# EXERCISE TRAINING: ONE ASPECT OF THE REHABILITATION OF PERSONS WITH CORONARY HEART DISEASE

by

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# CHAPTER I

## INTRODUCTION

In the United States approximately 1,000,000 people develop disabling angina pectoris each year. Another 600,000 persons survive acute myocardial infarction resulting from coronary heart disease (CHD). A continuing rehabilitation program must be provided for these people if they are again to become productive participants in community life. An important component of such a program for persons with disabling CHD is the rebuilding of strength and endurance after the period of limited activity which occurs during the acute stage of illness. Medically supervised group exercise programs which use community facilities and utilize skilled nursing assessment are one means for achieving the rehabilitation goal.

Rusk (1958) describes medical rehabilitation as a dynamic concept and as an action program in contrast to convalescence which is pictured as a period where one is left alone to rest and "let nature take its course". Three objectives for rehabilitation are proposed by Rusk: first, to eliminate the physical disability if possible; second, to reduce or alleviate the physical disability to the greatest extent possible; and third, to retrain an individual with physical disability "to live and work within the limits of the disability but to the hilt of capabilities."

In considering the patient with coronary heart disease, health personnel are involved with a person suffering from a hidden disease. His disability, because it is not visible, is frequently over or underestimated by himself and others. He is either held back--encouraged, almost, to become a "cardiac cripple" or, he is pushed ahead too fast because he "looks good". The push often results in a quick return to the hospital with extention of damage or other complications. The hidden disease adds to the challenge of helping the cardiac patient to utilize and enhance his remaining assets.

When a person has been hospitalized for CHD, he must cope with pathological changes due to the disease process. Characteristic changes are narrowing of the coronary arteries, due, usually to atherosclerotic plaques. Pain results from the inability of the arteries to supply a sufficient amount of oxygenated blood to the myocardium causing myocardial ischemia. If ischemia persists the result is necrosis of the heart muscle. Any damage to the heart is likely to make the heart a less efficient pump. (Guyton, 1971) With a hypoeffective heart there is a resultant decrease in cardiac output. Congestive heart failure, pulmonary edema, shock or various arrhythmias may contribute to progressive disability. Iatrogenic changes from prescribed bed rest also share in the development of physiological changes that must be reversed. (Hellerstein, 1972) These changes include urinary calcium excretion, reduced maximal aerobic power and deterioration in the cardiovascular response to posture, as measured by heart rate and blood pressure changes produced by an upright position. (Astrand & Rodahl, 1970) Weakness, muscle wasting and depression also are often present.

A planned exercise program prescribed by the physician and adapted for each patient will help alleviate many symptoms associated with physiological changes. The professional nurse is qualified to meet the challenge of implementing and assisting in such a program. Coordinating the transition from acute care through gradually increasing levels of activity leading to organized exercise programs demands knowledge of both physiology and psychology. An understanding of normal functions is essential before pathological changes resulting from disease can be appreciated. Skills in assessment and teaching must be utilized and expanded. The coronary care nurse pioneered one such expanded role of the nurse. Now it is time for nurses to expand their role even further in providing patients continuity of care. In some instances this plan for continuing care is initiated before discharge from the hospital. (Barry et al., 1972) In other instances a planned regimen is not considered until later.

> In the past, planned physical rehabilitation for the coronary patient has often been overlooked. With the myriad of adjustments he must make upon entering the world of the chronically ill, the coronary

> patient has generally been given such vague instructions upon discharge as "take it easy" or "don't overdo it". Such vagueness is not helpful to the patient; instead it leads to insecurity, confusion and contributes to the depression that many postcoronary patients experience. (Germain, 1972)

The imporance of the regulation of rest and activity has been debated by physicians for many years. In 1912 Herrick described the clinical aspects of acute myocardial infarction. Presentation of several cases served to illustrate both subjective and objective symptoms of the assault. Necropsy revealed typical anatomical changes including atherosclerotic plaques and, in some instances, developing collateral circulation. Herrick's thesis at that time was: "If these cases are recognized, the importance of absolute rest in bed for several days is clear." He further postulated: "The hope for the damaged myocardium lies in the direction of securing a supply of blood through friendly neighboring vessels so as to restore so far as possible its functional integrity." More than sixty years later the question of rest and activity in treatment of CHD remains unresolved.

In the period following Herrick's report, many physicians prescribed as long as eight weeks bed rest followed by six months of inactivity. Dock (1944) and Levine (1944) observed the ill effects of bed rest, opposed prolonged recumbency and advocated deep breathing exercises, use of bedside commodes and frequent change of position including use of a comfortable chair at the bedside. This may have heralded the continuing debate regarding the feasibility of exercise in the rehabilitation program prescribed for the patient with CHD.

Dr. Paul Dudley White gave impetus to research when he gave medical consent to Dwight Eisenhower to resume the duties of the presidency as well as his favorite sport (golf) following his myocardial infarction in 1955. Scientific investigation was stimulated by a study (Eckstein, 1957) in which experimental occlusion of the circumflex artery of dogs was performed surgically. It was found that dogs that were exercised following occlusion not only developed greater collateral circulation than those not exercised, but also had an increased survival rate, suggesting that physical activity would be protective in patients who had a capacity to develop additional circulation. While it remains unproven that exercise increases the collateral vascular system of the myocardium in ischemic coronary disease of human subjects (Phillips, 1973), very little is found to discount the value of exercise training.

Paul (1969) feels that studies concerned with improvement of patients following exercise programs are inconclusive. He states that "very modest" differences have been reported and that many studies are uncontrolled and statistically insignificant. Skinner (1970) also discusses the lack of longitudinal studies as a deterrent in deciding on the feasibility of exercise. No studies were found that contraindicated prescribed exercise programs.

The prescription for physical conditioning should be approached in a manner similar to the prescribing of a drug or other therapeutic agent. Consideration must be given to evaluation of current status, action (onset and duration), advantages, possible complications, necessary precautions, adverse reactions, administration, dosage, form or modality, interaction with other therapy, and clinical data to support its usage. The exercise stress test is the instrument used to provide most of this information to the physician.

"The purpose of exercise stress testing is to evaluate the severity of disease, reveal unexpected responses to exertion, and provide an appropriate base line by which the effects of rehabilitation may be assessed physiologically." (Bruce, 1973) Certain patients should be excluded from testing and training programs. These patients would include individuals with acute or chronic systemic illnesses, for example, acute liver or kidney disease, neuro-muscular-skeletal disease, certain cardiac anatomic or physiologic abnormalities or psychiatric problems. ( Bruce, 1973)

Three methods of testing are most frequently discussed in the literature: Master's two step, bicycle ergometer and treadmill. Information obtained from a stress test includes work load tolerance and physiological measurements such as pulse rate, blood pressure and oxygen consumption. Electrocardiographic tracings are recorded.

Data are recorded before the test begins, at specified intervals during the exercise test and during the recovery period following the exercise test. This information provides a baseline for the physician's consideration when writing the "exercise prescription". The reliability of these measures has been investigated by several researchers.

Zohman (1973) found that an exercise stress test is reproducible under the same conditions 95 percent of the time. However, these conditions include testing at the same time of day, after the same meal, same amount of activity for the preceding 24 hours, with the patient in the same emotional state, using the same staff and modality. Other studies discussed by Zohman and Phillips include one by Mason (1967) in which it was stated that 20 out of 25 tests were completely reproducible when conditions described above were not reproduced. Specifically it was stated that if three tests are done under random conditions, two out of three will be consistent and correct. Smokler and Kattus (1972), using 70 pairs of treadmill tests found no significant differences in total minutes of walking, time of onset of angina and heart rate at onset of angina after the first test. Naughton (1973) stated that systemic blood pressure is usually measured by auscultation. The blood pressure cuff is attached to the upperarm in the usual fashion. If tubing parallels the triceps muscle and hangs straight down extrinsic noise is reduced. The first sound detects the systolic blood pressure. Noise of the treadmill or ergometer and movement of the exercising subject make it difficult to hear the subtle change of Korotkoff sounds in detecting the diastolic pressure. Pulse rates are computed from ECG tracings for accuracy.

Exercise testing represents an extention of the clinical examination of the ambulatory cardiac patient. As such it is essential that nurses be familiar with the normal response to an exercise stress test. Deviation from these normal responses is not only diagnostic but is helpful in ascertaining fitness level when developing the individual exercise prescription. For example, work load tolerance measured during the exercise stress test assesses the amount of stress the myocardium can tolerate before demonstrating ischemic changes electrocardiographically. Pulse and blood pressure give an indication of the effectiveness of the heart and how it responds to stress. Together, heart rate x systolic blood pressure are an estimate of myocardial oxygen consumption.[1] The length of time before dyspnea, fatigue, or chest pain appear are noted and can be compared at subsequent testings. Maximum oxygen uptake can also be measured directly or estimated by means of nomograms.

The circulatory response to exercise is indeed a complex, marvelously integrated series of occurrences involving peripheral, neural, and humoral input. (Berne & Levy, 1972) Anticipation and

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[1] Heart rate x systolic blood pressure divided by 100 is the formula (HR x SBP/100) to estimate myocardial oxygen consumption.

preparation for exercise evoke the beginning of adaptive mechanisms that support the body through the challenge of the circulatory system. Systolic blood pressure typically rises with exercise and it is common to find pressures above 200 mm Hg in normal individuals following vigorous treadmill or ergometer workout. Failure of the systolic pressure to rise with increased work load is abnormal. Diastolic pressure usually varies little even with strenuous exercise, although it may decrease slightly. An increase in diastolic pressure of 15 mm Hg over the recorded rest value is considered abnormal and a hypertensive response. (Naughton & Haider, 1973) Systolic pressure increases to a greater degree because of enhanced stroke volume of the heart with severe exercise. Diastolic pressure may at first decrease because of dilitation of the vessels of skeletal muscles during exercise (Selkurt, 1971)

Pulse rate characteristically accelerates with increased physical work and the degree corresponds closely with the rate of oxygen consumption. At increasing work loads approaching exhaustion, the pulse rate levels off close to the work level at which maximum oxygen consumption occurs. Therefore the pulse rate is a convenient and fairly accurate reflection of oxygen consumption at any level of activity and is often used in exercise training programs in determining target levels. Maximum pulse rate is correlated with age and from statistical data it can be predicted in a fairly reliable manner. (Astrand & Rodahl, 1970)

Myocardial oxygen consumption cannot be measured directly by non-invasive methods. It can be estimated. Kitamura et al. (1972) studied a group of ten normal male volunteers during sub-maximal exercise levels. Direct measurements were made using catheterization equipment to obtain blood samples. The researchers were able to conclude that the heart rate blood pressure product was a satisfactory predictor of coronary blood flow and myocardial oxygen consumption in these young normal subjects. In patients with moderate coronary atherosclerotic heart disease, coronary blood flow and oxygen consumption per gram of tissue are usually normal at rest, but during exercise many such patients have an inadequate increase in coronary blood flow. It has been reported by Hellerstein et al. (1973) that for the same absolute work load, untrained normals and untrained arteriosclerotic heart disease (ASHD) subjects have higher systolic and diastolic pressures, heart rates and HR x SBP product than trained subjects. The untrained have relative tachycardia and hypertensive response during effort. The results of their research indicate that "in practical terms myocardial oxygen consumption in ml/min/100 gm. left ventricle may be estimated from the relationship of the product of the heart rate and systolic blood pressure, $r = 0.88$." (Hellerstein, 1973) Responses of 2,332 subjects to maximal exercise were reported by Bruce and associates (1974) as part of their study to predict risk of future cardiac events. Of those studied, 1,275 were healthy "normal" subjects; the remainder were hypertensive, had experienced previous myocardial infarction, were suffering from angina pectoris or were found to have a combination of these conditions. The data demonstrated that work tolerance (duration in seconds) and myocardial oxygen consumption (as measured by HR x SBP/100) were greater in the healthy subjects than those who were post myocardial infarction or suffering from angina pectoris. Approximately one-half of the subjects in each of these groups were sedentary. Conclusions must await an adequate period of follow-up to prove the validity of the predictive value of this study. Of interest at this point are the data establishing differences in myocardial oxygen consumption and work tolerance of healthy subjects versus those post myocardial infarction.

Thus, it can be seen that physiological responses to maximal exercise are helpful measures in individualizing the exercise prescription. The foremost consideration in any prescription is the safety of the patient. Stress testing will enable determination of an exercise load (intensity, frequency and duration) that will produce desired training effects for the participant. Concurrent consideration must be given to the education of subjects and their families regarding risk factors that can be reversed to some degree. Community based programs often include special sessions for this purpose.

