. The results were limited by the tests which could be used under field conditions.

4. It was not possible to control the diets of the subjects.

Delimitations

This study was limited to two groups of male officer candidates 18 to 22 years of age who were randomly selected at the freshmen level at the Kuwait Police Academy.

Research Hypotheses

To compare between the circuit training program (experimental) and the traditional calisthenics training program on the physical fitness level of the police officer candidates at the police academy, the following hypotheses were formulated:

Hypothesis 1: There is no statistically significant difference in the body weight measures between the experimental group and the traditional group.

Hypothesis 2: There is no statistically significant difference in the body fat measures between the experimental group and the traditional group.

Hypothesis 3: There is no statistically significant difference in the heart rate measures between the experimental group and the traditional group.

Hypothesis 4: There is no statistically significant difference in resting systolic blood pressure measures between the experimental group and the traditional group.

Hypothesis 5: There is no statistically significant difference in resting diastolic blood pressure measures between the experimental group and the traditional group.

Hypothesis 6: There is no statistically significant difference in the pull-ups score between the experimental group and the traditional group.

Hypothesis 7: There is no statistically significant difference in the sit-ups scores between the experimental group and the traditional group.

Hypothesis 8: There is no statistically significant difference in vertical jump scores between the experimental group and the traditional group.

Hypothesis 9: There is no statistically significant difference in sit and reach (flexibility) scores between the experimental group and the traditional group.

Hypothesis 10: There is no statistically significant difference in agility scores between the experimental group and the traditional group.

Hypothesis 11: There is no statistically significant difference in the one and one-half (1.5 mile) mile run between the experimental group and the traditional group.

Definition of Terms

Aerobic capacity: A functional measure of physical fitness based on the measurement of maximal oxygen uptake.

Generally synonymous with terms maximal oxygen uptake and cardiorespiratory endurance (Getchell, 1983).

Agility: Refers to the controlled ability to change position and direction rapidly and accurately (Bosco and Gustafson, 1983).

Artery: A vessel carrying blood away from the heart (Fox and Mathews, 1981).

Blood pressure: The driving force that moves blood through the circulatory system. Systolic pressure is obtained when blood is ejected into the arteries; diastolic pressure is obtained when blood drains from the arteries (Fox and Mathews, 1981).

Calisthenic exercises: Systematic methods of moving the body, generally executed without apparatus, in a rhythmatical sequence (Souter, 1980).

Cardiorespiratory endurance: The ability of the lungs and heart to take in and transport adequate amounts of oxygen to the working muscles, allowing activities that involve large muscle masses (e.g., running, swimming, bicycling) to be performed over long periods of time (Fox and Mathews, 1981).

Circuit training: A routine of selected exercises or activities performed in sequence at individual stations. The circuit may be performed slowly or on a timed basis (Getchell, 1983).

Coronary arteries: The small blood vessels that supply blood to the heart muscles (Hockey, 1985).

Duration: The amount of time the activity must be sustained with the heart rate at a specified level to result in significant improvement of cardiovascular fitness (Hockey, 1985).

Endurance: A measure of one's ability to continue exercising with a given submaximal workload (Westcott, 1982).

Flexibility: The range of motion about a joint (static flexibility); opposition or resistance of a joint to motion (dynamic flexibility) (Fox and Mathews, 1981).

Frequency: The number of workouts needed to reach a training effect in conjunction with the intensity and duration factors recommended (Getchell, 1983).

Heart rate: Frequency of contraction, often inferred from pulse rate (expansion of artery resulting from beat of heart) (Sharkey, 1977).

Intensity: The physiological stress on the body during exercise. The level of intensity can be readily

determined by measuring the pulse rate (heart rate) immediately following an exercise bout (Getchell, 1983).

Isometric: A muscle contraction with the muscle generating force that does not allow significant shortening of the muscle (e.g., pushing against a wall) (Getchell, 1983).

Isotonic: A muscle contraction with the muscle generating force against a constant resistance with a shortening of the muscle (e.g., curling a barbell) (Getchell, 1983).

Maximal oxygen uptake (VO_2 max): Aerobic fitness. Best single measure of fitness with implications for health; synonymous with cardiorespiratory endurance (Sharkey, 1979).

Overload principle: Progressively increasing the intensity of the workouts over the course of the training program as fitness capacity improves (Fox and Mathews, 1981).

Physical fitness: The ability to carry out daily tasks with vigor and alertness, without undue fatigue, with ample energy to enjoy leisure time pursuits, and to meet unforeseen emergencies (Allsen, et al., 1984).

Skinfold caliper: An instrument used to measure the thickness of fat folds pinched up on the body (Getchell, 1983).

Training effect: The term used to describe the many physiological changes that result from participation in vigorous muscular fitness activities (Getchell, 1983).

Ventilatory Efficiency (VE): The amount of ventilation required per liter of oxygen consumed (Fox and Mathews, 1981).

Overview

In the first chapter, the rationale for the purpose of this study were presented. The assumptions and limitations along with the definitions of important terms were also presented. Research hypotheses in the null form were stated.

In the second chapter, the selected literature and research materials will be reviewed as they relate to the basic elements of the study. The components of physical fitness and the types of exercise programs will be discussed, and the concept of circuit training will be reviewed.

In the third chapter, the survey research methodology of this study will be explained. First, the sampling techniques will be detailed. Second, the experimental

design, testing administration and statistical analysis that were used in interpreting the data will be examined. Finally, the research hypotheses will be presented in testable form.

In the fourth chapter, the data results will be examined with regard to each of the hypotheses included in the study.

Conclusions regarding the study will be drawn in the fifth chapter. Implications of this study for the circuit training program will be discussed. Finally, suggestions for further research regarding circuit training as related to total physical fitness will be presented.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter includes a review of research and related literature pertinent to this study in the following areas:

1. Conditioning history at the Kuwait Police Academy.
2. Research on conditioning at other police academies in the United States.
3. The effect of an exercise program on: (a) the incidence of coronary heart disease, (b) aerobic capacity, (c) strength and endurance, and (d) flexibility.
4. Types of physical fitness programs: (a) cardiorespiratory endurance, (b) strength and endurance -- isometric and isotonic exercise, (c) flexibility, and (d) circuit training.

Conditioning History at the Kuwait Police Academy

An important administrative goal of the Kuwait Police Academy is to increase the general physical fitness of its police officer candidates. Lack of physical fitness has been a continual problem at the academy since it opened in 1958. Operating the physical training program in a traditional manner at the Kuwait Police Academy has been the main problem. Usually the senior candidate leaders who led the physical training program were inexperienced, had

no theoretical knowledge of physical fitness, and had no written physical fitness program to follow. The daily program began with exercises at six o'clock in the morning starting with 15 to 20 minutes of jogging, and followed by 10 to 15 minutes of calisthenics with a final jogging. The candidates finished their exercises at six-forty, took showers, ate breakfast, and got ready to begin their daily police training schedules which started at 8:00 a.m.

Unfortunately, many times these physical training sessions were used as a form of punishment for the candidates rather than for creating the feeling of the importance of maintaining personal physical fitness. For example, the officer candidate who did not work hard enough on the commands was given punishment by the senior officer candidate leader, for being lazy or talking during the physical training sessions and required to jog several laps around the field as well as perform additional calisthenics. The consequences of these punishment sessions, included injury, fatigue, runaways (AWOL's), resignations, and an all around dislike for exercise.

The first physical educator in charge of physical training was hired at the academy in 1977, he established a written physical fitness program and replaced the former senior leaders with a staff of physical fitness instructors

who were former athletes from the academy's physical education department. He reorganized the physical training sessions and trained the new staff members using such methods of training as calisthenics, strength and endurance exercises, flexibility, and educated his staff in the meaning of each component of physical fitness, but the results of these new training sessions were the same. There was still not enough improvement in the general physical fitness of the officer candidates (a copy of the above program was not available). After reviewing the literature, it appears that the physical training program of the Kuwait Police Academy was not strenuous enough: there was insufficient exercise frequency, graduated intensity, and increased duration (length) of the training period.

The officer candidate who is physically fit should be able to improve physical performance in his daily job tasks and adjust to the occasional heavy physical demands of such emergency situations as running, assisting a victim, or chasing a suspect.

Conditioning Research on Police Officers in the United States

Many studies have been conducted on police performance in order to improve their general physical fitness,

especially in three general areas: cardiorespiratory endurance, muscular strength and endurance, and flexibility.

Researchers seem to agree that any training program must include intensity, duration, and frequency in order to improve general physical fitness. Emes et al. (1981) reported that the key to developing fitness is not necessarily the activity engaged in, but the frequency, duration, and intensity of the activity when performed. Bucher and Prentice (1985) said that the "principle of overload" must be included in training programs. Overload is a gradual increase in the intensity of the physical activity which is a part of the training program. For example, to improve cardiorespiratory endurance through jogging, exercise intensity must be sufficient to stress the cardiovascular system. This stress must be provided so that over a period of time the system will improve to the point at which it can easily accommodate the additional stress.

Heyward (1984) stated that the intensity and duration of exercise are inversely related; the higher the exercise intensity, the shorter the duration of the exercise. Fox and Mathews (1981) reported that "the progressive overload principle implies that exercise resistance is near maximal

and that it is gradually increased as the person's fitness capacity improves through the course of the training program" (p. 262).

Byrd (1976) conducted a study regarding the impact of physical fitness on police performance. He used two groups of patrolmen: 45 in an experimental group and 45 in a control group. Both groups were matched by age, sex, and physical agility. The experimental group had one hour per week training sessions and individualized programs for six months at the Young Mens Christian Association. The equipment used in this program included an indoor pool, universal weight-lifting machines, and a running area. The control group knew nothing of the study. The tests used to measure physical fitness were: grip strength, pull-ups, visual reaction time, 25 meter speed test (running), vital capacity, maximal breathing capacity, cardiovascular-pulmonary, blood pressure, pulse rate, and anthropometric measures.

The results of this study showed that after six months of training, there was a significant improvement in the experimental group over the control group. The improvement was in muscular endurance, visual reaction time, maximum breathing capacity, resting heart rate, systolic blood pressure, and weight. Byrd (1976) concluded that improving

the physical fitness levels of police officers will lead to long term savings in sick time, injury, and heart illness.

Another study concerning the physical fitness status of police officers was conducted by Klinzing (1980). A comparison was made between 15 volunteer police officers and a group of undergraduates attending Cleveland State University. All subjects were given a physical fitness test including VO_2 max (maximal oxygen uptake), body composition, hand grip and bench press strength, sit and reach flexibility, pull-ups, sit-ups, 12 minute run, and agility run. He found that the police officers had greater percentages of body fat, covered less distance in the 12 minute run, and performed fewer pull-ups and sit-ups; however, their sit and reach flexibility was similar and their grip strength was superior. As a result of these tests, he concluded that emphasis on developing physical fitness is essential in police work.

Stamford et al. (1978) conducted an experimental study regarding the status of police officer fitness. There were 136 males and females ranging from 20 to 55 years of age. The main activity for these subjects was running, which was supplemented with calisthenics, weight training, and combative techniques. Data were collected from subjects in four separate classes over a two-year period. A minimum of

one hour per day, five days per week was invested in fitness activities. The fitness measures included maximal oxygen uptake (VO_2 max) on the Monark bicycle ergometer. Body fat was measured using the skinfold technique. The two arm pull-up was utilized as an estimate of upper body strength. The results revealed that there were significant increases in VO_2 max and upper body strength as well as a decrease in body fatness of male recruits; and there was a greater increase in VO_2 max for females than males.

Gettman (1977) constructed an experimental study regarding the effects of various exercise programs on six groups of police officers. The exercise sessions were held for 45 minutes three times per week for 20 weeks. There were three experimental groups who participated in exercise programs, and three control groups who did not participate in any exercise activities. Experimental group one (aged 22 to 35) participated in a jogging program, experimental group two (aged 22 to 35) participated in a weight lifting program, and experimental group three (aged 36 to 55) used progressive jogging as their exercise program and it was similar to the one given to group one.

The results indicated significant improvement in working capacity, cardiovascular function, body composition, strength, and muscular endurance for groups

one and three; however group two, involved in the weight lifting program, showed no significant improvement in any of these areas. The researcher's conclusion was that future exercise programs for police officers should include a combination of running, strength training, and motor development.

Collingwood (1980) reported a study regarding on duty police and their physical activity. As a group, police had high rates of physical and emotional problems related to stress because of inactive job tasks and lifestyles. His conclusion was that one way to reduce stress is to provide training and educational programs for police officers to help them maintain individualized physical fitness programs.

All of the previous studies advocated that a well-planned and well-constructed physical training program is essential for police officers to maintain mental and physical well being. Improving all of the physical fitness elements such as cardiovascular endurance, muscular strength and endurance, flexibility, power, and agility should reduce injuries, stress, early retirement, and absenteeism in the workplace, while motivating the police officers to continue participating in a physical training program.

Effects of an Exercise Program

Effects on Incidence of Coronary Heart Disease (CHD)

Many physiologists and physicians have been encouraging people to engage in exercise and sports programs because the more physically active individuals appear to have a lower risk of coronary heart disease. Arnot (1984) said that evidence from studies of laboratory animals suggested that obstructions in the coronary arteries that provide blood to the heart muscles can be prevented, decreased, or delayed by exercise. The author continued by saying that blood pressure, another important factor, may contribute to cardiac risk. All of these risk factors may be significantly decreased, by increasing physical training activities.

One of the first CHD studies initiated by Morris (1975) at the University of London tested groups of bus drivers and bus conductors. Morris found that the city's bus drivers had 30 percent more heart attacks than did the conductors who walked up and down the double-decker bus collecting fares. Chave et al. (1978) also found similar results when reviewing the exercise patterns and CHD risk status of thousands of civil servants. Pollack et al. (1978) reported that the role of exercise in cardiovascular

disease was unclear at that time (1978). It would appear from a large number of studies, that people who are physically active have a lower incidence of cardiovascular disease when compared with those who are sedentary.

Froelicher et al. (1981) and Wyndham (1979) said that there is strong evidence that indicates that higher levels of activity are associated with a reduced risk of cardiovascular disease. Strauss (1984) reported that results of animal research supported the hypothesis that physically active individuals have greater resistance to coronary heart disease and its clinical manifestations.

Paffenbarger et al. (1978) reported that the study of leisure time exercise patterns and health status among college alumni showed that heart attacks decline with increased activity in individuals of all ages. Kulund (1982) reported that active people had only 50 percent of the incidence of coronary artery disease manifestations and 30 percent less mortality from coronary artery disease when compared to less active persons. Regular physical activity of a moderate to high level may decrease one's risk for developing the manifestations of coronary artery disease.

Effects on Aerobic Capacity

Considerable information is available concerning the changes in the cardiovascular system during exercise.

Astrand (1968) stated that the most important of these change responses was the increase of maximal oxygen uptake or aerobic capacity. The maximal oxygen uptake (max O_2) was defined by Astrand as the highest oxygen intake the individual can attain during physical work while breathing at sea level.

Brook and Fahey (1985) took the position that the whole body maximal oxygen consumption (VO_2 max) was the best measure of the work capacity of the cardiovascular system. Changes in cardiovascular function during exercise depend on the type and intensity of the exercise. Corbin and Lindsey (1984) stated that through endurance activities the heart muscle gets stronger, as does any muscle of the body during endurance exercises. The heart is then able to work more efficiently and effectively. It can pump more blood and oxygen to the body with each contraction, and thus does not need to beat as frequently as a less fit heart, and more work can be accomplished with less effort.

Gettman et al. (1976) discovered a significant increase in maximal oxygen uptake (VO_2 max) for a group of male police cadets whose initial VO_2 max was a substandard 40.0 ml/kg/min. These cadets entered into a circuit weight training program for 20 weeks and their generally poor cardiorespiratory condition was favorably influenced by the

length and intensity of the training regimen. Consequently, the literature indicates that the effect of circuit weight training on cardiorespiratory fitness is dependent upon many variables, none of which was satisfactorily isolated in past experimentation.

Wilmore et al. (1976) found that subjects showed a significant increase in maximal oxygen uptake during a three day per week, 10-week program of circuit weight training. The authors concluded that circuit training is an adequate general conditioning activity with a significant aerobic component.

Girandola and Katch (1973) studied the effects of a nine-week circuit training program on 29 college men. There were 11 different exercises per circuit, consisting of calisthenics, running, and weight training. Each participant in the study was asked to complete the circuit three times during each training session. Each subject also completed pre- and post- VO_2 max tests on a Monarch bicycle ergometer. Significant changes were found in their VO_2 max.

VanHuss et al. (1969) indicated that involvement in any physical activity of moderate intensity for several minutes produces an increase in pulse rate, oxygen consumption, more air breath per respiration, higher body

core temperature of working musculature, and an opening of additional functional small blood vessels in working muscles and lungs. The effects of the exercise throws the body out of balance, and as a result, the body reflexes and the hormonal system functions in a particular manner in order to maintain the individual during work, and then returns the body to normal function as soon as possible after exercise.

Effects on Strength and Endurance

Hales and Hales (1985) pointed out that exercise enables muscles to work efficiently and reliably. Conditioned muscles function more smoothly and contract more vigorously with less effort than unconditioned muscles. Getchell (1983) said that involvement in training activities can increase strength and the thickness of connective tissue within and around muscle. DeVries (1986) stated that the muscle grows larger in girth when it is trained with adequate heavy resistance exercise. This growth could be the result of either the enlargement of each muscle fiber (hypertrophy), or an increasing in the number of cells (hyperplasia).

Fox and Mathews (1981) pointed out that muscular strength and endurance will be developed effectively by providing an "exercise overload." Increase in muscular

strength, and endurance, are associated with physiological changes such as increased muscle size, small biochemical alterations, and adaptations within the nervous system and can be significantly improved with properly planned weight resistance exercise programs.

Effects on Flexibility

Flexibility has been recognized as one of the major components of physical fitness. Many researchers reported that flexibility is significant for success in physical fitness exercises, sports, and general good health. Poor flexibility is often associated with muscle injury and chronic lower back problems.

Johnson and Nelson (1986) defined flexibility as the ability to move the body and its parts through a wide range of motion without undue strain to articulation and muscle attachments.

Fox and Mathews (1981) reported that flexibility exercises can be performed in two common ways: static or ballistic movements. Static stretching involves stretching without jerking or bouncing, followed by holding the final stretched position for a given amount of time. Ballistic stretching involves jerking or active movement with the final position not being held. The authors stated that both types of stretching will improve flexibility, but the

static method is the preferred method because there is less danger of tissue damage. The energy requirement for the static method is less, and there is prevention and relief from muscular distress and soreness.

DeVries (1962) did a study that supported the claim that flexibility at the hip and lower back can be increased significantly with either ballistic or slow-tension (static) exercises. The subjects who performed the ballistic exercises experienced soreness, but those who did slow-tension stretching suffered little or no soreness.

Types of Exercise Programs

Cardiorespiratory Endurance Exercise

This is considered to be the most important area of the physical fitness program. Through cardiorespiratory exercise, the body becomes more capable of processing and delivering oxygen to the affected muscle tissue. There are four major training principles that must be considered in the promotion of cardiovascular endurance. These principles are: type, frequency, duration, and intensity of exercise.

The type of exercises that improve cardiorespiratory endurance are repetitive exercises that use large muscle groups. These include such aerobic activities as running

two miles in less than 20 minutes, swimming 800 yards in 20 minutes, or cycling five miles in less than 20 minutes. Wilmore (1981) stated that the main purpose of cardiorespiratory exercise is to build stamina and endurance and build a healthy and strong heart-lung relationship. Frequency of exercise is necessary to improve cardiorespiratory endurance, so it is important to engage in exercise three to four times per week, but not less than three times per week. Duration should be between 20 to 40 minutes per day of endurance training activities with the heart rate elevated to a training level. Intensity should be maintained at between approximately 60 to 80 percent of the individual's capacity. Exercising at too low of an intensity will result in little or no improvement.

