PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF A CARDIAC REHABILITATION EXERCISE TRAINING PROGRAM

by

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CHAPTER I

INTRODUCTION

Physical exercise, as an adjunct to good physical health, has been accepted in principle throughout history. Most individuals acknowledge that by maintaining habitual physical activity patterns, they experience an increased level of physical stamina and vigor, in addition to having enhanced feelings of well being.

Before 1950 physical exercise (although always considered appropriate for healthy individuals) was considered dangerous for persons suffering from coronary heart disease (CHD). After 1950 studies began to reveal that early activity patterns for the myocardial infarction patient lessened complications of the disease and reduced mortality rates. At this time several epidemiological studies reported a positive association between habitual physical activity and a decreased incidence of CHD.

As the rate of mortality and morbidity from CHD continued to dramatically rise in the western world over the past 25 years, a plethora of field and experimental studies emerged, exploring the relationship between physical activity and CHD. During this same period secondary prevention rehabilitation programs, involving exercise as a therapeutic agent in CHD, slowly began to evolve (Zohman and Tobis, 1970).

Other aspects of exercise which were studied after the advent of cardiac catheterization and other refined hemodynamic techniques, produced valuable information regarding three facets of exercise: (1) the application of exercise testing in evaluating and assessing exertion responses, (2) the training effects of exercise, and (3) the hemodynamics

of exercise. Because of this research the physiological effects of exercise training are now fairly well recognized and understood. Far less is known regarding the psychological effects of exercise (in persons with CHD). Two common psychological problems in persons suffering with CHD are depression and anxiety (Hackett and Cassem, 1973). The use of exercise training as a tool in improving both physiological and psychological parameters is the focus of this investigation.

Review of the Literature

Historical:

Historically physical exercise has been widely accepted as a basic premise for good health. As early as the time of Plato the effects of exercise were noted in the archives of history. In the Dialogues of Plato, Timaeus tells Socrates, "moderate exercise reduces to order, according to their affinities, the particles and affections which are wandering about the body" (Fox and Skinner, 1964).

Early in American history, exercise attained popularity as an adjunct to good physical health. Thomas Jefferson, in 1785, wrote to his nephew: "Walking is the best possible exercise. Habituate yourself to walk fast without fatigue" (Alexander, 1959).

Paul Dudley White, a noted cardiologist, felt that our ancestors were in better physical health because of their lives spent in active physical labor. In bidding farewell to friends or acquaintances he would always say "take it hard" rather than "take it easy" (White, 1969).

The historical development of exercise for the patient with CHD began in 1944 when Levine first described the harmful effects of recumbency in the treatment of heart disease. By advocating frequent position changes, the use of a comfortable chair at the bedside, and deep breathing

exercises, Levine (1951) was able to demonstrate that early mobilization of the patient with a myocardial infarction reduced mortality rates and lessened complications.

Epidemiological Studies:

At the same time that early mobilization was being advocated for the myocardial infarction patient, investigators were beginning a series of field studies relating exercise to the incidence of CHD. The first persuasive evidence showing a statistically significant relationship between physical activity and CHD was presented by Morris, Heady, Raffle, Roberts and Park (1953). In studying the conductors and drivers of the London Transportation System, Morris and his colleagues found that among 31,000 transportation workers, the prevalence of CHD was lower in the more physically active conductors than in the sedentary drivers. These results showed an association of fewer cases of CHD with more physical activity, not necessarily a cause and effect relationship. The relative psychic stresses of driving and ticket collection were not assessed in this study and questions remain as to whether the two groups of workers differed in prior coronary symptoms, prevalence of hypertension, smoking and eating habits, or other qualities in addition to physical activity that might account for the observed results.

In a subsequent study, Morris, Heady, and Raffle (1954) did further work comparing London postmen with the less active postal clerks. The results indicated that the incidence of CHD was lower among the postmen than among their more sedentary colleagues, confirming the results of the 1953 study, but still not accounting for factors of personal and system selection.

Interestingly, Morris published a paper in 1958 entitled "The

Epidemiology of Uniforms", in which he documented the fact that drivers in the London Transportation System had greater girth than did the conductors. A still later study by Morris, Kagan, Pattison, and Raffle (1958) reported that the drivers also had a higher serum cholesterol level and blood pressure than did the conductors, which further increased the risk of CHD (for other reasons than different levels of physical activity).

A similar study on American railway employees was conducted by Taylor, Klepetar, Keys, Parlin, Blackborn, and Puchner (1962). Taylor and his colleagues found that the age-adjusted deaths (per 100 subject years) for CHD were 5.7, 3.9, and 2.8 for clerks, switchmen, and section men, respectively. These data supported those of Morris and associates since the clerk jobs were sedentary, the switchmen moderately active, and the section men has a job that requires heavy labor. Taylor did point out that the occupational mobility of the switchmen with CHD was greater than that of the clerks, thus confounding the results with some bias.

A well known extensive prospective study done in Framingham, Massachusetts by Kannel (1967) assessed the physical activity of 5127 men and women, using a 24-hour history of usual physical activity plus a number of objective physiological measurements. The risk magnitude associated with each classification of physical activity was estimated by observing the subsequent rate of development of initial coronary events in each population parameter. When three possible objective indicators of physical activity were used (weight gain, vital capacity, and resting pulse rate), individuals showing adverse values for two or more of the indicators had a five-fold greater mortality rate from CHD

than those with no adverse traits and were physically active. Kannel felt that other explanations were possible but he insisted that all the parameters used had a relationship to the level of habitual activity.

In addition to the studies mentioned above, a large number of other epidemiological studies relating to the alleged association between CHD and physical activity have been reported in the literature. For a complete review of these studies the reader is directed to an analysis compiled by Froelicher and Oberman (1972).

Animal Experiments:

At the same time that the above mentioned field studies were being conducted, more highly controlled studies were being done in the laboratory. Eckstein (1957) studied the effects of exercise and coronary artery narrowing on collateral circulation in dogs. Various degrees of narrowing in the circumflex coronary artery were surgically produced in 117 dogs. This simulated the process of atherosclerosis in coronary arteries. After the dogs with constricted arteries were exercised, there was an increase in the capacity of coronary blood flow, thus signifying increased collateral circulation. Kaplinsky (1968) did not detect any increase in coronary circulation in dogs with exercise training, however this may have been related to his technique of complete ligation of a large coronary vessel.

Data produced in animal experiments indicated that regular exercise stimulated growth of the coronary vascular tree in rats (Stevenson, 1964). An interesting extension of Stevenson's work concerned the effect of intensity and frequency of exercise upon the increase in coronary vessel size. This investigator found that moderate exercise (2 hours per day and 3 days per week) was more beneficial than severe exercise

(4 hours per day and 4 days per week) (Stevenson, 1965).

Exercise Training Programs:

These findings and others provided a beginning point for physical training programs for the coronary patient. During the past decade numerous investigators have described the benefits of exercise programs for victims of CHD. One of the studies, dealing with the largest number of patients enrolled in an exercise training program, was reported by Gottheimer (1968) in Israel. He reported a 5 year follow-up program, from 1959 to 1964, on 1,103 male patients with CHD. This exercised group had a mortality rate of 3.6 percent compared to 12 percent for a comparable nonexercised group of post infarction patients.

In the United States, Hellerstein (1968) engaged in a 6 year feasibility study to determine whether an enhanced physical activity program would retard the effects of atherosclerosis, particularly reduced morbidity; and whether activity would modify thrombotic incidence in subjects who were highly rated as coronary prone. The study design was comprehensive with emphasis placed upon enhancement of physical fitness. The study population consisted of 656 middle aged men, of whom 402 were normal coronary prone subjects with an average age of 45 years. The remaining 254 subjects had CHD and their average age was 49 years. A detailed physical examination with extensive laboratory data, plus an exercise tolerance test was performed on each subject prior to initiating physical training. Psychological testing done in this same study will be discussed in a later section of this study.

After receiving an individualized exercise prescription each subject attended an exercise class 3 times a week. Monthly examinations determined whether the subject could progress to an increased level of activity.

At 6 month intervals all subjects were completely re-examined including physiological and psychological parameters.

Over a 7 year period of time, 11 subjects with coronary artery disease died (death rate of 2 per 100 subject years) compared to a death rate of 5 per 100 subject years in the matched group of conventionally treated subjects. As in the Gottheimer (1968) study, there was a selection of a healthier patient group because of patient drop out rate in the exercise program. It is also important to note that other risk factors, such as smoking and weight, were modified during this study.

Other studies of physical rehabilitation programs for persons with CHD described results of reduced mortality and morbidity rates that appeared to be inconclusive and contradictory (Sanne, 1973; Kellerman, 1972). Unfortunately, all of these studies had improper controls. The participants were all volunteers, and there was the loss of higher risk patients who were unable to stay in an exercise program.

Although it appears that there is no conclusive evidence to support the use of exercise training in reducing mortality and morbidity from CHD, there are other important modalities of exercise that have contributed to a better understanding and treatment of this disease process. They are exercise testing, and exercise training. These useful functions of exercise will be discussed in detail in the following section.

Exercise Testing:

A useful function of exercise is exercise testing, a method of applying controlled stress to the heart. Objective information is provided in the diagnosis of ischemic heart disease, underlying causes of cardiac symptoms (angina, arrhythmias, abnormal blood pressure rise), and as a measurement of functional capacity for work, recreation, or participation

in a rehabilitation program (American Heart Committee on Exercise, 1975).

Basically there are three methods of exercise testing, the step test, bicycle or arm cranking ergometers, and the multistage treadmill (Bruce, 1973). As early as 1929, Master and Oppenheimer reported the use of the step test to evaluate subjects with CHD. Although it is not the optimal procedure for assessing physical fitness, it is an established one for detecting myocardial ischemia and may be expected to disclose myocardial ischemia in 2 to 3 percent of asymptomatic middle age males (Master and Rosenfeld, 1961). The bicycle ergometer has the advantage of being relatively inexpensive and occupies little space. However, most Americans, not accustomed to bicycle riding, fatigue quickly at low work loads (Naughton and Haider, 1973). The multi-stage treadmill test has the advantage of being a familiar type of exercise (walking or jogging) and involuntarily controls the rate of energy expenditure. The Committee on Exercise of the American Heart Association (1975) agree that the multi-stage treadmill exercise test is the most informative and reliable method of exercise testing.

Exercise tolerance tests are described as submaximal or maximal. The submaximal tests always have some arbitrary predetermined ending point, usually a heart rate that is 85 percent of a maximum age-related heart rate, while the maximal test has no arbitrary end point other than the determined limits of maximal exertion for the person being tested (Bruce, 1973). The Committee on Exercise for the American Heart Association (1975) further define maximal testing in physiological terms as "that level of intensity beyond which further increases in the magnitude of work will not be accompanied by increased oxygen uptake; the

individual has attained his maximal oxygen uptake ($\dot{V}_{O_2}M$)", (p. 18). The Committee further explained that when maximal limit is reached, physiological measurements of intensity and duration of effort, heart rate, and blood pressure are recorded defining maximum limits for that person. Doan, Peterson, Blackmon, and Bruce (1968) pointed out that maximal testing reveals myocardial ischemia in about 8 to 12% of an asymptomatic middle-aged population.

The normal physiological responses to a multi-stage exercise tolerance test include an increase in systolic blood pressure as the work load increases. The blood pressure is affected by changes due to aging and the state of physical fitness and health. Persons with cardiac disease or sedentary persons may be unable to generate an adequate blood pressure rise during effort (Fox, 1973). The heart rate also increases during exercise testing in response to level of work load. The extent of this response relates to age, health, degree of physical fitness, and environmental factors. The attainable maximum heart rate decreases with age, whereas the maximum systolic blood pressure usually increases with age (Bruce, 1973).

For a comprehensive description of exercise testing and its interpretation the reader is directed to the handbook published by the American Heart Association (1975) and the report from the Arlie Conference edited by Naughton and Hellerstein (1973).

Training Effect of Exercise:

Another useful function of exercise is the training effect. Cardiac training is the development of increased efficiency of aerobic metabolism through endurance type exercises (Phillips, 1973). Endurance or isotonic type exercises are dynamic and rhythmic, during which muscles change their

length. Walking, jogging, bicycling, and swimming are all examples of aerobic exercises (Cooper, 1968). Isotonic exercises produce increased flexibility and endurance as opposed to isometric exercises, in which muscle contractions are characterized by no motion, just a change in tension. Because isometric exercises dramatically raise pulse rates and blood pressure, and block venous return, persons with CHD are advised not to use them (Douglas, 1975).