Exercise training, using the individual prescription written following the stress test, is to be carried out under medical supervision. It is emphasized that competition is contraindicated except that the patient is, in effect, competing with himself for improvement of his physiological and psychological health. Recommendations have been made that sessions lasting 30 to 45 minutes be held three times a week for the desired effects of training to develop. (Hellerstein, 1972)

Desirable changes are a lowering of resting and sub-maximal pulse and systolic blood pressure, and the ability to increase pulse and systolic blood pressure at maximal exercise levels without development of chest pain or other adverse symptomology. The exercise program ideally commences with a warm-up period of 10 to 15 minutes. This is a preparatory period during which the muscles and joints "loosen-up". It is postulated that muscle temperature may be raised so that enzymatic action at the cellular level will improve oxygen metabolism. (Levitas, 1973)

Especially important for patients having clinical symptoms of coronary insufficiency is the suggestion that capillary networks in both skeletal and myocardial muscle open, increasing blood flow in response to gradually increasing demand. Local formation of vaso-active metabolites induces marked dilation of the resistance vessels at moderate exercise. Potassium is one of the vasodilator substances released by contracting muscles. "There is some evidence that its release in the tissue elicits a reflex stimulation of the vasomotor center, resulting in an increase in peripheral resistance, heart rate and myocarial contractility." (Berne & Levy, 1972) Accumulation of metabolites influence relaxation of the precapillary sphincters allowing blood flow through the muscle to increase as much as 15 to 20 times that of the resting level even though the increment in blood volume in the muscle increases only about 50 percent. Vasodilitation of the precapillary vessels in the active muscles occurs very soon after the onset of exercise, with the resulting decrease in total peripheral resistance enabling the heart to pump more blood at a lesser load and more efficiently than with unchanged peripheral resistance. Hydrostatic pressure also increases with the relaxation of the resistance vessels so that there is a net movement of water and solutes into muscle tissue causing tissue pressure to rise and remain elevated during exercise. (Berne & Levy, 1972)

The training stimulus period, the second stage of the conditioning period, is the actual working period. This is the time that the pulse rate is raised to a prescribed "target rate". The target rate for persons in a therapeutic exercise program is that rate (expressed as a number of beats per minute) which will provide sufficient challenge to the cardiovascular system to result in physical fitness without causing harm to the patient. About 15 minutes is the amount of time allowed for activities that will result in this physiological effect. The pulse rate is checked frequently in the beginning until the person is able to subjectively judge his condition.

Thus, the purpose of exercise training, or exercise conditioning, involves the development through endurance exercise of increased efficiency of aerobic metabolism. The conditioning may protect the heart and blood vessels against degenerative diseases. This concept is designated "cardiovascular training". Training effects include adaptation in the heart and skeletal muscles which provide greater oxygen delivery to the mitochondria, enhanced mobilization of substrates for oxidation and accelerated oxidative phosphorylation.

> The contracting muscle avidly extracts needed oxygen from the perfusing blood, so that venous blood leaving the active muscles has a low oxygen content (about 5 vol %). The removal of oxygen is facilitated by the nature of oxyhemoglobin dissociation. The high concentration of carbon dioxide, the reduction of pH caused by the formation of lactic acid and the increase of temperature in the contracting muscle contribute to the shifting of the oxyhemoglobin curve to the right, so that at any given partial pressure of oxygen, less oxygen is held by the hemoglobin in the red cells. As a result of a more effective oxygen removal from the blood, oxygen consumption may increase as much as sixty fold with only a fifteen fold increase in muscle blood flow.
> (Berne & Levy, 1972)

The third and final stage of the exercise session is a 5 to 10 minute "cooling down" period. A gradual reduction of activity allows the body to adjust, preventing sudden pooling of blood in the lower extremities and splanchnic bed. Patients are cautioned not to take hot showers following exercise. Vasodilation due to heat stress may result. (Taggert, 1972)

Phillips (1973) discusses the desired benefits of this training stimulus for the person with CHD as follows:

1. Development of a greater work capacity

2. Decreased cardiac demand after training

   a. Increased proficiency of skeletal muscle
   b. Improvement of cardiac function
   c. Training bradycardia may develop which will have a favorable influence on myocardial performance during exertion by allowing longer diastolic coronary artery flow time.

3. Time of onset of angina in standardized effort is prolonged.

4. Alteration of myocardial oxygen consumption

   $$\frac{(HR \times SBP)}{100}$$

5. Exercise conditioning appears to decrease the content and uptake of catecholemines in the myocardium. This may lessen the tendency toward ectopic rhythms in cardiac patients.

6. It remains unproven as to the effect of exercise in relation to development of increased collateral vascular circulation. The results of animal experimentation lend hope to this effect.

To summarize, the main componetns of an "exercise by prescription" plan are: Testing for evaluation, a planned prescription for activity, the training period under medical supervision, and reevaluation. Hopefully the habit of exercise will be formed. Medical supervision is, of course, a safety factor. In addition, Barry (1966) found that optimal results were noted in supervised individuals as opposed to those performing at home without supervision.

During the last decade a plethora of literature has been published advocating that prescribed exercise be included in the treatment plan for post-coronary patients and patients suffering from angina pectoris. One of the early studies supporting the hypothesis that significant improvement in work capacity and work electrocardiograms could be achieved in post-coronary patients through a program of regular physical training was published in the American Journal of Cardiology (N=6). (Barry, et al., 1966) It was found that some training effect was achieved in all six patients studied, although it was transitory in some cases. When one considers that almost every case of myocardial infarction is different (location, degree of damage and extent of scar tissue), it is not surprising to note marked differences between individual subjects and their response to training. Significant improvement in some cases occurred only after thirteen months of the training program, reinforcing the concept that to achieve and maintain desired results new life time habits must be established.

Naughton et al. (1966) studied a group of 36 patients to ascertain the difference, if any, in the cardiovascular responses of post infarction patients versus healthy subjects under the demands of physical exertion. Also observed was the ability of post infarction patients to undergo physical conditioning. After initial evaluation the subjects were divided into three groups of twelve: a group of post-coronary patients who volunteered for a physical conditioning program; a group of post-coronary patients who remained sedentary; a group of healthy men who remained sedentary. After eight months, there were significant training effects in the exercising cardiac as reflected by systolic and diastolic blood pressure and pulse rates during rest and standing at comparable levels of energy expenditures. No differences were observed in either sedentary cardiacs or sedentary healthy men. Indications that the presence of disease did not necessarily affect the physiologic response of the subjects is encouraging. Findings cannot be generalized to all post infarction patients. This point is illustrated effectively by the following excerpt from the resport:

> Those with irreversible myocardial restriction from extensive scarring or fibrosis would not be expected to respond to physical conditioning. For example, one patient trained for six months and increased his daily activity trmendously. He claimed he felt better throughout conditioning. When he was reevaluated, no differences in his cardiovascular adjustments during identical levels of physical stress were detected indicating that he had lost his ability to gain a conditioning response. His systolic B/P response was of a lower magnitude than that observed in other

> men and the pulse pressure remained narrow throughout the test. Despite this limitation, he was able to perform the entire test.

Progressive exercise stress has also been used to treat cases of angina pectoris due to CHD. (Smith & Kideran, 1966) A pre-selected group (N=12) consisting of pilots and corporate executives already being treated by other physicians was referred to the program. The age spread was 41 to 56 years with a mean age of 47 years. After initial evaluation, the exercise stress was performed by gradual increase in walking pace up to and including a slow running pace after a variable length of time. Fifteen patients had excellent results with a complete relief of chest discomfort on exertion. Two cases were unable to continue the program due to adverse symptoms as a response to stress. Four cases chose not to complete the program for various complex reasons, presumably related to motivation.

Sims and Neill (1974) were interested in the physiological basis for the increased exercise threshold for angina pectoris. They also attempted to define more clearly the effect of physical conditioning on myocardial oxygen supply. Three criteria were used for evaluation: 1) indirect indices of myocardial oxygen consumption; 2) measurements of coronary blood flow, myocardial oxygen consumption and myocardial lactate extraction; 3) coronary arteriography. They found that after conditioning the increase in exercise angina threshold was significant, as judged by work level reached or the duration of exercise. The angina threshold as determined by atrial pacing was not increased by conditioning. The data obtained from these subjects indicate that the complex response to the stimulus of exercise, as discussed previously, operate to improve delivery and utilization of oxygen. This is a functional adaptation rather than a static alteration in the coronary circulation.

Hellerstein and colleagues engaged in a prospective study to determine the feasibility and efficacy of development of physical fitness programs for patients with CHD or coronary-prone subjects. The results of the six year investigation were reported in the Bulletin of the New York Academy of Medicine, and Minnesota Medicine. (Hellerstein, 1968, 1969) Many subsequent studies refer back to this design as a classic for reconditioning of patients with CHD. The program was multifaceted with emphasis placed on enhancement of physical fitness. The study population included both coronary-stricken and normal coronary-prone subjects. Subjects included 656 middle-aged men. Two hundred and fifty-four had CHD. The average age of the subjects with CHD was 49. The average age of the normal coronary-prone subjects was 45. All were employed in sedentary occupations. An attempt was made to persuade the patients to attain a normal body weight by reducing intake of saturated body fats. Recommendations were made to abstain from the use of tobacco, continuation of a normal social and work mode of life, and plan for adequate amount of rest and sleep. The patients were evaluated by interview and exercise stress testing. Individual work prescriptions were written, and progressive conditioning program was then conducted. Records of attendance and reactions to the exercise were kept. These were examined at monthly intervals and it was determined whether the subject was ready to progress to a more strenuous level. Complete re-examination (including bicycle ergometry and psychological testing) was carried out at six month intervals and progress was assessed. A group of 100 coronary stricken and 58 normal coronary-prone were analyzed (average period of follow-up was 33 months). This evaluation revealed that the subjects were able to perform muscular effort more efficiently than before training, i.e., fewer heart beats, lower blood pressure and greater aerobic capacity. Ishemic ST-T changes in the exercise electrocardiograms decreased in two-thirds of the subjects after conditioning. Hellerstein and his colleagues were impressed with accompanying striking improvement of self-image, insight and marital relations. It was felt that a relationship between psychologic and circulatory changes may exist after physical conditioning. The nature of this relationship, coincidental or correlative, remains conjectural.

A study to assess the effects of four to six weeks physical conditioning on the cardiovascular and respiratory responses to exercise was undertaken with nine patients with coronary heart disease.

(Clausen, et al., 1969) Clinical improvement was noted in increased stroke volume and increased physical work capacity in all patients. The premise was that at sub-maximal work loads a reduction of blood flow to working muscles occurs after training. In contrast to what is seen in healthy young persons, the training does not directly improve cardiac performance in many patients but causes an alteration of the peripheral circulation. The conclusion was that hemodynamic changes form a rational physiologic basis for the use of physical training in the management of patients with CHD.

In Sweden a study utilizing a non-selected series of 315 patients, 57 years old or younger, who had survived actue myocardial infarction were uniformly treated and followed at a post-infarction clinic at the University of Goteborg. (Sanne, 1973) The sequence of testing, prescribing, training and re-testing was followed. Improvement of physiological parameters were documented. Although no "r" value is given, correlation between the systolic blood pressure and heart rate at heavy work loads before training was in the negative gradient range. After training there was a positive correlation between HR and SBP. The training improved the maximal aerobic power by 17 percent in the patients who could exercise to fatigue--the same extent as in training of healthy subjects. The importance of the patients increased self-esteem was not neglected. The disability of post myocardial infarction patients is often expressed as the rate of inability to return to gainful employment. The disability is indeed often traumatizing to the person with cardiac disease. The degree of invalidism, however, is greater if non-occupational physical activity and emotional factors are considered. Sanne found that often the reason for limiting exertion three months after myocardial infarction was fear. Inquiry indicated that there existed a need of reassurance with respect to physical exertion on the part of the patients. This study provides a worthy reference for those interested in the effects of exercise training.

In 1972 a postgraduate course on the physiology and psychology of exercise testing and training of coronary disease patients and coronary-prone subjects was held at Airlie Conference Center, Warrenton, Virginia. It is evident from the material presented that the concept of supervised exercise for the treatment of coronary heart disease is growing in favor among large numbers of physicians in the country.

Kavanaugh of the Toronto Rehabilitation Center recently reported a medically significant event. (JAMA, 1973) A very dramatic example of the possibilities for post-coronary improvement using exercise training as the stimulus was emphasized when seven subjects after years of practice completed the Boston Marathon (a 26 mile race). The team did not win but the significant point is that they ran at all. Their time was a very respectable four hours. The subjects came from varied backgrounds, with ages ranging from approximately 30 to 55. Kavanaugh states: "I think the lesson we can take from all this is that with proper training the post-coronary patient can sustain every bit as much, if not more, physical stress as the average guy." Granted, not everyone wants to run a marathon. But what a glowing example of what can be done!

Many patients faced with assuming new life styles and adapting to new behaviors need the support and empathy of others in like circumstances. Coach Wm. J. Bowerman and Dr. W.E. Harris conducted studies at the University of Oregon on the benefits of physical exercise for the normal sedentary person. Community programs were found helpful for purposes of supervision and encouragement to participants. For similar reasons the concept of community programs for rehabilitating patients with coronary heart disease is growing. Hellerstein (1969, 1972), Zohman and Moreau (1971), and Pyfer and Doan (1972), have reported such programs. The study of Pyfer and Doan describes a program organized in the state of Washington by the Cardio-Pulmonary Research Institute (CAPRI). CAPRI was formulated as a non-profit corporation which received partial funding in 1969 from Washington/Alaska Regional Medical Program. Its purpose was initially to determine the feasibility of community programs. There are now four CAPRI programs in the Northwest. CAPRI utilizes the concepts of group participation and the accepted rationale for exercise conditioning as previously discussed. Group treatment reduces cost to the individual and economizes the physician's time. Medically supervised testing and exercise sessions provide a safe environment for the patient. The initial rehabilitation program is a series of 36 sessions (three days weekly) lasting one hour. They are conducted by a program director who has been trained in emergency treatment. The Portland chapter has recently engaged a nurse to assume these duties. She will assist the physician in all stress testing and supervision of exercise sessions. Observation and assessment of the participants' progress as well as giving encouragement are among her duties. Plans for diet consultation, counseling regarding risk factors and patient education are high on the list of priorities for expanding her role. When the patient completes 36 sessions, he is again tested and the results recorded. A report is sent to the referring physician. Some members choose to remain with the program. If so, they are re-tested at the end of a year and yearly thereafter. Hopefully, those who terminate will continue individual exercise activities to maintain and increase their level of fitness. The group concept promotes an air of comradeship and is undoubtedly a motivating factor for many participants.