Bucher and Prentice (1985) stated that "because heart rate is linearly related to the intensity of the exercise as well as to the rate of oxygen consumption, it becomes a relatively simple process to identify a specific workload (pace) that will make the heart rate plateau at the desired level". The authors commented that the most reliable measure of heart rate is the radial artery located on the thumb side of the wrist joint. Place the index and middle fingers on the thumb side of the flexor tendon. A strong

pulse should be located. Each pulse represents one heart beat. Then, the heart rate should be monitored for 10 seconds. After 10 seconds, multiply the number of heart beats by six to get the total number of beats per minute. Heart rate can be increased or decreased by either speeding up or slowing down the exercise pace.

Allsen (1984) gave a relatively simple estimate of a person's maximum heart rate which is subtracting the participant's age from 220. This gives an estimate of his maximum heart rate. Bucher and Prentice (1985) pointed out that the intensity of the workload will usually plateau after two to three minutes of activity.

An aerobic program developed by Dr. Kenneth Cooper (1982) was based on the needs of military personnel. His program included a variety of aerobic activities. Point values were given for the different types of exercises involved. Cooper (1968) said that aerobic activities promote cardiovascular fitness and make the heart muscle stronger; therefore, it can pump more blood. The program utilized common activities, and depending on the energy expenditure, points were equated with performance. The more strenuous activities were given a higher point value. The harder one worked in the aerobic exercise program, the greater the demand for oxygen. The more the aerobic

capacity improved, the more oxygen the body was able to process in a given time.

DeVries (1986) and Hockey (1985) stated that to improve aerobic capacity (or VO_2 max), there were three important variables of training that must be considered: (a) frequency, (b) duration, and (c) intensity. Intensity of training is the most important variable that dictates the magnitude of change. Pollock et al. (1978) pointed out that a training intensity 50 to 80 percent of one's endurance capacity (maximal oxygen uptake) appears to be optimal. This can be determined by knowing that the heart rate is equivalent to the selected working intensity.

Cooper (1968) stated that vigorous exercise producing a sustained heart rate of 150 beats per minute for 12 to 20 minutes a day can improve aerobic capacity. Wilmore (1981) stated that a training heart rate set at 70 percent of the individual's maximal heart rate represents a level of only 60 to 65 percent of his maximal oxygen uptake. This has been found to be sufficient to produce a substantial training response.

All training programs are based on monitoring heart rate during aerobic activity. An increase or decrease in heart rate can be achieved by altering the pace.

Strength and Endurance

The police officer candidate needs to increase muscle strength in order to enable him to successfully encounter an emergency situation such as saving somebody's life or property. Corbin and Lindsey (1985) said it is essential to have strong muscles in order to prevent lower back pain, promote good posture, prevent injuries, and improve athletic performance. Two types of strength and endurance exercises are isometric and isotonic.

Isometric Exercise. Isometric exercise is characterized by physical exercise that contracts muscles when force is being exerted by an immovable resistance. Marley (1982) stated that there is little muscle shortening and no appreciable movement. Consequently, it is a very poor cardiorespiratory activity and because there is no movement during isometric exercise, coordination, and flexibility are not increased. Corbin and Lindsey (1985) reported that "isometric exercises are effective for developing strength and require no equipment and only minimal space. However, these exercises do not develop as much strength as isotonic exercises, nor do muscles hypertrophy as much" (p. 48).

Wilmore (1981) stated that isometric exercises can be performed without equipment. Necessary resistance can be

provided by pushing or pulling against immovable objects, using towels, chairs, and other similar objects. There are two main disadvantages with isometric exercise: first, it is impossible to know how much force is being exerted, and second, the lack of information and feedback is a hindrance to motivation.

According to VanHuss et al. (1969), isometric exercise appears to be an excellent way to develop strength and it is as effective as weight training. Isometrics are effective only if they are maximal, held for six to 10 seconds, and are executed at a minimum of three positions in the joint's range of motion. The authors stated that a combination of both isometric and isotonic (static and dynamic) exercise can improve both power and strength.

Isotonic Exercise. Strength exercises utilizing isotonic contractions of the muscles are a popular form of exercise. Hockey (1985) said that "an isotonic contraction occurs when the force generated by the muscle is greater than the resistance. Movement occurs at the joint involved, and there is a shortening and lengthening of the muscles involved" (p. 56).

Corbin and Lindsey (1985) stated that isotonic refers to activities in which the muscles alternately shorten and lengthen such as calisthenics and weight lifting. The

major advantage of isotonic training is that a full range of motion can be performed. One disadvantage is that this type of exercise does little to increase strength unless more resistance is added. Isotonic calisthenics, such as sit-ups and push-ups, are suitable for people with different ability levels, and can be used to improve both strength and muscle endurance.

The exercises in this study consist of isotonic movements incorporated into a circuit training design in order to promote muscular strength, muscular endurance, and cardiovascular fitness.

Circuit Training Program

The notion of circuit training was developed by Morgan and Adamson (1961) in 1953. The authors developed a circuit training program because of the physical fitness levels of the students who were attending Leeds University. Their purpose was to improve all-around fitness rather than fitness required for any particular activity or game. Capon (1979) said that a carefully planned circuit training activity is the most challenging and motivating method for developing physical fitness and motor skills. Historically, circuit training is a modification of the obstacle course concept utilized in military training.

Researchers have been performing many experimental studies on the effects of circuit training on physical fitness components. Howell et al. (1963) conducted an experimental study on the effects of circuit training on two groups of 17 freshmen using the Modified Harvard Step Test. This test is a cardiovascular measure of the circulatory system to response and recovery from physical exertion. Group I, the experimental group, executed a circuit training program twice a week for one month. The control group utilized the regular service program consisting of badminton and volleyball. Results showed that after one month on the Modified Harvard Step Test, there was significant improvement in the experimental group; however, the control group did not show this same improvement.

A study was conducted by Taylor (1961) on 42 businessmen from the Vancouver YMCA. The subjects were equally divided into three groups. Two experiment groups (1 and 2), and one control group (group 3). Group 1 was given a calisthenics program, group 2 was given a circuit training program, and group 3 was a control group. All three groups were given a pre- and post-test over a two month experimental period. The two tests given were the Larson Muscular Strength Test (chin-ups, arm dips, and

vertical jumps) and the Harvard Step Test (cardiovascular measurement of the circulatory system). The results showed that both experimental groups improved significantly in the cardiovascular and muscular strength tests. There were no statistically significant differences between the two experimental groups. The control group showed no statistically significant improvement in cardiovascular and muscular strength tests. The conclusion was that both the calisthenics and circuit training programs were effective methods of improving the cardiovascular and muscular status of the businessmen.

Wilmore et al. (1978) performed an experimental study of the physiological alternations consequent to circuit weight training. Two experimental groups of 16 men and 12 women practiced circuit weight training three days per week for 10 weeks. The two control groups did not participate in any organized physical activities. The results showed that the experimental groups had significant increases in lean body weight, flexed biceps girth, treadmill endurance time, maximum ventilatory efficiency (VE max -- women only), VO_2 max in ml/kg/min. (women only), flexibility, and strength. Significant decreases were found in selected skinfold measurements, and in resting heart rate. (The control group showed similar decreases.) No changes were

found in body weight or in relative or absolute body fat. It was concluded that circuit weight training is a good general conditioning activity, because it attends to more than one component of fitness. Pollock and Jackson (1977) and Wilmore et al. (1978) indicated that a training program of eight to 10 weeks in duration generally results in less change in body composition than a program of longer duration.

Watt (1961) conducted an experimental study on a comparison of two methods of physical fitness training in low fitness males at the University of Oregon. The subjects of 38 freshmen of age ranged between 18-20 year olds; were randomly assigned in two groups. Group A of 21 subjects was given standard developmental exercises used at the University of Oregon since 1952, group B of 17 subjects was given circuit training exercises used by Morgan and Adamson. All subjects were given a pre-and post-test over an eleven week experimental period. The tests given were pull-ups, 60 second sit-ups, leg lifts, 300 yard shuttle run, and sargent vertical jump.

The results showed that both experimental groups improved significantly in all test items except in the pull-ups test. Both showed no significant improvment. The conclusion was that both methods of fitness training were effective in improving cardiorespiratory function as measured by the 300 yard shuttle-run, and power as as measured by the vertical jump.

A study was conducted by Fusco and Butin (1974) on 60 male college freshmen between the ages of 16 and 22. The subjects were randomly divided into three groups. Group 1 was given a distance running program, group 2 was given a weight circuit training program, and group 3 was a control group. The training programs were done as part of their regular physical education classes: three times per week, 50 minutes per session, for nine weeks.

The tests given were the Harvard Step Test, grip strength, resting heart rate, resting systolic and diastolic blood pressure, and finger temperature (peripheral vasoconstriction). The results showed that both of the experimental groups improved significantly over the control group on the Harvard Step Test. Improvements were shown in the resting heart rate and resting diastolic and systolic blood pressure, and there was no significant difference between both experimental groups. Significant improvement was found in grip strength for the weight circuit training group over the distance running group and control group, but there was no significant difference in improvement of the means between groups 1 and 3. Consequently, the literature indicated that the effects of distance running and weight circuit training improved cardiovascular fitness; however, weight circuit training can improve strength over distance running.

Morgan and Adamson (1961) stated that circuit training has three main characteristics:

1. It aims at the development of muscular and circulo-respiratory fitness.

2. It applies the principle of progressive overload.

3. It enables large numbers of performers to train at the same time by employing a circuit of consecutively numbered exercises around which each performer progresses, doing prescribed allocations of work, and checking progress against the clock. (p. 31)

It is not possible to assess the effectiveness of "circuit training" as circuits differ. One can only assess the improvements produced as a result of the exercises selected for the circuit.

Sorani (1966) said that circuit training has many benefits for individuals. It improves cardiovascular function, muscular strength, endurance, and joint flexibility; it develops an understanding of the role of exercise in maintaining good health and coordination; and it provides relaxation and release of tension.

Circuit training has the following advantages:

1. Circuit training can be set up in any adequate area whether inside or outside.

2. It is inexpensive.

3. It can be changed by adding or subtracting stations and/or repetitions.

4. It does not require many instructors.

5. Instructions are self-explanatory, using pictures.

6. It enables large numbers of persons to train together at the same time.

7. The exercises are easily standardized so that the participant is able to perform the same way each day.

8. The participant knows exactly how he progresses each day. He can set a daily goal and objectively see how he is progressing toward the target time.

9. Economy of time is inherent in the organization of a circuit.

10. A training circuit is easy to supervise. (p. 5)

Smith et al. (1979) stated that, "circuit training has proven to be one of the best ways to achieve physiological conditioning among students in physical education classes or members of athletic teams" (p. 60). Under optimum conditions, circuit training utilizes load, repetitions, and time to improve strength, muscular endurance, and circulorespiratory endurance.

In conclusion, the future officer candidates need to engage in a well-constructed physical training program to improve their general physical fitness. A carefully planned circuit training program is one of the most challenging and motivating methods for improving all-around fitness and for maintaining a healthy lifestyle. Consequently, more research in the area of circuit training is needed in order to determine the effects of the training program on the physical fitness levels of the future officer candidates at the Kuwait Police Academy.

Summary

In Chapter II, a theoretical base and related research were established for this study. Many researchers such as Byrd, Klinzing, Stamford, Gettman and Collingwood were cited for their contributions in the area of physical fitness. Their work contributed to the quality of conditioning of police officers in the United States. The effects of exercise programs on coronary heart disease (CHD) were also included by this investigator. The effects of exercise on aerobic capacity were addressed by Astrand, Brooks and Fahey, Gettman et al., Wilmore et al., Girandola and Katch, and VanHuss et al.; the effects of exercise on strength and endurance were reviewed by Hales and Hales, Getchell, DeVries, and Fox and Mathews; the effects of exercise on flexibility were reviewed by Johnson and Nelson, Fox and Mathews, and DeVries. Types of exercise programs were reviewed by Wilmore, Bucher and Prentice, Allsen, Cooper, DeVries, Corbin and Lindsey, Marley, VanHuss, and Hockey. Finally, circuit training programs were addressed by Morgan and Adamson, Capon, Homell et al., Taylor, Wilmore et al., Watt, Fusco and Butin, and Sorani. Those reviewed were considered to have importance relative to this study.

In the next chapter, the research design for this study will be detailed.

CHAPTER III

PROCEDURES

The primary purpose of this study was to compare the circuit training program with the traditional calisthenics training program on the physical fitness levels of the officer candidates at the Kuwait Police Academy.

Selection of Subjects

Sixty male subjects were selected, but only 59 participated in this investigation. They were all freshmen officer candidates enrolled at the Kuwait Police Academy during the winter semester of 1986. The ages of the subjects ranged from 18 to 22 years.

The subjects were randomly assigned into two groups. One group, identified as the experimental group, used the circuit training program. The other group, identified as the traditional group, used the academy's traditional calisthenics training program. All subjects were non-athletic, so each individual was encouraged to exert maximum effort during the entire circuit training program, and traditional calisthenics training program.

Pilot Study

Six selected officer candidates were in the one-week pilot study. The purpose of the pilot study was to:

1. Determine the time needed for conducting the circuit training program.
2. Check the accuracy of the test apparatus.
3. Determine the appropriate number of assistant instructors needed for this study.
4. Receive feedback from the subjects and the instructors.
5. Determine any relevant changes to be made as a result of information obtained from the pilot study procedure.

Experimental Design

The 59 officer candidate subjects were randomly assigned into two groups. The experimental group utilized the circuit training program while the traditional group trained with the academy's calisthenics program. The exercise sessions were four days each week: Saturday, Sunday, Tuesday, and Wednesday. Both groups participated, in their respective programs, for 40 minutes between three and four o'clock in the afternoon. The two groups competed in intramural volleyball and basketball activities at six a.m. twice a week for 35 minutes.

The experimental group was provided with instructions regarding the level at which the exercise was to be

performed. Each subject was given a record card that assisted him in recording his workout days, the date, and the number of repetitions and sets completed on the circuit (see Appendix A).

Before each circuit training session, the subjects warmed up for five to seven minutes to help prepare their bodies for vigorous movement and to avoid injury. They did some static stretching exercises (for the lower back, hamstring and calf muscles, and upper body) and light jogging (two to three laps around the circuit area).

There were 14 separate exercises on the seven station circuit at the academy, with each station serving a dual purpose. These stations were organized in sequential order to avoid a similar type of exercise being placed next to another at the stations (see Appendix C). All stations took the individual differences in physical ability of the candidates into consideration. There were two candidates at each station, one was to count and the other to record the number of repetitions. At the command of a shrill whistle, each candidate started the exercise indicated at his station and continued for 30 seconds. During this time, he performed as many repetitions as he could until a deeper whistle indicated the end of the 30-second time period. The candidate then ran to the next station where

he started a different exercise at the sound of the whistle and so forth.

All subjects continued these procedures at each station until two to three sets of the circuit had been completed, then they ran two to three laps around the circuit. Between each set of the circuit they were allowed to rest for 30 to 60 seconds. After all sets of the 14 exercise stations and the running laps were completed, each candidate monitored his pulse heart rate at the wrist just below the base of the thumb. The pulse was counted for 10 seconds and multiplied by six. The total number of heart beats per minute indicated how strenuous the exercises were, which in turn helped the researcher determine the effectiveness of the exercises.

After the circuit training program and the calisthenics training program were completed, a gradual cool-down followed to avoid sore muscles. The cool-down was very similar to the warm-up: a slow jog or walk (two to three laps) followed by static stretching exercises which were done in order to continue the pumping action of the muscles and to promote circulation.

The traditional group performed the calisthenics program still in use at the academy. The calisthenic exercises included arm circles, jumping jacks, alternate

toe touches, trunk rotation, push-ups, sit-ups, side stretch, hamstring stretch, forward bend squat jumps, side leg raises, and jogging.

Testing Administration

Testing sessions were also conducted at the Kuwait Police Academy. A testing team was composed of five physical fitness instructors from the academy, including the investigator who directed the test. The testing team that administered and measured these tests met together several times to study the testing procedures. In addition, each tester had a copy of the test sheet as a reference prior to and during administration of the test.

During the first meeting, the subjects were instructed to arrive 15 minutes before each testing session. Each subject had his height and weight recorded, along with his body fat, resting heart rate, and resting systolic and diastolic blood pressure. After these procedures, the following physical fitness tests were given to all subjects: pull-ups, two minute sit-ups, Sargent's vertical jump (power), sit and reach (flexibility), Illinois agility run, and 1.5 mile run. These tests were conducted in the gymnasium at the academy, except the 1.5 mile run which was conducted the following day on 440 yard tartan surface track at Kaifan High School near Kuwait City.

There were two testing sessions during this study: a pre-test given before the training period, and a post-test was given 10 weeks later at the end of the training period. Both tests were recorded on an individual data sheet for each subject (see Appendix B).

Test Battery

The physical fitness test battery was conducted during per-post testing sessions on all of the subjects. The following test battery was measured.

Body Weight Measures

Body weight was recorded before and after the study. The weight was recorded in kilograms for all subjects. The body weight measure will be used to estimate weight gain or reduction (see Appendix D).

Body Fat Measures

Body fat was taken by a skinfold measure (calipers). The subjects were measured before and after the 10-week period of study, and the results were averaged together. The skinfold measure method will be used (triceps, biceps, subscapular, and suprailiac) and thin body fat will be computed by employing the technique described by Durnin and Rahaman (1967) (see Appendix D).

Resting Heart Rate

The resting heart rate test was taken with a stethoscope placed in the center of the chest. The number of heart beats within a 10-second period were multiplied by six to get the total number of beats per minute. The heart rate test was taken while the subject was lying down on his back. All subjects were tested by the investigator (see Appendix E).

Resting Systolic and Diastolic Blood Pressure Measures

Resting systolic and diastolic blood pressure tests simply required the subject to lie on his back while a blood pressure cuff was placed around his right arm. Both systolic and diastolic blood pressure were recorded (see Appendix E).

Pull-up Test

The pull-up test (AAHPERD, 1976) is a measure of the muscular strength and endurance for the arms, shoulders, and chest. The subjects grasped the overhead bar with palms facing forward, hanging with arms straight and elbows locked, their feet off the floor. At the command "go" the subject pulled up until his chin was over the top of the bar and horizontal to the floor. Then, he returned down to the starting position. The subject was required to perform

as many pull-ups as possible. Each repetition for which the subject did not place his chin over the top of the bar, or during which he kicked and swung, was not counted (see Appendix F).

Sit-up Test (With Bent Knees)

The intent of the sit-up measure is to estimate the muscular strength and endurance of the abdominal muscles (AAHPERD, 1957). The subject lay flat on his back with knees bent at approximately a 90 degree angle. The feet were held by a partner in order to keep them on the mat at all times. Fingers had to be interlocked behind the head. At the command "go" the subject raised the upper body forward to the vertical position so that the chest touched the thighs and then returned to the prone position. The subject had to do all sit-ups correctly within a two-minute period in order to be recorded (see Appendix F).

Sargent's Vertical Jump Test

The measurement of the vertical jump will be used to estimate the explosive isotonic strength of the extensor muscles in the legs and feet (Sargent, 1921). Each subject had three trials. The average of the three measurements was recorded. This test required a wallboard marked off in inches as well as centimeters. Each subject in turn stood

sideways to the wall, with the hand closest to the wall raised as high as possible under the wallboard. The examiner stood on a step ladder to measure the reaching height of the jumper. The subject then took a crouched position with both hands at his side. At the command "go" the subject jumped as high as possible to touch the wallboard at the peak of the vertical jump with his fingers. The examiner recorded each trial (see Appendix G).