The slower resting pulse, which is directed through the vagus nerve complex (Astrand, 1970) is a prominent indicator of physical fitness. With increased work loads the pulse rate of the trained person is usually lower than the untrained person at each level of work. Zohman (1970) noted that a higher work load is required for the trained person, compared to the untrained, to reach a maximum leveling off point at the pulse rate.

Lower resting systolic and diastolic blood pressure measurement are another benefit of cardiovascular training. Boyer and Kasch reported a study done in 1970 in which 23 hypertensive men lowered their systolic and diastolic blood pressure measurements by 12 and 13 mm Hg. respectively, following a 6 month exercise training program.

Another training effect of exercise relates to the stroke volume (SV) of the heart. In a physically well conditioned person the SV tends to increase with higher work loads up to maximum effort while the sedentary person tends to have a leveling off of stroke volume at a relatively low intensity level of work (Sanne, 1973). The SV and the pulse rate (PR) determine the cardiac output (CO). In a trained individual doing maximal work, the increase in CO may be 5 or 6 times, compared to only 3 or 4 times in the untrained person (Zohman, 1970). At a given submaximal work level the blood flow to exercising muscle is less for the trained

person because there is an increased efficiency of trained muscle to extract O_2 from blood (Astrand, 1970).

Cardiovascular exercise training therefore signifies that for a given work load the physically fit person can perform a given task with a lower pulse rate and systolic blood pressure which is achieved primarily through the development of a more efficient aerobic metabolism. This increased work capacity is especially important to people with CHD because of physical limitations resulting from their disease process.

The Hemodynamics of Exercise:

An interesting aspect of exercise relates to the hemodynamic effects of exercise. Hemodynamic studies give information regarding changes in cardiac function, also changes and efficiency in the peripheral circulation. Because these studies help to explain the cardiovascular response to physical conditioning, they have provided the necessary knowledge base for both exercise testing and exercise training.

It was only after the advent of cardiac catheterization and other refined techniques that hemodynamic studies could properly evaluate physical conditioning. Evaluation techniques include arterial and venous catheterization during exercise testing, the Douglas bag technique for collection of expired air, accurate oxygen uptake, and the Frick dye dilution technique for estimation of cardiac output (Frick, 1968).

There are comparatively few studies that adequately evaluate the hemodynamic effects of physical training. A review of these studies was presented by Froelicher (1973) at the Arlie Conference. Froelicher concluded that increases in work capacity result from both changes in cardiac function and increased efficiency of oxygen extraction in the peripherial circulation. However in some patients with CHD the peripheral

changes are greater than the increase in cardiac function. Froelicher also concluded that although myocardial oxygen consumption may not be changed by exercise training, the most important result was the training bradycardia which allows a longer myocardial perfusion time by increasing the diastolic time during the cardiac cycle.

This section of the review of literature has covered the historical aspect of exercise, its relationship to CHD, the controversial issue of exercise lowering mortality and morbidity rates from CHD, and the use of exercise as a testing and training modality. Because of inadequate study designs, no solid evidence exists linking exercise to decreased mortality and morbidity rates. However, the positive physiological effects of exercise have been well documented with the advent of sophisticated hemodynamic studies. Exercise testing is now a valuable evaluation tool for CHD. Exercise training produces beneficial physiological effects that increase the work capacity of persons with CHD. The following section will discuss in detail the psychological effects of exercise.

The Psychological Effects of Exercise:

Equally as important as the physiological effects of exercise for persons with CHD are the psychological effects. Because it is now well recognized that the emotional aspect of coronary disease is as severe as the physical manifestations of the disease process itself, wide impetus has been directed toward the approach and treatment of psychological problems involved in CHD (Hackett and Cassem, 1973).

Although historically the psychological effects of exercise have long been recognized, these effects have been primarily subject impressions that a person "feels better". Only in the past 20 years have

investigators begun to scientifically examine psychological responses to exercise training involving persons in cardiac rehabilitation programs. Dr. Uwe Stocksmeier in addressing the Council on Rehabilitation of The International Society of Cardiologist in 1974 explained two reasons why more scientific research has not been done on the psychological aspects of coronary rehabilitation. First, there has been a lack of interdisciplinary teamwork between physician, psychologist, and sociologist, who frequently work on their own, yielding little clarification or unification in this field of research. Secondly, because psychology and sociology are still young sciences, the instruments to observe and measure the problems are still in the developmental stage.

Lehav (1967) has documented the methodological difficulties in studying psychological and sociological factors in CHD. These difficulties are largely due to the complex interrelationships between psychosocial factors and changes in the degree and nature of their interaction over time. The disease process of CHD further modifies these interactions. It has also been difficult to develop precise, objective, and replicable methods for studying the psychological components of CHD. Often clinical judgments are substituted for objective measurements, making it difficult to compare or replicate results.

The two techniques that have been most commonly used in personality assessment of persons with CHD are objective and projective testing. The objective tests are most likely to provide exact norms and information about correlations with other measures, while the projective tests have only a loose relationship to interpretive material (Sundberg, 1977).

The objective test that has been most frequently used in investigating psychological changes following exercise training has been the

Minnesota Multiphasic Personality Inventory (MMPI). Although this inventory has been widely researched, the question of its applicability for testing coronary patients has been raised by Martic (1976), who conducted a longitudinal study in Yugoslavia on the psychological effects of exercise training. Martic also questioned the validity of the MMPI when applied to populations that were not American.

The Cattell Personality Factor Questionnaire is another commonly used objective test in cardiac rehabilitation research (Bruhn, 1973). This is a factorial instrument which has been criticized because its relationship to outside empirical criteria has not been established (Sundberg, 1977).

Although the Rorschach has been the most widely used projective test, research evaluation of the Rorschach reveals variable reliability and questionable validity (Sundberg, 1977). In a study entitled "Rehabilitation of Coronary Patients", Kellerman (1968) used several projective tests including the Rorschach. However, after administering many tests he reported that few results were available for research or statistical analysis. Kellerman recommended that fewer projective techniques be used in the future while extending the use of objective questionnaires.

Increasing interest has also been shown in the use of predictive testing for prospective CHD studies. One technique that is frequently used is the A-B behavioral pattern typology developed by the Western Collaborative Group (Jenkins, Rosenman and Friedman, 1967). This approach is based on the assessment of overt behavior and verbal analysis.

Another predictive technique is the Social Readjustment and Rating Scale (SRRS) which reports to predict the onset of all types of illnesses

using Life Change Units (LCU), (Holmes & Rahe, 1968). In applying the SRRS to CHD patients, Theorell and Rahe (1971) reported that patients with no previous history of CHD showed a significant increase in their LCU scores during the 2 years prior to suffering a myocardial infarction. In a pilot study conducted by Bruce, Edwards, Frederick, Bruce, and Holmes (1974) in the Cardio-Pulmonary Research Institute in Seattle, there was evidence of enhanced coping mechanisms following exercise training, with no apparent relationship between LCU scores and the timed occurrence of subsequent illnesses.

Although there may be questions concerning psychological factors as a cause of heart disease, there appears to be no questions concerning the significance of psychological problems present after the diagnosis of CHD. An international survey conducted by the International Society of Cardiology's Psychological Aspects Committee reported that the chief psychological problems of cardiac patients are anxiety, fear of sudden death, depression, and lack of confidence in themselves (Fisher, 1973). It had been hypothesized that exercise training programs would improve these crucial psychological factors. Two early studies measuring the psychological effects of exercise training were done by Hellerstein (1968) and Naughton (1968). Both Hellerstein and Naughton tested subjects pre and post exercise training using the Taylor Manifest Anxiety scale of the MMPI. Hellerstein reported that persons with cardiac disease generally showed higher levels of psychasthenia and depression scales, compared to a normal population, and there was a significant drop in these scores after physical training. Naughton reported no difference in pre and post testing, however, he did observe that there was an increase in self-confidence produced by the physical activity. A review

of the studies relating to the psychological effects of training programs for cardiac patients and the psychological instruments used is summarized by Fisher (1973).

For purposes of this study anxiety and depression were chosen as the two psychological responses which are most frequently experienced by persons with CHD. The development of anxiety with CHD is the response to fear of death, just as depression is a reaction to anticipated restrictions and limitations (Hackett & Cassem, 1973).

Historically anxiety has been considered as a unitary concept, but a more recent trend has been toward a concern for trait-state differences (Spielberger, 1970). Traits are relatively enduring aspects of personality and states are relatively temporary conditions. The use of exercise has been suggested as a useful modality in modifying trait-state anxiety scores. In a study conducted by Gillet, Morgan, and Balke (1972) measurements of state-anxiety scores were obtained on a group of healthy subjects, before and after exercise. These scores demonstrated that exercise does indeed change state-anxiety scores. Studies involving exercise and changes in trait-anxiety scores were not found in the literature although previously mentioned objective questionnaires, such as the MMPI and Cantell's Personality Factor Questionnaire, reflect characteristics of trait-anxiety.

From the three main theoretical frameworks of depression Beck's (1967, 1974) negative cognitive set was chosen for this study. The depressed person appears to have a negative view of himself, his world, and the future. The depression may be externally precipitated, e.g., a myocardial infarction, but it is the individual's perception of that event which creates the depression.

The Task Force on Cardiovascular Rehabilitation (1974) reported that depression is likely to occur in nearly all post coronary patients because of diminished feelings of self-esteem, fear over loss of earning power, doubts concerning sexual performance, and fears concerning future mortality and morbidity. Because the individual's perception of an event is altered by time, there is often a resolution of depression about 3 months following a coronary event. In others the depression does not improve concommitantly with the physically damaged heart, resulting in the person continuing to see himself as a cripple, both socially and professionally.

In Great Britain, a study conducted by Nagle, Morgan, Bird and Bird (1976) measured depression using the Beck Depression Inventory (BDI) on cardiac subjects who were 4 months post myocardial infarction. Nagle and his associates reported most depressions were resolved after 4 months. However, a few patients with unresolved depression were still not working although their physical conditions were stable.

This needless prolongation of anxiety and depression with CHD might be prevented or limited by an exercise training program where the person could gain sufficient confidence to resume former patterns of rewarding behaviors. At the present time the American Heart Association lists approximately 100 cardiac rehabilitation exercise programs throughout the United States. The usefulness of this type of medical intervention is reported by Hellerstein (1968), Pyfer, Mead, Frederick and Doan (1976), Boyer and Kasch (1969), Brunner and Mashulam (1969), Sanne (1973), Wenger (1973), and others. Pyfer and his associates described a program organized in the State of Washington by the Cardio-Pulmonary Research Institute (CAPRI). CAPRI is a nonprofit organization with

medically supervised exercise rehabilitation programs in Seattle, Mercer Island, Auburn and Yakima, Washington, and Portland, Oregon. Participants, referred by their personal physicians, meet three times weekly for individually prescribed group walking-jogging-calisthenic sessions lasting 45 minutes each. The goal of the CAPRI program is to improve the quality of life for men and women with CHD or chronic obstructive lung disease. This study will focus on the physiological and psychological parameters of exercise in subjects enrolled in the Seattle and Portland CAPRI programs.

Summary:

The available scientific evidence suggests that an increase in habitual physical activity is beneficial to persons with CHD and the physiological effects of exercise training have been well documented. Exercise training has also been suggested as a useful adjunct in improving psychological reactions to CHD, especially anxiety and depression. Unfortunately there are little research generated data available to compare the psychological effects of exercise to the physiological changes. A further study demonstrating the relationship between the psychological and physiological effects of exercise is necessary to evaluate the scope and benefits of secondary prevention programs.

Purpose of the Study

The purpose of the study was to compare physiological and psychological measurements of individuals made prior to exercise training with those taken after 36 training sessions in order to evaluate the effects of exercise training on these measurements. An additional purpose of this study was to explore relationships between all combinations of

physiological and psychological variables.

Hypotheses

The following hypotheses were tested in relation to the effects of 36 exercise training sessions using pre and post test scores on the following variables:

1. There will be a significant increase in exercise tolerance time (ETT).

2. There will be a significant increase in pressure rate-product (PRP) (HR X SBP/100) at maximal exertion.

3. There will be a significant decrease in functional aerobic impairment (FAI) as computed from the Bruce nomograms.

4. There will be a significant decrease in state anxiety scores, as measured by the A-State scale of the State-Trait Anxiety Inventory (STAI).