Other benefits of CAPRI are a monthly newsletter, social activities, and a group for family members. The purpose of the newsletter is to welcome new members, announce instructional seminars, and give brief, lucid explanations of procedures such as cardiac catheterization, stress testing, and angiography. Diet information is given and risk factors discussed. CAPRI has much to offer toward the rehabilitation of the cardiac patient.

## Statement of the Problem

There is a need for development of rehabilitation programs for patients suffering from CHD. It has been proposed that medically supervised community programs may be one answer to this problem. The CAPRI program is an example of such an organization. Review of the literature in the area of exercise training offers inconclusive results, indicating a need for further research. Since CAPRI's inception in 1968, data for each patient has been collected and recorded. A unique opportunity to examine the progress of patients in the CAPRI programs has presented itself. Evaluation of such a program is an important contribution toward determining the value of exercise in rehabilitating the patient with CHD.

## Purpose

The purpose of the study is to compare physiological measurements made prior to exercise training with those taken at three months and at one year later in order to evaluate the benefits of prescribed exercise in a community rehabilitation program for the person with coronary heart disease.

Hypotheses to be tested are:

1. Exercise training will not influence the ability of the participant to increase his work tolerance when measured at three months and one year after exercise training.
2. There will be no difference in improvement of work capacity following exercise training in those patients who have been diagnosed as having experienced a myocardial infarction and those who have not.
3. There will be no change in pulse readings in participants following three months or one year of exercise training when measured during stress level at:
   a. Resting level
   b. Sub-maximal level
   c. Maximal level
4. There will be no change in systolic blood pressure reading in participants following three months or one year of exercise training when measured during stress testing at:
   a. Resting level
   b. Sub-maximal level
   c. Maximal level

5. Myocardial oxygen consumption as measured by HR x SBP/100 will be unchanged by three months or one year of exercise training when computed during stress testing at:

   a. Resting level

   b. Sub-maximal level

   c. Maximal level

6. Correlation between HR and SBP will be unchanged by the administration of the stimulus of exercise training when measured at three months and one year.

7. Correlation of HR x $\frac{SBP}{100}$ product with work tolerance will remain unchanged by the administration of the stimulus of exercise training when measured at three months and one year during stress testing.

# CHAPTER II

# METHOD

## The Sample

The 36 subjects (32 men and 4 women) who comprised the sample of the study represent members of four chapters of the CAPRI program participating in prescribed exercise training for one year. The year 1972-1973 was chosen arbitrarily. The ages of the subjects ranged from 39 to 68 with a mean age of 51.86 years. Persons who were eligible for the program include: patients who have had a myocardial infarction, angina pectoris or other forms of heart disease; individuals with chronic broncho-pulmonary disease, post surgical disability and those persons predisposed to cardio-pulmonary problems. The subjects included in this sample all have cardio-vascular disease. Twenty-three have been diagnosed by enzyme studies and ECG changes as having experienced a myocardial infarction. One had open heart surgery after his infarction. Of the 13 remaining subjects, 2 were hypertensive (one had arrhythmias when physically stressed), and 11 suffered from debilitating angina. All were referred by their private physicians and met further criteria for admission to CAPRI by being able to climb one flight of stairs or walk one city block. All were considered sedentary at the start of their program. Their disease was considered chronic and not in an acute phase.

## Study Design and Data Collection Procedures

The study was of a descriptive design. The population was a purposive sample with no control for sex, age or diagnosis. The independent variable was exercise training in which subjects met three times a week for one hour in the early morning for their exercise sessions. Dependent variables considered were work tolerance, pulse, blood pressure and myocardial oxygen consumption as represented by HR x SBP/100. Data were collected during maximal stress testing administered by a physician. The tests were made prior to a subject's beginning an exercise program, at the end of three months and again at the end of a year. When CAPRI was first organized in 1968, the bicycle ergometer was used exclusively for measuring work capacity. When funds were available treadmills were purchased and are presently used for all stress testing. During the year 1972, 20 of the subjects were stress tested on the bicycle ergometer and 16 on the treadmill. While procedures differed in mechanics the concept of increasing increments of "work" was similar and the data were collected in the same manner. Exercise tolerance was recorded in cumulative KPM's[2] on the ergometer and by total seconds on the treadmill. Both methods utilized the concept of addition of increasing increments of work as the test progressed.

Each stress test was conducted as follows. The subject reported to the center at least one hour prior to the scheduled test. He rested in a supine position for approximately one-half hour. A resting electrocardiagram, blood pressure, and pulse were then recorded. He proceeded to the ergometer or treadmill and electrodes were affixed for monitoring. An aneroid sphygmomanometer was placed on the right arm and taped in place to prevent slipping. Before exercise began, baseline recordings were made. These were recorded as the resting stage of the test. It has been noted in the literature (Buskirk, 1973) that there is a response to preparation for exercise above normal resting readings. Therefore this reading was utilized as the first reading rather than the recording after one-half hour of complete rest. The test then commenced. The subject's ECG was monitored constantly on an oscilloscope. Every three minutes an ECG strip was recorded and pulse and blood pressure measured and recorded. The work load was then increased to the next level. After the test was terminated, the subject rested for six minutes. The vital signs were checked frequently and at the end of six minutes a

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[2] A KPM is a Kilopond meter; one Kp = the force acting on a mass of 1 Kg at normal acceleration of gravity: 100 KPM = 723 foot pounds.

final measure of B/P, pulse and ECG were recorded. Reasons for terminating the test were: anxiety, dyspnea, general fatigue, chest pain, leg weakness, claudication, faintness or dizziness, nausea, ECG changes or abnormal B/P changes.

The same procedure was repeated for subsequent exercise testing. Oxygen, emergency drugs, and a D. C. defibrillator were available in the room.

After the initial stress test, the patient met with physicians and program director and an exercise prescription was formulated and explained. It included specified routines of walking/jogging and calisthenics with slowly increasing exercise increments added. Each patient proceeded at his own speed. Competition between participants was not encouraged. Every exercise session was physician supervised.

When a subject had completed 36 sessions he was tested again. Results were forwarded to his private physician and if he wished to continue in the program, the decision was made at this time. The subjects remaining in the program were again tested at the end of a year and tested yearly following this time. Data were recorded at each test and the referring physician was kept up-to-date on his patient's progress. If it was felt that a patient should not continue in the program, the physician was made aware of any existing problems. Records were also kept of each exercise session. These flow sheets recorded the amount of work completed, pulse and B/P recordings, ECG strips and mention of any signs or symptoms of distress as well as any medication taken during the exercise session. For this study only recordings from the stress tests were utilized.

## Data Storage and Computational Methods

A folder containing information on patients participating in each of the four CAPRI programs is on file in the central office in Seattle. Results from all stress tests are included along with correspondence, mounted ECG's, flow sheets for each month of exercise training sessions and any other information considered pertinent to the patient's program. Some charts had a summary sheet. The majority, at this time, did not. In order to facilitate collating the data, a flow sheet was developed. (See Appendix A, page 60) A list of all patients who had enrolled in CAPRI, and had performed the initial stress test for evaluation during the year of 1972 was compared with monthly testing schedules of 1973 in order to compile the sample for the study. The charts of these patients were then utilized to obtain the desired information.

The processing and computational analysis of the data was performed at the Oregon State University Computer Center. The center consists of a Control Data 3300 Central Processing Unit with either remote teletypewriter or punched card data and control input accessibility. The test data were placed on IBM cards using an IBM Model 26 Printing Card Punch Machine. From these cards the data were transferred to the computer memory for use in the computational analysis. Computation was performed through use of a Teletype Model 33 ASR Communications Terminal for the computer demands. The commands were part of the Statistical Interactive Programming System (SIPS) version 4.0.

Consultation with a statistician resulted in the decision to use the Paired t test rather than ANOVA to assess the effect of the independent variable on the dependent variables. Hellerstein (1969) used this statistic when reporting his study. In order for statistical input to provide useful information it must be supplied to those concerned in such a way that interpretation and comparison of the data is readily available. It was felt that the Paired t test best suited this need. Therefore, the hypothesis of no difference between the means was tested using an alpha level of .05, and the "Distribution of t Probability" table used for interpretation.

Because 20 patients were tested on the ergometer and 16 on the treadmill, it was necessary to separate the subjects to examine the variable "work capacity". The findings suggested that it would be of interest to look at other variables in the same manner.

The subjects were further dichotomized by diagnosis: Myocardial Infarction and non-Myocardial Infarction subjects. The mean difference of the work capacity of these groups was tested to find if patients who had suffered myocardial infarction could show improvement equal to those without this damage to their heart after exercise conditioning.

Frequency counts from the raw data allowed an opportunity to compare reasons for terminating the stress tests.

# CHAPTER III

## RESULTS

Evaluation of conditioning, or exercise training, of the person with coronary heart disease, or other cardio-vascular problems must be approached in a somewhat different manner than conditioning or training of the healthy individual. The most modest improvement noted in the person with CHD is cause for comments of pleasure and often is a motivating factor for the continuation of the program. Criteria for improvement of patients participating in the CAPRI programs include: increase in exercise tolerance; decreased resting pulse, blood pressure or an improved ECG; decreased sub-maximal pulse and/or blood pressure; lower recovery pulse, indicating faster recovery from exercise; increased maximal pulse and systolic blood pressure without resultant pain.

Because the purpose of this study was to evaluate the effect of exercise training in a community program, no separation was made between those who improved and those who did not improve. The inclusive group is different from the design of some other reported studies. For example, Hellerstein (1969) used a sub-sample of 100 patients which he divided into groups of improved, no change, or worsened. He also divided patients with CHD from normal patients before he made his comparisons. Hypothesis testing in this study was performed without benefit of such a division. Division was made according to the modality of the stress test. Those tested on the bicycle ergometer were examined separately from those tested by treadmill. The ease of computer testing encouraged a look at parameters other than those hypothesized and reported. Paired t tests were also computed on the difference between the means of the three-month test and the one-year test. Diastolic blood pressure and recovery measurements were tested. Results are found in Appendix B, page 64.

Hypothesis #1: Exercise training will not influence the ability of the participant to increase his work tolerance when measured at three months and one year after exercise training. This hypothesis was rejected as stated at alpha levels less than p = .05. Tables 1 and

Table 1

Repeated Work Tolerance as Measured by Ergometer Stress Tests, N=20, df=19.

| Comparison | Test | $\bar{x}^{a}$ | t value | $p^{b}$ |
|---|---|---|---|---|
| At 3 months | Test 1<br>Test 2 | 3591.25<br>4072.50 | 1.998 | p = .05 |
| At 1 year | Test 1<br>Test 2 | 3591.25<br>5071.50 | 5.0008 | p = .0005 |

a = Cumulated KPM : Test 1 = Evaluation, Test 2 = 3 months, Test 3 = 1 year

b = Determined by the t-test for paired samples, one tailed test

2 demonstrate the interesting differences between the results of those tested on the bicycle ergometer and those tested on treadmill.

Table 2

Repeated Work Tolerance as Measured by Treadmill Stress Tests, N=16, df=15

| Comparison | Test $\bar{x}^a$ | | t value | $p^b$ |
|---|---|---|---|---|
| At 3 months | Test 1 | 385.00 | 4.3770 | p = .0005 |
| | Test 2 | 530.00 | | |
| At 1 year | Test 1 | 385.00 | 4.4074 | p = .0005 |
| | Test 2 | 534.93 | | |

a = Cumulated Seconds: Test 1 = Evaluation, Test 2 = 3 months, Test 3 = 1 year
b = Determined by the t-test for paired samples, one tailed test

Hypothesis #2: There will be no difference in work capacity following exercise training in those patients who have been diagnosed as having experienced a myocardial infarction and those who have not. The hypothesis was accepted. There was no significant difference in the improvement of work capacity in either those tested by the ergometer or those tested by treadmill.

Hypothesis #3: There will be no change in pulse readings in participants following three months or one year of exercise training when measured during stress testing at (a) resting level, (b) submaximal level, (c) maximal level. At the resting level, utilizing data of ergometer tested subjects, the hypothesis was accepted at both the three-month testing session and the one-year testing session. With

Table 3

Comparison of Resting Pulse Measures

| Comparison | Ergometer (N=20) | | | Treadmill (N=16) | | |
|---|---|---|---|---|---|---|
| | Test $\bar{x}$[a] | t-value | p[b] | Test $\bar{x}$[a] | t-value | p[b] |
| At 3 months | Test 1 78<br>Test 2 75 | 1.284 | NS | 76<br>67 | 2.363 | p = .025 |
| At 1 year | Test 1 78<br>Test 3 74 | 1.214 | NS | 76<br>74 | .6231 | NS |

a = Heart beats per minute: Test 1 = Evaluation test, Test 2 = 3 months, Test 3 = 1 year
b = Determined by t-test for paired samples, one tailed test

the treadmill tested subjects, the hypothesis was rejected (p = .025) at the three-month test but accepted at the one-year testing session. This hypothesis was rejected for ergometer-tested subjects at the three-months test and the year test (p = .0005). The results of the treadmill-tested subjects also allowed rejection of the hypothesis at three months (p = .05) and one year (p = .0005).

Table 4

Comparison of Sub-maximal Pulse Measures

| Comparison | Ergometer (N=20) | | | Treadmill (N=16) | | |
|---|---|---|---|---|---|---|
| | Test $\bar{x}$[a] | t-value | p[b] | Test $\bar{x}$[a] | t-value | p[b] |
| At 3 months | Test 1 107<br>Test 2 97 | 4.221 | p = .0005 | Test 1 118<br>Test 2 109 | 2.002 | p = .05 |
| At 1 year | Test 1 107<br>Test 3 96 | 3.888 | p = .0005 | Test 1 118<br>Test 3 105 | 5.009 | p = .0005 |

a = Heart beats per minute: Test 1 = Evaluation test, Test 2 = 3 month test, Test 3 = 1 year test
b = Determined by t-test for paired samples, one tailed test

The direction of change for both resting and sub-maximal pulse rates was toward a decrease in the pulse rate.