Sit and Reach Test

The sit and reach test was reported by Wells and Dillon (1952). This test is used to estimate the flexibility of the hamstrings. The subject sat on the rubber matting with knees fully extended and the bottoms of his feet against the two-foot stops which were 30 cm. apart. The subject bent his trunk forward and held the position of maximum reach. The knees were to remain straight in order to read the measuring tape (see Appendix H).

Illinois Agility Run

The agility run test (Cureton, 1951) will be used to estimate the runner's speed and ease with change of body position. Each subject had one chance to perform this test. The subjects stood at the starting line in a prone

position with hands at the sides of the body. At the command "go" the subjects sprinted 30 feet (9.14 m.) until one foot touched the line, ran around the medicine ball, and sprinted back toward the starting line. Then a left turn was made around the first medicine ball, followed by a zig-zag around each ball, and then another zig-zag toward the starting line. A left turn was made around the last ball, touching the line, and then returning at full speed across the finish line (see Appendix I).

1.5 Mile Run Test

This test was reported by Jackson (1974) to measure aerobic capacity. The subjects were instructed to wear suitable clothing and shoes for running. All subjects were instructed to cover the 1.5 mile course in the fastest possible time. All subjects participated in the pre-running stretches and calisthenics to help prevent injuries. They had to run around a 400-meter tartan track at Kaifan High School. If the subject became winded or had muscle cramps he could walk, but the 1.5 mile course had to be covered and the time recorded.

Statistical Analysis

The t-test will be used to determine the significance of training effect for each parameter measure. The test

one-test two differences for each group were also compared using paired t-test to determine the significance of the training effect between groups. A significance level of 0.05 was set for all analyses.

Testable Hypotheses

To determine the related improvements of physical fitness between the experimental versus the traditional group, the following testable hypotheses were analyzed.

Alternative Hypothesis 1: There is a statistically significant difference in the body weight measure between the experimental and the traditional group.

Alternative Hypothesis 2: There is a statistically significant difference in the body fat measures between the experimental group and the traditional group.

Alternative Hypothesis 3: There is a statistically significant difference in the resting heart rate measures between the experimental group and the traditional group.

Alternative Hypothesis 4: There is a statistically significant difference in resting systolic blood pressure measures between the experimental group and the traditional group.

Alternative Hypothesis 5: There is a statistically significant difference in diastolic blood pressure measures between the experimental group and the traditional group.

Alternative Hypothesis 6: There is a statistically significant difference in the pull-up score between the experimental group and the traditional group.

Alternative Hypothesis 7: There is a statistically significant difference in the sit-ups scores between the experimental group and the traditional group.

Alternative Hypothesis 8: There is a statistically significant difference in vertical jump scores between the experimental group and the traditional group.

Alternative Hypothesis 9: There is a statistically significant difference in sit and reach (flexibility) scores between the experimental group and the traditional group.

Alternative Hypothesis 10: There is a statistically significant difference in agility scores between the experimental group and the traditional group.

Alternative Hypothesis 11: There is a statistically significant difference in the one and one-half (1.5 mile) mile run between the experimental group and the traditional group.

Equipment

The chosen training apparatus used in this study were much like those selected by Sharkey in a similar program he designed for the U.S. Forest Service in 1977. The experimental group used circuit training for a 10-week period. The equipment consisted of seven stations with 14 different exercises. These stations were constructed around four tennis fields at the academy with approximately 30 meters between each station. The following pieces of circuit training equipment (and their uses) were used in this study. Each piece of equipment has a dual purpose of exercises:

1. Pull-up bar (pull-ups and basket hang).
2. Sit-up bench (sit-ups and leg lifts).

3. Push-up bar (squat jumps and push-ups).
4. Parallel bars (arm dips and bar walk).
5. Vault bar (vault/vault).
6. Step-up bars (bench blasts and step walk).
7. Log walk (log hop/log walk).

Description of the Circuit Training Exercises

Exercise #1: Pull-ups (30 sec.)

Instructions: Start using a palms forward grip, shoulder width apart, with arms extended to support the body suspended from the chinning bar. Action: Pull body upward toward the bar until your chin is over the bar, then return to the starting position and continue for 30 seconds (see Plate 1).

Exercise #8: Basket Hang (30 sec.)

Instructions: Start from a hanging position from the bar using a palms down grip. Action: Raise knees up toward the chest and return to the starting position (see Plate 2).

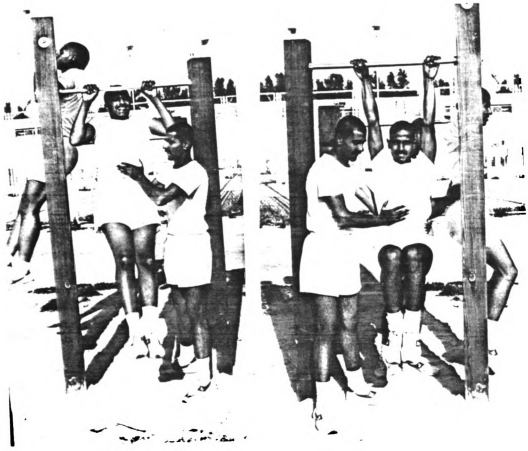


Plate 1

Plate 2

Exercise #2: Curling Sit-ups (30 sec.)

Instructions: Lie on back with legs bent at the knees, feet flat on the floor, hands grasping the bar overhead. Action: Curl up to a 30 degree angle and return to the starting position and repeat. This exercise can also be done on an incline (see Plate 3).

Exercise #9: Leg Lifts (30 sec.)

Instructions: Lie on back, arms extended above the head grasping the bar. Action: Lift legs slowly to a 90 degree angle; slowly return them to the starting position (see Plate 4).

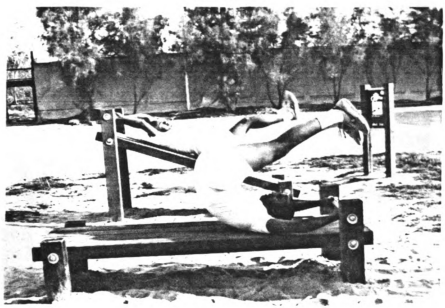
Exercise #3: Squat Jump (30 sec.)

Instructions: Start in a squat position with legs at a 90° angle; jump as high as possible, switch position of the feet on the way down and repeat (see Plate 5).

Exercise #10: Push-ups (30 sec.)

Instructions: Start in a front-leaning position with both legs extended, hands approximately shoulder width apart, with weight supported on hands and toes. Action: Lower body by bending arms until chest is within an inch of the bar, return and repeat (see Plate 6).

Plate 3



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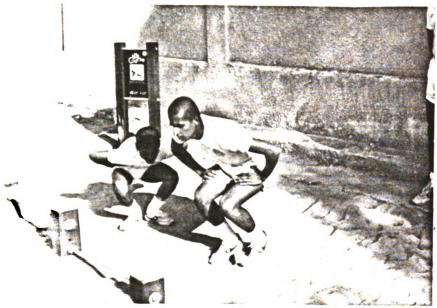

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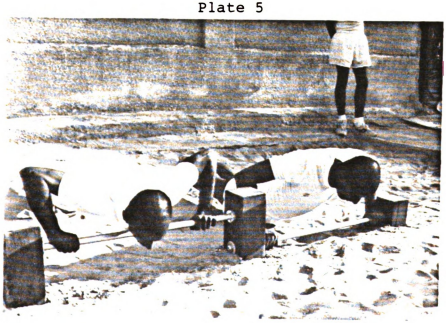

Plate 6

Exercise #4: Parallel Dips (30 sec.)

Instructions: Start with body supported in a suspended position between parallel bars. Action: Bend the elbows as much as possible and then return to the starting position to continue the repetitions (see Plate 7).

Exercise #11: Bar Walk (30 sec.)

Instructions: Supporting weight on arms, hand walk the length of the parallel bars as quickly as possible, then without turning, travel back again (see Plate 7).

Exercise #6: Bench-blasts (30 sec.)

Instructions: With right foot on the bench, blast off, switch position of the feet on the way down so that the opposite foot (left) will be on the bench. Recruits use the medium bench. For more resistance, use a higher bench (see Plate 8).

Exercise #13: Bench Step-up (30 sec.)

Instructions: Start with head up and arms at sides facing the bench. Action: Step up and down on the bench as fast as possible for each leg, using the medium bench, making sure to extend the leg completely on top of the bench (see Plate 8).

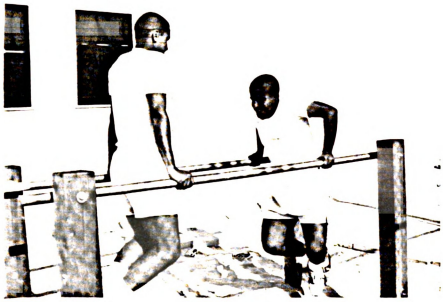

Plate 7

Plate 8

Exercise #5 and #12: Vault (30 sec.)

Instructions: Recruits may vault the bar of their choice (see Plate 9).

Exercise #7: Log-hop (30 sec.)

Instructions: Stand with feet slightly apart and arms at sides. Face the length of the log. Action: Hop sideways across the log. Repeat hop across the log (see Plate 10).

Exercise #14: Log Walk (30 sec.)

Instructions: Walk the length of the log as fast as possible, then reverse and walk backwards, start over if you fall off (see Plate 11).

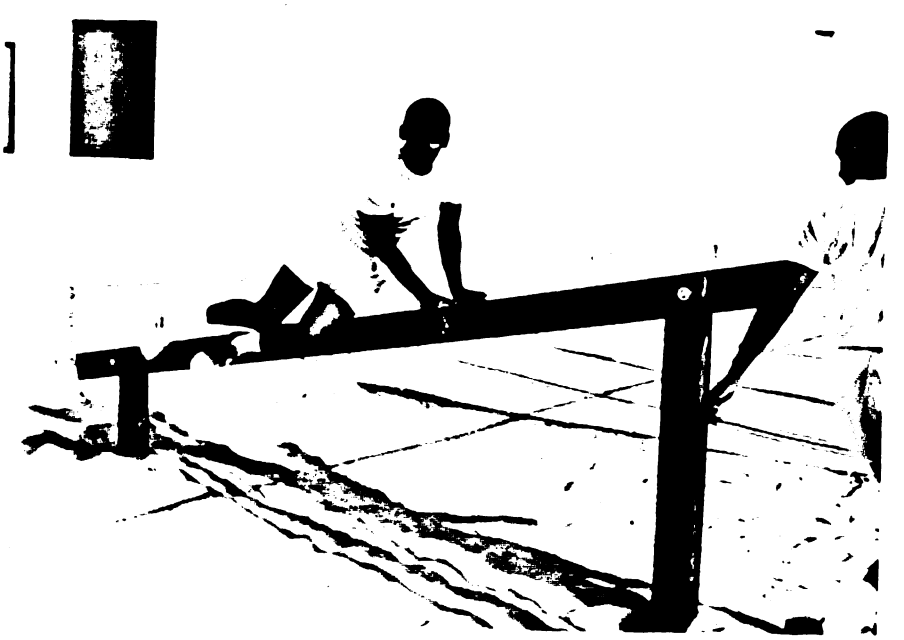

Plate 9

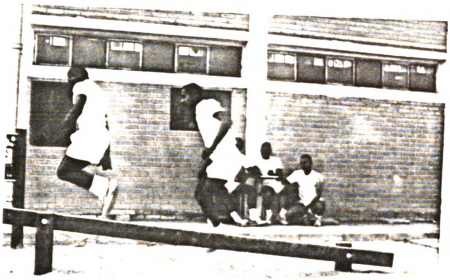

Plate 10

Plate 11

Summary

The samples for this study were drawn from police officer candidates in the Kuwait Police Academy. A simple random sampling technique was used to select the officer candidates. A pilot study was conducted for validation and applicability. Experimental research, which was designed specifically for use with the study, was used.

Testing administration techniques were explained in this chapter, as well as the statistical analysis applied to the hypotheses. The statistical analysis used was the t-test. Finally, the equipment and description of the circuit training exercises and the traditional calisthenics training program were described. The next chapter will contain a detailed statistical analysis of the data.

CHAPTER IV

ANALYSIS OF RESULTS

The purpose of this study was to compare between the effects of circuit training and the traditional calisthenics training program on the physical fitness levels of officer candidates at the Kuwait Policy Academy. The results of the physical tests for both the experimental group (circuit training) and the traditional group (calisthenic training) subjects from the police academy have been compared.

A total of 59 freshmen officer candidates attending the Kuwait Police Academy were involved in a 10-week physical fitness study. Thirty randomly selected subjects participated in the circuit training program, and the other 29 subjects participated in the traditional calisthenics program of the academy. All subjects were tested previous to and immediately following the 10-week training period. The statistical comparisons were considered significantly different if the alpha level was 0.05 or less.

H_o1: There is no statistically significant difference in the body weight measures between the experimental group and the traditional group.

The experimental group showed no significant improvement in body weight measures in pre-post tests. For the experimental group, the mean body weight score decreased from 68.08 to 68.03. The traditional group's average weight decreased significantly from 66.98 to 66.09 in the pre-post tests (Tables 4.1 and 4.2; Figures 4.1 and 4.2).

Table 4.1

Body Weight Changes of the Experimental and Traditional Groups

Variable/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Body Weight:						
Exp. Group	68.08	8.92	68.03	8.62	-0.14	.892
Trad. Group	66.98	6.19	66.09	5.19	-2.24	.033

Table 4.2

Mean Differences in Body Weight Between the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
Weight	-0.90	2.16	-0.05	2.00	1.56	.124

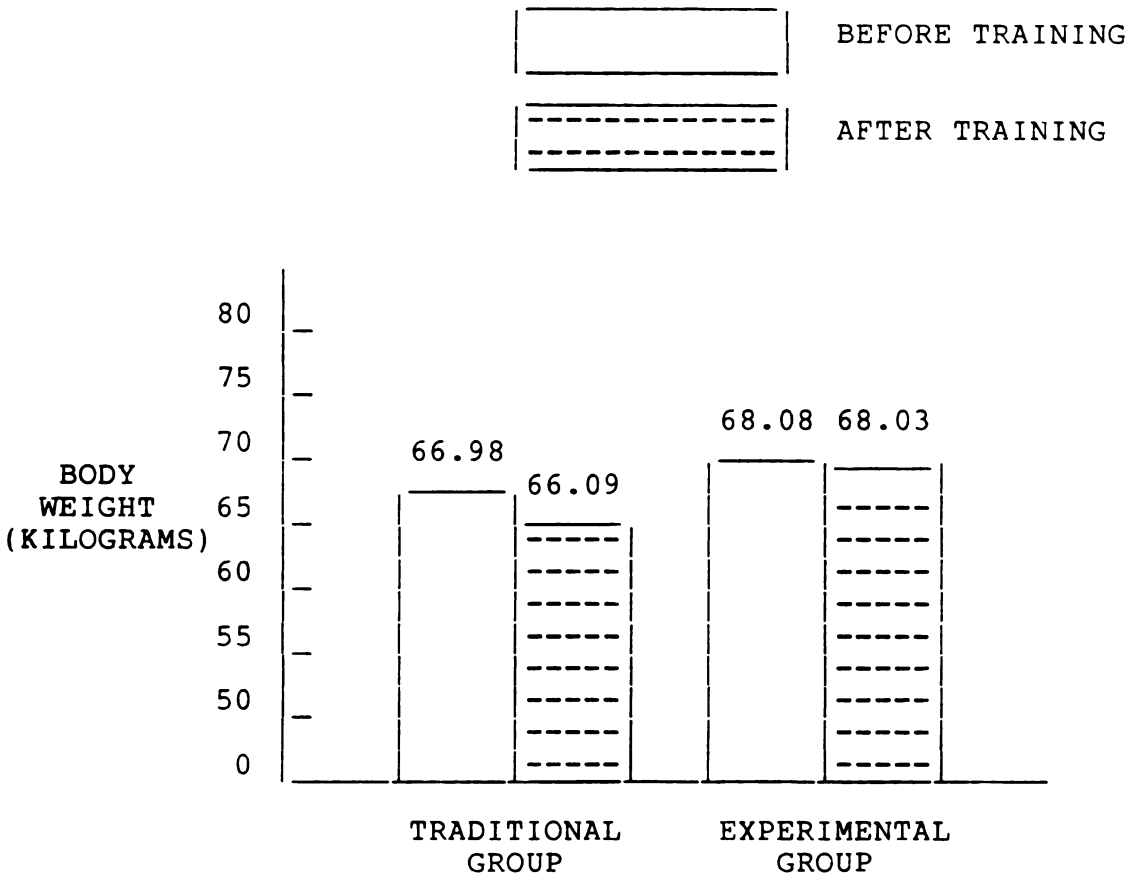

Figure 4.1. Mean Changes in Body Weight for the Traditional and Experimental Groups.

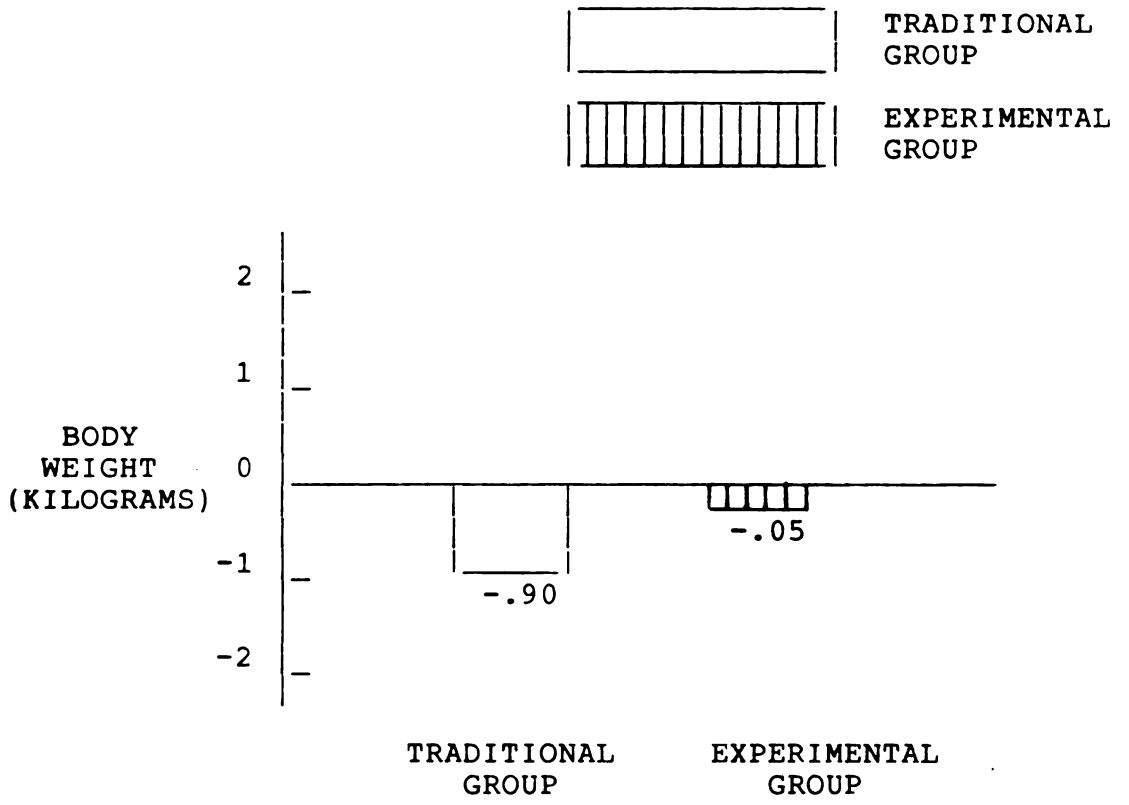

Figure 4.2. Comparison of Test Differences (post-test minus pre-test) in Body Weight between the Traditional and Experimental Groups.