5. There will be a significant decrease in trait anxiety scores, as measured by the A-Trait scale of the STAI.

6. There will be a significant decrease in depression scores, as measured by the Beck Depression Inventory (BDI).

In addition each of the physiological and psychological measures were compared for all possible interrelationships. Although hypotheses were not formed for these latter relationships, it was expected that the information would be valuable for descriptive purposes and in future research.

CHAPTER II

METHODOLOGY

Subjects

The sample of this study represented the first 30 subjects (24 men and 6 women) entering the Seattle and Portland sites of the Cardio-Pulmonary Research Institute (CAPRI) after August 1, 1976 who completed 36 exercise training classes before April 15, 1977. The ages of the subjects ranged from 31 to 68 years with a mean age of 54 years. The medical diagnosis of these subjects included myocardial infarction (10), myocardial infarction with angina (5), angina (5), post cardiac surgery (1), hypertension (3), pulmonary disease (1), and others (5). Each person entering the CAPRI program was referred by a private physician. They met the following criteria as appropriate, on the basis of their cardiovascular diagnosis: at least 8 weeks post-myocardial infarction; stable after cardiovascular surgery; stable angina; or at risk, as determined by their physician, because of myocardial ischemia, cardiac arrhythmia, a family history of coronary disease, hypertension, or other risk factors. Also eligible were those with chronic bronchitis or emphysema.

Sources of Data

Demographic Data:

The demographic data of age, sex, and diagnosis were supplied by the referring physician on the Physician Referral Form. (Appendix A)

Physiological Data:

Physiological measurements were obtained from a maximal exercise tolerance test on a standard motor driven treadmill (using the Bruce protocol) with standardized electrocardiographic and blood pressure monitoring. See Appendix A for the Bruce protocol. Using measurements derived from exercise testing three physiological variables were selected: (1) exercise tolerance time, (2) pressure rate product, and (3) functional aerobic impairment. The features of each is described in the following section.

Exercise Tolerance Time (ETT):

The total time that each subject performed on the treadmill during a maximal exercise tolerance test, measured in seconds, was indicated in this study by ETT. The ETT provided an adequate estimation of $\dot{V}_{O2}max$ ($r = +.93$) (Bruce, 1971).

Pressure Rate Product (PRP):

The PRP is the product of maximal heart rate and maximal systolic blood pressure divided by 100 (HR X SBP/100). The maximal HR was measured from an electrocardiographic readout. Blood pressure readings at maximal work load were taken by the physician supervising exercise testing. Kilamure, Jorgensen, and Goebel (1972) consider the PRP as a non-invasive method of approximating the myocardial oxygen consumption.

Functional Aerobic Impairment (FAI):

Bruce (1971) defines FAI as "the percent difference of observed or estimated maximal oxygen intake ($\dot{V}_{O2}max$) and that predicted in health for a person of the same sex, age, and habitual activity status" (p.53).

Bruce observed that the determination of $\dot{V}_{O2}max$ was not enough; a comparison to expected values of peers would furnish specific appraisal information on individual impairment (Bruce, 1971). The normal value of FAI is zero and indicates that the $\dot{V}_{O2}max$ is 100 percent of normal expected values. There is a 95% confidence interval from -26 to +27. Severity of FAI is classified as Mild (27-40%), Moderate (41-54%), Marked (55-68%), while Extreme is greater than 69% (Bruce, 1973). The calculation of the FAI has been simplified by Bruce (1973) with the construction of a FAI nomogram for both men and women. In this study all FAI scores were obtained from the two FAI nomograms, copies of which are included in Appendix A.

Psychological Data:

Psychological measurements were obtained from the State-Trait Anxiety Inventory and the Beck Depression Inventory. A description of each instrument follows.

State-Trait Anxiety Inventory. (STAI):

The STAI was designed and tested by Spielberger, Gorsuch, and Lushene (1970) to measure anxiety, an emotional process affecting cognitive, affective, and behavioral responses to stress. The STAI has been used in measuring the anxiety of neuropsychiatric, medical, and surgical patients in hospitals. The STAI is divided into state and trait components. The A-State scale consists of 20 statements that ask the respondent to indicate how they feel at a particular moment in time, denoting transitory levels of anxiety. In contrast the A-Trait, also consisting of 20 questions, instructs the respondent to describe how they generally feel, characterizing their dispositional level of anxiety proneness.

The range of scores for both the A-State and A-Trait scales vary from a minimum of 20 points to a maximum of 60 points. Higher scores indicate higher anxiety. A copy of the A-State scale (X-1) and the A-Trait scale (X-2) is found in Appendix B. Severity of anxiety scores are categories as Mild (35-49), Moderate (50-64), while Extreme is a score that is equal to or greater than 65 points.

There is a high degree of internal consistency on both the A-State and A-Trait scales. The concurrent and construct validity compares favorably with other published anxiety tests (Spielberger, 1972). Test-retest reliability is relatively high for the A-Trait, but lower on the A-State as it is sensitive to the influence of transient situational factors (Spielberger et al., 1970).

Beck Depression Inventory (BDI):

The BDI was designed by Beck, Ward, Mendelson, Mock, and Erbaugh (1961) to effectively discriminate varying degress of depression among groups of patients. Beck described depression in terms of behavioral attitudes and symptoms that were consistent with the descriptions of depression contained in the psychiatric literature (Kraines, 1957). These attitudes and symptoms are mood, pessimism, sense of failure, lack of satisfaction, guilty feeling, sense of punishment, self-hate, self-accusations, self-punitive wishes, crying spells, irritability, social withdrawal, indecisiveness, body-image, work inhibition, sleep disturbance, fatigability, loss of appetite, weight loss, somative preoccupation, and loss of libido (Beck, 1961). All items relate to overt behavioral manifestations of depression and do not reflect theories of etiology or underlying psychological processes in depression (Beck et al., 1961). This inventory also has the advantage of reflecting changes in the degree

of depression after a time interval.

The BDI, composed of 21 categories of symptoms and attitudes describing specific manifestations of depression, consists of a graded series of 4 or 5 self-evaluative statements for each category. Numerical values from 0 to 3 are assigned each statement to indicate the degree of severity. In some categories two alternative statements (for example 2a and 2b) are presented and assigned the same weight. The range of scores for the BDI vary from a minimum score of 21, indicating no depression, to a maximum score of 63 points, indicating severe depression. For purposes of scoring, the following categories with the range of score values were used: no depression (3-11), mild depression (12-20), moderate depression (21-29), and severe depression (a score which is equal to or greater than 30). A copy of the BDI and the BDI Scoring Guide can be found in Appendix B.

A high degree of reliability has been established by statistical and clinical testing. Furthermore, the highly significant relationship existing between inventory scores and clinical ratings of depth of depression attest to the validity of the BDI (Metcalfe & Goldmann, 1965).

Design and Procedure

This study was descriptive in nature and longitudinal in design using one group serving as their own control through pre and post testing. There was no control for age, sex, or diagnosis in the sample population. The focus of the study was the utilization of the independent variable, exercise training, as described by the CAPRI program. The dependent variables were divided into two categories, encompassing physiological and psychological measurements. The physiological dependent variables were further divided into exercise tolerance time, pressure

rate product, and functional aerobic impairment. All of these measurements were obtained from a maximal exercise tolerance test. The three psychological dependent variables considered were state anxiety, trait anxiety, and depression. The State-Trait Anxiety Inventory was used to measure anxiety levels while the Beck Depression Inventory measured manifestations of depression.

All prospective participants in CAPRI first attended an Open House in which they observed an exercise class and also obtained complete information about the program. Upon receiving a physician referral form (copy in Appendix A), initial physical and psychological evaluation tests were scheduled. (See Figure 1). The subject, after arriving at the test center, first completed the psychological test forms (STAI-X-1, STAI-X-2, and the BDI). Next, each person completed a medical history questionnaire and signed an informed consent form, copies of which are in Appendix A.

To begin the physiological evaluation each subject was screened for possible contraindications to exercise testing by history, physical examination, and a 12-lead resting electrocardiogram (EKG) before beginning the multi-stage exercise tolerance test. Electrodes were secured to the chest and inferior tip of the right scapula, producing a simulated V_5. This signal was viewed constantly on the oscilloscope throughout the exercise test for rhythm, rate, and ST-T changes. A graphic write out on a standard EKG machine was recorded while the subject was sitting at rest, for each minute of exercise, and also for each minute of recovery time following the test (6 minutes). Blood pressure was monitored by cuff sphygmomanometer, before exercise, during each work load, and at 0, 1, 3 and 5 minutes during the recovery time. The speed in miles per

PROCEDURE FLOW CHART

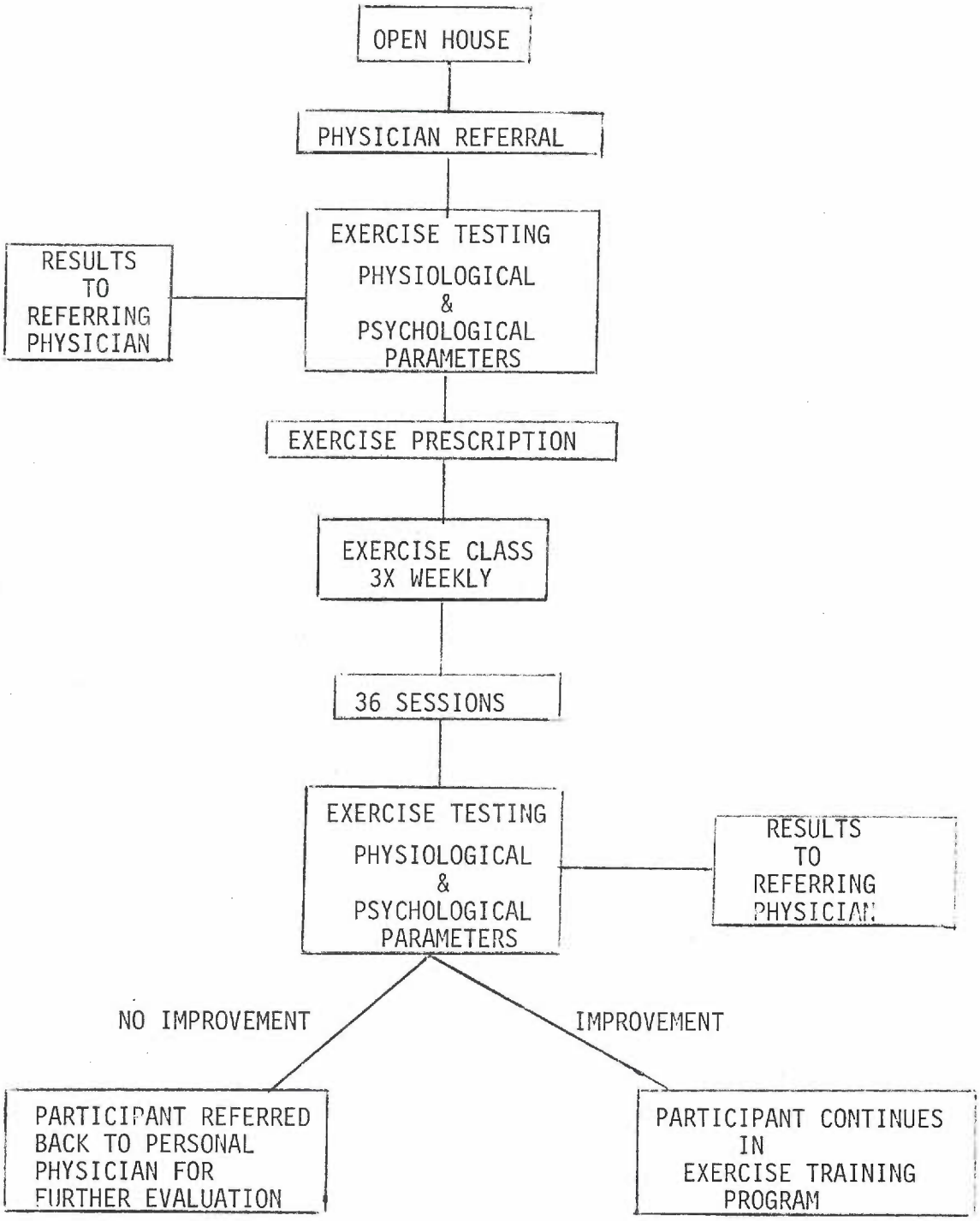


Figure 1.

hour and the grade of each work load stage is shown in Appendix A.