At maximal levels of stress testing this hypothesis must be accepted for all subjects whether testing was by bicycle ergometer or treadmill.

Hypothesis #4: There will be no change in systolic blood pressure readings in participants following three months or one year of exercise training when measured during stress testing at (a) resting level, (b) sub-maximal level, and (c) maximal.

Table 5

Comparison of Resting Systolic Blood Pressures

| Comparison | Ergometer Sample (N=20) | | | Treadmill Sample (N=16) | | |
|---|---|---|---|---|---|---|
| | Test $\bar{x}^{a}$ | t-value | $p^{b}$ | Test $\bar{x}^{a}$ | t-value | $p^{b}$ |
| At 3 months | Test 1 139<br>Test 2 124 | 3.404 | p = .005 | Test 1 125<br>Test 2 118 | 0.8898 | NS |
| At 1 year | Test 1 139<br>Test 3 128 | 2.056 | p = .05 | Test 1 125<br>Test 3 131 | -1.096 | NS |

a = Mean systolic blood pressure: Test 1 = Evaluation test, Test 2 = 3 months test, Test 3 = 1 year test

b = Determined by t-test for paired sample, one tailed test

At resting measurements of the stress tests the hypothesis must be accepted when tested statistically with the treadmill sample. The hypothesis was rejected when data from the ergometer sample were utilized; at three months (p = .005) and at one year (p = .05).

The ergometer-tested subjects showed results that allowed the hypothesis to be rejected at both the three-month test and the test after one year of exercise training (p = .005). The results obtained from data of treadmill-tested subjects were non-significant at both three months and one year. There was a decrease in blood pressure at three months, but at one year it was higher than during the initial test for evaluation.

Table 6

Comparison of Sub-Maximal Systolic Blood Pressures

| Comparison | Ergometer Sample (N=20) | | | Treadmill Sample (N=16) | | |
|---|---|---|---|---|---|---|
| | Test $\bar{x}^a$ | t-value | $p^b$ | Test $\bar{x}^a$ | t-value | $p^b$ |
| At 3 months | Test 1 161<br>Test 2 145 | 3.211 | p = .005 | Test 1 151<br>Test 2 144 | 1.602 | NS |
| At 1 year | Test 1 161<br>Test 3 144 | 3.386 | p = .005 | Test 1 151<br>Test 3 154 | 0.652 | NS |

a = Mean systolic blood pressure: Test 1 = Evaluation test, Test 2 = 3 month test, Test 3 = 1 year test

b = Determined by t-test for paired samples, one tailed test

The hypothesis was accepted for measures made at the maximal level during stress testing. The direction of change was toward an increase in systolic blood pressure. This is a desirable result.

Hypothesis #5: Myocardial oxygen consumption was measured by HR x SBP/100 will be unchanged by three months or one year of exercise training when computed during stress testing at (a) resting level, (b) sub-maximal level, and (c) maximal level.

At the resting level this hypothesis was rejected when applied to the ergometer sample at three months (p = .005) and at one year (p = .05). When the hypothesis was tested using data obtained from treadmill testing, it was rejected at three months (p = .05), but accepted at the one-year test. The direction of the change was toward a decrease in myocardial oxygen consumption.

At sub-maximal levels the hypothesis was rejected at both three months and one year for ergometer and treadmill-tested subjects: ergometer, three months and one year $p = .0005$; treadmill, three months and one year $p = .05$. Again, the direction of change was toward a decrease in myocardial oxygen consumption.

At the maximal level the hypothesis must be accepted. While the results of statistical testing were non-significant, the direction of change was toward an increase in myocardial oxygen consumption.

Hypothesis #6: Correlation between HR and SBP/100 will be unchanged by the administration of the stimulus of exercise training when measured at three months and one year.

The hypothesis is accepted. Attempt to duplicate the results of Sanne (1973) showing a negative correlation between HR and SBP at maximal workloads before training and a positive correlation after training was unsuccessful.

Hypothesis #7: Correlation of HR x SBP/100 product with work tolerance will remain unchanged by the administration of the stimulus of exercise training when measured at three months and one year during stress testing.

This hypothesis is accepted. The significance of the r values was tested using the appropriate df and the table, "Vaues of r for different levels of significance" (Downie & Heath, 1970). Testing the Ho: R = 0, the hypothesis was rejected at the one percent level in all except the treadmill sample at three months, which was rejected at the five percent level. Data for comparison of the above results have not been found. The correlation is modest, but it seems to reflect some hemodynamic improvement accompanies the increased work tolerance. Whether or not this means increased coronary blood supply cannot be known at this time.

Table 7

Correlation of HR x SBP Product with Work Tolerance

| Stress Test | Ergometer Sample (N=20) | Treadmill Sample (N=16) |
|---|---|---|
| At 3 months | r = 0.6503 | r = 0.4647 |
| At 1 year | r = 0.6664 | r = 0.6488 |

Frequency counts were useful for determining subjective reasons for participants terminating the stress tests. These reasons were varied and usually more than one reason was given. Complete tables at termination are found in the Appendix C, page 103. The most prevalent reason given was leg weakness.

Test 8

Number of Subjects Terminating Stress Tests due to Leg Weakness

| Test | M.I. Subjects | | Non M.I. Subjects | |
|---|---|---|---|---|
| | Ergometer N=12 | Treadmill N=11 | Ergometer N=8 | Treadmill N=5 |
| Evaluation | 10 | 9 | 8 | 3 |
| 3 Months | 11 | 8 | 7 | 1 |
| 1 Year | 7 | 6 | 6 | 2 |

Among the non-myocardial infarction subjects, chest pain was given as the sole reason for discontinuing the test in only two instances. One of these occations was after a significant increase in work load. Subjects who had experienced a myocardial infarction terminated the test for chest pain alone four times on the first test which is used for evaluation purposes. Only two of these subjects terminated subsequent tests for chest pain alone without substantial increases in work tolerance.

# CHAPTER IV

## DISCUSSION

In a cardiac rehabilitation program, each subject is his own control. This makes it difficult to generalize findings of one subject to another and almost impossible to make general statements concerning one population that can be applied to another population. However, certain interesting directions do emerge.

The most impressive improvement was that of the ability of a subject to increase his work tolerance. This is an important consideration in determining whether or not the subject can continue his accustomed employment. Of equal importance is the effect of his social life. The varied response to bicycle ergometer and treadmill testing may reflect an increased proficiency in skeletal muscles as well as cardiac function. Almost without exception, the greatest improvement noted as a result of the stimulus of exercise training on a dependent variable occurred during the first three months of conditioning. This has been noted previously. (Hellerstein, 1972) The most sedentary are capable of showing the greatest improvement in this first training period. An interesting comparison can be made by observing the progression of work tolerance in subjects tested by treadmill as opposed to those tested by ergometer. In the first three months the progress made by those tested on the ergometer is not as great as that made in the next nine months. The treadmill test, in contrast, shows the greatest improvement during the first three months with a lesser degree of improvement following. One questions whether familiarity of testing equipment is the only causal element involved. With regard to the ergometer sample, it may be postulated that leg weakness rather than cardio-vascular deficit is responsible for the difference in results. The differences demonstrate that interchangeable use of testing methods in longitudinal studies is not advisable. CAPRI has maintained this separation and presently is using only the treadmill for stress tests.

A note of encouragement is found for the persons who have had a myocardial infarction when improvement in work capacity is compared between these people and persons who have not had actual destruction of the myocardium. Comparison of the difference between the means showed values that proved non-significant in tests at both three months and one year. This indicates that life as they enjoy it may not be over. They need not "take it easy" forever. With proper testing, prescribing and training they may be able to return to a useful life.

The results of a comparison between pre-training and post-training pulse and blood pressure measurements showed the expected direction of improvement. While the decrease in resting pulse may be statistically insignificant, one must also consider the impact of 4 beats/min x 60 min x 24 hours x 1 week for the duration of the life of a person. It is on this level that it becomes significant to the individual. When stroke volume is imparied, as is often the case after injury to the heart, the deficit is partly compensated for by adjustment of pulse rate. Therefore a higher pulse rate for a given work load is typically found in patients with myocardial disease. (Guyton, 1971) Since the subjects are trained at sub-maximal levels but tested to maximal levels, improvement at sub-maximal levels is the measure of most significant change. (Complete summary of pre-training and post-training pulse rates and blood pressure changes is found in Appendix B, pages 63-64.

Changes in both cardiac function and the peripheral circulation are responsible for the increase in work capacity. In some patients the peripheral changes are most important. Hellerstein et al. (1973) have reported that for the same absolute work load, untrained normals and trained arteriosclerotic heart disease patients have higher HR x SBP/100 products than trained subjects. Myocardial oxygen consumption is decreased at resting and sub-maximal levels after training; thus, the heart may be functioning in a more efficient manner. Under normal conditions the cardiac response is probably not limited by myocardial hypoxia; the latter does however become a major limiting factor in patients with CHD. Therefore, lowered myocardial oxygen consumption at rest and at sub-maximal levels is a desired physiological effect. It is intriguing to see the small rise in myocardial oxygen consumption during maximal exercise. Bruce (1974) demonstrated that myocardial oxygen consumption in normal subjects was higher than in post myocardial infarction subjects at maximal levels of testing. It was felt that this demonstrated a more efficient extraction of oxygen or possibly better coronary blood flow. Speculation rises, then, as to whether coronary blood flow increases with exercise or is a result of more efficient utilization of oxygen by skeletal muscles with the secondary result of more available oxygen for use by myocardial cells. Sim and Neil (1974) addressed themselves to these questions as they compared data obtained using both exercise and atrial pacing to induce tachycardia in patients suffering from angina pectoris. They concluded that exercise conditioning exerted a special effect that pertained specifically to exercise and was not generalized to different stress, i.e., atrial pacing. Two hypothesis posed were:

(a) conditioning increased myocardial oxygen supply only during exercise, or

(b) conditioning changed the relationship (only during exercise) between systemic hemodynamic factors believed to be indirect indices or myocardial oxygen consumption on the one hand, and the actual oxygen consumption on the other hand.

Since coronary artery studies were not detectably altered on arteriography, it is unlikely that new collateral circulation had developed at this point.

The correlation of the HR x SBP/100 product with work tolerance remained almost constant. As work tolerance increased, the myocardial oxygen consumption increased. This appears to be related to the foregoing discussion of myocardial oxygen consumption. Perhaps this reflects improvement of delivery of coronary flow by other hemodynamic mechanisms.

Review of the reasons for terminating the stress tests were varied. Leg weakness and general fatigue were the major limiting factors. Chest pain was seldom given as the sole reason for terminating the test, and was only common during the initial test. Apprehension may have contributed to the occurrence of chest pain.

The evidence for the case of prescribed exercise as a part of the rehabilitation program for patients with CHD becomes more favorable and more accepted annually as evidenced by the growth of community programs such as CAPRI. Six hundred and twenty-seven participants have enrolled since the inception of the program in 1968 (through March 1974). Cumulative experience to date has included: a total of 70, 975 supervised man hours of exercise training; a total of 1, 563 supervised maximal exercise tolerance tests; and no deaths during exercise training.

In 1972 there were 143 new admissions to the program. Sixteen participants (11 percent) dropped before completion of three months training. Thirty-six subjects (28 percent) continued for a year and participated in the yearly exercise test. Of these, 36 patients, 29 (81 percent) were still active as of May, 1974. It is assumed that leading reasons for drop-outs are lack of motivation and financial considerations.

It is of interest that at the present time a professional nurse has assumed the duties of Program Director with the Portland CAPRI program. This is the beginning of a new role for the nurse in the rehabilitation process of patients with coronary heart disease. It is expected that in the near future, nurses will be assuming more responsibility in other exercise testing and training programs.

# CHAPTER V

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## Summary

The purpose of this investigation was to observe the effect of prescribed exercise training on patients with cardiovascular disease who were participating in a community rehabilitation program. The contribution of the professional nurse to such a program was considered.

Data were collated from charts of subjects participating in CAPRI programs for one full year. The data have been recorded during the course of three maximal stress tests: (1) an initial evaluation test, (2) a test after completion of three-months training, and (3) the test made after completion of one year of training. Comparison of these tests showed that exercise training was a valid method of increasing work capacity. While questions still remain concerning the mechanism responsible, a decrease was noted in resting and submaximal measurements of pulse and systolic blood pressure after exercise conditioning. Maximal pulse and systolic blood pressure increased slightly but when tested for significance, the null hypothesis could not be rejected. The most significant improvement in all measures except one occurred during the first three months of exercise training. The exception was the increase in work tolerance for ergometer tested subjects. The improvement reflected between the three-month test and the yearly test was larger than the initial improvement made during the first three months. This most likely is a result of strengthening of leg muscles as well as more efficient use of oxygen by the muscles, rather than a cardiovascular training effect.

## Conclusions

Because of the many variables inherent in each subject, generalizations cannot be drawn from these findings. The movement toward improved physical fitness is encouraging. Increased work tolerance showed the most impressive improvement from exercise training. The decrease in myocardial oxygen consumption at rest and submaximal levels indicates a more efficient heart after training.

The role of community programs is an important one. They provide motivation, instruction and medical supervision during testing and training. They provide an answer to a means of conserving physician time and reducing patient cost. Because exercise sessions are supervised by a physician, fear and apprehension in the patient is reduced. They are providing, at least in one instance, the opportunity for the expanded role of the nurse to be explored.

## Recommendations

1. A study using a larger sample of treadmill test subjects, protracted over a longer time interval would be of interest.