There was no significant decrease in body weight tests for the experimental group over the traditional group, when comparing the difference between the means of the pre-test and post-test. The mean body weight difference of the experimental group was -0.05 with a standard deviation of 2.00. The traditional group had a mean difference of -0.90 with a standard deviation of 2.16. The t-value of 1.56 was not significant at the .124 level for the mean differences (Table 4.2; Figure 4.2). Thus, hypothesis 1 could not be rejected.

H_o2: There is no statistically significant difference in body fat measures between the experimental group and the traditional group.

The body fat was determined from skinfold measurement. The experimental group reduced significantly in body fat percentage from 19.08 to 17.15 (Table 4.3; Figures 4.3 and 4.4). The traditional group's average body fat percentage reduced significantly from 19.28 to 17.55.

Table 4.3

Body Fat Changes of the Experimental and Traditional Groups

Variable/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Body Fat:						
Exp. Group	19.08	4.37	17.15	4.12	-7.72	.000
Trad. Group	19.28	3.22	17.55	3.78	-2.69	.012

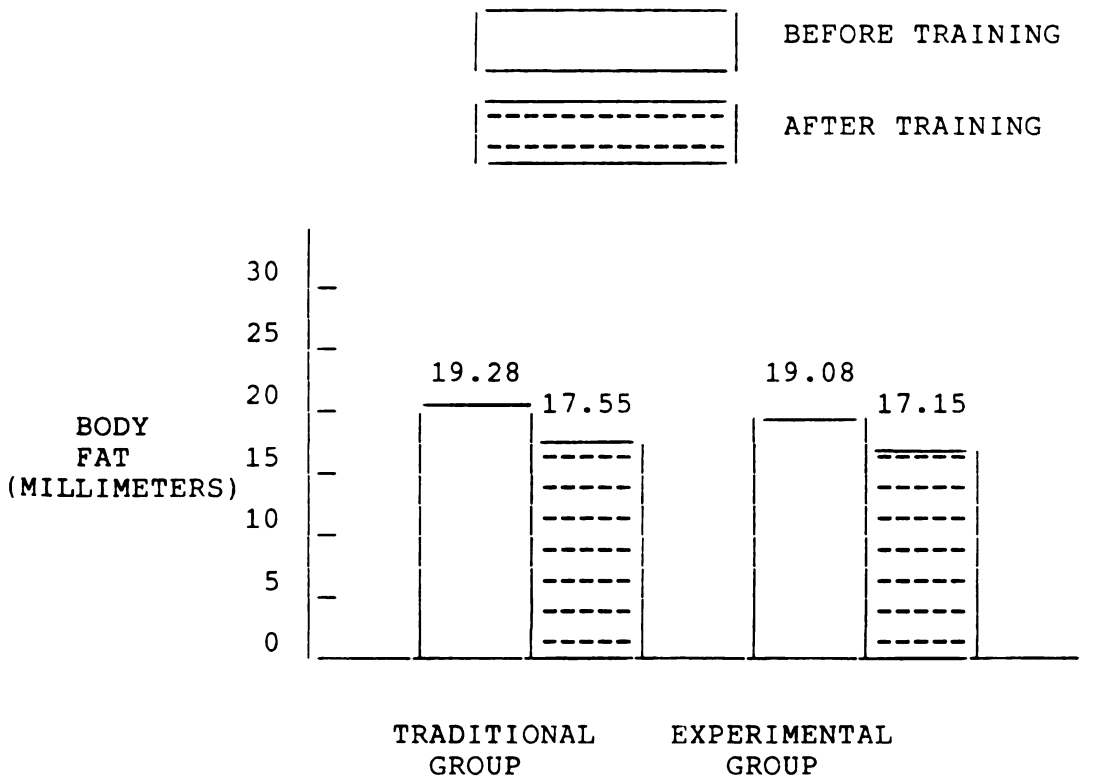

Figure 4.3. Mean Changes in Body Fat for the Traditional and Experimental Groups.

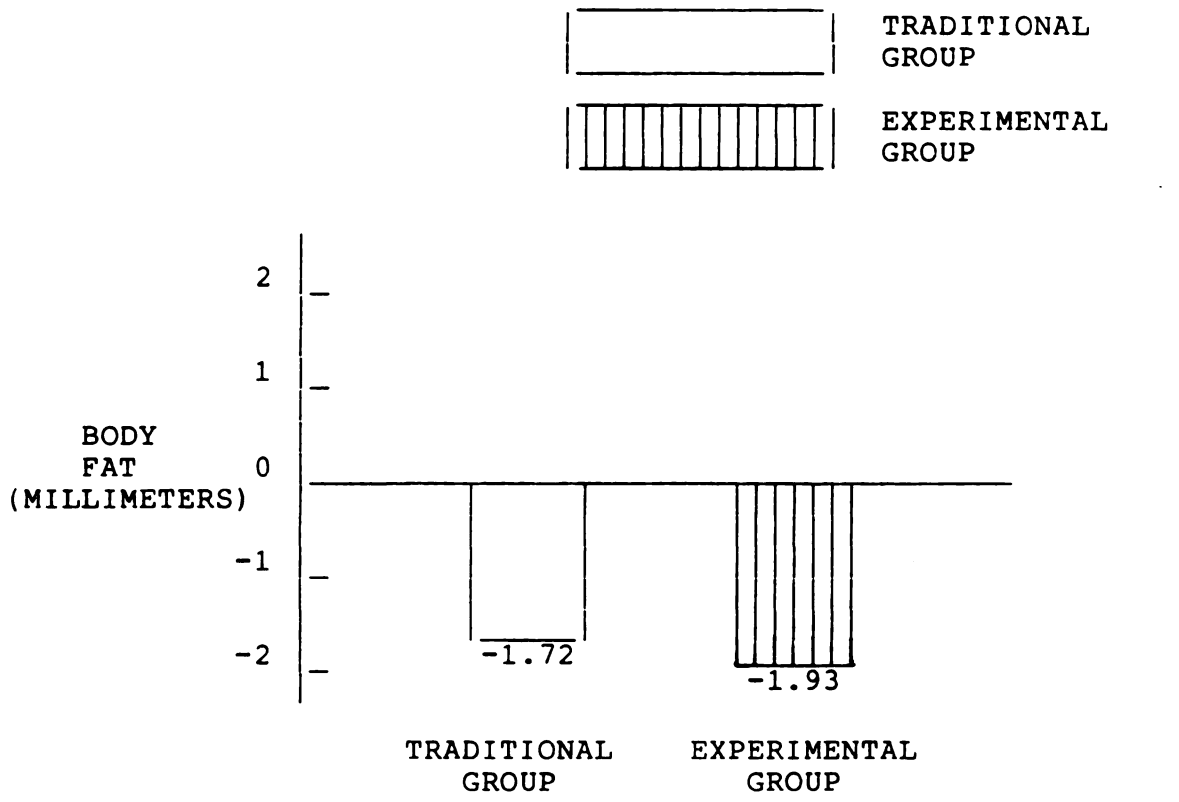

Figure 4.4. A Comparison of Tests of the Differences (post-test minus pre-test) in Body Fat Between the Traditional and Experimental Groups.

On the body fat percentage, the experimental group did not lose more weight than the traditional group. The experimental group had a mean difference of -1.93 with a standard deviation of 1.37. The traditional group had a mean difference of -1.72 with a standard deviation of 3.45. The t-value for the difference of means of -0.30 was not significant at the .762 level. Thus, the hypothesis was not rejected (Table 4.4).

Table 4.4

Mean Differences in Body Fat Between the Traditional and Experimental Groups

	Trad. Group		Exp. Group			
Variable	X	SD	X	SD	t-Value	P-Value
Body Fat	-1.72	3.45	-1.93	1.37	-0.30	.762

H_o3: There is no statistically significant difference in resting heart rate measures between the experimental group and the traditional group.

The experimental group showed significant pre-post test decreases in resting heart rate. The group average for resting heart rate reduced from 69.93 to 62.23. The traditional group showed no significant reduction in resting heart rate. The change was from 64.14 to 64.97 (Table 4.5; Figures 4.5 and 4.6).

There was a significant decrease in resting heart rate for the experimental group over the traditional group. The experimental group had a mean of -7.70 with a standard deviation of 5.80. The traditional group had a mean of .83

with a standard deviation of 6.27. The t-value of -5.43 was significant at the .000 level (Table 4.6). Therefore, the null hypothesis was rejected.

Table 4.5

Resting Heart Rate Changes:
Experimental Versus Traditional Group

Variable/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Resting Heart Rate:						
Exp. Group	69.93	7.38	62.23	7.09	-7.72	.000
Trad. Group	64.14	6.96	64.97	6.82	0.71	.483

Table 4.6

Mean Differences in Resting Heart Rate Between
the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
Resting Heart Rate	0.83	6.27	-7.70	5.80	-5.43	.000

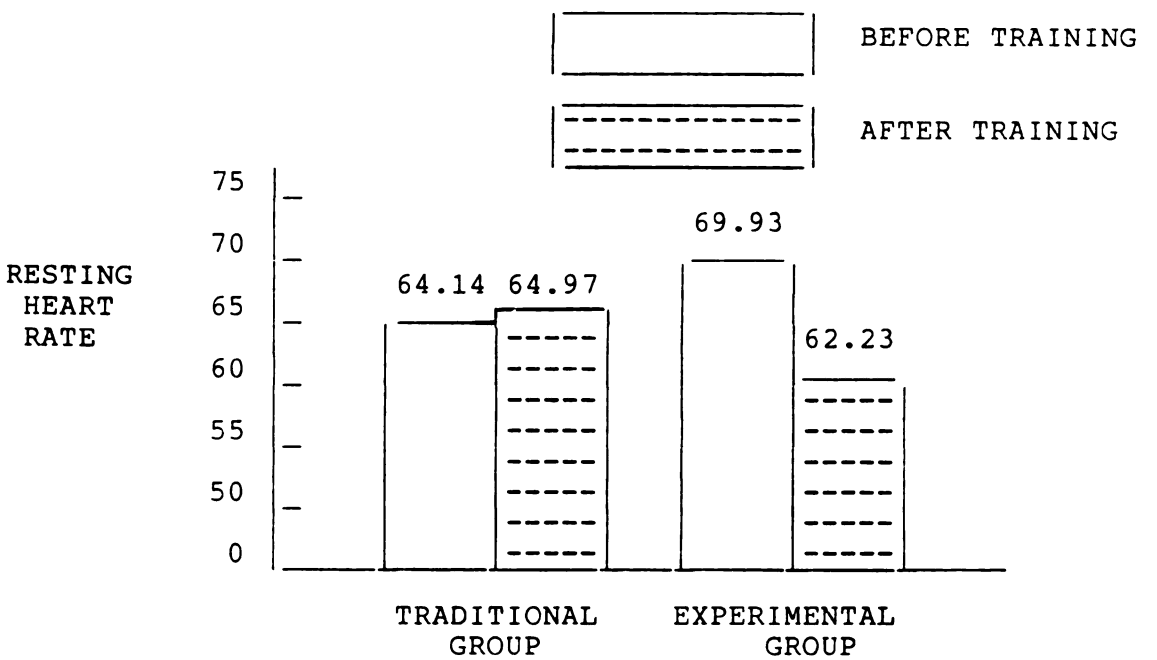

Figure 4.5. Mean Changes in Resting Heart Rate for the Traditional and Experimental Groups.

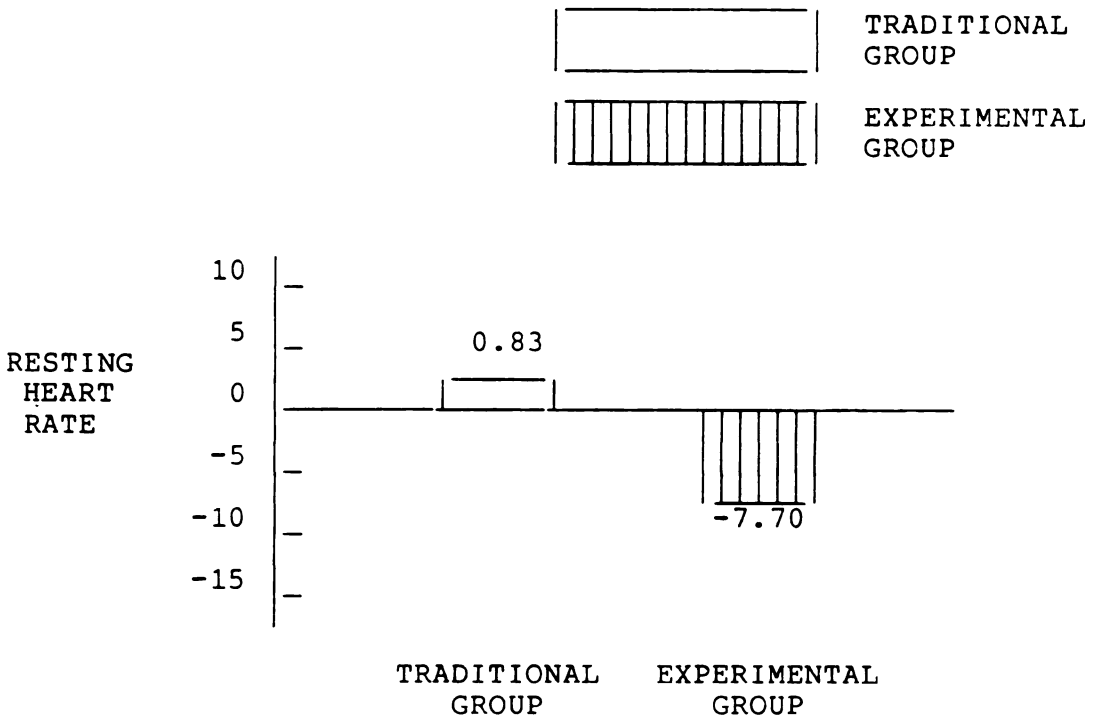

Figure 4.6. A Comparison of Test Differences (post-test minus pre-test) in Resting Heart Rate Between the Traditional and Experimental Groups.

H_o4: There is no statistically significant difference in resting systolic blood pressure measures between the experimental group and the traditional group.

Both groups showed a significant pre-post test decrease in systolic blood pressure. The mean average of the experimental group decreased from 127.67 to 113.00 mm. The mean of the traditional group decreased from 120.34 to 113.79 (Table 4.7; Figures 4.7 and 4.8).

Table 4.7

Resting Systolic Blood Pressure Changes: Experimental Versus Traditional Group

Variable/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Resting Systolic Blood Pressure:						
Exp. Group	127.67	8.17	113.00	8.37	-8.26	.000
Trad. Group	120.34	6.54	113.79	6.64	-4.98	.000

In resting systolic blood pressure, the experimental group showed a significantly greater decrease than the traditional group on the mean differences of post-test minus pre-test. The experimental group had an average decrease of -14.67 with a standard deviation of 9.73. The traditional group had a mean of -6.55 with a standard deviation of 7.08. The t-value for the difference of means of -3.67 was significant at the .001 level; therefore, hypothesis 4 was rejected (Table 4.8, p. 85).

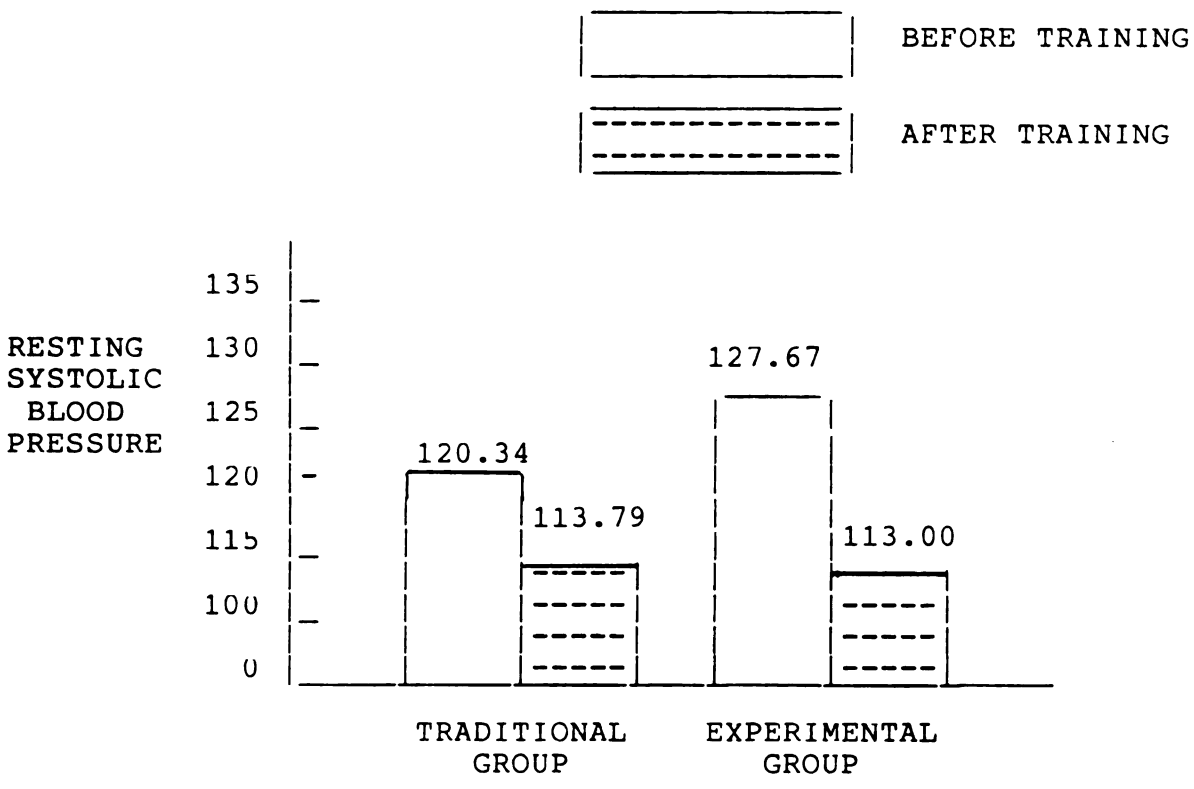

Figure 4.7. Mean Changes in Resting Systolic Blood Pressure for the Traditional and Experimental Groups.