The subject was urged to continue on the treadmill to the maximal limits of tolerated exertion. When that limit was attained, intensity and duration of effort, heart rate, and blood pressure readings were observed to define maximum limits for that individual.

Reasons for stopping the test before reaching maximal limits included a drop in systolic blood pressure with increasing exercise work load, the presence of three or more consecutive premature ventricular contractions (PVCs), progressive angina, or significant ST-T segment displacement. A physician and a registered nurse were in attendance for all testing sessions.

Following completion of the initial physiological and psychological evaluations, the status of each subject was evaluated by the program and medical directors, after which a specific exercise program was prescribed for each individual.

Protocol for Training Sessions:

The exercise training class met three times each week for a 45 minute period of time. The initial 15 minutes of class was devoted to warm up and walking-jogging. Body toning and stretching exercises occupied the next 15 minutes; followed by a walking-jogging and a cool down period which completed the exercise class. Each participant kept a daily performance log, including recording of heart rate, laps walked, laps jogged non-stop, and total laps jogged during each exercise class. An exercise log may be found in Appendix A.

During exercise training the work load performed was gradually increased as the participant was able to comfortably complete the present work load without electrocardiographic or hemodynamic contraindications.

See progressive order of work load assignments with exercise level description in Appendix A. To achieve an appropriate training response each subject was instructed to exercise at a training heart rate that was 70% to 85% of the maximal heart rate achieved on the maximal exercise tolerance test (Pyfer, Mead, Frederick, & Doane, 1976).

The equipment available at all sites for testing and exercise sessions included a Portable Life-Pak defibrillator, a Direct Current defibrillator, oxygen tanks with adjustable flow valves, airways, electrical suctioning equipment, stethoscopes, sphygmomanometers, syringes, and cardiac emergency drugs.

Upon completion of 36 exercise sessions the subject again completed the same psychological and physiological evaluations, using the same protocol as was previously described for the initial evaluation. The referring physician retained control of the subject's medical management throughout the exercise training period in CAPRI, and copies of all evaluation results were mailed to the referring physician. Following the second evaluation an appraisal was made considering the degree of progress and the advisability of proceeding with exercise training. If there was insufficient progress or the subject's condition was deteriorating, the subject was returned to the referring physician for further evaluation.

Data Storage and Analysis

The central CAPRI office in Seattle houses a file on each participant enrolled in all the CAPRI training programs. Each file contains an application form, physician referral form, medical history form, copies of all exercise tolerance tests, mounted ECG's, both resting and during exercise tolerance testing, a summary sheet of physiological

measures obtained from each exercise tolerance test, monthly log sheets from exercise training sessions, and other pertinent data. In addition, all psychological tests, including a summary sheet, are kept in the central CAPRI office. All physiological and psychological data used in this study were obtained from the summary sheets of each subject. (See Appendix A).

The Paired t test was chosen as an appropriate statistical method to test the six hypotheses of this study. The correlation matrix was used to describe the relationship between the physiological and psychological variables.

CHAPTER III

RESULTS AND DISCUSSION

This study of subjects in an exercise training program was concerned with the effects of exercise training on both physiological and psychological dependent variables. In addition, an exploratory study was made of the relationships between these two sets of variables.

The expected effects of exercise training on physiological parameters were specified by hypotheses one through three. Comparisons were made between the initial exercise evaluation test and the post exercise test following completion of 36 exercise training sessions.

The first hypothesis stated that there will be a significant increase in exercise tolerance time (ETT). This hypothesis was accepted. ($t = 3.51$, $p < .01$) The test results of the ETT are shown in Table 1. Upon inspection of the individual scores, 21 subjects increased their ETT, 2 subjects had identical times on both tests, and only 7 subjects decreased their ETT. An increase in ETT signifies an increase in $\dot{V}_{O2}max$, indicating that the functional limits of the cardiovascular system to deliver oxygen to satisfy aerobic requirements is improved.

Although there was considerable lack of uniformity in the testing and training protocols of other studies, a substantial number of studies concur that exercise training significally increases ETT. For instance, Hellerstein (1968) used training methods similar to those employed by CAPRI, however all testing was accomplished on a bicycle ergometer with post testing following the completion of 6 months of training. Sanne (1973) also used the ergometer for testing. In addition the ergometer

TABLE 1

PHYSIOLOGICAL MEASUREMENTS OBTAINED FROM MAXIMAL EXERCISE TOLERANCE TESTS.

Physiological Variables	Pretests Scores@	Posttest Scores@	Tvalue
ETT	401.57	444.97	*3.51
SD	118.64	114.72	
PRP	245.80	243.20	.39
SD	59.52	59.35	
*** FAI	74.20	81.63	**3.72
SD	21.16	22.20	

n = 30
df = 29
*$P < .01$
**$P < .001$

***FAI Scores were changed to positive numbers by adding 100.

@ All scores are mean values

was used for training purposes by some subjects training individually at home.

Another confirmation of improvement in ETT, following exercise training, was reported by Gottheimer (1968), however specific training and testing procedures were not disclosed, making methodology comparisons difficult to evaluate. Subjects in an exercise training program in Canada directed by Kavanaugh (1974) showed significant improvement in ETT. The testing methods approximated those employed by CAPRI, but subjects accomplished part of their training (walking and jogging) on an individual basis with group classes held only once weekly.

It would appear that although all these studies demonstrate methodological differences in testing and training, there are similarities in the resultant improvement in ETT. This improvement contributes to an increase in the quality of life for the person with CHD, relating to cardiac work, professional work, and leisure time activities.

It must also be mentioned here that there are confounding reports concerning improvement of ETT. As was previously noted in an earlier section of this paper, Hackett and Cassem (1973) reported an increase in ETT simply through the process of familiarization with the test procedure itself, while Bergman and Varnauskas (1971) examined the placebo effect in relation to increased work capacity. Hopefully this significant increase in ETT represents largely a physiological phenomenon, however these aforementioned components of increased ETT need to be considered.

The second hypothesis stated that there will be a significant increase in PRP, which is a method of approximating the myocardial oxygen consumption. This hypothesis was rejected ($t = .388$). Similar results

were supported by Sanne (1973), who disclosed that in his study the PRP of persons with CHD did not significantly increase after exercise training. He explained that in healthy subjects the PRP is linearly correlated with the oxygen consumption in the myocardium ($r = .90$) and with the coronary blood flow ($r = .87$) during submaximal and up to maximal exercise levels. However, in subjects with CHD this linear relationship often does not exist at maximal levels because of a lower coronary blood flow, a higher myocardial arterio-venous oxygen difference, and lower myocardial oxygen consumption. This explanation has application to the present study because all testing was done at maximal levels.

Other factors that influence PRP in persons with CHD are changes in heart size, revascularization, and drug usage (Berne & Levy, 1972). All of these factors, singly or combined, could affect the subjects in the present study.

The third hypothesis stated that there would be a significant decrease in functional aerobic impairment. This hypothesis was accepted ($t = 3.72$, $p < .001$). See Table 1 for FAI results. Although the approximation of $\dot{V}_{O2}max$ has already been determined in this study through the use of ETT, it will be recalled that these are only absolute values and are insufficient for a complete evaluation without comparisons of normal standards in health, adjusted for sex, age, and habitual activity status (Bruce, 1973). Using the FAI impairment categories listed by Bruce (1973), this present study showed that 9 subjects improved, 18 remained in the same category, and 3 subjects had further impairment. It was further noted that 5 of the 7 subjects showing the greatest initial impairment (moderate to extreme) improved following exercise training.

The development of the FAI nomogram is recent; consequently comparative

studies using FAI scores are not available. However, it would seem likely that both the patient with CHD and the referring physician would find reassurance in an improvement in FAI scores.

The expected effects of exercise training on psychological parameters were specified by hypotheses four through six. The data compared results between the pre-post tests measuring state anxiety, trait anxiety, and depression.

The fourth hypothesis stated that there will be a significant decrease in the state anxiety scores of subjects following exercise training. This hypothesis was rejected ($t = 2.02$). Although the results were not statistically significant, there was a definite direction of change toward decreased state anxiety. See Table 2 for psychological test results.

The difficulty encountered in comparing these results to other studies relate to several factors which were pointed out in an earlier section of this paper. However, one study of healthy subjects investigated by Gillet, Morgan, and Balke (1972) used the STAI instrument to measure state anxiety scores. Gillet and associates noted that physical activity reduced state anxiety scores, although no statistical information was available on this unpublished study. As other studies relating to anxiety in persons with CHD used instruments reflecting characteristics of trait anxiety, further commentary will follow in the discussion of trait anxiety.

One must also consider that since the A-State Scale was specifically designed to reflect the momentary feelings of the subject, many uncontrolled variables, such as environmental and situational factors, as well as the effects of the disease process itself, influence changes in test scores. An additional factor influencing these state anxiety scores

TABLE 2

PSYCHOLOGICAL MEASUREMENTS OBTAINED FROM THE STATE TRAIT ANXIETY INVENTORY AND THE BECK DEPRESSION INVENTORY

Psychological Variables	Pretest Scores[@]	Posttest Scores[@]	T values
State Anxiety	38.20	34.10	2.02
SD	11.66	10.48	
Trait Anxiety	37.10	35.00	*2.80
SD	9.54	9.39	
Depression	7.83	6.37	1.88
SD	5.23	6.31	

n = 30
df = 29
*$P < .01$
@ All scores are mean values

related to the frequency of administering these tests. In the present study only one session of pre-post testing was done. Repeated measures of the A-State Scale; before, after, and at frequent intervals throughout the training period, would probably have produced a more reliable measurement of true state scores.

Furthermore, it will be noted in Table 2 that the standard deviations (SD) of the state anxiety scores were larger than the SD for the trait anxiety scores. This greater SD probably accounted for the non-significant result for the state anxiety scores.

The fifth hypothesis stated that there would be a significant decrease in the trait anxiety scores of subjects following exercise training. This hypothesis was accepted ($t = 2.80$, $p \leq .05$). See Table 2 for trait anxiety scores.

By placing the subjects in categories according to Spielberger et al. (1970), it was noted that two subjects decreased their level of anxiety from moderate to mild following exercise training. Two persons showing moderate anxiety on the pre test displayed no anxiety on the post test. There were six additional subjects who decreased their level of trait anxiety from the mild category to one of no anxiety. Only one subject displayed a significant increase in trait anxiety on the post test, changing from a mild to moderate category.

According to Spielberger et al. (1970), trait anxiety scores reflect little change over a short period of time. In this study, using 35 exercise training sessions as the time criteria for post testing, the minimum retest time was 3 months and for some subjects the time interval exceeded 5 months. The trait anxiety scores of subjects enrolled in the CAPRI exercise program did significantly alter over this period of time.

In comparable studies a variety of instruments were used to measure trait anxiety. For example, both Naughton, Bruhn and Lategola, (1968) and Hellerstein (1968) measured anxiety using the hypochondriasis and hysteria scales of the Minnesota Multiphasic Personality Inventory (MMPI) before and after exercise training. Hellerstein did not give statistical information on these measures, however he reported that after 6 months of training, "psychologically the group as a whole appeared to improve, subjectively and objectively" (p. 1045). Naughton, using experimental and control subjects, found that after the initial year of a reconditioning program the training subjects had lower, but statistically insignificant hypochondriasis scores. Subjective observations made by Naughton et al. (1968) indicated that there seemed to be an increase in self-confidence produced by the physical activity.

In an Israeli exercise training group, comparable to the CAPRI program, Kellerman (1970) measured the effects of exercise on anxiety by means of the Rorschach Projective test, which was administered before and after exercise training. Lower anxiety levels were demonstrated following training. The author did not discuss the anxiety scores in terms of state or trait categories. Given the instrument used by Kellerman it is likely that the anxiety scores indicated trait anxiety.

The subjects mentioned in the above studies were all selected from a male population. However, in Yugoslavia, a study conducted by Martic (1976) over an 18 month period, described the psychological effects of exercise training on both male and female subjects with CHD. The MMPI personality test was used for both the experimental and control groups. The results demonstrated no essential changes in test scores under the influence of training. There was a significant drop out rate of over

50 percent during the 18 month training period, creating the question of whether the subject sample was different at the end of the study.