2. An investigative study reflecting psychological benefits of such a program would seem important.

3. A descriptive study which demonstrates the development of the expanding role of the nurse in this setting might be combined with an exploration of perceived needs of the subject.

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# APPENDICES

# APPENDIX A

## Data Collecting Forms

MEN'S
CARDIO-PULMONARY REHABILITATION PROGRAM
EXERCISE TOLERANCE TEST

SHW # ________

NAME ______________________ SS# ______________ TEST ____ MONTH

HEIGHT ______________ WEIGHT ______________ AGE ________

| BICYCLE ERGOMETER ___ TREADMILL ___ | MIN | CUM KPM'S | HR | BP | REC MIN | REC HR | REC BP |
|---|---|---|---|---|---|---|---|
| RESTING | 0 | 0 | | | 0 | | |
| LEVEL 1 | L1-1 | 300 | | | 1 | | |
| BE=300 KPM/min | L1-2 | 600 | | | 2 | | |
| TM=1.7mph, 10%gr | L1-3 | 900 | | | 3 | | |
| LEVEL 2 | L2-1 | 1,500 | | | 4 | | |
| BE=600 KPM/min | L2-2 | 2,100 | | | 5 | | |
| TM=2.5mph, 12%gr | L2-3 | 2,700 | | | 6 | | |
| LEVEL 3 | L3-1 | 3,600 | | | 7 | | |
| BE=900 KPM/min | L3-2 | 4,500 | | | 8 | | |
| TM=3.4mph, 14%gr | L3-3 | 5,400 | | | 9 | | |
| LEVEL 4 | L4-1 | 6,600 | | | 10 | | |
| BE=1200 KPM/min | L4-2 | 7,800 | | | 11 | | |
| TM=4.2mph, 16%gr | L4-3 | 9,000 | | | 12 | | |
| LEVEL 5 | L5-1 | 10,500 | | | 13 | | |
| BE=1500 KPM/min | L5-2 | 12,000 | | | 14 | | |
| TM=5.0mph, 18%gr | L5-3 | 13,500 | | | 15 | | |

REASON FOR STOPPING

___ 1. Anxiety
___ 2. Dyspnea
___ 3. Gen'l Fatigue
___ 4. Chest Pain
___ 5. Leg Weakness
___ 6. Claudication
___ 7. Faint, Dizzy
___ 8. Nausea
___ 9. ECG Changes
___ 10. Abnormal BP Change
___ 11. Other ______

| PULMONARY FUNCTION | PRED | ACT |
|---|---|---|
| $FEV_1$ | | |
| FVC | | |
| RESTING HR LEAD 1 | | |

(BE): TOTAL WORK KPM'S ______ (TM): ______ SECONDS ______ LEVEL ______ TOTAL SECONDS

PRESENT MEDICATIONS: ______________________________

ALLERGIES: ______________________________

COMMENTS: ______________________________

______________________________

FAI ____ % ☐ Active ☐ Sedentary Smoking? ____ yes ____ no; Qty. ________

Supervising Physician's Signature ______________________

Date of Test ______________________

CARDIO-PULMONARY REHABILITATION PROGRAM
EXERCISE TOLERANCE TEST
WORK SHEET - TREADMILL

Name ______________________ SS# ______________________ Test ______ Month

Height ____________ Weight ____________ Age ______ Date of Test ____________

| | Level | Cum. Sec. | HR | BP | Rec. Min. | HR | BP | REASON FOR STOPPING |
|---|---|---|---|---|---|---|---|---|
| RESTING | 0 | 0 | | | R-0 | | | _____ Anxiety |
| LEVEL 1 | 1-1 | 60 | | | R-1 | | | _____ Dyspnea |
| 1.7 MPH | 1-2 | 120 | | | R-2 | | | _____ Gen'l Fatigue |
| 10% Grade | 1-3 | 180 | | | R-3 | | | _____ Chest Pain |
| LEVEL 2 | 2-1 | 240 | | | R-4 | | | _____ Leg Weakness |
| 2.5 MPH | 2-2 | 300 | | | R-5 | | | _____ Claudication |
| 12% Grade | 2-3 | 360 | | | R-6 | | | _____ Faint, Dizzy |
| LEVEL 3 | 3-1 | 420 | | | | | | _____ Nausea |
| 3.4 MPH | 3-2 | 480 | | | | | | _____ ECG Changes |
| 14% Grade | 3-3 | 540 | | | | | | _____ Abnormal BP Chg |
| LEVEL 4 | 4-1 | 600 | | | | | | _____ Other |
| 4.2 MPH | 4-2 | 660 | | | PULMONARY FUNCTION | | | |
| 16% Grade | 4-3 | 720 | | | | PRED | ACT | |
| LEVEL 5 | 5-1 | 780 | | | $FEV_1$ | | | |
| 5.0 MPH | 5-2 | 840 | | | FVC | | | |
| 18% Grade | 5-3 | 900 | | | Resting HR Lead 1 | | | |

TIME: Level ________ Seconds ________ TOTAL DURATION ____________sec.

PRESENT MEDICATIONS ______________________________________________

______________________________________________

COMMENTS ______________________________________________

______________________________ ALLERGIES ______________________

SMOKING ____________ Quantity/Day ____________ FAI ______% Active Sedentary

Testing Physician ____________________

Patient Number

Age

Treadmill or Ergometer

Diagnosis

| Variable | Pre-test | 3 months | 1 year |
|---|---|---|---|
| Exercise Tolerance | | | |
| Resting pulse | | | |
| Sub-maximal pulse | | | |
| Maximal pulse | | | |
| Recovery pulse | | | |
| Resting B/P | | | |
| Sub-maximal B/P | | | |
| Maximal B/P | | | |
| Recovery B/P | | | |
| FEV | | | |
| FVC | | | |
| ECG Change? | | | |
| Other (reason for terminating test | | | |

# APPENDIX B

## The Data

Exercise Stress Test

Variables Numbered for Paired t Tests

| Variable | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| Work Load | 1 | 14 | 27 |
| Resting Pulse | 2 | 15 | 28 |
| Sub-maximal Pulse | 3 | 16 | 29 |
| Maximal Pulse | 4 | 17 | 30 |
| Recovery Pulse | 5 | 18 | 31 |
| Resting Systolic Blood Pressure | 6 | 19 | 32 |
| Resting Diastolic Blood Pressure | 7 | 20 | 33 |
| Sub-max. Systolic Blood Pressure | 8 | 21 | 34 |
| Sub-max. Diastolic Blood Pressure | 9 | 22 | 35 |
| Maximal Systolic Blood Pressure | 10 | 23 | 36 |
| Maximal Diastolic Blood Pressure | 11 | 24 | 37 |
| Recovery Systolic Blood Pressure | 12 | 25 | 38 |
| Recovery Diastolic Blood Pressure | 13 | 26 | 39 |

Test 1: Initial Evaluation Test
Test 2: Test after three months of exercise training
Test 3: Test after one year of exercise training

Mean Values of Heart Rate Recorded During Exercise Stress Tests

| Variable | Total Sample N=36 | | | | | | Ergometer Sample N=20 | | | | | | Treadmill Sample N=16 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\overline{x}$ Test 1 | $\overline{x}$ Test 2 | $\overline{x}$ Test 3 | Test A | Test B | Test C | $\overline{x}$ Test 1 | $\overline{x}$ Test 2 | $\overline{x}$ Test 3 | Test A | Test B | Test C | $\overline{x}$ Test 1 | $\overline{x}$ Test 2 | $\overline{x}$ Test 3 | Test A | Test B | Test C |
| Work Load | | | | | | | 3591 | 4072 | 5071 | a | a | a | 385 | 530 | 534 | a | | a |
| Resting Pulse | 78 | 72 | 74 | a* | | | 78 | 75 | 74 | | | | 76 | 67 | 74 | a | a | |
| Sub-maximal Pulse | 110 | 101 | 100 | a | | a | 107 | 97 | 96 | a | | a | 118 | 109 | 105 | a | | a |
| Maximal Pulse | 155 | 153 | 154 | | | | 148 | 149 | 150 | | | | 159 | 158 | 162 | | a | |
| Recovery Pulse | 98 | 94 | 94 | | | | 96 | 93 | 94 | a | | | 99 | 94 | 90 | | | |

Test 1: Pre-training Evaluation Test
Test 2: Three-month Evaluation Test
Test 3: One-year Evaluation Test

Test A compares Test 1 and Test 2
Test B compares Test 2 and Test 3
Test C compares Test 1 and Test 3

*a = Significant at alpha level of p = .05 or beyond (One Tail Test)

Mean Values of Blood Pressures Measured During Exercise Stress Tests

| Variable | Total Sample N=36 | | | | | | Ergometer Sample N=20 | | | | | | Treadmill Sample N=16 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ Test 1 | $\bar{x}$ Test 2 | $\bar{x}$ Test 3 | Test A | Test B | Test C | $\bar{x}$ Test 1 | $\bar{x}$ Test 2 | $\bar{x}$ Test 3 | Test A | Test B | Test C | $\bar{x}$ Test 1 | $\bar{x}$ Test 2 | $\bar{x}$ Test 3 | Test A | Test B | Test C |
| Resting SBP | 130 | 125 | 129 | | | | 139 | 124 | 128 | a* | | a | 125 | 118 | 131 | | | |
| Resting DBP | 83 | 84 | 83 | | | | 84 | 83 | 84 | | | | 86 | 79 | 84 | | | |
| Sub-maximal SBP | 157 | 145 | 149 | a | | | 161 | 145 | 144 | a | | a | 151 | 144 | 154 | | | |
| Sub-maximal DBP | 88 | 84 | 85 | a | | a | 89 | 84 | 87 | a | | | 88 | 82 | 83 | | | a |
| Maximal SBP | 176 | 177 | 180 | | | | 181 | 186 | 188 | | | | 156 | 167 | 171 | | | |
| Maximal DBP | 87 | 89 | 91 | | | | 87 | 91 | 96 | | a | | 87 | 86 | 86 | | | |
| Recovery SBP | 134 | 134 | 134 | | | | 134 | 130 | 134 | a | | | 136 | 140 | 136 | | | |
| Recovery DBP | 79 | 78 | 78 | | | | 81 | 78 | 83 | a | a | | 77 | 78 | 75 | | | |

Test 1: Pre-training Evaluation
Test 2: Three-month Evaluation Test
Test 3: One-year Evaluation Test

Test A compares Test 1 and Test 2
Test B compares Test 2 and Test 3
Test C compares Test 1 and Test 3

* a = Significant at alpha level of p = .05 or beyond (One Tail Test)

## ERGOMETER SAMPLE

PAIREDT , 1, 14, C

| Work Load | Test 1 - Test 2 |
|---|---|
| Sample Size | 20 |
| Mean of Var 1 | 3591.250000 |
| Mean of Var 14 | 4072.500000 |
| Mean Difference | -481.250000 |
| Std. Err. of Difference | 240.796888 |
| T-Value | -1.998572 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT , 14, 27, C

| Work Load | Test 2 - Test 3 |
|---|---|
| Sample Size | 20 |
| Mean of Var 14 | 4072.500000 |
| Mean of Var 27 | 5071.500000 |
| Mean Difference | -999.000000 |
| Std. Err. of Difference | 312.756758 |
| T-Value | -3.194176 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT , 1, 27, C

| Work Load | Test 1 - Test 3 |
|---|---|
| Sample Size | 20 |
| Mean of Var 1 | 3591.250000 |
| Mean of Var 37 | 5071.500000 |
| Mean Difference | -1480.250000 |
| Std. Err. of Difference | 295.524617 |
| T-Value | -5.008889 |
| Degrees of Freedom | 19 |

PAIREDT, 2, 15, C

| Resting Pulse | Test 1 - Test 2 |
| --- | --- |
| Sample Size | 20 |
| Mean of Var 2 | 78.400000 |
| Mean of Var 15 | 75.400000 |
| Mean Difference | 3.000000 |
| Std. Err. of Difference | 2.335087 |
| T-Value | 1.284749 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 3, 16, C

| Submaximal Pulse | Test 1 - Test 2 |
| --- | --- |
| Sample Size | 20 |
| Mean of Var 3 | 107.300000 |
| Mean of Var 16 | 97.150000 |
| Mean Difference | 10.150000 |
| Std. Err. of Difference | 2.404245 |
| T-Value | 4.221699 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 4, 17, C

| Maximal Pulse | Test 1 - Test 2 |
| --- | --- |
| Sample Size | 20 |
| Mean of Var 4 | 148.550000 |
| Mean of Var 17 | 149.300000 |
| Mean Difference | -0.750000 |
| Std. Err. of Difference | 2.275586 |
| T-Value | -0.329586 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 5, 18, C

| Recovery Pulse | Test 1 - Test 2 |
|---|---|
| Sample Size | 20 |
| Mean of Var 5 | 96.650000 |
| Mean of Var 18 | 93.050000 |
| Mean Difference | 3.600000 |
| Std. Err. of Difference | 2.043475 |
| T-Value | 1.761705 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 6, 19, C

| Resting SBP | Test 1 - Test 2 |
|---|---|
| Sample Size | 20 |
| Mean of Var 6 | 139.550000 |
| Mean of Var 19 | 124.700000 |
| Mean Difference | 14.850000 |
| Std. Err. of Difference | 4.362082 |
| T-Value | 3.404337 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 7, 20, C

| Resting DBP | Test 1 - Test 2 |
|---|---|
| Sample Size | 20 |
| Mean of Var 7 | 84.200000 |
| Mean of Var 20 | 83.150000 |
| Mean Difference | 1.050000 |
| Std. Err. of Difference | 3.477352 |
| T-Value | .301954 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 8, 21, C
Submaximal SBP Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 8 | 161.900000 |
| Mean of Var 21 | 145.750000 |
| Mean Difference | 16.150000 |
| Std. Err. of Difference | 5.029531 |
| T-Value | 3.211035 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 9, 22, C
Submaximal DBP Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 9 | 89.300000 |
| Mean of Var 22 | 84.000000 |
| Mean Difference | 5.300000 |
| Std. Err. of Difference | 2.058457 |
| T-Value | 2.574707 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 10, 23, C
Maximal SBP Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 10 | 181.200000 |
| Mean of Var 23 | 186.550000 |
| Mean Difference | -5.350000 |
| Std. Err. of Difference | 4.895366 |
| T-Value | -1.092670 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 11, 24, C
Maximal DBP Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 11 | 87.100000 |
| Mean of Var 24 | 91.600000 |
| Mean Difference | -4.500000 |
| Std. Err. of Difference | 5.690944 |
| T-Value | -0.790730 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 12, 25, C
Recovery SBP Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 12 | 134.750000 |
| Mean of Var 25 | 130.300000 |
| Mean Difference | 4.450000 |
| Std. Err. of Difference | 1.929651 |
| T-Value | 2.306117 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 13, 26, C
Recovery DBP Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 13 | 81.900000 |
| Mean of Var 26 | 78.300000 |
| Mean Difference | 3.600000 |
| Std. Err. of Difference | 2.085539 |
| T-Value | 1.726172 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 16, 28, C