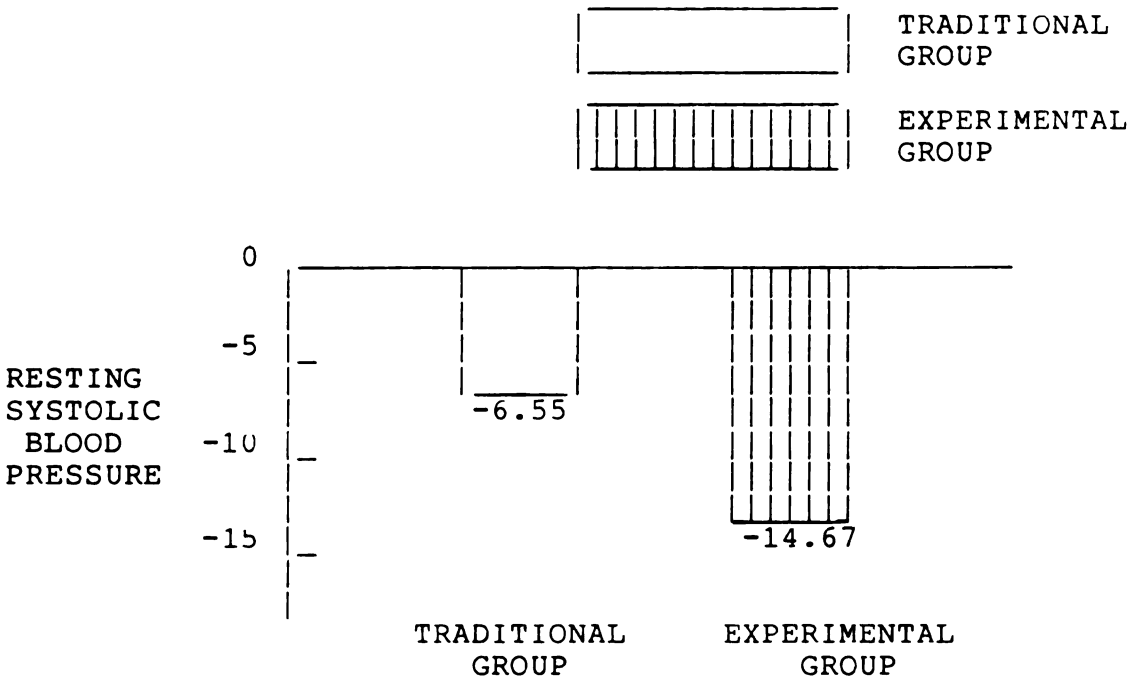

Figure 4.8. A Comparison of Test Differences (post-test minus pre-test) in Resting Systolic Blood Pressure Between the Traditional and Experimental Groups.

Table 4.8

Mean Differences in Resting Systolic Blood Pressure Between the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
Resting Systolic Blood Pressure	-6.55	7.08	-14.67	9.73	-3.67	.001

H_o5: There is no statistically significant difference in resting diastolic blood pressure measures between the experimental group and the traditional group.

Both groups showed significant pre-post decreases for diastolic blood pressure. The diastolic mean of the experimental group decreased from 75.83 to 59.33, while the traditional group's diastolic mean decreased from 69.66 to 63.10 (Table 4.9; Figures 4.9 and 4.10).

Table 4.9

Resting Diastolic Blood Pressure Changes: Experimental Versus Traditional Group

Variable-Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Resting Diastolic Blood Pressure:						
Exp. Group	75.83	4.37	59.33	5.83	-12.97	.000
Trad. Group	69.66	5.33	63.10	5.25	-5.62	.000

The mean of the differences obtained by subtracting pre-test scores from post-test scores for the experimental group in resting diastolic blood pressure was -16.50 with a

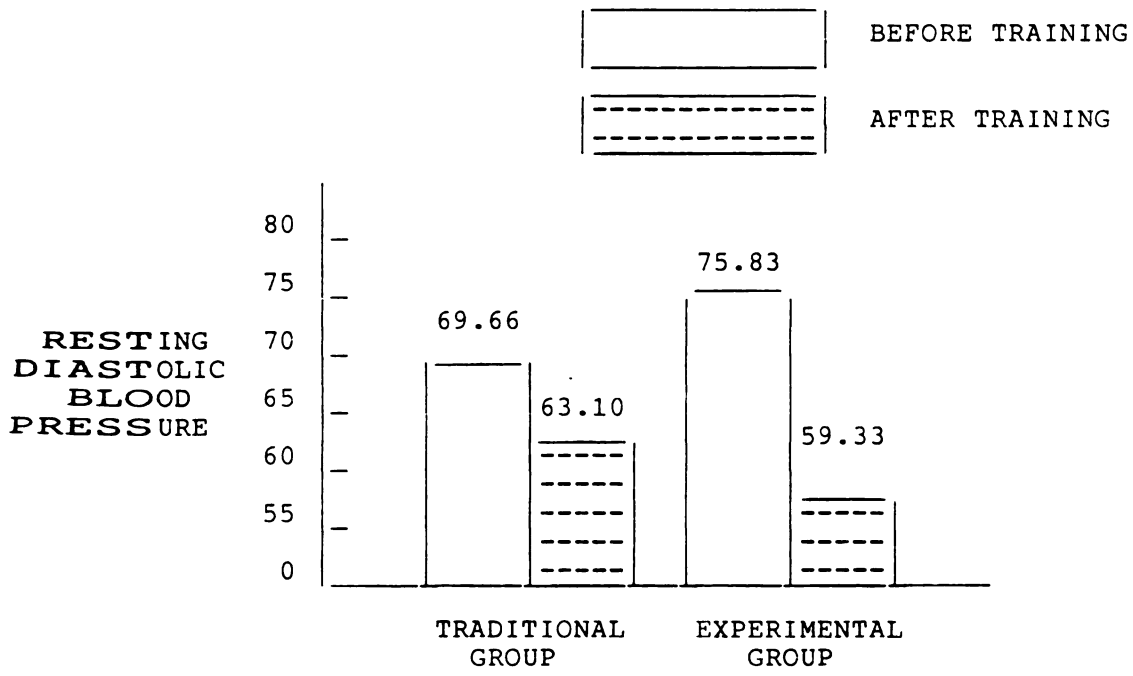

Figure 4.9. Mean Changes in Diastolic Blood Pressure for the Traditional and Experimental Groups.

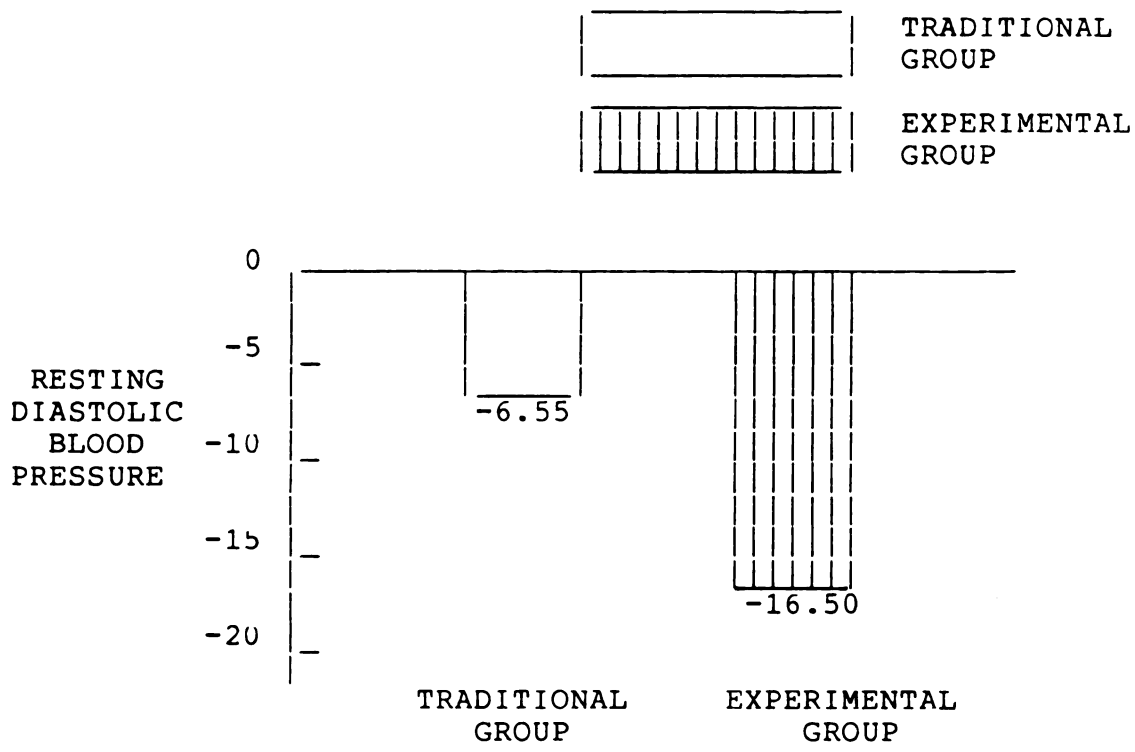

Figure 4.10. A Comparison of Test Differences (post-test minus pre-test) in Resting Diastolic Blood Pressure Between the Traditional and Experimental Groups.

standard deviation of 6.97. The traditional group had a mean difference of -6.55 with a standard deviation of 6.28. The t-value of -5.75 was significant at the .000 level, showing that the experimental group improved more than the traditional group in decreasing their resting diastolic blood pressure; therefore, hypothesis 5 was rejected (Table 4.10).

Table 4.10

Mean Differences in Resting Diastolic Blood Pressure Between the Traditional and Experimental Groups

	Trad. Group		Exp. Group			
Variable	X	SD	X	SD	t-Value	P-Value
Resting Diastolic Blood Pressure	-6.55	6.28	-16.50	6.97	-5.75	.000

H_O6: There is no statistically significant difference in the pull-ups score between the experimental group and the traditional group.

There was significant pre-post test improvement in pull-ups for both groups. The mean of the experimental group increased from 3.07 to 7.63 repetitions. The traditional group's mean pull-up increased from 3.97 to 6.45 repetitions (Table 4.11; Figures 4.11 and 4.12).

Table 4.11

Overall Improvement in Pull-ups for the Experimental and Traditional Groups

Variable/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Pull-ups:						
Exp. Group	3.07	2.45	7.63	4.00	11.32	.000
Trad. Group	3.97	2.46	6.45	2.96	6.30	.000

The mean of the difference of post-test minus pre-test for the experimental group in pull-ups was 4.57 with a standard deviation of 2.21. The traditional group had a mean difference of 2.48 with a standard deviation of 2.12. The t-value of 3.70 was significant at the .000 level which indicated that the experimental group's involvement in pull-ups was greater than that of the traditional group on the mean differences (Table 4.12). Hypothesis 6 was rejected.

Table 4.12

Mean Differences in Pull-ups Between the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
Pull-ups	2.48	2.12	4.57	2.21	3.70	.000

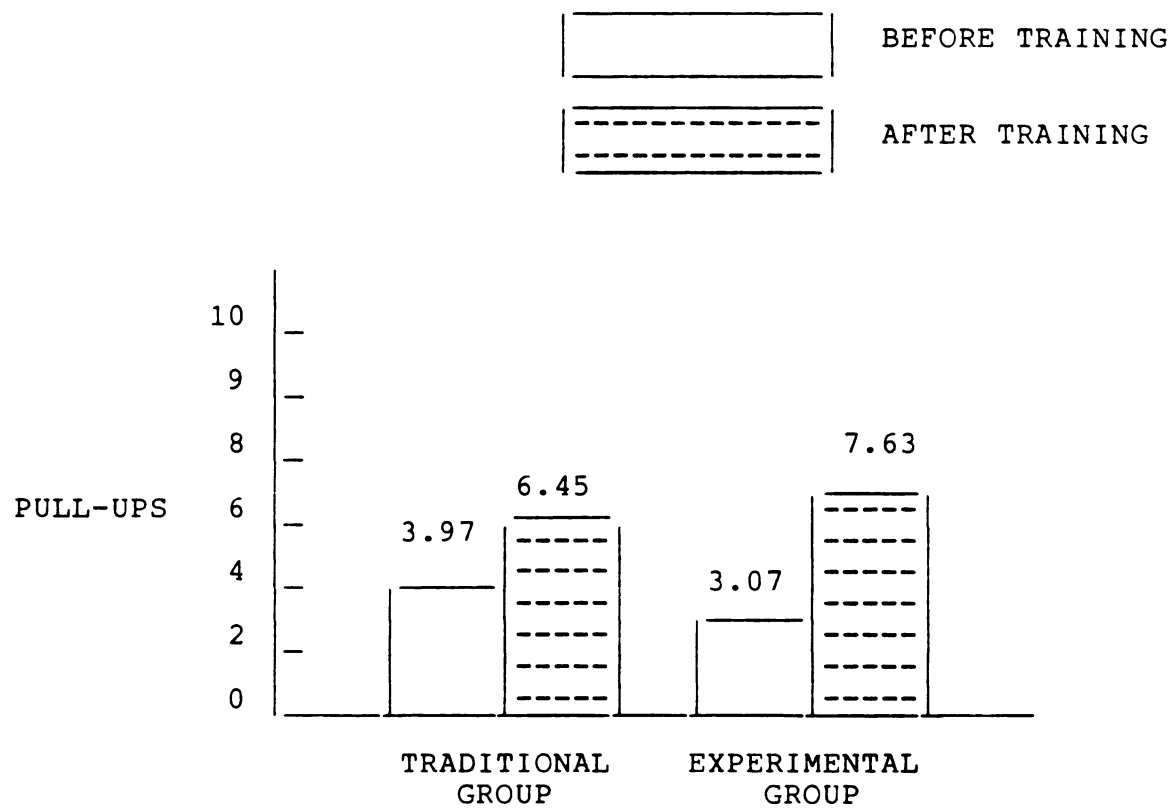

Figure 4.11. Mean Changes in Pull-up Scores for the Traditional and Experimental Groups.

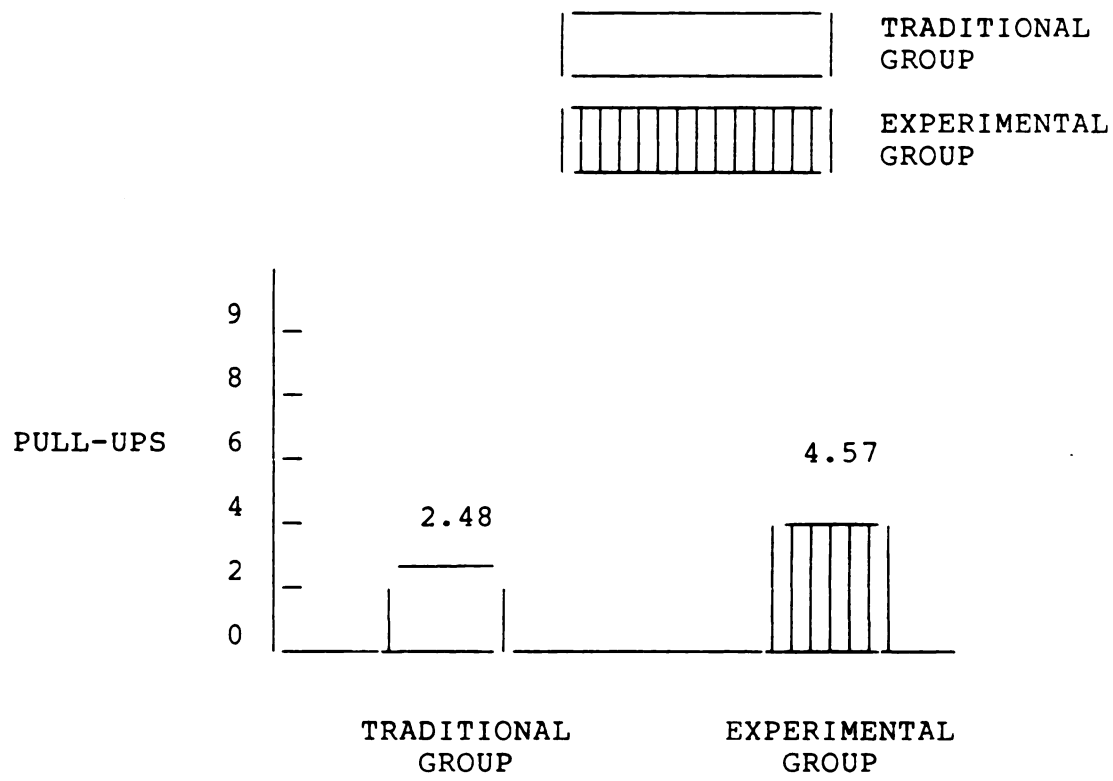

Figure 4.12. A Comparison of Test Differences (post-test minus pre-test) in Pull-ups between the Traditional and Experimental Groups.

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H_o7 There is no statistically significant difference in sit-ups scores between the experimental group and the traditional group.

There was significant pre-post test improvement shown by the experimental group in the sit-ups tests. Their mean increased from 47.43 to 57.30 repetitions. The traditional group showed no significant improvement. Their mean increased from 46.59 to 48.41 (Table 4.13; Figures 4.13 and 4.14).

Table 4.13

Overall Improvement in Sit-ups for the Experimental and Traditional Groups

Variables/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Sit-ups:						
Exp. Group	47.43	12.48	57.30	10.80	5.03	.000
Trad. Group	46.59	8.24	48.41	6.60	1.40	.174

The experimental group improved significantly more in sit-ups than the traditional group. The mean difference between the post-test minus pre-test for the experimental group was 9.87 with a standard deviation of 10.74. The traditional group had a mean difference of 1.83 with a standard deviation of 7.06. The t-value or 3.41 was significant at the .001 level (Table 4.14). Thus, hypothesis 7 was rejected.

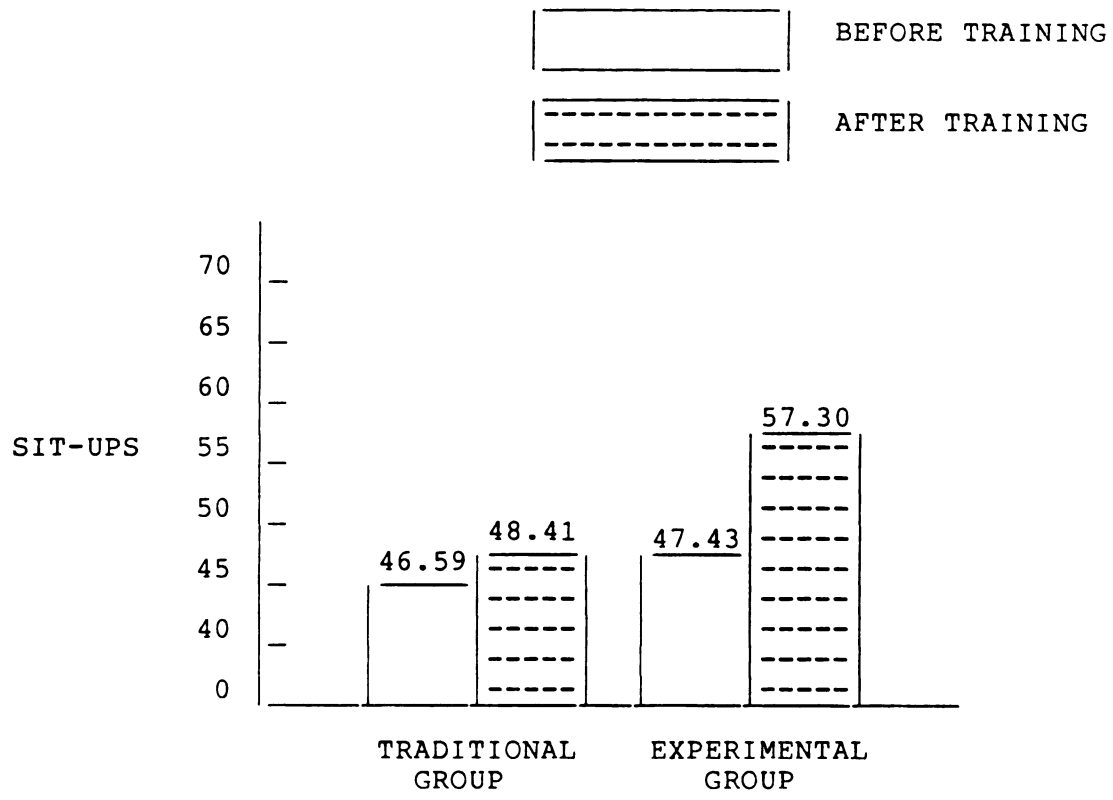


Figure 4.13. Mean Changes in Sit-ups Scores for the Traditional and Experimental Groups.