Because man is basically a social being, the same valid criticism of many uncontrolled variables in testing for state anxiety can be leveled against trait anxiety tests. For instance, McPherson (1967) demonstrated that a control cardiac group given the opportunity to gather socially once weekly also achieved an improved sense of well-being and felt less anxiety. A companion issue arises when subjects spontaneously make changes in their life style, thus adding factors that are not controlled by the experimental design. For example, Naughton (1968) discovered that 76% of both training and control cardiacs altered their life style, including smoking, eating, and sleeping habits.

Other factors relating to the permanence of behavioral changes after training programs show that coping styles for anxiety tend to revert to less optimal levels unless extrinsic controls are maintained. For example, Kellerman (1972) noted that 4 months after a 16 week exercise training program, patients had returned to their pre-exercise level of ability in dealing with anxiety. Thus it appears that favorable effects of exercise training on anxiety reactions are probably transient unless the subject persists in a formal program.

It was stated in the sixth hypothesis that depression scores will be significantly decreased following exercise training. This hypothesis was rejected ($t = 1.88$). According to Beck's (1961) classification of degree of depression, 24 of the 30 subjects on pre testing recorded no depression, 4 subjects had mild depression, and only 2 persons demonstrated moderate depression. These results indicated that if indeed there was a high incidence of depression following the diagnosis of CHD,

this depression had significantly diminished in most of the study group by the time they were admitted to the CAPRI program.

In contrast to the present study, Hellerstein (1968) related that persons entering his exercise training program had a high degree of depression as judged by the MMPI profile. Their degree of depression was significantly decreased following 6 months in a physical conditioning program.

In another study not involving an exercise training program, Nagle, Morgan, Bird, and Bird (1976) found no significant differences in depression scores, measured by the BDI, of patients tested soon after discharge from the coronary care unit of a hospital in Great Britain, and at the follow up clinic 4 months later. The mean scores for pre-post tests were within the normal range of less than 11. Nagle further explained that before beginning his study a vigorous community educational program had been inaugurated, teaching the importance of psychological support for patients with CHD. Perhaps the study by Nagle et al. (1976) was altered by community understanding and support of the psychological aspects of CHD.

The increased emphasis on the treatment and understanding of emotional responses to CHD, especially myocardial infarction, has facilitated medical and nursing personnel to assess and begin early interventions in the treatment of anxiety and depression. Both Hackett and Cassem (1974) agree with Fox (1973) that physical conditioning is an excellent way of preventing depression. They suggest that an appropriate level of physical activity, from the moment of diagnosis throughout convalescence, will reduce or prevent most depression in patients with CHD by raising self-esteem and the sense of independence.

No information was obtained regarding the exercise patterns of the subjects in the present study before entering the CAPRI program. Could the low incidence of depression in this study group be related to the effects of time, or was there an early activity pattern experienced by these subjects following their diagnosis of CHD?

An additional purpose of this study was to compare the interrelationship of the physiological and psychological measures. A correlation matrix of all dependent variables and selected demographic data of age, sex, and diagnosis is shown in Table 3.

In examining the demographic variables, age was significantly correlated to the FAI at the .05 level. Because age is one of the components in the compilation of FAI, this was certainly an expected outcome. The intercorrelations of sex, diagnosis and changes in ETT scores all were significant at the .05 level. However, this study included 6 females in a sample size of 30; so this restricted range of the data could impose a spuriously high correlation.

In examining the relationship between pre-post test scores of the physiological variables and pre-post test scores of the psychological variables, all variables within these categories correlated at the .05 level except for the PRP. Interestingly enough however, in comparing the changes in pre-post scores there was no significant correlation between the psychological and physiological variables. This investigator had believed that a strong relationship existed between the physiological and the psychological improvement experienced by the trained subject. The correlation matrix did not support this relationship, nor did studies by Kellerman (1968) and Nagle (1976). Both Kellerman and Nagle reported that there is no positive correlation between the physiological and

Table 3. Correlation Matrix[@] of Demographic, Psychological and Physiological Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Age	1	1.00																				
Sex	2	-.346	1.00																			
			*																			
Dx.	3	-.062	.400	1.00																		
BDI Pre	4	-.166	.290	-.049	1.00																	
					***																	
BDI Post	5	-.000	-.096	-.050	.739	1.00																
Chg.						***																
BDI	6	-.202	.300	.013	.132	-.568	1.00															
STAI					*																	
STAI Pre	7	-.080	-.037	-.049	.396	.211	.173	1.00														
					*	*		**														
STAI Post	8	.004	-.279	.043	.390	.393	-.101	.500	1.00													
Chg.								***	*													
STAI	9	-.089	.244	-.092	.047	-.148	.277	.577	-.417	1.00												
STAII					***	***		**	***													
STAII Pre	10	-.254	.136	.047	.716	.693	-.145	.552	.598	.014	1.00											
					***	***		*	***		***											
STAII Post	11	-.205	.027	-.094	.756	.799	-.253	.398	.603	-.150	.906	1.00										
Chg.								*	*													
STAII	12	-.120	.256	.326	-.065	-.217	.240	.370	.010	.379	.249	-.183	1.00									
ETT					***	***					**	***										
ETT Pre	13	.152	-.331	-.103	-.569	-.639	.246	-.107	-.003	-.110	-.466	-.589	.263	1.00								
					***	***					***	***		***								
ETT Post	14	.059	-.130	-.221	-.652	-.687	.215	-.221	-.223	-.021	-.562	-.623	.119	.832	1.00							
Chg.			*						*													
ETT	15	-.187	.362	-.246	-.061	-.050	-.001	-.173	-.404	.199	-.141	-.037	-.242	-.334	.222	1.00						
PRP													*									
PRP Pre	16	-.217	.168	.270	.028	-.048	.105	.109	.049	.068	-.018	-.186	.384	.266	.223	-.022	1.00					
																	***					
PRP Post	17	-.209	.159	.062	.109	.013	.114	-.053	-.096	.034	-.047	-.102	.126	.207	.289	.192	.809	1.00				
Chg.													*									
PRP	18	.012	-.014	-.336	.129	.098	.012	-.264	-.235	-.055	-.046	.135	-.419	-.095	.106	.347	-.314	.303	1.00			
FAI		*			**	***					**	***		***	***							
FAI Pre	19	.424	-.036	.039	-.521	-.615	.269	-.179	.099	-.094	-.487	-.617	.280	.863	.761	-.226	.247	.192	.090	1.00		
		*			***	***					**	***		***	***						***	
FAI Post	20	.354	.107	-.048	-.596	-.644	.219	-.266	-.295	-.011	-.549	-.633	.173	.693	.874	.243	.182	.218	.058	.873	1.00	
Chg.									*							***					*	
FAI	21	-.111	.290	-.190	-.229	-.150	-.058	-.214	-.432	.183	-.199	-.118	-.194	-.238	.324	.930	-.107	.074	.295	.139	.358	1.00

*p .05 ** p .01 ***p .001 Notation of significance appears above correlation

@ Pearson Product Correlation

(See subject scores in Appendix C)

psychological improvement following an exercise training program.

Kellerman (1970) further noted that the physiological improvement is frequently limited to increased work capacity in many patients. On the other hand, Kellerman described outstanding psychological improvement for almost all patients.

In the present study it will be noted that there was only a small degree of psychological impairment in the sample population upon entering the CAPRI program, making the possibility of large gains in psychological improvement a highly unlikely outcome based on the psychological instruments used in this study. Questions also remain concerning the psychological variables that this investigator chose to study. Perhaps anxiety and depression do not adequately reflect the relevant parameters that should be evaluated. Further speculation and investigation may lead to different psychological variables such as quality of life or adaptation responses to stress. Further questions centered on the choice of psychological measuring instruments for the present study. Perhaps forthcoming research will yield instruments that are more sensitive and specific in nature to evaluate the psychological aspects of CHD.

In conclusion, it is important to point out some of the inherent weaknesses that may have biased the findings of the present study. First, the study population was a self-selected group, consequently the training program may have drawn a healthier groups of patients with CHD than a randomly selected sample. Secondly, the cost of participating in the CAPRI program may have been a limiting factor for certain socio-economic groups, even though program policy specifies that no one is to be excluded because of inability to pay the fees.

As noted in the study design, there was no separate control group,

rather all subjects acted as their own control. Further limitation of this study related to the small sample size of only 30 subjects. This small sample had further inequalities, both in the distribution of male and female subjects, and also in the categories of diagnosis. Therefore, because of these limitations, it is recommended that caution should be exercised in generalizing this study to other populations.

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this investigation was to study the physiological and psychological effects of exercise training on subjects with coronary heart disease. These subjects were participants in CAPRI, a community rehabilitation program that was supervised by medical and nursing personnel.

The study sample represented 30 subjects who completed 36 exercise training classes during this nine-month study. The study was descriptive and longitudinal in design. One group, serving as their own control, was tested before and after exercise training.

The focus of the study was the utilization of the independent variable, exercise training, as described by the CAPRI program. The dependent variables were divided into two categories, encompassing physiological and psychological measurements. The physiological variables were further divided into exercise tolerance time, pulse-rate product, and functional aerobic impairment. All physiological measurements were obtained from a maximal exercise tolerance test, both pre-post exercise training. The three psychological dependent variables considered were state anxiety, trait anxiety, and depression. The psychological data were also collected immediately prior to training and at the completion of 36 exercise training sessions by the use of two instruments, the Beck Depression Inventory (BDI) and the State-Trait Anxiety Inventory (STAI). The paired t-test and the correlation matrix was used to analyze the data.

Comparisons of pre-post physiological test scores showed that exercise training significantly increased the exercise tolerance time, or work capacity, of the subjects. Further comparisons of the subjects in the present study to a normal population revealed a significant reduction in functional aerobic impairment following exercise training. The changes in the pulse-rate product between pre and post testing were insignificant.

Psychological test scores confirmed that most subjects entering the CAPRI exercise training program had little or no depression, consequently changes in pre-post test scores were minimal. Trait anxiety test scores improved significantly following 36 training sessions. Although state anxiety scores remained below the level of significance, a definite trend in improvement was evident from the data. Examination of the intercorrelation of changes in the pre-post test scores revealed that no significant correlation existed between the physiological and psychological variables.

Conclusions

Conclusions drawn from the present study were (1) exercise training is a useful method of increasing the exercise tolerance time of persons with CHD, (2) the pulse-rate product is unaffected following exercise training, (3) functional aerobic impairment levels are lowered by exercise training, (4) little or no depression was evident in subjects entering the CAPRI program, (5) trait anxiety, as measured by the STAI A-Trait scale, is significantly reduced following 36 exercise training classes, (6) state anxiety scores remained below the level of significance following exercise training, although a definite trend in improvement was evident from the data.

It was further concluded that there was no significant correlation between physiological improvement and psychological improvement following

exercise training.

Exercise training programs also provide new opportunities for the health care professional. A new role for nursing has emerged. Nurses working in cardiac rehabilitation exercise programs now have the opportunity to provide information, teaching, and counseling to persons with CHD over an extended period of time.

Recommendations for Further Study

1. A study investigating physiological and psychological variables in persons with CHD, from the time between the onset of illness and the institution of an exercise training program.

2. A replication of the present study using a properly matched control group.

3. A study exploring other psychological variables that might contribute to the quality of life in persons with CHD.

4. A study to find the psychological factors that may contribute to the speed and effectiveness of the rehabilitation process in persons with CHD.

5. A further examination of the physiological and psychological data to determine differences in the rate of improvement between the subject groups (classification by medical diagnosis).

REFERENCES

Alexander, J.K. Exercise and coronary heart disease. Cardiovascular Residence Center Bulletin (Baylor College of Medicine), 1969, 8, 2-7.

Astrand, P. & Rodahl, L. Textbook of work physiology, New York: McGraw Hill, 1970.

Beck, A.T., Ward, C.H., Mendelson, M., Mock, J., & Erbaugh, J. An inventory for measuring depression. Archives of General Psychiatry, 1961, 4(6),53-63.

Beck, A.T. Depression: Clinical, experimental and theoretical aspects. New York: Hoeber, 1973.

Beck, A.T. The development of depression: A cognitive model. In Friedman, R.J. & Katz, M.M. (Eds.) The psychology of depression: Contemporary theory and research. Washington, D.C.: H. Winston,1974.

Bergman, H. & Varnauskas, E. Placebo effect in physical training of coronary heart disease patients. In Larson, O.A. & Halmborg, R.O. (Eds.) Coronary heart disease and physical fitness. Baltimore: University Press, 1971

Berne, R.M. & Levy, M.N. Cardiovascular physiology. St. Louis: C.V. Mosby, 1972.