Resting Pulse        Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 15 | 75.400000 |
| Mean of Var 28 | 74.550000 |
| Mean Difference | .850000 |
| Std. Err. of Difference | 2.774200 |
| T-Value | .306395 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 16, 29, C

Submaximal Pulse        Test 2 = Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 16 | 97.150000 |
| Mean of Var 29 | 96.900000 |
| Mean Difference | .250000 |
| Std. Err. of Difference | 2.701729 |
| T-Value | .092533 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 17, 30, C

Maximal Pulse        Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 17 | 149.300000 |
| Mean of Var 30 | 150.150000 |
| Mean Difference | -0.850000 |
| Std. Err. of Difference | 2.606949 |
| T-Value | -0.326052 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 13, 31, C
Recovery Pulse Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 13 | 93.050000 |
| Mean of Var 31 | 94.100000 |
| Mean Difference | -1.050000 |
| Std. Err. of Difference | 2.172162 |
| T-Value | -0.483389 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 19, 32, C
Resting SBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 19 | 124.700000 |
| Mean of Var 32 | 128.850000 |
| Mean Difference | -4.150000 |
| Std. Err. of Difference | 3.073036 |
| T-Value | -1.350456 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 20, 33, C
Resting DBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 20 | 83.150000 |
| Mean of Var 33 | 84.750000 |
| Mean Difference | -1.600000 |
| Std. Err. of Difference | 2.123056 |
| T-Value | -0.753630 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 21, 34, C
Submaximal SBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 21 | 145.750000 |
| Mean of Var 34 | 144.700000 |
| Mean Difference | 1.050000 |
| Std. Err. of Difference | 3.155175 |
| T-Value | .332787 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 22, 35, C
Submaximal DBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 22 | 84.000000 |
| Mean of Var 35 | 87.450000 |
| Mean Difference | -3.450000 |
| Std. Err. of Difference | 1.725162 |
| T-Value | -1.999812 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 23, 36, C
Maximal SBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 23 | 186.550000 |
| Mean of Var 36 | 188.100000 |
| Mean Difference | -1.550000 |
| Std. Err. of Difference | 4.313672 |
| T-Value | -0.359323 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 24, 37, C

| Maximal DBP | Test 2 - Test 3 |
|---|---|
| Sample Size | 20 |
| Mean of Var 24 | 91.600000 |
| Mean of Var 37 | 96.900000 |
| Mean Difference | -5.300000 |
| Std. Err. of Difference | 2.215463 |
| T-Value | -2.389041 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 25, 38, C

| Recovery SBP | Test 2 - Test 3 |
|---|---|
| Sample Size | 20 |
| Mean of Var 25 | 130.300000 |
| Mean of Var 38 | 134.350000 |
| Mean Difference | -4.050000 |
| Std. Err. of Difference | 3.077486 |
| T-Value | -1.316009 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 26, 39, C

| Recovery DBP | Test 2 - Test 3 |
|---|---|
| Sample Size | 20 |
| Mean of Var 26 | 78.300000 |
| Mean of Var 39 | 83.000000 |
| Mean Difference | -4.700000 |
| Std. Err. of Difference | 1.777195 |
| T-Value | -2.644617 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 2, 28, C

Resting Pulse Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 2 | 78.400000 |
| Mean of Var 28 | 74.550000 |
| Mean Difference | 3.650000 |
| Std. Err. of Difference | 3.169156 |
| T-Value | 1.214834 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 3, 29, C

Submaximal Pulse Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 3 | 107.300000 |
| Mean of Var 29 | 96.900000 |
| Mean Difference | 10.400000 |
| Std. Err. of Difference | 2.674834 |
| T-Value | 3.888092 |
| Degrees of Freedom | 19 |
| T-Table Vaue at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 4, 30, C

Maximal Pulse Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 4 | 148.550000 |
| Mean of Var 30 | 150.150000 |
| Mean Difference | -1.600000 |
| Std. Err. of Difference | 2.775267 |
| T-Value | -0.576521 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.681000 |

PAIREDT, 5, 31, C
Recovery Pulse Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 5 | 96.650000 |
| Mean of Var 31 | 94.100000 |
| Mean Difference | 2.550000 |
| Std. Err. of Difference | 2.820484 |
| T-Value | .904100 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 6, 32, C
Resting SBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 6 | 139.550000 |
| Mean of Var 32 | 128.850000 |
| Mean Difference | 10.700000 |
| Std. Err. of Difference | 5.202277 |
| T-Value | 2.056792 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 7, 33, C
Resting DBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 7 | 84.200000 |
| Mean of Var 33 | 84.750000 |
| Mean Difference | -0.550000 |
| Std. Err. of Difference | 4.088800 |
| T-Value | -0.134514 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 8, 34, C
Submaximal SBP    Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 8 | 161.900000 |
| Mean of Var 34 | 144.700000 |
| Mean Difference | 17.200000 |
| Std. Err. of Difference | 5.079681 |
| T-Value | 3.386039 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 9, 35, C
Submaximal DBP    Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 9 | 89.300000 |
| Mean of Var 35 | 87.450000 |
| Mean Difference | 1.850000 |
| Std. Err. of Difference | 2.308195 |
| T-Value | .801492 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 10, 36, C
Maximal SBP    Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 10 | 181.200000 |
| Mean of Var 36 | 188.100000 |
| Mean Difference | -6.900000 |
| Std. Err. of Difference | 6.187381 |
| T-Value | -1.115173 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 11, 37, C
Maximal DBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 11 | 87.100000 |
| Mean of Var 37 | 96.900000 |
| Mean Difference | -9.800000 |
| Std. Err. of Difference | 6.052229 |
| T-Value | -1.619238 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 12, 38, C
Recovery SBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 12 | 134.750000 |
| Mean of Var 38 | 134.350000 |
| Mean Difference | .400000 |
| Std. Err. of Difference | 3.452230 |
| T-Value | .115867 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 13, 39, C
Recovery DBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 13 | 81.900000 |
| Mean of Var 39 | 83.000000 |
| Mean Difference | -1.100000 |
| Std. Err. of Difference | 2.687104 |
| T-Value | -0.409363 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

SET, 40=2*6 Resting Pulse x SBP - Test 1
SET, 41=15*19 Resting Pulse x SBP - Test 2
SET, 42-28*32 Resting Pulse x SBP - Test 3
SET, 43=3*8 Submaximal Pulse x SBP - Test 1
SET, 44=16*21 Submaximal Pulse x SBP - Test 2
SET, 45=29*34 Submaximal Pulse x SBP - Test 3

PAIREDT, 40, 41, C
Resting Product Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 40 | 10981.400000 |
| Mean of Var 41 | 9419.100000 |
| Mean Difference | 1562.300000 |
| Std. Err. of Difference | 504.577187 |
| T-Value | 3.096256 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 41, 42, C
Resting Product Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 41 | 9419.100000 |
| Mean of Var 42 | 9624.400000 |
| Mean Difference | -205.300000 |
| Std. Err. of Difference | 476.048721 |
| T-Value | -0.431258 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 40, 42, C
Resting Product Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 40 | 10981.400000 |
| Mean of Var 42 | 9624.400000 |
| Mean Difference | 1357.000000 |
| Std. Err. of Difference | 663.264590 |
| T-Value | 2.045941 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 43, 44, C
Submaximal Product Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 43 | 17463.550000 |
| Mean of Var 44 | 14187.250000 |
| Mean Difference | 3276.300000 |
| Std. Err. of Difference | 775.380779 |
| T-Value | 4.225408 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 44, 45, C
Submaximal Product Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 44 | 14187.250000 |
| Mean of Var 45 | 14024.150000 |
| Mean Difference | 163.100000 |
| Std. Err. of Difference | 564.592214 |
| T-Value | .288881 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 43, 45, C
Submaximal Product Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 43 | 17463.550000 |
| Mean of Var 45 | 14024.150000 |
| Mean Difference | 3439.400000 |
| Std. Err. of Difference | 817.648150 |
| T-Value | 4.206455 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 31, 32, C
Maximal Product Test 1 - Test 2

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 31 | 27057.250000 |
| Mean of Var 32 | 27337.750000 |
| Mean Difference | -750.500000 |
| Std. Err. of Difference | 776.460326 |
| T-Value | -0.966541 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.096000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 31, 33, C
Maximal Product Test 1 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 31 | 27087.250000 |
| Mean of Var 33 | 28449.250000 |
| Mean Difference | -1362.000000 |
| Std. Err. of Difference | 1140.685586 |
| T-Value | -1.194019 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093000 |
| T-Table Value at (.99) | 2.861000 |

PAIREDT, 32, 33, C
Maximal Product Test 2 - Test 3

| | |
|---|---|
| Sample Size | 20 |
| Mean of Var 32 | 27837.750000 |
| Mean of Var 33 | 28449.250000 |
| Mean Difference | -611.500000 |
| Std. Err. of Difference | 907.993312 |
| T-Value | -0.673463 |
| Degrees of Freedom | 19 |
| T-Table Value at (.95) | 2.093800 |
| T-Table Value at (.99) | 2.551000 |

## Treadmill Sample

PAIREDT, 1, 14, C
Work Load Test 1 - Test 2

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 1 | 385.000000 |
| Mean of Var 14 | 530.312500 |
| Mean Difference | -145.312500 |
| Std. Err. of Difference | 33.199111 |
| T-Value | -4.377000 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 14, 27, C
Work Load Test 2 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 14 | 530.312500 |
| Mean of Var 27 | 534.937500 |
| Mean Difference | -4.625000 |
| Std. Err. of Difference | 32.631257 |
| T-Value | -0.141735 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 1, 27, C

Work Load — Test 1 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 1 | 385.000000 |
| Mean of Var 27 | 534.937500 |
| Mean Difference | -149.937500 |
| Std. Err. of Difference | 34.018925 |
| T-Value | -4.407473 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 2, 15, C

Resting Pulse — Test 1 - Test 2

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 2 | 76.937500 |
| Mean of Var 15 | 67.625000 |
| Mean Difference | 9.312500 |
| Std. Err. of Difference | 3.940938 |
| T-Value | 2.363016 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 3, 16, C

Submaximal Pulse — Test 1 - Test 2

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 3 | 118.187500 |
| Mean of Var 16 | 109.375000 |
| Mean Difference | 8.812500 |
| Std. Err. of Difference | 4.400018 |
| T-Value | 2.002833 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 4, 17, C

Maximal Pulse Test 1 - Test 2

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 4 | 159.812500 |
| Mean of Var 17 | 158.187500 |
| Mean Difference | 1.625000 |
| Std. Err. of Difference | 4.447729 |
| T-Value | .365355 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 5, 18, C

Recovery Pulse Test 1 - Test 2

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 5 | 99,062500 |
| Mean of Var 18 | 94.062500 |
| Mean Difference | 5.000000 |
| Std. Err. of Difference | 3.482097 |
| T-Value | 1.435916 |
| Degrees of Freedom | 15 |
| T-Table Valu at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 6, 19, C

Resting SBP Test 1 - Test 2

| | |
|---|---|
| Sample Size | |
| Mean of Var 6 | 125.312500 |
| Mean of Var 19 | 118.187500 |
| Mean Difference | 7.125000 |
| Std. Err. of Difference | 8.006703 |
| T-Value | .889879 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 7, 20, C

| Resting DBP | Test 1 - Test 2 |
|---|---|
| Sample Size | 16 |
| Mean of Var 7 | 86, 187500 |
| Mean of Var 20 | 79. 750000 |
| Mean Difference | 6, 437500 |
| Std. Err. of Difference | 5. 898424 |
| T-Value | 1. 091393 |
| Degrees of Freedom | 15 |
| T-Table Value at (. 95) | 2. 131000 |
| T-Table Value at (. 99) | 2. 947000 |

PAIREDT, 8, 21, C

| Submaximal SBP | Test 1 - Test 2 |
|---|---|
| Sample Size | 14 |
| Mean of Var 8 | 140. 812500 |
| Mean of Var 21 | 137. 312500 |
| Number of Missing Pairs | 2 |
| Mean Difference | 7. 571429 |
| Std. Err. of Difference | 4. 725096 |
| T-Value | 1. 602386 |
| Degrees of Freedom | 13 |
| T-Table Value at (. 95) | 2. 160000 |
| T-Table Value at (. 99) | 3. 012000 |