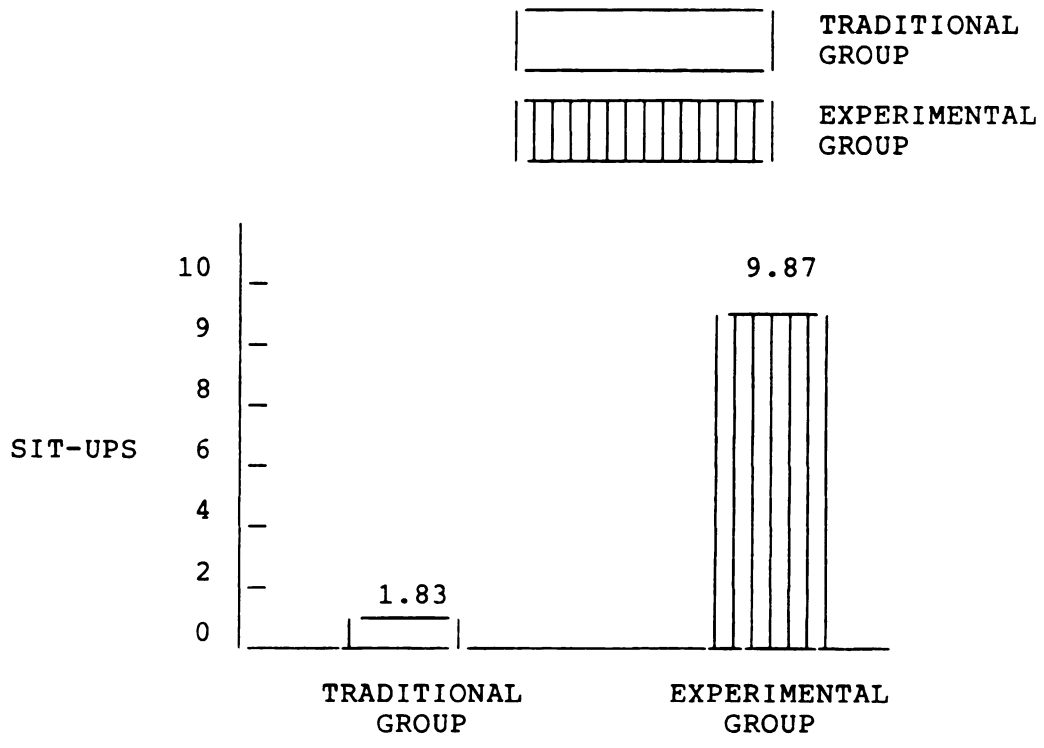


Figure 4.14. A Comparison of Test Differences (post-test minus pre-test) in Sit-ups Between the Traditional and Experimental Groups.

Table 4.14

Mean Differences in Sit-ups Between the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
Sit-ups	1.83	7.06	9.87	10.74	3.41	.001

H_o8: There is no statistically significant difference in vertical jump scores between the experimental and the traditional group.

Both groups showed significant improvement between the pre-test and post-test for the vertical jump test, which is a power measure. The mean of the experimental group in the vertical jump increased from 40.30 to 46.30 cm, while the traditional group's mean increased from 43.65 to 49.05 cm (Table 4.15; Figures 4.15 and 4.16). Both groups' improvement in power was significant over the 10 weeks of training.

Table 4.15

Vertical Jump Changes for the Experimental and Traditional Groups

Variables/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Vertical Jump:						
Exp. Group	40.30	7.47	46.03	5.61	7.04	.000
Trad. Group	43.65	6.85	49.05	5.93	6.89	.000

On the vertical jump, the experimental group had a mean difference of 5.72 with a standard deviation of 4.45. The

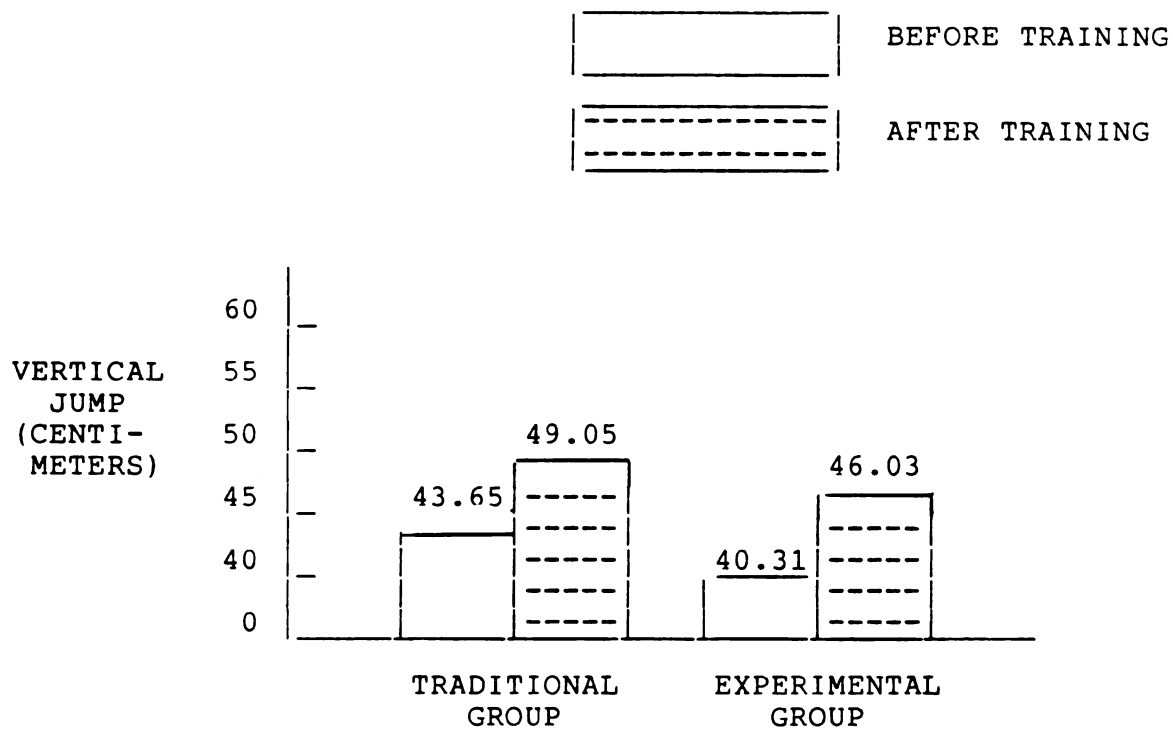


Figure 4.15. Mean Changes in Vertical Jump Scores for the Traditional and Experimental Groups.

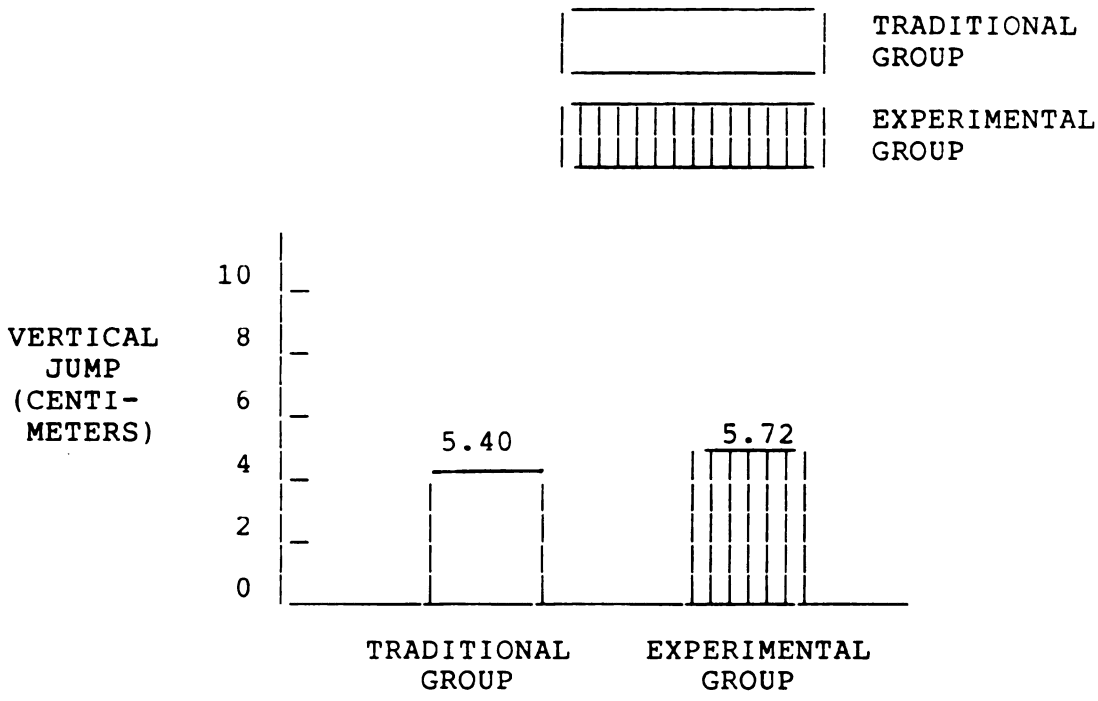


Figure 4.16. A Comparison of Test Differences (post-test minus pre-test) in the Vertical Jump Between the Experimental and Traditional Groups.

traditional group had a mean difference of 5.40 with a standard deviation of 4.22. The t-value of .28 was not significant at the .780 level (Table 4.16). Thus, hypothesis 8 could not be rejected.

Table 4.16

Mean Differences in the Vertical Jump Between the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
Vertical Jump	5.40	4.22	5.72	4.45	0.28	.780

H_o9: There is no statistically significant difference in sit and reach (flexibility) scores between the experimental group and the traditional group.

There was significant improvement in the sit and reach test for both groups from the first to the final test (Table 4.17; Figures 4.17 and 4.18) over the 10-week training program. The experimental group's mean increased from 29.90 to 38.80 cm, while the traditional group's mean increased from 28.07 to 31.97 cm. It was clear that both training programs produced a good level of flexibility in the hamstring muscles.

Table 4.17

Sit and Reach Changes for the Experimental and Traditional Groups

Variables/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Sit and Reach:						
Exp. Group	29.90	9.36	33.80	8.23	7.58	.000
Trad. Group	28.07	8.54	31.97	7.77	5.57	.000

In the comparison of the groups in the sit and reach, the experimental group had a mean pre-post test difference of 3.90 with a standard deviation of 2.82, and the traditional group had a mean pre-post test difference of 3.90 with a standard deviation of 3.77. The experimental group was not better than the traditional group. The t-value of .000 was not statistically significant at the .997 level (Table 4.18). Thus, hypothesis 9 could not be rejected.

Table 4.18

Mean Differences in the Sit and Reach Between the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
Sit and Reach	3.90	3.77	3.90	2.82	0.00	.997

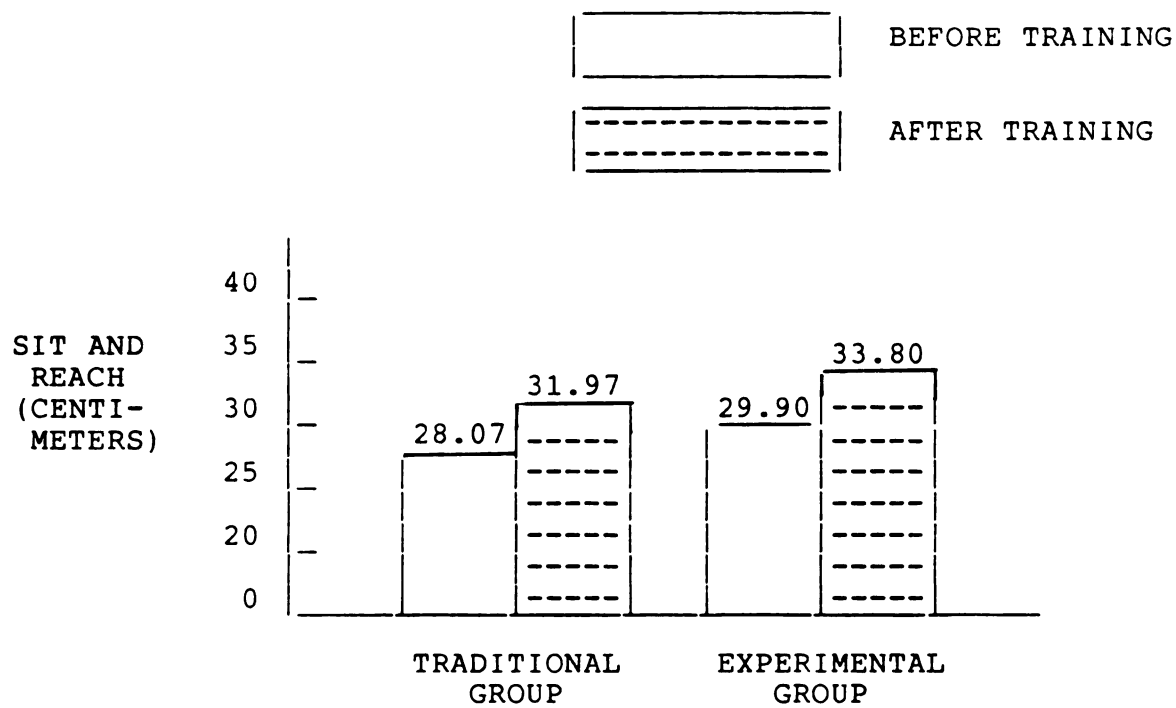


Figure 4.17. Mean Changes in the Sit and Reach for the Traditional and Experimental Groups.

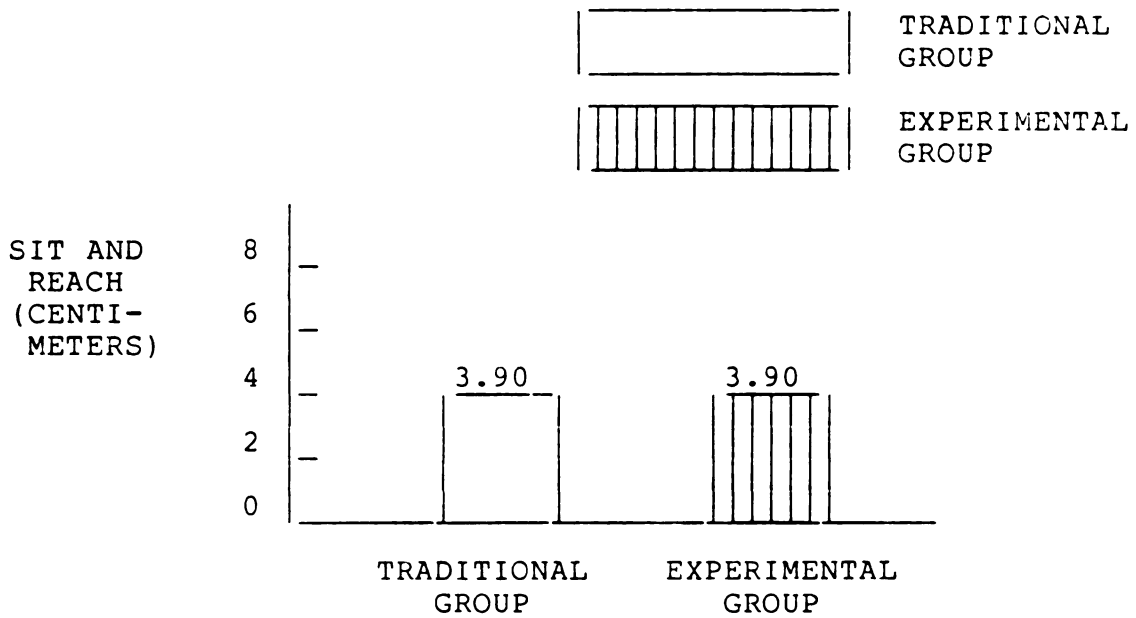


Figure 4.18. A Comparison of Test Differences (post-test minus pre-test) in the Sit and Reach Between the Traditional and Experimental Groups.

H_o10: There is no statistically significant difference in agility scores between the experimental and the traditional group.

There were significant pre-post test improvements observed in the agility run time for both the experimental and traditional groups (Table 4.19; Figures 4.19 and 4.20). The mean time decreased from 18:70 to 17:48 for the experimental group, while the traditional group's average time decreased from 18:32 to 17:52.

Table 4.19

Agility Run Changes for the Experimental and Traditional Groups

Variables/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
Agility Run:						
Exp. Group	18:70	0.71	17:48	0.79	-9.64	.000
Trad. Group	18:32	0.92	17:52	0.71	-3.95	.000

Both groups improved significantly in the agility run over the 10 weeks; however, the training responses in the agility run for the two groups were not significantly different. The t-value was -1.70 at the .082 level (Table 4.20). It is evident that both training programs were effective in producing improvement in agility. Thus, hypothesis 10 could not be rejected.

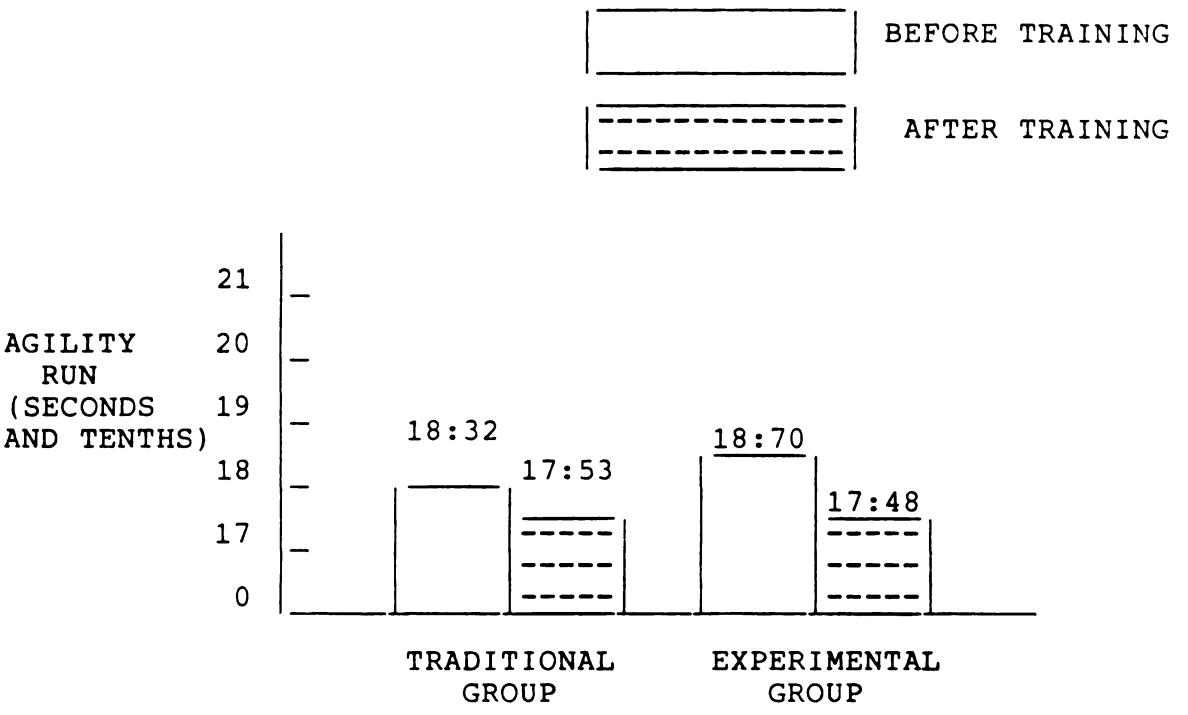


Figure 4.19. Mean Changes in the Agility Run Scores for the Traditional and Experimental Groups.