Boyer, J.L. & Kasch, F.W. Exercise therapy in hypertensive man. Journal of The American Medical Association, 1970, 211, 1668-1671.

Bruce, E.H., Edwards, M.K., Frederick, R., Bruce, R.A., Holmes, T.H. Is coping with life stresses enhanced by cardiac rehabilitation programs? In Stocksmeier, U. (Ed.) Psychological approach to the rehabilitation of coronary patients. Heidelberg, Germany: Springer-Verlag, 1976.

Bruce, R.A. Exercise testing of patients with coronary heart disease. Annals of Clinical Research, 1971, 3, 323-326.

Bruce, R.A. Principles of exercise testing. In Naughton, J.P. & Hellerstein, H.K. (Eds.) Exercise testing and exercise training in coronary heart disease. New York: Academic Press, 1973.

Bruce, R.A., Kasumi, F., Hosher, D. Maximal oxygen intake and nomographic assessment of functional aerobic impairment in cardiovascular disease. American Heart Journal, 1973, 85, 546-552.

Bruhn, J.G. Obtaining and interpreting psychosocial data in studies of coronary heart disease. In Naughton, J.P. & Hellerstein, H.K. (Eds.) Exercise testing and exercise training in coronary heart disease. New York: Academic Press, 1973.

Committee on Exercise, A handbook for physicians. Exercise testing and training of individuals with heart disease or at high risk for its development. American Heart Association, 1975.

Cooper, K. The new aerobics. New York: M. Evans, 1970.

Doan, A.E., Peterson, D.R., Blackmon, J.R., & Bruce, R.A. Myocardial ischemia after maximal exercise in healthy men. A method for detecting potential coronary heart disease? American Heart Journal, 1968, 69, 11-21.

Douglas, J.E. & Wilkes, T.D. Reconditioning cardiac patients. American Fitness Publications, 1975, 11(1), 123-129.

Eckstein, R.W. Effect of exercise and coronary artery narrowing on coronary collateral circulation. Circulation Research, 1957, 5, 230-235.

Fisher, S. Unmet needs in psychological evaluation of intervention programs. In Naughton, J.P. & Hellerstein, H.D. (Eds.) Exercise testing and exercise training in coronary heart disease. New York: Academic Press, 1973.

Fox, S.M. & Skinner, J.S. Physical activity and cardiovascular health. American Journal of Cardiology, 1964, 14, 731-746.

Fox, S.M. Relationship of activity habits to coronary heart disease. In Naughton, J. & Hellerstein, H.D. (Eds.) Exercise testing and exercise training in heart disease. New York: Academic Press, 1973.

Fox, S.M. & Paul, O. Physical activity and coronary heart disease. American Journal of Cardiology, 1969, 23, 298-303.

Frick, M.H. Coronary implications of hemodynamic changes caused by physical training. American Journal of Cardiology, 1968, 22, 417-425.

Froelicher, V.F. & Oberman, A. Analysis of epidemiologic studies of physical inactivity as risk factor for coronary artery disease. Progress in Cardiovascular Disease, 1972, 15(1),41-65.

Froelicher, V.F. The hemodynamic effects of physical conditioning in healthy young, and middle-aged individuals, and in coronary heart disease patients. In Naughton, J. & Hellerstein, H.D. (Eds.) Exercise testing and exercise training in heart disease. New York: Academic Press, 1973.

Gillet, M.C., Morgan, W.P. & Balke, B. Influence of acute physical activity on state anxiety. (In preparation.)

Gottheimer, V. Long range strenuous sports training for cardiac reconditioning and rehabilitation. American Journal of Cardiology, 1968, 22, 426-432.

Hackett, T.P., & Cassem, N.H. Psychological adaptation to convalescence in myocardial infarction patients. In Naughton, J.P. & Hellerstein, H.K. (Eds.) Exercise testing and exercise training in coronary heart disease. New York: Academic Press, 1973.

Hellerstein, H.D. Exercise therapy in coronary disease. Bulletin of the New York Academy of Medicine, 1968, 44, 1028-1047.

Holmes, T.H. & Rahe, R.H. The social readjustment rating scale. The Journal of Psychosomatic Research, 1968, 11, 213-218.

Jenkins, C.D., Rosenman, R.H. & Friedman, M. Development of an objective psychological test for the determination of the coronary prone behavior pattern in employed men. Journal of Chronic Diseases, 1967, 20, 371-379.

Kaines, S.N. Mental depressions and their treatment. New York: The Macmillan Company, 1957.

Kannel, W.B. Habitual level of physical activity and risk of coronary heart disease. In Proceeding of the International Symposium on Physical Activity and Cardiovascular Health. The Canadian Medical Association Journal, 1967, 96, 811-816.

Kaplinsky, E., Hood, W.B., McCarthy, B., McCombs, H.L. & Lown, B. Effects of physical training in dogs with coronary artery ligation. Circulation, 1968, 37, 556-565.

Kavanaugh, T. Cardiac patients run a good race. Journal of the American Medical Assocation, 1973, 224(12),1580.

Kellerman, J.J. Rehabilitation of coronary patients. Washington, D.C., Department of Health, Education and Welfare (Social and Rehabilitation Services), 1968, (Grant No. ISR) 17-62.

Kellerman, J.J. The evaluation and rehabilitation of coronary patients. Cardiology current topics and progress. New York: Academic Press, 1970.

Kellerman, J.J. Physical rehabilitation in patients after myocardial infarction - post convalescent phase. Presented at The Arlie House Conference, April 16-21, 1972.

Kilamura, K., Jorgensen, C.R., & Gobel, F.L. Hemodynamic correlates of myocardial oxygen consumption during upright exercise. The Journal of Applied Physiology, 1972, 32, 516-522.

Kohn, R.M. Determinants of maximal performance. In Zohman, L.R. & Phillips, R.E. (Eds.) Medical aspects of exercise testing and training. New York: Intercontinental Medical Book Corporation, 1973.

Lehav, E. Methodological problems in behavioral research on disease. Journal of Chronic Disease, 1967, 20, 333-340.

Levine, S.A. & Lown, B. The "chair" treatment of acute coronary thrombosis. Journal of the Association of American Physicians, 1951, 64, 316-320.

Levine, S.A. Some harmful effects of recumbency in the treatment of heart disease. Journal of the American Medical Association, 1944, 126,80-85.

McPherson, B.D., Paivio, A., Yuhasz, M.S., Rechnitzer, P.A., Pickard, H.A., & Lefcos, N.M. Psychological effects of an exercise program for post-infarct and normal adult men. Journal of Sports Medicine, 1967, 7, 95-102.

Martic, M. Results of psychological testing of coronary paths in a longitudinal study of the following up of effects of training. In Stocksmeier, U. (Ed.) Psychological approach to the rehabilitation of coronary patients. Heidelberg, Germany: Springer-Verlag, 1976.

Master, A.M. & Rosenfeld, I. Two step exercise test brought up to date. New York Journal of Medicine, 1961, 61,1850-1854.

Metcalfe, M., & Goldman, E. Validation of an inventory for measuring depression. British Journal of Psychiatry, 1965, III, 240-242.

Mitchell, J.H. & Blomqvist, G. The effects of physical training on sedentary American men. The Journal of Cardiac Rehabilitation, 1972, 2,33-38.

Morris, J.N., Heady, J.A., Raffle, P.A., Roberts, C.G. & Parks, J.W. Coronary heart disease and physical activity of work, Lancet, 1953, 2,1053-1062.

Morris, J.N., Heady, J.A., Raffle, P.A. Physicque of London bus men: Epidemiology of uniforms. Lancet, 1958, 2,569-578.

Morris, J.N. & Crawford, M.D. Coronary heart disease and physical activity at work. The British Medical Journal, 1958, 2,1485-1493.

Nagle, R., Morgan, D., Bird, J., & Bird, Janet. Interaction between physical and psychological abnormalities after myocardial infarction. In Stocksmeier, U. (Ed.) Psychological approach to the rehabilitation of coronary patients. Heidelberg, Germany: Springer-Verlag, 1976.

National Heart & Lung Institute. Needs and opportunities for rehabilitation of the coronary heart disease patient; Report of the task force on cardio-vascular rehabilitation of the National Heart and Lung Institute, December 15, 1974. DHEW Publication No. (NIH) 75-750, Public Health Service, Washington, D.C. U.S. Government Printing Office, 1974.

Naughton, J., Bruhn, J.G., Lategota, M.T. Physiologic and behavioral characteristics of physically reconditioned and sedentary cardiac subjects. Archives of Physical Medicine and Rehabilitation, 1968, 49, 131-137.

Naughton, J. & Haider, R. Methods of exercise testing. In Naughton, J.P. & Hellerstein, H.D. (Eds.) Exercise testing and exercise training in coronary heart disease. New York: Academic Press,1973.

Pyfer, H.R., Mead, W.F., Frederick, R.C. & Doane, B.L. Exercise rehabilitation in coronary heart disease: Community group programs. Archives of Physical Medicine and Rehabilitation, 1976, 57(7),325-342.

Phillips, R.E. Medical aspects of exercise testing and training. New York: Intercontinental Medical Book Corporation, 1973.

Sanne, H. Exercise tolerance and physical training of non-selected patients after myocardial infarction. Acta Medica Scandinavia, 1973, Supplementum 551.

Spielberger, C.D., Forsuch, R.L., & Lushene, R.E. Manual for the state-trait anxiety inventory. Palo Alto, Ca.: Consulting Psychologist Press, 1970.

Spielberger, C. (Ed.) Anxiety current trends in theory and research. (Vol. ii). New York: Academic Press, 1972.

Stevenson, J.A., Feleki, V., Rechnitzer, P. & Beaton, J.R. Effects of exercise on coronary tree size in the rat. Circulation Research, 1964, 15,265-272.

Stocksmeier, U. Words by the Editor. Psychological approach to the rehabilitation of coronary patients. Heidelberg, Germany: Springer-Verlag, 1976.

Sundberg, N.D. Assessment of persons. Englewood Cliffs, N.J.: Prentice-Hall, 1977.

Taylor, H.L., Klepetar, E., Keys, A., Parlin, W., Blackburn, H. & Puchner, T. Death rates among physically active and sedentary employees of the railroad industry. The American Journal of Public Health, 1962, 52,1967-1975.

Theorell, T. & Rahe, R.H. Psychosocial factors and myocardial infarction. (An inpatient study in Sweden) The Journal of Psychosomatic Research, 1971, 15,25-31

White, P.D. Personal communications. September, 1969.

Wenger, N.K. Coronary care: Rehabilitation after myocardial infarction. New York: American Heart Association, 1973.

Wintner, I., Kellerman, J.J. Psychological factors involved in cardiac rehabilitation. In Stocksmeier, U. (Ed.) Psychological approach to the rehabilitation of coronary patients. Heidelberg, Germany: Springer-Verlag, 1976.

Zohman, L.R., & Tobis, J.S. Cardiac Rehabilitation. New York: Grune & Stratton, 1970.

APPENDICES

APPENDIX A

CAPRI FORMS:

- Physician Referral Form
- Bruce Treadmill Test Protocol
- FAI Nomograms - Men and Women
- Medical History Questionnaire
- Informed Consent Form
- Exercise Tolerance Test-Work Sheet
- Exercise Log
- Exercise Level Description
- Summary Sheet of Physiological Data
- Summary Sheet of Psychological Data
- Study Consent Form

CAPRI

CARDIO PULMONARY
REHABILITATION PROGRAMS

7645 S.W. Capitol Highway * Portland, OR 97219 * (503) 245-2291

To refer one of your patients to the program, please complete this form and send it with a copy of his most recent ECG (the ECG at time of infarction if available) and any other pertinent records to the program office. Also, inform your patient that he should contact the program office to complete registration and obtain additional information.

NAME OF PATIENT _____ Phone _____ Age _____

STREET ADDRESS _____ CITY _____ Zip _____

HISTORY: Please indicate the history of and date of onset of any of the following (past or present).