PAIREDT, 9, 22, C

| Submaximal DBP | Test 1 - Test 2 |
|---|---|
| Sample Size | 14 |
| Mean of Var 9 | 87. 928571 |
| Mean of Var 22 | 82. 714286 |
| Number of Missing Pairs | 2 |
| Mean Difference | 5. 214286 |
| Std. Err. of Difference | 3. 024040 |
| T-Value | 1. 724278 |
| Degrees of Freedom | 13 |
| T-Table Value at (. 95) | 2. 160000 |
| T-Table Value at (. 99) | 3. 012000 |

PAIREDT, 10, 23, C

| Maximal SBP | Test 1 - Test 2 |
|---|---|
| Sample Size | 14 |
| Mean of Var 10 | 167.214286 |
| Mean of Var 23 | 167.857143 |
| Number of Missing Pairs | 2 |
| Mean Difference | -0.642857 |
| Std. Err. of Difference | 4.901903 |
| T-Value | -0.131141 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 11, 24, C

| Maximal DBP | Test 1 - Test 2 |
|---|---|
| Sample Size | 14 |
| Mean of Var 11 | 87.142857 |
| Mean of Var 24 | 86.357143 |
| Number of Missing Pairs | 2 |
| Mean Difference | .785714 |
| Std. Err. of Difference | 2.785714 |
| T-Value | .282051 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 12, 25, C

| Recovery SBP | Test 1 - Test 2 |
|---|---|
| Sample Size | 16 |
| Mean of Var 12 | 136.687500 |
| Mean of Var 25 | 140.312500 |
| Mean Difference | -3.625000 |
| Std. Err. of Difference | 3.890025 |
| T-Value | -0.931871 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 13, 26, C
Recovery DBP Test 1 - Test 2

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 13 | 77.562500 |
| Mean of Var 26 | 78.062500 |
| Mean Difference | -0.500000 |
| Std. Err. of Difference | 3.567212 |
| T-Value | -0.140165 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 15, 23, C
Resting Pulse Test 2 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 15 | 67.625000 |
| Mean of Var 28 | 74.375000 |
| Mean Difference | -6.750000 |
| Std. Err. of Difference | 2.919047 |
| T-Value | -2.312399 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 16, 29, C
Submaximal Pulse Test 2 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 15 | 109.375000 |
| Mean of Var 29 | 105.500000 |
| Mean Difference | 3.875000 |
| Std. Err. of Difference | 3.305141 |
| T-Value | 1.172416 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 17, 30, C

| Maximal Pulse | Test 2 - Test 3 |
|---|---|
| Sample Size | 16 |
| Mean of Var 17 | 158.187500 |
| Mean of Var 30 | 162.875000 |
| Mean Difference | -4.687500 |
| Std. Err. of Difference | 2.610426 |
| T-Value | -1.795684 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 13, 31, C

| Recovery Pulse | Test 2 - Test 3 |
|---|---|
| Sample Size | 16 |
| Mean of Var 18 | 94.062500 |
| Mean of Var 31 | 90.187500 |
| Mean Difference | 3.875000 |
| Std. Err. of Difference | 6.793302 |
| T-Value | .570415 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 19, 32, C

| Resting SBP | Test 2 - Test 3 |
|---|---|
| Sample Size | 15 |
| Mean of Var 19 | 126.066667 |
| Mean of Var 32 | 129.466667 |
| Number of Missing Pairs | 1 |
| Mean Difference | -3.400000 |
| Std. Err. of Difference | 3.020249 |
| T-Value | -1.125735 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

PAIREDT, 20, 33, C
Resting DBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 15 |
| Mean of Var 20 | 85.066667 |
| Mean of Var 33 | 85.266667 |
| Number of Missing Pairs | 1 |
| Mean Difference | -0.200000 |
| Std. Err. of Difference | 2.703085 |
| T-Value | -0.073990 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

PAIREDT, 21, 34, C
Submaximal SBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 14 |
| Mean of Var 21 | 148.357143 |
| Mean of Var 34 | 156.071429 |
| Number of Missing Pairs | 2 |
| Mean Difference | -7.714286 |
| Std. Err. of Difference | 7.674296 |
| T-Value | -1.005211 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 22, 35, C
Submaximal DBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 14 |
| Mean of Var 22 | 84.142857 |
| Mean of Var 35 | 83.857143 |
| Number of Missing Pairs | 2 |
| Mean Difference | .285714 |
| Std. Err. of Difference | 3.356851 |
| T-Value | .085114 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 23, 36, C
Maximal SBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 15 |
| Mean of Var 23 | 166.000000 |
| Mean of Var 36 | 172.000000 |
| Number of Missing Pairs | 1 |
| Mean Difference | -6.000000 |
| Std. Err. of Difference | 7.367238 |
| T-Value | -0.814417 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

PAIREDT, 24, 37, C
Maximal DBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 15 |
| Mean of Var 24 | 84.600000 |
| Mean of Var 37 | 85.466667 |
| Number of Missing Pairs | 1 |
| Mean Difference | -0.866667 |
| Std. Err. of Difference | 3.853096 |
| T-Value | -0.224927 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

PAIREDT, 25, 38, C
Recovery SBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 25 | 140.312500 |
| Mean of Var 38 | 136.312500 |
| Mean Difference | 4.000000 |
| Std. Err. of Difference | 4.191261 |
| T-Value | .954367 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 25, 39, C
Recovery DBP Test 2 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 26 | 78.062500 |
| Mean of Var 39 | 75.312500 |
| Mean Difference | 2.750000 |
| Std. Err. of Difference | 3.174770 |
| T-Value | .866204 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 2, 28, C
Resting Pulse Test 1 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 2 | 76.937500 |
| Mean of Var 28 | 74.375000 |
| Mean Difference | 2.562500 |
| Std. Err. of Difference | 4.111943 |
| T-Value | .623185 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 3, 29, C
Submaximal Pulse Test 1 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 3 | 118.187500 |
| Mean of Var 29 | 105.500000 |
| Mean Difference | 12.687500 |
| Std. Err. of Difference | 2.487835 |
| T-Value | 5.099816 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 4, 30, C

| Maximal Pulse | Test 1 - Test 3 |
|---|---|
| Sample Size | 16 |
| Mean of Var 4 | 159.812500 |
| Mean of Var 30 | 162.875000 |
| Mean Difference | -3.062500 |
| Std. Err. of Difference | 4.681941 |
| T-Value | -0.654109 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 5, 31, C

| Recovery Pulse | Test 1 - Test 3 |
|---|---|
| Sample Size | 15 |
| Mean of Var 5 | 98.333333 |
| Mean of Var 31 | 96.200000 |
| Number of Missing Pairs | 1 |
| Mean Difference | 2.133333 |
| Std. Err. of Difference | 4.509109 |
| T-Value | .473118 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

PAIREDT, 6, 32, C

| Resting SBP | Test 1 - Test 3 |
|---|---|
| Sample Size | 16 |
| Mean of Var 6 | 125.312500 |
| Mean of Var 32 | 131.250000 |
| Mean Difference | -5.937500 |
| Std. Err. of Difference | 5.417155 |
| T-Value | -1.096055 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 7, 33, C
Resting DBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 7 | 86.187500 |
| Mean of Var 33 | 84.937500 |
| Mean Difference | 1.250000 |
| Std. Err. of Difference | 3.367120 |
| T-Value | .371237 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 8, 34, C
Submaximal SBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 14 |
| Mean of Var 8 | 150.928571 |
| Mean of Var 34 | 154.928571 |
| Number of Missing Pairs | 2 |
| Mean Difference | -4.000000 |
| Std. Err. of Difference | 6.125967 |
| T-Value | -0.652958 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 9, 35, C
Submaximal DBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 14 |
| Mean of Var 9 | 88.642857 |
| Mean of Var 35 | 83.857143 |
| Number of Missing Pairs | 2 |
| Mean Difference | 4.785714 |
| Std. Err. of Difference | 2.027770 |
| T-Value | 2.360087 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 10, 36, C
Maximal SBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 10 | 156.937500 |
| Mean of Var 36 | 171.875000 |
| Mean Difference | -14.937500 |
| Std. Err. of Difference | 12.891040 |
| T-Value | -1.158751 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 11, 37, C
Maximal DBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 11 | 83.125000 |
| Mean of Var 37 | 86.375000 |
| Mean Difference | -3.250000 |
| Std. Err. of Difference | 6.096105 |
| T-Value | -0.533127 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 12, 38, C
Resting SBP Test 1 - Test 3

| | |
|---|---|
| Sample Size | 16 |
| Mean of Var 12 | 136.687500 |
| Mean of Var 38 | 136.312500 |
| Mean Difference | .375000 |
| Std. Err. of Difference | 4.949642 |
| T-Value | .075763 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 13, 39, C

| Resting DBP | Test 1 - Test 3 |
|---|---|
| Sample Size | 16 |
| Mean of Var 13 | 77.562500 |
| Mean of Var 39 | 75.312500 |
| Mean Difference | 2.250000 |
| Std. Err. of Difference | 3.566628 |
| T-Value | .630848 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

SET, 40=2*6 Resting Pulse x SBP - Test 1
SET, 41=15*19 Resting Pulse x SBP - Test 2
SET, 42=28*32 Resting Pulse x SBP - Test 3
SET, 43=3*8 Submaximal Pulse x SBP - Test 1
SET, 44=16*21 Submaximal Pulse x SBP - Test 2
SET, 45=29*34 Submaximal Pulse x SBP - Test 3

PAIREDT, 40, 41

| Resting Product | Test 1 - Test 2 |
|---|---|
| Sample Size | 15 |
| Mean of Var 40 | 9884.066667 |
| Mean of Var 41 | 8473.933333 |
| Number of Missing Pairs | 1 |
| Mean Difference | 1410.133333 |
| Std. Err. of Difference | 694.110372 |
| T-Value | 2.031569 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

PAIREDT, 41, 42

| Resting Product | Test 2 - Test 3 |
|---|---|
| Sample Size | 15 |
| Mean of Var 41 | 8473.933333 |
| Mean of Var 42 | 9594.066667 |
| Number of Missing Pairs | 1 |
| Mean Difference | -1120.133333 |
| Std. Err. of Difference | 465.212720 |
| T-Value | -2.407787 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

PAIREDT, 40, 42

| Resting Product | Test 1 - Test 3 |
|---|---|
| Sample Size | 16 |
| Mean of Var 40 | 9745.562500 |
| Mean of Var 42 | 9814.062500 |
| Mean Difference | -68.500000 |
| Std. Err. of Difference | 819.513143 |
| T-Value | -0.083586 |
| Degrees of Freedom | 15 |
| T-Table Value at (.95) | 2.131000 |
| T-Table Value at (.99) | 2.947000 |

PAIREDT, 43, 44

| Submax. Product | Test 1 - Test 2 |
|---|---|
| Sample Size | 14 |
| Mean of Var 43 | 17932.285714 |
| Mean of Var 44 | 15785.928571 |
| Number of Missing Pairs | 2 |
| Mean Difference | 2146.357143 |
| Std. Err. of Difference | 1181.879215 |
| T-Value | 1.816055 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 44, 45
Submax. Product Test 2 - Test 3

| | |
|---|---|
| Sample Size | 14 |
| Mean of Var 44 | 16557.357143 |
| Mean of Var 45 | 16489.142857 |
| Number of Missing Pairs | 2 |
| Mean Difference | 68.214286 |
| Std. Err. of Difference | 1233.522465 |
| T-Value | .055300 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 43, 45
Submax. Product Test 2 - Test 3

| | |
|---|---|
| Sample Size | 14 |
| Mean of Var 43 | 17694.428571 |
| Mean of Var 45 | 16249.142857 |
| Number of Missing Pairs | 2 |
| Mean Difference | 1445.285714 |
| Std. Err. of Difference | 723.522719 |
| T-Value | 1.997568 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

MAXIMAL PULSE x SBP

PAIREDT, 31, 32
Maximal Product Test 1 - Test 2

| | |
|---|---|
| Sample Size | 14 |
| Mean of Var 31 | 27682.642857 |
| Mean of Var 32 | 26716.785714 |
| Number of Missing Pairs | 2 |
| Mean Difference | 965.857143 |
| Std. Err. of Difference | 1070.645727 |
| T-Value | .902126 |
| Degrees of Freedom | 13 |
| T-Table Value at (.95) | 2.160000 |
| T-Table Value at (.99) | 3.012000 |

PAIREDT, 31, 33, C
Maximal Product Test 1 - Test 3

| | |
|---|---|
| Sample Size | 15 |
| Mean of Var 31 | 27310.466667 |
| Mean of Var 33 | 28350.266667 |
| Number of Missing Pairs | 1 |
| Mean Difference | -1039.800000 |
| Std. Err. of Difference | 1601.629962 |
| T-Value | -0.649214 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

PAIREDT, 32, 33, C
Maximal Product Test 2 - Test 3

| | |
|---|---|
| Sample Size | 15 |
| Mean of Var 32 | 26289.000000 |
| Mean of Var 33 | 28058.933333 |
| Number of Missing Pairs | 1 |
| Mean Difference | -1769.933333 |
| Std. Err. of Difference | 1385.396950 |
| T-Value | -1.277564 |
| Degrees of Freedom | 14 |
| T-Table Value at (.95) | 2.145000 |
| T-Table Value at (.99) | 2.977000 |