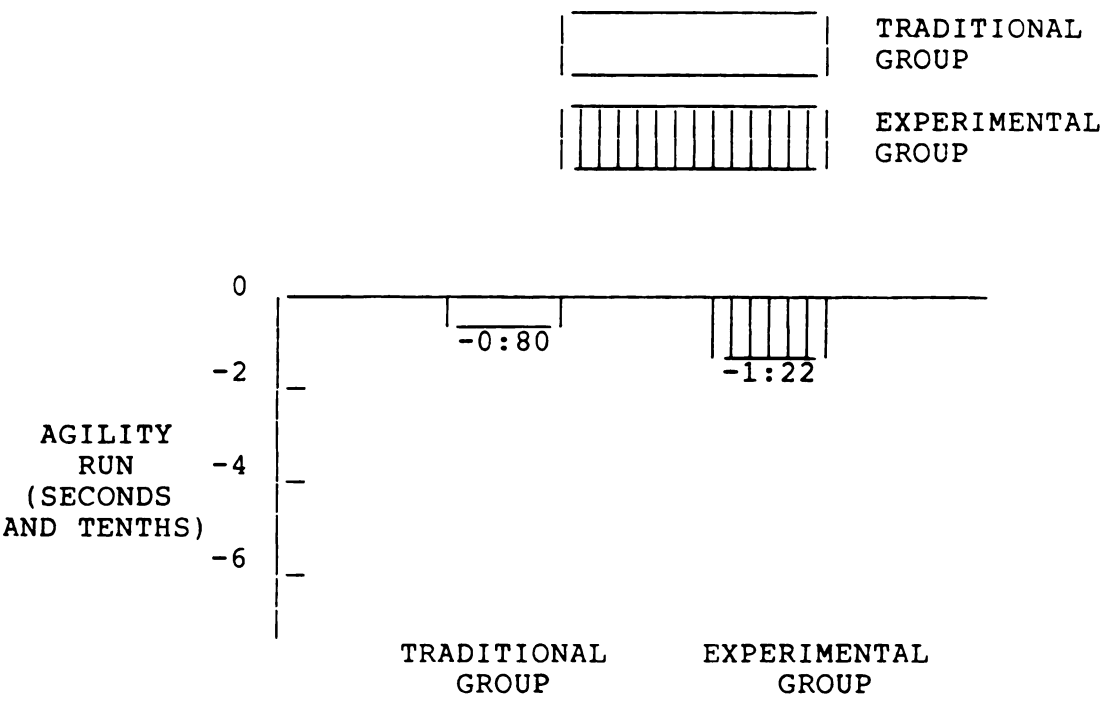


Figure 4.20. A Comparison of Test Differences (post-test minus pre-test) in the Agility Run Between the Traditional and Experimental Groups.

Table 4.20

Mean Differences in the Agility Run Between the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
Agility Run	-0:80	1.09	-1:22	0.69	-1.70	.082

H_o11: There is no statistically significant difference in the one and one-half (1.5) mile run between the experimental group and the traditional group.

There was significant pre-post test improvement in the experimental group in the one and one-half mile run. The mean time decreased from 11:62 to 10:42 minutes. The traditional group's improvement was significant. Their mean time decreased from 10:95 to 10:55 minutes (Table 4.21; Figures 4.21 and 4.22).

Table 4.21

One and One-half Mile Run Changes for the Experimental and Traditional Groups

Variables/ Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	t-Value	P-Value
One and One-half Mile Run (Minutes):						
Exp. Group	11:62	1.43	10:42	0.86	-5.32	.000
Trad. Group	10:95	0.98	10:55	0.98	-2.80	.009

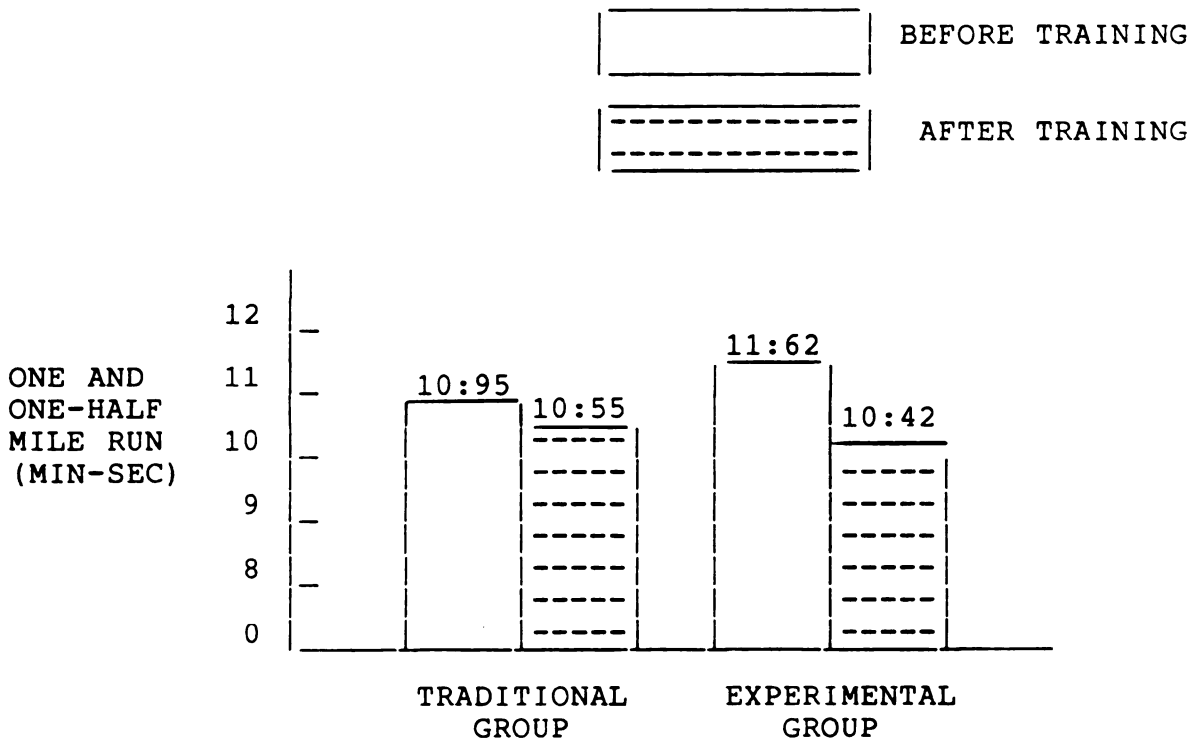


Figure 4.21. Mean Changes in the One and One-half Mile Run for the Traditional and Experimental Groups.

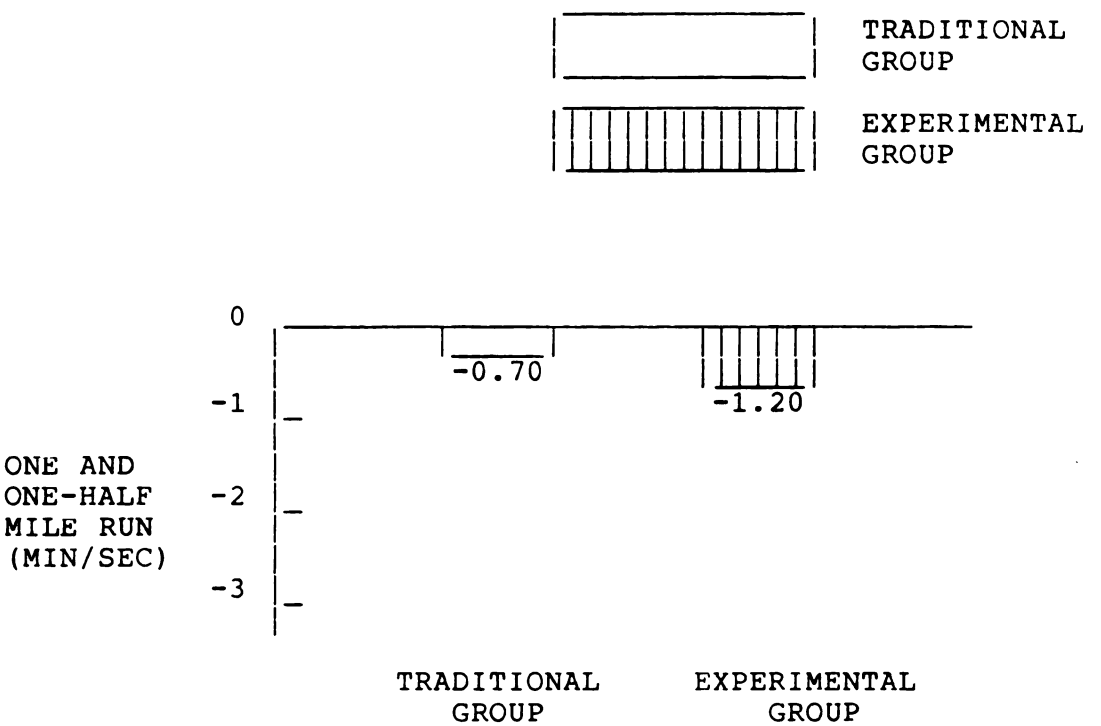


Figure 4.22. A Comparison of Test Differences (post-test minus pre-test) in the One and One-half Mile Run Between the Traditional and Experimental Groups.

In the one and one-half mile run, the experimental group's improvement was significantly greater than that of the traditional group when comparing the post-test minus pre-test mean differences. The t-value of 2.99 was significant at the .004 level (Table 4.22). Thus, hypothesis 11 was rejected.

Table 4.22

Mean Differences in the One and One-Half Mile Run Between the Traditional and Experimental Groups

Variable	Trad. Group X	Trad. Group SD	Exp. Group X	Exp. Group SD	t-Value	P-Value
One and One-half Mile Run	-0:40	0.77	-1:20	1.23	2.99	.004

Summary

In summary, the following tables (4.23, 4.24 and 4.25) present the significant findings of this study. The results of pre-post differences within each group are summarized in Tables 4.23 and 4.24. The comparisons of pre-post test differences between both the experimental group and the traditional group are summarized in Table 4.25. The null hypotheses are restated along with whether they were accepted or rejected. Both groups were tested by 11 variables. A comparison between both groups showed that the experimental group improved significantly over the traditional group in

Table 4.23

Test of Differences (post-test minus pre-test)
Within the Traditional Group

Variables	d	SD	t-value	P-value
Body Weight	-0.90	2.16	-2.24	.033
Body Fat	-1.72	3.45	-2.70	.012
Resting Heart Rate	0.83	6.27	0.71	.483
Resting Systolic Blood Pressure	-6.55	7.08	-4.98	.000
Resting Diastolic Blood Pressure	-6.55	6.28	-5.62	.000
Pull-ups	2.48	2.12	6.32	.000
Sit-ups	1.83	7.06	1.40	.174
Vertical Jump	5.40	4.22	6.89	.000
Sit and Reach	3.90	3.77	5.57	.000
Agility Run	-0:80	1.09	-3.95	.000
1.5 Mile Run	-0:40	0.77	-2.80	.009

d = Mean Difference

Table 4.24

Tests of Differences (post-test minus pre-test) Within the Experimental Group

Variables	d	SD	t-value	P-value
Body Weight	-0.05	2.00	-0.14	.892
Body Fat	-1.93	1.37	-7.72	.000
Resting Heart Rate	-7.70	5.80	-7.28	.000
Resting Systolic Blood Pressure	-14.67	9.73	-8.26	.000
Resting Diastolic Blood Pressure	-16.50	6.97	-12.97	.000
Pull-ups	4.57	2.21	11.32	.000
Sit-ups	9.87	10.74	5.03	.000
Vertical Jump	5.72	4.45	7.04	.000
Sit and Reach	3.90	2.82	7.58	.000
Agility Run	-1:22	0.69	-9.64	.000
1.5 Mile Run	-1:20	1.23	-5.32	.000

d = Mean Difference

Table 4.25

Tests of Differences (post-test minus pre-test) Between the Traditional Group and the Experimental Group

Variables	Trad. Group x	Trad. Group SD	Exp. Group x	Exp. Group SD	t-value	P-value
Body Weight	-0.90	2.16	-0.05	2.00	1.56	.124
Body Fat	-1.72	3.45	-1.93	1.37	-0.30	.762
Resting Heart Rate	0.83	6.27	-7.70	5.80	-5.43	.000
Resting Systolic Blood Pressure	-6.55	7.08	-14.67	9.73	-3.67	.001
Resting Diastolic Blood Pressure	-6.55	6.28	-16.50	6.97	-5.75	.000
Pull-ups	2.48	2.12	4.57	2.21	3.70	.000
Sit-ups	1.83	7.06	9.87	10.74	3.41	.001
Vertical Jump	5.40	4.22	5.72	4.45	0.28	.780
Sit and Reach	3.90	3.77	3.90	2.82	0.00	.997
Agility Run	-0:80	1.09	-1:22	0.69	-1.70	.082
1.5 Mile Run	-0:40	0.77	-1:20	1.23	-2.99	.004

six variables. A summary of the hypotheses as well as their levels of significance is given as follows:

Hypothesis 1 concerns the differences in body weight between the experimental group and the traditional group. There was no significant difference in body weight at the .124 level between the experimental group and the traditional groups.

Hypothesis 2 concerns the difference in body fat between the experimental group and the traditional group. There was no significant difference in body fat at the .762 level between the experimental group and the traditional group.

Hypothesis 3 concerns the differences in resting heart rate between the experimental group and the traditional group. There was no significant reduction in resting heart rate at the .000 level between the experimental group over the traditional group.

Hypothesis 4 concerns the differences in systolic blood pressure between the experimental group and the traditional group. There was significant reduction in resting systolic blood pressure at the .001 level for the experimental group over the traditional group.

Hypothesis 5 concerns the differences in diastolic blood pressure between the experimental group and the traditional group. There was a significant reduction in resting

diastolic blood pressure at the .000 level for the experimental group over the traditional group.

Hypothesis 6 concerns the differences in pull-ups between the experimental group and the traditional group. There was a significant improvement in pull-ups scores at the .000 level for the experimental group over the traditional group.

Hypothesis 7 concerns the differences in sit-ups scores between the experimental group and the traditional group. There was a significant improvement in sit-ups scores at the .001 level for the experimental group over the traditional group.

Hypothesis 8 concerns the differences in the vertical jump between the experimental group and the traditional group. There was no significant difference in the vertical jump at the .780 level between the experimental group and the traditional group.

Hypothesis 9 concerns the differences in the sit and reach between the experimental group and the traditional group. There was no significant difference in the sit and reach at the .997 level between the experimental group and the traditional group.

Hypothesis 10 concerns the differences in agility between the experimental group and the traditional group.

There was no significant improvement in agility at the .082 level between the experimental group over the traditional group.

Hypothesis 11 concerns the differences in the 1.5 mile run between the experimental group and the traditional group. There was a significant improvement in the 1.5 mile run at the .004 level for the experimental group over the traditional group.

The last chapter of this study examines the total project, including a summary of the review of literature. The study procedures, findings and conclusions are also discussed. Finally, recommendations for future research, based on the findings of this study, are given.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The problem addressed by this study was to determine the effects of a circuit training program with the effects of a calisthenics training program on the physical fitness levels of the officer candidates at the Kuwait Police Academy. There were two main purposes of this study: first, to determine whether the circuit training program had a significant effect on the candidate officer's physical fitness performances; and second, to compare the results of the physical fitness tests in the circuit training program with the traditional calisthenics program at the academy.

The study was conducted on 59 male officer candidates at the Kuwait Police Academy during a 10-week period. The subjects were randomly divided into two groups. The first group (30 freshmen officer candidates) participated in circuit training while the remaining 29 participated in the academy's traditional calisthenics program.

Both groups trained a total of 40 minutes, four times a week for 10 weeks. Each group initiated their training

with a warm-up for five to seven minutes followed by 30 minutes of vigorous exercise. Each group also spent three to five minutes cooling down by doing such exercises as walking or jogging and some stretching.

The subjects in both the experimental and traditional groups completed the following pre-post fitness tests administered during January and the last week of March of 1986: body weight, body fat, resting systolic and diastolic blood pressure, resting heart rate, pull-ups, two-minute sit-ups, Sargent's vertical jump, sit and reach, Illinois agility run, and the one and one-half mile run.

These selected fitness tests were given to both groups to determine the effects of training on body composition, muscular strength, cardiovascular variables, power measurement, flexibility, agility, and endurance run.

Summary of Literature Reviewed

The literature reviewed addressed the effects of circuit training on physical fitness components. Studies relating to this concept are cited in the areas of the incidence of coronary heart disease, aerobic capacity, strength and endurance, and flexibility.

Important studies were conducted on the effects of circuit training on physical fitness components. Such

researchers as Morgan and Adamson (1961) developed a circuit training program because of the low physical fitness levels of the students who were attending Leeds University in London. Their purpose was to improve all-around fitness rather than fitness required for any particular activity or game. Howell et al. (1963), Taylor (1961), Wilmore et al. (1978), Watt (1981), and Fusco and Butin (1974) examined circuit training through research and studies done in the field. The research literature provided limited information related to the effectiveness of circuit training on the physical fitness components of law enforcement officers (Price, et al., 1978).

Summary of Study Procedures

The study attempted to determine the effects of a circuit training program on physical fitness levels. The population of this study included a sample of 59 freshmen officer candidates at the Kuwait Police Academy. The subjects were randomly assigned into two groups. The experimental group (30 subjects) used the circuit training program. The traditional group (29 subjects) used the academy's traditional calisthenics training program. All subjects were non-athletic.

The training programs for both the experimental group and the traditional group were conducted over a 10-week time

period. All officer candidates exercised 40 minutes a day, four days per week. They warmed up for approximately seven minutes before each session by performing stretches and light jogging. The remaining 33 minutes of each workout session were devoted to the specific exercises prescribed for each group. Each exercise program was completed in the order described below.

Circuit Training Program
(Experimental Group)

Station #1.	Pull-ups	Station # 8.	Basket hang
Station #2.	Sit-ups	Station # 9.	Leg lifts
Station #3.	Squat jumps	Station #10.	Push-ups
Station #4.	Arm dips	Station #11.	Arm bar walk
Station #5.	Vault	Station #12.	Vault
Station #6.	Benchblasts	Station #13.	Step walk
Station #7.	Log hop	Station #14.	Log walk

All subjects continued these exercises at each station until two or three sets of the circuit had been completed. Between each set of the circuit, they were allowed to rest for approximately 30 to 60 seconds. After all sets of the 14 exercise stations and the running laps were completed, each candidate monitored his pulse heart rate at the wrist just below the base of the thumb. The pulse was counted for 10 seconds and multiplied by six. The total number of heart

beats per minute indicated how strenuous the exercises were, which in turn helped the researcher determine the effectiveness of the exercises.

After the circuit training program was completed, each participant did a gradual cool-down to avoid sore muscles. The cool-down was very similar to the warm-up.

Calisthenics Training Program
(Traditional Group)

The traditional group performed the calisthenics exercise program still in use at the academy:

1. Arm circles
2. Jumping jacks
3. Alternate toe touches
4. Trunk rotations
5. Push-ups
6. Sit-ups
7. Side stretch
8. Hamstring stretch
9. Forward bend
10. Squat jumps
11. Side leg raises
12. Jogging

There were two test sessions during the 10-week study. A pre-test given at the beginning of the study, and a post-test was given at the end of it. The fitness tests used were body weight, body fat, resting heart rate, diastolic blood pressure, systolic blood pressure, pull-ups, sit-ups, vertical jump, sit and reach (flexibility), agility, and the one and one-half (1.5) mile run.

The statistical treatment used was the t-test which measured variables in all hypotheses. Data was obtained from the test items, which were computer scored. The statistical procedures were derived from the Statistical Package for the Social Sciences (SPSS).