CARDIAC

Myocardial Infarction (type) _____ Date(s) _____
Diagnosed by enzyme ___ Values _____ ECG _____ Other _____
Angina Pectoris _____ Date of onset _____ Precipitated by _____
Arrhythmias (type) _____ Date(s) _____
Angiograph _____ Date(s) _____
Cardiac Surgery _____ Date(s) _____

PULMONARY

Emphysema _____ Date _____ Chronic Bronchitis _____ Date(s) _____
Pulmonary Surgery (type) _____ Date(s) _____
Other Pulmonary _____ Date(s) _____

OTHER

Diabetes (type) _____ Date _____ Gout _____ Date(s) _____
Other Chronic Diseases _____
Physical Disabilities _____
Present Medications (with dosage) _____
_____

RESULTS OF LATEST BLOOD STUDIES - (Important for pre-entry evaluation) Date _____

Cholesterol _____ Triglyceride _____ Blood Sugar _____
Uric Acid _____ Hemoglobin _____ Hematocrit _____

I hereby recommend the above named patient to the Cardio-Pulmonary Rehabilitation Program.

Please return promptly to:
CAPRI Rehabilitation Program
7645 SW Capitol Highway
Portland, Oregon 97219
(503) 245-2291

X _____
Referring Physician _____
Street Address _____
City, State, Zip _____
Phone _____ Date _____

CARDIO-PULMONARY REHABILITATION PROGRAM
TREADMILL TEST PROTOCOL

INTRODUCTION

The protocol outlined below is that developed over the past several years by Bruce, Doan, et al, at the University of Washington. The protocol has been modified to suit the specific needs of the rehabilitation program. It is designed to achieve the following objectives:

1. Quantitative assessment of functional aerobic capacity in order to define degree of impairment
2. Quantitative determination as to the effectiveness or ineffectiveness of the exercise rehabilitation regime (both prospectively and retrospectively)
3. Subjective observation of the patient's response to exercise

The basic goal of the test is to provide the necessary information to adequately prescribe beginning workloads and a rate of progression that is suitable to the patient's capabilities.

The test is a multistage test without arbitrary limits – it measures the patient's maximum functional aerobic capacity. The nature of the treadmill exercise makes it largely involuntary, hopefully minimizing the subjective factors resulting from submaximal testing.

SCHEDULING

The treadmill test requires approximately one hour of the patient's time. In order to maintain efficiency several tests will be scheduled consecutively. Scheduling of tests will be accomplished by the director of the rehabilitation program. Consideration will be given to the convenience of the patient.

PATIENT INSTRUCTIONS

1. Patients must have attended an orientation meeting prior to the test.
2. The referring physician's referral form and the patient's admission application form must be completed and returned prior to the test.
3. There must be an informed consent form signed by each patient undergoing a treadmill test.
4. Patients must fast for three (3) hours preceding the test.
5. Patients should bring gym shoes for the test. Shorts are provided through the rehabilitation program.
6. No smoking for one (1) hour prior to the test.

7. No exercise of significance on the day of the test.
8. Patients will take all prescribed medications as on any normal day.
9. Patients on Pronestyl and Quinidine should be monitored closely for excessive tachycardia due to vagolytic effect. Patients on beta-blockers or catecholamine depleters (Propranolol, Reserpine) must be watched for failure.

METHODOLOGY OF TEST

1. Patient is required to lay down and relax for approximately ten (10) minutes.
2. Technician should perform full ECG, plus long lead II immediately prior to test.
3. History, stressing recent changes in symptoms, must be taken immediately prior to test.
4. Contraindications to performing test:
   a. Changing cardiac condition on resting ECG
   b. Evidence of congestive failure
   c. Arrhythmias:
      (1) Third degree AV block
      (2) Second degree AV block
      (3) Paroxysmal atrial tachycardia (at rest)
      (4) Atrial flutter (at rest)
5. Patient will be attached to monitoring equipment as follows:
   a. One (1) electrode on V4 position.
   b. One (1) electrode in V5 position
   c. One (1) electrode on right shoulder blade

   (These may be varied as needed to get satisfactory complexes)
6. Sit patient on chair on treadmill.
7. Physician obtains resting blood pressure.
8. Obtain one (1) strip of V5 while patient is still in sitting position.
9. Obtain one (1) strip of V5 with patient in a standing position on the treadmill.
10. Begin treadmill.
11. Patients should use rail for minimal support only.

12. Take patient through all stages, increasing speed and grade every three (3) minutes as listed below:

Stage	Speed	Grade	Duration
I	1.7 MPH	10%	3 minutes
II	2.5 MPH	12%	3 minutes
III	3.4 MPH	14%	3 minutes
IV	4.2 MPH	16%	3 minutes
V	5.0 MPH	18%	3 minutes
VI	5.5 MPH	20%	3 minutes
VII	6.0 MPH	22%	3 minutes

13. Get paper write-out at end of each minute or as indicated by M.D. Mark stages and grade.

14. Obtain blood pressure at first and third minute of each stage.

15. This test is designed to measure maximal exercise tolerance. The patient should continue until he feels subjectively he can go no further, i.e., short windedness, leg fatigue, significant chest pain. In addition, he should be instructed to stop in the event of lightheadedness, dizziness, nausea, or visual disturbances. The physician should closely observe the patient and stop the test in the event of ataxia and/or head nodding (indicating cerebral ischemia), unusual pallor or cold moist skin, suggesting falling blood pressure, or objective signs of excessive dyspnea or chest pain. The test should also be stopped if the blood pressure exceeds prudent limits. ECG indications for termination include three (3) consecutive PVC's, multifocal PVC's, paroxysmal atrial tachycardia, atrial flutter or fibrillation, ventricular bigeminy, intraventricular conduction defects.

16. Immediately following treadmill exercise place patient in chair and take ECG write-out and blood pressure. Repeat at two (2) minute intervals until normal. Require patient to remain seated in chair until blood pressure is back to normal (usually this requires five (5) minutes). If there is lightheadedness or hypotension, patient should be put in trendelenberg (head down on treadmill).

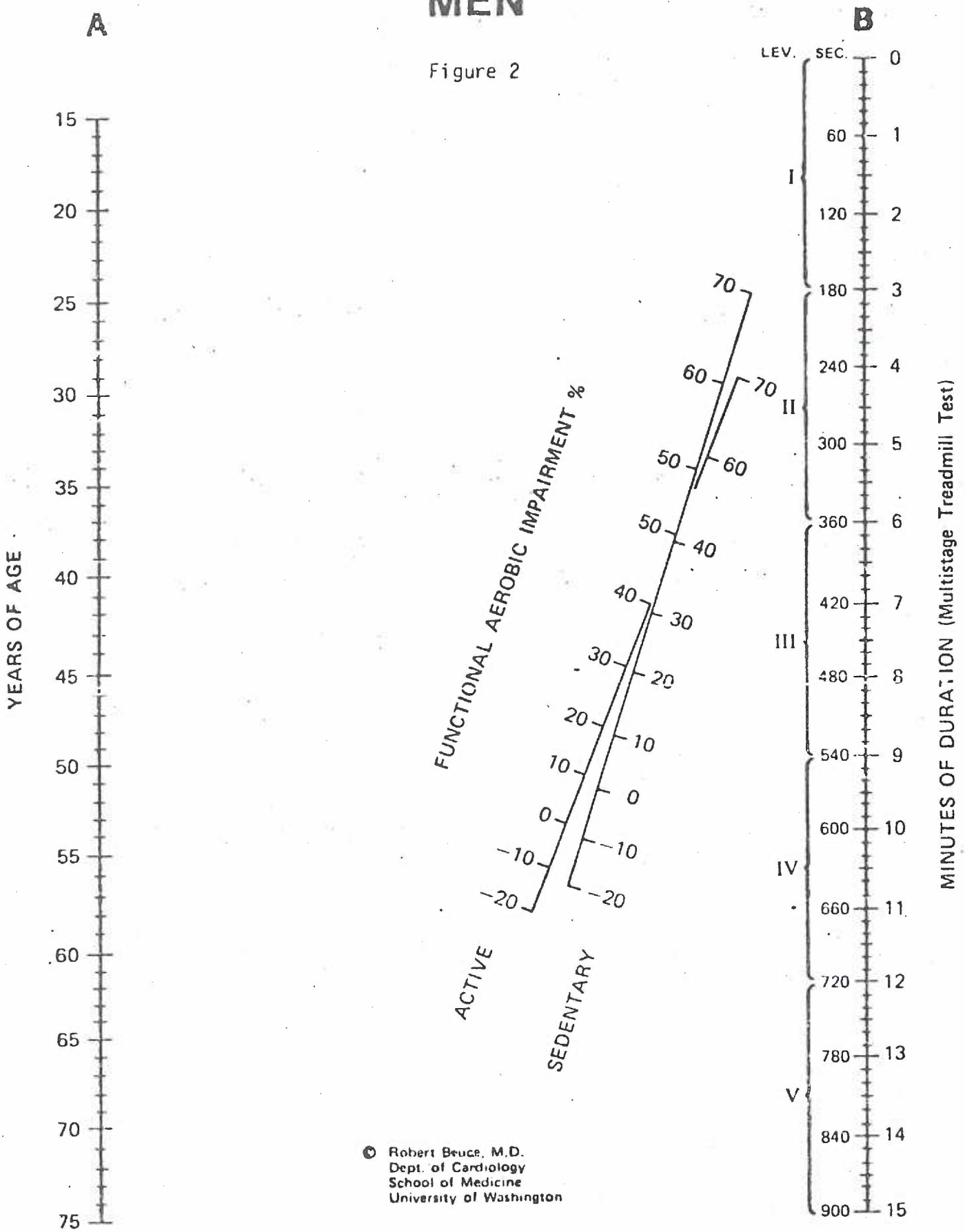
17. Have patient take a tepid, not hot, shower and dress.

EMERGENCY DRUGS AND EQUIPMENT TO BE AVAILABLE

Isuprel
Aramine
Propranolol Hydrochloride (1cc amps)
Neo Synephrine 0.2%
Nitro Glycerine
Digoxin 0.5 mg. injection
Pronestyl
Xylocaine 2%
Atropine Sulfate
Pacemaker
Ambu Bag, Airway
Cedilanid
Epinephrine

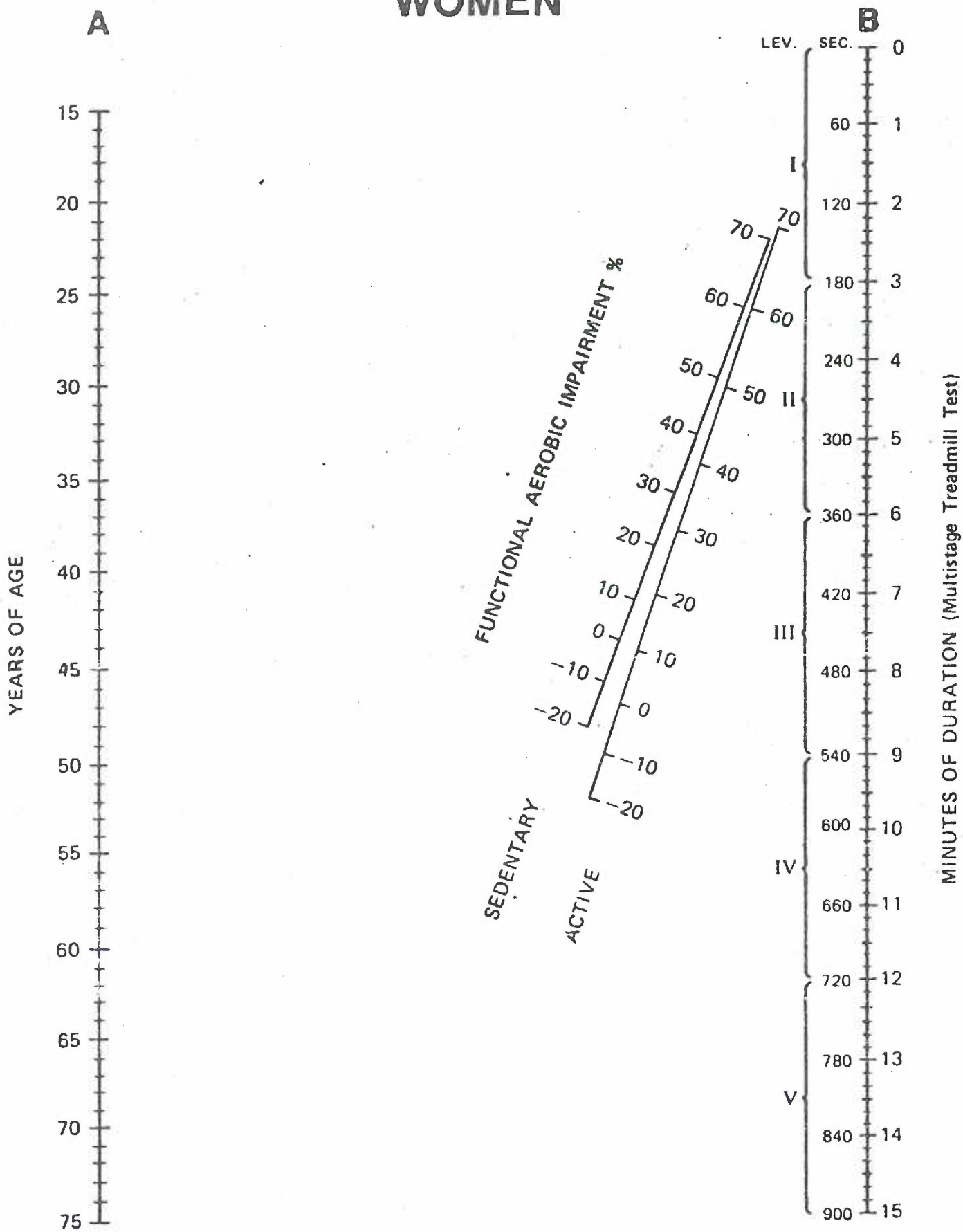
MEN

Figure 2



© Robert Bruce, M.D.
Dept. of Cardiology
School of Medicine
University of Washington