Difference in Improvement of Work Load of M.I. Subjects vs Non-M.I. Subjects After One Year of Exercise Training

| PAIREDT, 8, 10, C | Ergometer |
|---|---|
| Sample Size | 8 |
| Mean of Var 8 | -1497.500000 |
| Mean of Var 10 | -1537.500000 |
| Number of Missing Pairs | 4 |
| Mean Difference | 40.000000 |
| Std. Err. of Difference | 722.095166 |
| T-Value | .055394 |
| Degrees of Freedom | 7 |
| T-Table Value at (.95) | 2.365000 |
| T-Table Value at (.99) | 3.499000 |

| PAIREDT, 18, 20, C | Treadmill |
|---|---|
| Sample Size | 5 |
| Mean of Var 18 | -103.800000 |
| Mean of Var 20 | -194.000000 |
| Number of Missing Pairs | 6 |
| Mean Difference | 90.200000 |
| Std. Err. of Difference | 101.101632 |
| T-Value | .892172 |
| Degrees of Freedom | 4 |
| T-Table Value at (.95) | 2.776000 |
| T-Table Value at (.99) | 4.604000 |

Ergometer Sample Correlation of
HR x SBP with Work Load

SET 31=4*10
SET 32=14*20
SET 33=24*30

LIST, 31

| | | | | |
|---|---|---|---|---|
| (31 | , | 1) | = | 30600.00000 |
| (31 | , | 2) | = | 33220.00000 |
| (31 | , | 3) | = | 21600.00000 |
| (31 | , | 4) | = | 26085.00000 |
| (31 | , | 5) | = | 27200.00000 |
| (31 | , | 6) | = | 36120.00000 |
| (31 | , | 7) | = | 20640.00000 |
| (31 | , | 8) | = | 34850.00000 |
| (31 | , | 9) | = | 28000.00000 |
| (31 | , | 10) | = | 35000.00000 |
| (31 | , | 11) | = | 20800.00000 |
| (31 | , | 12) | = | 23100.00000 |
| (31 | , | 13) | = | 32000.00000 |
| (31 | , | 14) | = | 34080.00000 |
| (31 | , | 15) | = | 23200.00000 |
| (31 | , | 16) | = | 21420.00000 |
| (31 | , | 17) | = | 34000.00000 |
| (31 | , | 18) | = | 23290.00000 |
| (31 | , | 19) | = | 15840.00000 |
| (31 | , | 20) | = | 20700.00000 |

LIST, 32

| | | | | |
|---|---|---|---|---|
| (32 | , | 1) | = | 36120.00000 |
| (32 | , | 2) | = | 31680.00000 |
| (32 | , | 3) | = | 26600.00000 |
| (32 | , | 4) | = | 29140.00000 |
| (32 | , | 5) | = | 28000.00000 |
| (32 | , | 6) | = | 34000.00000 |
| (32 | , | 7) | = | 25200.00000 |
| (32 | , | 8) | = | 29200.00000 |
| (32 | , | 9) | = | 29340.00000 |
| (32 | , | 10) | = | 40500.00000 |
| (32 | , | 11) | = | 22410.00000 |
| (32 | , | 12) | = | 24500.00000 |
| (32 | , | 13) | = | 26400.00000 |
| (32 | , | 14) | = | 32200.00000 |

| | | | | |
|---|---|---|---|---|
| (32 | , | 15) | = | 23200.00000 |
| (32 | , | 16) | = | 19775.00000 |
| (32 | , | 17) | = | 30600.00000 |
| (32 | , | 18) | = | 23750.00000 |
| (32 | , | 19) | = | 19140.00000 |
| (32 | , | 20) | = | 25000.00000 |

LIST, 33

| | | | | |
|---|---|---|---|---|
| (33 | , | 1) | = | 32760.00000 |
| (33 | , | 2) | = | 27550.00000 |
| (33 | , | 3) | = | 26100.00000 |
| (33 | , | 4) | = | 35700.00000 |
| (33 | , | 5) | = | 29700.00000 |
| (33 | , | 6) | = | 35800.00000 |
| (33 | , | 7) | = | 27000.00000 |
| (33 | , | 8) | = | 36340.00000 |
| (33 | , | 9) | = | 33000.00000 |
| (33 | , | 10) | = | 38400.00000 |
| (33 | , | 11) | = | 20000.00000 |
| (33 | , | 12) | = | 25085.00000 |
| (33 | , | 13) | = | 16200.00000 |
| (33 | , | 14) | = | 36250.00000 |
| (33 | , | 15) | = | 27200.00000 |
| (33 | , | 16) | = | 20250.00000 |
| (33 | , | 17) | = | 35700.00000 |
| (33 | , | 18) | = | 23800.00000 |
| (33 | , | 19) | = | 17850.00000 |
| (33 | , | 20) | = | 24300.00000 |

CORRELATION, 1, 31

1 , 31 = 0.464787060

CORRELATION, 11, 32

11 , 32 = 0.276331103

CORRELATION, 21, 33

21 , 33 = 0.648840797

Treadmill Sample Correlation of
HR x SBP with Work Load

```
SET 31=4*10
SET 32=14*20
SET 33=24*30

LIST, 31
(31    ,   1)  =  27200.00000
(31    ,   2)  =  20862.00000
(31    ,   3)  =  48000.00000
(31    ,   4)  =  20300.00000
(31    ,   5)  =  20300.00000
(31    ,   6)  =  27200.00000
(31    ,   7)  =  32040.00000
(31    ,   8)  =  25500.00000
(31    ,   9)  =  32025.00000
(31    ,  10)  =  30600.00000
(31    ,  11)  =  22100.00000
(31    ,  12)  =  17520.00000
(31    ,  13)  =  24800.00000
(31    ,  14)  =  35400.00000
(31    ,  15)  =  0.000000000
(31    ,  16)  =  25810.00000

LIST, 32
(32    ,   1)  =  26250.00000
(32    ,   2)  =  22500.00000
(32    ,   3)  =  38850.00000
(32    ,   4)  =  23250.00000
(32    ,   5)  =  18200.00000
(32    ,   6)  =  25600.00000
(32    ,   7)  =  31000.00000
(32    ,   8)  =  27200.00000
(32    ,   9)  =  33480.00000
(32    ,  10)  =  34000.00000
(32    ,  11)  =  0.000000000
(32    ,  12)  =  21600.00000
(32    ,  13)  =  21780.00000
(32    ,  14)  =  27125.00000
(32    ,  15)  =  20300.00000
(32    ,  16)  =  23200.00000
```

```
LIST, 33
(33          ,      1)  =  29750.00000
(33          ,      2)  =  30600.00000
(33          ,      3)  =  36100.00000
(33          ,      4)  =  23104.00000
(33          ,      5)  =  18200.00000
(33          ,      6)  =  28880.00000
(33          ,      7)  =  32600.00000
(33          ,      8)  =  32300.00000
(33          ,      9)  =  25200.00000
(33          ,     10)  =  31648.00000
(33          ,     11)  =  29750.00000
(33          ,     12)  =  18270.00000
(33          ,     13)  =  19320.00000
(33          ,     14)  =  33280.00000
(33          ,     15)  =  25380.00000
(33          ,     16)  =  36252.00000

CORRELATION, 1, 31
 1           , 31       =  0.650350876

CORRELATION, 11, 32
 11          , 32       =  0.363859918

CORRELATION, 21, 33
 21          , 33       =  0.666429170
```

# APPENDIX C

## Reasons for Terminating Stress Tests

Reasons for Terminating Ergometer Stress Tests and the Work Load Achieved
(N=8 Subjects have not experienced a myocardial infarction)

| Pt. Number | Test 1 | | Test 2 | | Test 3 | | Age |
|---|---|---|---|---|---|---|---|
| | Reasons for stopping test | Work accomplished cum. KPM | Reasons for stopping test | Work accomplished cum. KPM | Reasons for stopping test | Work accomplished cum. KPM | |
| 1 | b, e, j | 3600 | b, e, j | 3600 | b, e, j | 2100 | 48 |
| 4 | e, f | 4300 | e | 6000 | f | 7800 | 60 |
| 9 | d, e | 3600 | d, e, j | 4500 | d, j | 6100 | 57 |
| 10 | b, d, e | 1950 | b, e | 3450 | e | 3450 | 68 |
| 11 | e, j | 4500 | b, j | 5400 | e, j | 7200 | 51 |
| 15 | e, j | 3600 | d, e | 2700 | e | 4500 | 59 |
| 17 | e | 3600 | e | 4500 | e, j | 3600 | 53 |
| 19 | b, e | 2700 | b, e, j | 2700 | b, e | 5400 | 50 |

a = Abnormal B/P changes
b = Angina
c = Anxiety
d = Dyspnea
e = Leg Weakness
f = General fatigue
g = Nausea
h = Faintness
i = Dizzyness
j = ECG changes (ST Depression, arrhythmias)

Reasons for Terminating Treadmill Stress Tests and the Work Load Achieved
(N=5 Subjects have not experienced a myocardial infarction)

| Pt. Number | Test 1 | | Test 2 | | Test 3 | | Age |
|---|---|---|---|---|---|---|---|
| | Reasons for stopping test | Work accomplished | Reasons for stopping test | Work accomplished | Reasons for stopping test | Work accomplished | |
| | | total secs. | | total secs. | | total secs. | |
| 21 | e, f, h, i | 210 | e | 390 | f | 405 | 62 |
| 26 | b, e, j | 390 | b | 360 | b, d, e | 400 | 47 |
| 29 | j | 250 | f, j | 710 | d | 590 | 55 |
| 34 | a | 190 | d | 420 | e | 615 | 49 |
| 27 | f, e | 435 | f | 495 | f | 435 | 58 |

a = Abnormal B/P changes
b = Angina
c = Anxiety
d = Dyspnea
e = Leg Weakness
f = General fatigue
i = Dizzyness
j = ECG changes (ST depression, arrhythmias)

Reasons for Terminating Ergometer Stress Tests and the Work Load Achieved
(N=12 Subjects are post myocardial infarction)

| Pt. Number | Test 1 | | Test 2 | | Test 3 | | Age |
|---|---|---|---|---|---|---|---|
| | Reasons for stopping test | Work accomplished cum. KPM | Reasons for stopping test | Work accomplished cum. KPM | Reasons for stopping test | Work accomplished cum. KPM | |
| 2 | e | 2500 | e | 3150 | e | 2700 | 53 |
| 3 | d, e | 2800 | e | 3600 | f | 3600 | 58 |
| 5 | e | 3150 | e | 4050 | f | 5400 | 61 |
| 6 | b, e | 4500 | e | 7200 | b, f | 7800 | 50 |
| 7 | e, f | 3600 | e | 4500 | f | 4730 | 52 |
| 8 | d, e, f, j | 5400 | d, e, f, j | 5400 | d, e, f, j | 9000 | 41 |
| 12 | b | 1200 | b, d, e, f | 1500 | d, e | 1200 | 60 |
| 13 | e | 4500 | e | 4200 | e, f | 4950 | 54 |
| 14 | e | 7800 | d, e | 5400 | e | 9000 | 42 |
| 16 | e | 3600 | d, e | 2700 | e | 4500 | 59 |
| 18 | b | 900 | b, j | 2100 | b, j | 2100 | 38 |
| 20 | e, f, j | 3600 | d, e, j | 3900 | d, e, j | 5400 | 43 |

a = Abnormal B/P changes
b = Angina
c = Anxiety
d = Dyspnea
e = Leg weakness
f = General fatigue
g = Nausea
h = Faintness
i = Dizzyness
j = ECG changes (ST depression, arrhythmias)

Reasons for Terminating Treadmill Stress Tests and the Work Load Achieved
(N=11 Subjects are post myocardial infarction)

| Pt. Number | Test 1 | | Test 2 | | Test 3 | | Age |
|---|---|---|---|---|---|---|---|
| | Reasons for stopping test | Work accomplished total secs. | Reasons for stopping test | Work accomplished total secs. | Reasons for stopping test total secs. | Work accomplished | |
| 22 | e, j | 470 | e, j | 600 | d, e, j | 615 | 54 |
| 23 | d, e | 445 | e | 470 | d, e | 540 | 46 |
| 24 | d, e, f | 600 | e | 640 | a | 744 | 39 |
| 25 | e | 485 | e | 540 | e | 600 | 64 |
| 28 | b, j | 220 | b, d, j | 240 | b, e, j | 240 | 54 |
| 30 | e | 470 | e | 570 | e | 597 | 40 |
| 31 | e | 460 | f | 570 | d | 540 | 50 |
| 32 | b, e | 360 | f | 600 | f | 658 | 32 |
| 33 | b | 405 | b, d, e | 500 | a, d | 590 | 47 |
| 35 | e, j | 510 | c, e, j | 540 | e, j | 595 | 47 |
| 36 | e | 260 | d, e | 480 | e | 575 | 68 |

a = Abnormal B/P changes
b = Angina
c = Anxiety
D = Dyspnea

e = Leg weakness
f = General fatigue
g = Nausea
h = Faintness

i = Dizzyness
j = ECG changes (ST depression arrhythmias)

AN ABSTRACT OF THE FIELD STUDY OF

DORIS BROWNLOW

For the Master of Nursing

Date of Receiving this Degree: June 13, 1975

Title: Exercise Training: One Aspect of the Rehabilitation of Persons with Coronary Heart Disease

Approved: ______________________________

Barbara Gaines, Associate Professor
Field Study Advisor

A descriptive study was undertaken to compare physiological measurements made prior to initiating a prescribed exercise program with those made at three months and one year after participation in a community rehabilitation program. The data were collected during exercise stress tests conducted either on a bicycle ergometer or a treadmill. Hypotheses of no difference were statistically tested using the Paired t Test. Computations were performed using version 4 of the Statistical Interactive Programming System (SIPS). The 36 subjects who comprised the sample of the study represented members of four chapters of the CAPRI program. All had cardiovascular disease; 23 had experienced a myocardial infarction, 11 had debilitating angina, and 2 were hypertensive. Because of the many variables inherent in each subject, generalizations could not be drawn from the findings. However, a movement toward physical fitness was encouraging. The

role of community programs was demonstrated. It appeared that they provided an opportunity for the professional nurse to utilize and expand her role.