Findings

The results of the hypotheses tested in Chapter IV have led to the following:

1. There was no significant decrease in body weight for the experimental group over the traditional group, when comparing the difference between the mean of the pre-test and post-test. The t-value for the differences between the means of the groups on the body weight measure was 1.56 which was greater than the .05 level. Therefore, the null hypothesis was accepted.

2. There was no significant decrease in body fat for the experimental group over the traditional group. in comparison between the mean differences of the pre and post-test. The t-value for the mean differences was -0.30, which was greater than the .05 level. Therefore, the null hypothesis was accepted.

3. There was a significant reduction in resting heart rate for the experimental group over the traditional group in comparison between the mean differences of the pre- and post-test. The t-value for the mean differences was -5.43 which was greater than the .05 level. Therefore, the null hypothesis was rejected.

4. There was significant improvement in resting systolic blood pressure, the experimental group showed a significantly greater decrease than the traditional group on the mean differences of the pre- and post-test. The t-value for the difference of means was -3.67 which was greater than the .05

level. Therefore, the null hypothesis was rejected.

5. There was significant improvement in resting diastolic blood pressure. The diastolic mean of the experimental group decreased significantly over the traditional group. The t-value for the difference of means was -16.50, which was greater than the .05 level. Therefore, the null hypothesis was rejected.

6. There was significant improvement in pull-ups. The experimental group improved significant-ly over the traditional group when comparing the mean of the differences of the pre- and post-test. The t-value of 3.70 was greater than the .05 level. Therefore, the null hypothesis was rejected.

7. There was significant improvement in sit-ups. The experimental group improved significant-ly over the traditional group when comparing the mean difference between the pre- and post-test. The t-value of 3.41 was greater than the .05 level. Therefore, the null hypothesis was rejected.

8. There was no significant improvement in the vertical jump. The experimental group did not show significant improvement over the traditional group when comparing the mean differences of pre- and post-tests. The t-value of .28 was not greater than the .05 level. Therefore, the null hypothesis was accepted.

9. There was no significant improvement in the sit and reach (flexibility). In the pre-test minus the post-test, the difference between means of the experimental group was not statistically significant over the traditional group. The P-value of 9.97 was less than the .05 level. Therefore, the null hypothesis was accepted.

10. There was no significant improvement in the agility run. The experimental group did not show significant improvement over the traditional group when comparing the mean differences of the pre- and post-tests. The t-value of -1.70 was less than the .05 level. Therefore, the null hypothesis was accepted.

11. There was a significant improvement in the one and one-half mile (1.5) run. The experimental group showed significant improvement over the traditional group when comparing the mean difference of pre-test minus post-test. The t-value of 2.99 was greater than the .05 level. Therefore, the null hypothesis was rejected.

Conclusions

Body Composition

Body composition was assessed by both body weight and body fat. The results of the statistical tests were summarized in Table 4.25. The data show that the circuit training (experimental) group did not significantly reduce in body weight or body fat percentage more than the traditional group (findings 1 and 2). The reason for this non-reduction in body weight or fat was possibly due to short duration of the 10-week study period, or an imbalance between the diet of the recruits and their training program. The recruits' diet was not under the control of the investigator.

Cardiovascular Variables

Cardiovascular variables were assessed by resting heart rate, resting systolic blood pressure, and resting diastolic blood pressure (findings 3, 4, and 5). There were significant improvements in the resting heart rate and resting systolic and diastolic blood pressure for both groups in this study. In comparing the mean differences between the

pre-test and post-test for both groups, the experimental group showed significantly greater decreases in resting heart rate and resting systolic and diastolic blood pressure than the traditional group. These changes in blood pressure were expected for the experimental group over the traditional group. The circuit used in this study was more effective in producing cardiovascular changes because it required more duration and intensity of aerobic training than the academy's calisthenics program.

Muscular Endurance

Muscular endurance was assessed by both pull-ups and sit-ups (findings 6 and 7). A comparison of the mean differences between the pre- and post-test for both groups showed that the experimental group improved significantly in muscular endurance over the traditional group. The greatest changes in muscular endurance were expected with the circuit training group because of the use of different types of abdominal strength exercises such as sit-ups, leg lifts, and basket hangs.

Power

Power was assessed using the vertical jump test (finding 8). Both groups showed significant improvement in the power measure (vertical jump) over the 10-week period. However,

the mean differences between the pre-test and post-test showed no significant differences between the groups. The circuit training program and the calisthenics exercises produced similar improvement in power.

Flexibility

Flexibility was assessed using the sit and reach test (finding 9). There was a significant improvement in the sit and reach test for both groups. In comparing the mean differences between the pre-test and post-test for both groups, the experimental group showed no significant improvement over the traditional group. It was felt that both training programs produced similar improvement in flexibility.

Agility

Agility was assessed by measuring the time of speed and change of body position (finding 10). Both groups showed significant improvement in the agility test. However, the mean differences between the pre-test and post-test showed no significant differences between the groups. Both training programs showed similar improvement in agility.

Endurance Run

The endurance run was assessed by measuring the time to run the distance of 1.5 miles (finding 11). Improvement in the cardiovascular variables (resting heart rate, resting systolic and diastolic blood pressure) correlates with the results of the one and one-half mile run in which the experimental group showed significantly more improvement than the traditional group during the 10-week study.

The circuit program used provided marked improvement in aerobic capacity, but it also resulted in significant improvement in muscular endurance. These are desirable fitness results for police officer candidates.

Recommendations

As stated in the findings and conclusion sections of this chapter and within the limitations of the 10-week study it was found that the experimental group demonstrated significant pre-post test improvements in eight out of 11 physical fitness items. The traditional group demonstrated significant pre-post test improvement in six of out of 11 physical fitness items. In comparison, the experimental group improved significantly more than the traditional group in resting heart rate, systolic and diastolic blood pressure, muscular endurance, and aerobic capacity. The circuit training program utilized was superior to the traditional

training program utilized was superior to the traditional program in producing cardiovascular-health related changes.

Since these basic precepts were evidenced in this study, the following recommendations are offered for both the circuit training program and the calisthenics program.

1. Any training program should consider three important factors: intensity, duration, and frequency in order to improve general physical fitness. It should be recalled from Chapter II that Emes et al. (1981) pointed out that the key to developing fitness is not necessarily the activity engaged in, but the intensity, duration, and frequency of the activity when performed.

2. The physical fitness instructors should include the "principle of overload" in their training programs. Bucher and Prentice (1985) explained about the concept of overload which is a gradual increase in the intensity of the physical activity. This principle can be used when the person's fitness capacity improves through the course of the training program.

3. The physical fitness instructors should include in their training programs enough time to warm up and cool down.

4. It is further recommended that individuals are different in physical ability and needs. The individuals will work with a positive attitude toward the training program when the instructors consider their abilities.

Recommendations for Further Research

Based on the findings and observations of this investigation, the following recommendations might be considered:

1. There is a need for further research using longer periods of training, or both groups.

2. Further investigation is needed to balance the diet with the circuit training program in order to reduce body weight and fat.

3. Further investigation should be conducted by adding some weight-lifting stations such as barbells and dumbbells to the circuit training program.

4. Further investigation with similar designs should use a third control group which would not participate in any training activities.

5. There is a need for further research using other methods of exercises to improve flexibility and vertical jump along with the training program.

APPENDIX A

DATA CARD FOR CIRCUIT TRAINING PROGRAM

DATA CARD FOR CIRCUIT TRAINING PROGRAM

GRADE ____________ LOCATION ________________ DATE _________

Name of Candidate	PULL-UPS	SIT-UPS	SQUAT JUMP	DIPS	VAULT	BENCH BLAST	LOG HOP	BASKET HANG	LEG LIFTS	PUSH-UPS	BAR WALK	VAULT	STEP-UPS	LOG WALK	Comments
	Reps/ Set														

APPENDIX B

POLICE OFFICER CANDIDATE DATA SHEET

POLICE OFFICER CANDIDATE DATA SHEET

NAME _____ DATE OF BIRTH _____
Yr/Mo/Day/Age

ADDRESS _____ HEIGHT _____

RANK LEVEL _____ DATE OF TEST _____
Pre-test/Post-test

PHONE NUMBER _____

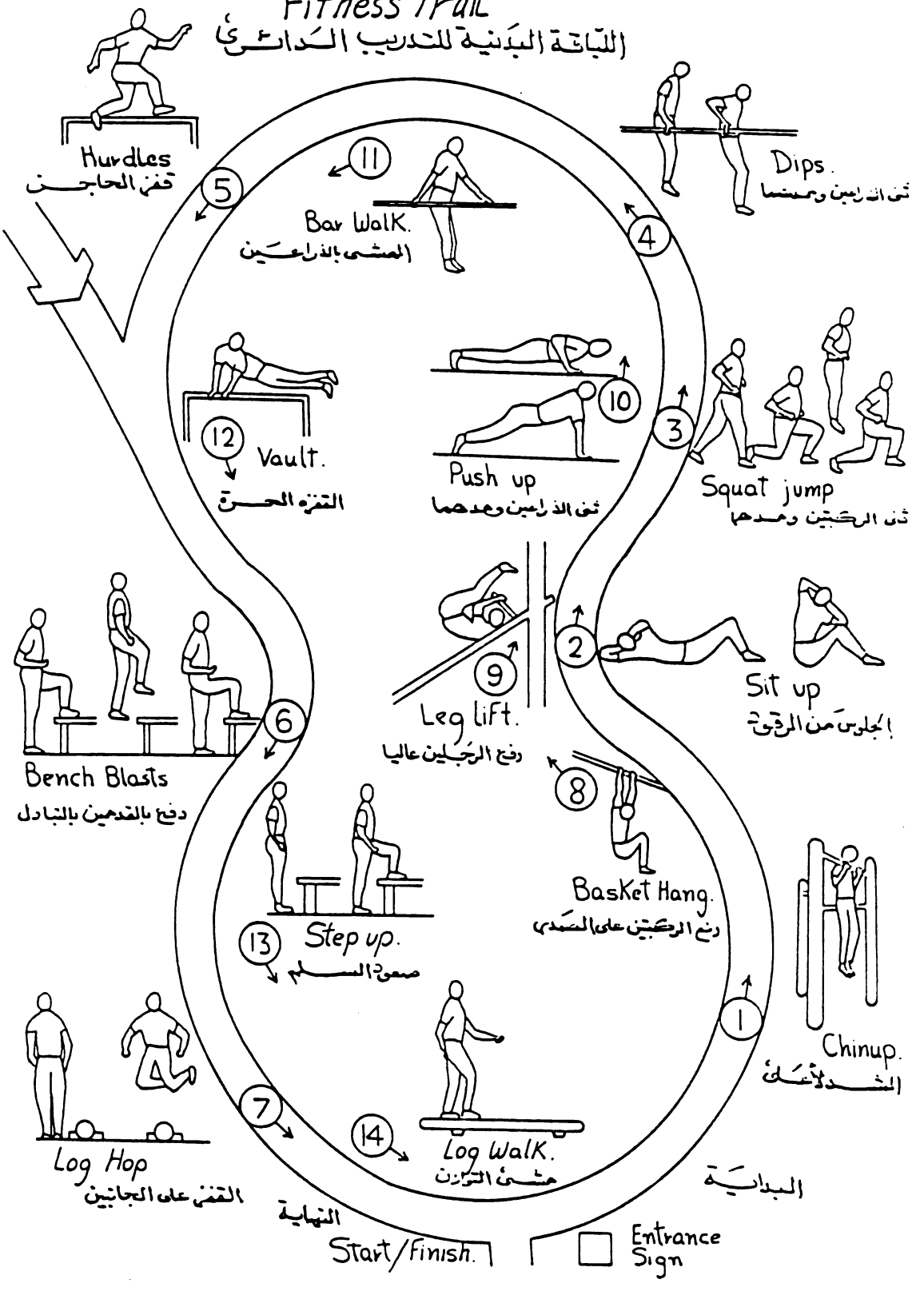
EXERCISE	PRE-TEST	POST-TEST	COMMENTS
WEIGHT			
RESTING HEART RATE			
RESTING BLOOD PRESSURE			
% BODY FAT			
PULL-UPS			
2 MIN. SIT-UPS			
VERTICAL JUMP			
SIT AND REACH			
AGILITY			
1.5 MILE RUN			

APPENDIX C

THE CIRCUIT TRAINING CHART

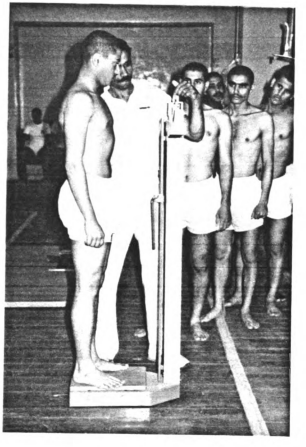
Fitness Trail

اللياقة البدنية للتدريب الدائري

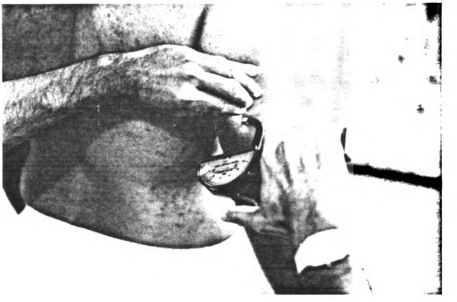


APPENDIX D

BODY COMPOSITION MEASUREMENTS
(Body Weight and Body Fat)



Body Weight Measurement in Kilograms

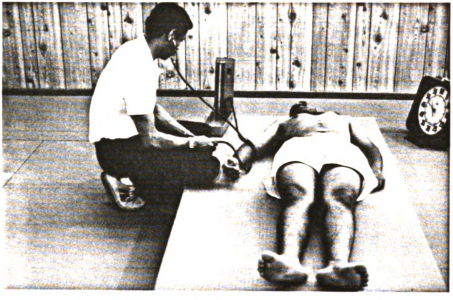


Skinfold Measurement for Body Fat
To the Nearest 0.5 Millimeter

APPENDIX E

CARDIOVASCULAR VARIABLE MEASUREMENTS

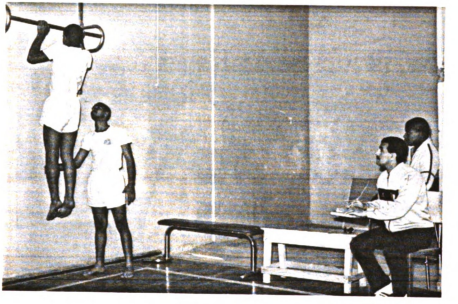
Monitoring Heart Rate Measures,
Supine Position



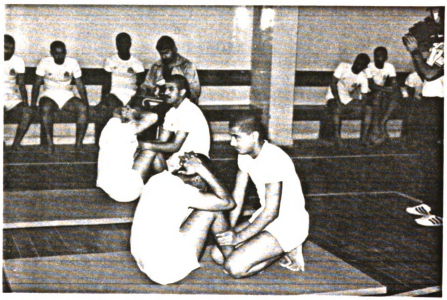
Monitoring Blood Pressure,
Supine Position

APPENDIX F

MUSCULAR ENDURANCE MEASUREMENTS



Pull-ups Test to Measure Muscular Endurance



Sit-ups test to Measure Muscular Endurance

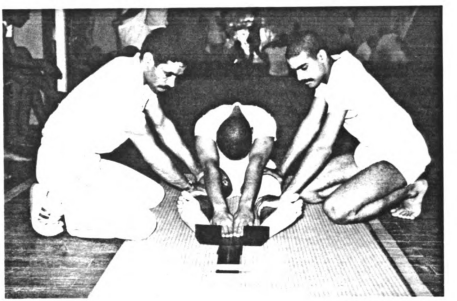
APPENDIX G

POWER MEASUREMENT

Vertical Jump Test to Measure Power

APPENDIX H

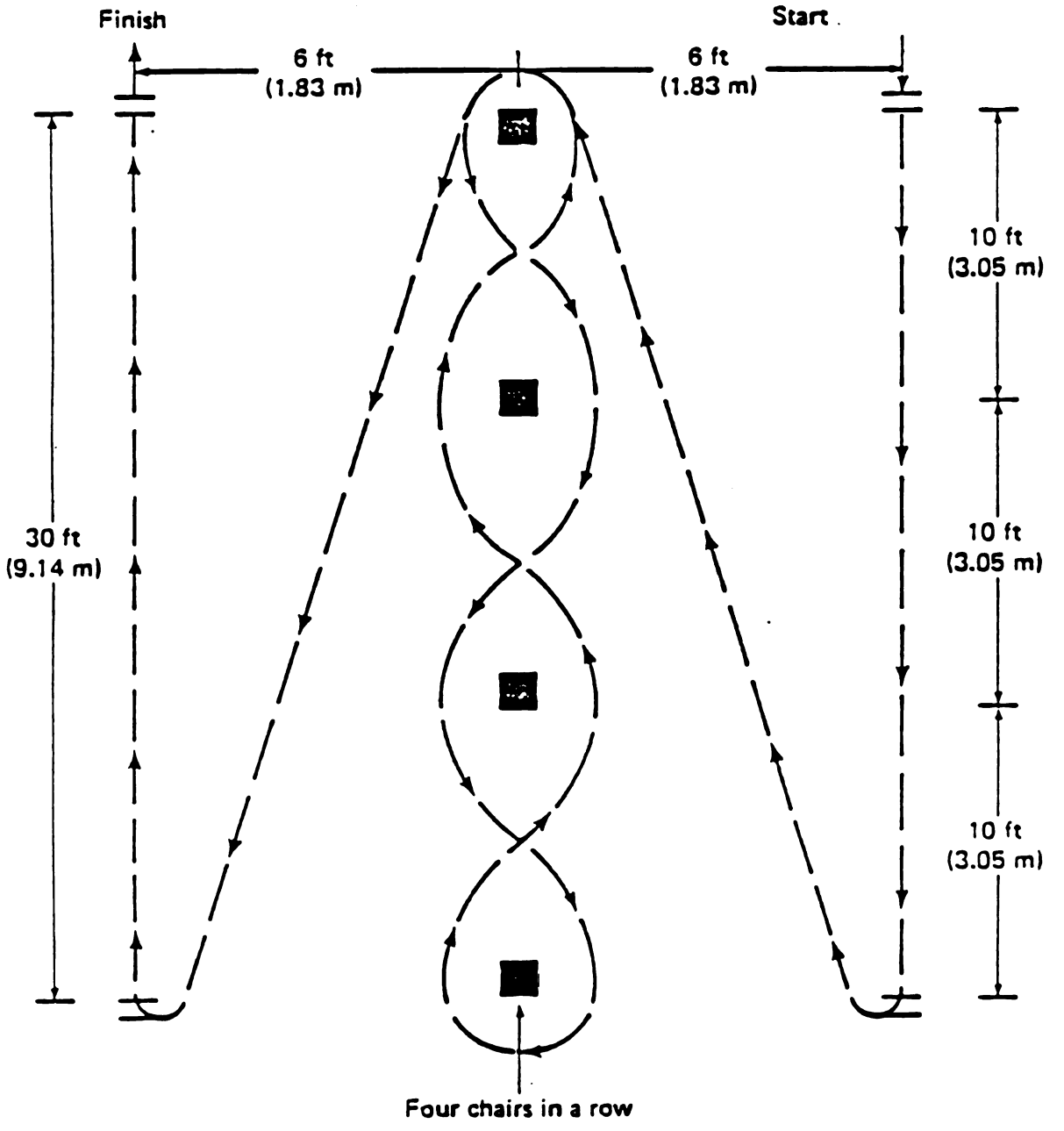
FLEXIBILITY MEASUREMENT



Sit and Reach Test
For Hip and Back Flexibility

APPENDIX I

THE ILLINOIS AGILITY MEASUREMENT



The Illinois Agility Run

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