WOMEN


A
B
YEARS OF AGE
15
20
25
30
35
40
45
50
55
60
65
70
75
FUNCTIONAL AEROBIC IMPAIRMENT %
70
60
50
40
30
20
10
0
-10
-20
SEDENTARY
ACTIVE
LEV.
SEC.
I
II
III
IV
V
0
60
120
180
240
300
360
420
480
540
600
660
720
780
840
900
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
MINUTES OF DURATION (Multistage Treadmill Test)

CAPRI
Cardio-Pulmonary Rehabilitation Program
914 East Jefferson Street
Seattle, Washington 98122
(206) 323-7550

Note - Mark with a "✓" if you know the answer; if unsure, leave blank. Please Print!

Name: _____ Age: _____ Date: _____

HISTORY: Mark with check or complete the following:

A. Do you feel well: Yes _____ No _____

B. Do you have or have you had:

1. Angina Pectoris/Chest Discomfort Yes _____ No _____
2. Heart Attack (or Myocardial Infarction) Yes _____ No _____
3. Congestive Heart Failure Yes _____ No _____
4. Palpitations Yes _____ No _____
5. High Blood Pressure Yes _____ No _____
6. Diabetes Yes _____ No _____
7. Stroke Yes _____ No _____
8. Pain in Leg on Walking Yes _____ No _____
9. Arteriography Yes _____ No _____
10. Heart Surgery Yes _____ No _____
11. Currently Smoking Yes _____ No _____
    a) If Yes, how long _____ How much _____
    b) If ever smoked, how long _____ How much _____ When Stopped _____
12. Asthma Yes _____ No _____
13. Emphysema Yes _____ No _____
14. Elevated Cholesterol - (Value _____ Date _____) Yes _____ No _____
15. Elevated Triglyceride - (Value _____ Date _____) Yes _____ No _____

C. Family History (mother, father, grandparents, aunts, uncles, brothers, sisters - give ages if known)

1. Sudden Cardiac Death Yes _____ No _____ Who _____
2. Heart Attack Yes _____ No _____ Who _____
3. Heart Failure Yes _____ No _____ Who _____
4. High Blood Pressure Yes _____ No _____ Who _____
5. Stroke Yes _____ No _____ Who _____

D. Medications (please list)

Name	Dosage
_____	_____
_____	_____
_____	_____

E. Comments: _____

_____

Signed _____ Date _____

UNIVERSITY OF WASHINGTON

CONSENT FOR EXERCISE TESTING AND DATA REGISTRATION

After a preliminary clinical examination, including electrocardiogram (ECG) at rest, I voluntarily consent to perform, with monitoring of symptoms, blood pressure and ECG responses, a multistage treadmill exercise test, which increases speed and gradient of walking every three minutes, until I experience fatigue or other symptoms that cause me to stop.

I understand that: the purpose is to determine the functional performance and/or capacity of my heart and possible causes or mechanisms of impairment and to evaluate performance in relation to comparable healthy persons. The risks of testing include occasional changes in rhythm of the heart, in blood pressure, and in less than one in a thousand cases the possibility of heart damage (especially if I take a hot shower afterwards) or sudden death (about one chance in ten thousand from experience elsewhere).

I may benefit from better understanding and management of any heart disease that I may have.

I have the right to stop the test at any time, and to prevent the release of information about my test to employers, insurance companies, etc. without additional consent.

My personal welfare is ensured by the professional supervision of the test, and if necessary appropriate medical consultation.

Any subsequent hospital admissions will be reported by my physician to the network terminal registry to aid future evaluations.

I have also had the opportunity to discuss or question the details cited above.

Signed _____

Witnessed _____

(please print)

NAME _____ Date _____

last first Da Mo Yr

ADDRESS _____

_____

city state zip

TELEPHONE _____

BIRTH DATE SEX RACE (for statistics only)

____/____ Male _____ Caucasian _____ Black _____

Mo Yr Female _____ Oriental _____ American Indian _____

Other _____ Unknown _____

REFERRING PHYSICIAN _____

last first

OFFICE ADDRESS _____

_____

city state zip

TELEPHONE _____

Subsequent Clinical Events or Hospital Admissions
(to be reported by physician via terminal)

Date	Cardiovascular*	Non-cardio-vascular	Comments	Reported

*AP = angina pectoris
SVG = coronary by-pass surgery for AP
MI = myocardial infarction
SCA = sudden cardiac arrest

SCD = sudden cardiac death (witnessed within 1 hour)
OD = operative death
LD = later postoperative death
MID = MI death
OCD = other cardiac death

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

Blue Shirt #_____

Name _____ SS# _____ Test _____ Month

Height _____ Weight _____ Age _____ Date of Test _____

	Level	Cum. Sec.	HR	BP	Rec. Min.	HR	BP
RESTING	0	0			R-0		
LEVEL 1	1-1	60			R-1		
1.7 MPH	1-2	120			R-2		
10% Grade	1-3	180			R-3		
LEVEL 2	2-1	240			R-4		
2.5 MPH	2-2	300			R-5		
12% Grade	2-3	360			R-6		
LEVEL 3	3-1	420					
3.4 MPH	3-2	480					
14% Grade	3-3	540					
LEVEL 4	4-1	600					
4.2 MPH	4-2	660					
16% Grade	4-3	720					
LEVEL 5	5-1	780					
5.0 MPH	5-2	840					
18% Grade	5-3	900					

PULMONARY FUNCTION

	PRED	ACT
FEV_1		
FVC		
FAI ____% Act. Sed.		

REASON FOR STOPPING

_____ Anxiety
_____ Dyspnea
_____ Gen'l Fatigue
_____ Chest Pain
_____ Leg Weakness
_____ Claudication
_____ Faint, Dizzy
_____ Nausea
_____ ECG Changes
_____ Abnormal BP Change
_____ Other (specify)

RESTING ECG

Rhythm _____ Rate ____
Axis _____
PR_____ QRS_____ QT_____
BP_____
Impression: _____

TIME: Level _____ Seconds _____ TOTAL DURATION _____ sec.

PRESENT MEDICATIONS _____

COMMENTS _____

SMOKING _____ Quantity/Day _____ ALLERGIES _____

Testing Physician X _____

Lead tester's initials _____

6/75

S/E/Y/P/U

DATE _____ CAPRI EXERCISE LOG

MAX. HEART RATE _____

NAME _____

Training HR Range _____ DAY	F	M	W	F	M	W	F	M	W	F	M	W	F		
DATE	2	5	7	9	12	14	16	19	21	23	26	28	30		
EXERCISE LEVEL															
# of Nitro Pills Taken											H				
Total # of Laps WALKED											O				
Total # of Laps JOGGED											L				
Laps jogged NON-STOP											I				
Pulse count immediately after first and last set of jogging											D				
											A				
Complete Group Assignment?											Y				
Weight (each session please)															
Resting Blood Pressure (2x / month)															
* BICYCLE USE ONLY *															
Total # KM's															
KM's NON-STOP											N				
Pulse Count after first & last KM											O				
* SYMPTOMS *															
IF YOU EXPERIENCE ANY OF THE SYMPTOMS BELOW															
1. Anxiety															
2. Shortness of Breath											C				
3. General Fatigue											L				
4. Chest Pain in Class											A				
5. Chest Pain outside Class											S				
6. Leg Weakness/Cramps											S				
7. Faint, Dizzy															
8. Nausea															
9. Palpitations															
10. Other															

Medications	Dosage (Amount)	# Tabs Per Day	If Discontinued Mark Date	If Changed Mark Date

CAPRI

EXERCISE LEVEL DESCRIPTION

GROUP	1	2	3	4	5	6	7	8	9	10
WARM-UP		Walk 3	Walk 3	Walk 3	Walk 3	Walk 3	Walk 3	Walk 3	Walk 3	Walk 3
WALK & JOG	Walk 4 Slow Walk 4 Fast Walk 4 Slow	Jog ½ Walk 2 Jog ¼ Walk 2 Jog ½ Walk 2	Jog 1 Walk 2 Jog ½ Walk 2 Jog 1 Walk 2	Jog 1 Walk 2 Jog 1½ Walk 2 Jog 1 Walk 2	Jog 2 Walk 2 Jog 3 Walk 2 Jog 2 Walk 2	Jog 4 Walk 2 Jog 4 Walk 2 Jog 4 Walk 2	Jog 6 Walk 2 Jog 6 Walk 2	Jog 8 Walk 2 Jog 8 Walk 2	Jog 12 Walk 3 Jog 4 Walk 2	Jog 16 Walk 3
CALS.	6	7	8	9	10	11	12	13	14	15
WALK & JOG	Walk 4 Slow Walk 4 Fast Walk 4 Slow	Walk 2 Jog ½ Walk 2 Jog ¼ Walk 2 Jog ½	Walk 2 Jog 1 Walk 2 Jog ½ Walk 2 Jog 1	Walk 2 Jog 1 Walk 2 Jog 1½ Walk 2 Jog 1	Walk 2 Jog 2 Walk 2 Jog 3 Walk 2 Jog 2	Walk 2 Jog 3 Walk 2 Jog 3	Walk 2 Jog 3 Walk 2 Jog 4	Walk 2 Jog 5 Walk 2 Jog 5	Walk 2 Jog 5 Walk 2 Jog 5	Walk 2 Jog 10
TRAIN DOWN		Walk 2	Walk 2	Walk 2	Walk 2	Walk 2	Walk 2	Walk 2	Walk 2	Walk 2
TOTAL LAPS WALKED	24 (1.5 mi.)	17	17	17	17	15	13	13	14	10
TOTAL LAPS JOGGED	0	2½	5	7	14	18	19	26	26	26

16 Laps = 1 mile

CAPRI
CARDIO-PULMONARY REHABILITATION PROGRAM
EXERCISE LEVEL DESCRIPTION

GROUP & ACTIVITY	11	12	13	14	15
WARM-UP	WALK 3	WALK 3	WALK 3	WALK 3	WALK 3
WALK & JOG	JOG 18 WALK 3	JOG 20 WALK 3	JOG 22 WALK 3	JOG 25 WALK 3	JOG 27 WALK 3
CALS	15	15	15	15	15
WALK & JOG	WALK 2 JOG 11	WALK 2 JOG 14	WALK 2 JOG 16	WALK 2 JOG 18	WALK 2 JOG 21
TRAINDOWN	WALK 3	WALK 3	WALK 3	WALK 3	WALK 3
TOTAL WALKED	11	11	11	11	11
JOGGED NON-STOP	18 (1.1 mi.)	20 (1.25 mi.)	22 (1.4 mi.)	25 (1.6 mi.)	27 (1.7 mi.)
JOGGED TOTAL	29 (1.8 mi.)	34 (2.1 mi.)	38 (2.4 mi.)	43 (2.7 mi.)	48 (3.0 mi.)

16 Laps = 1 mile

8/74

COMPARATIVE INFORMATION ON

EXERCISE TOLERANCE TEST RESULTS

NAME _____

AGE					
WEIGHT					
DATE OF TEST		/ /	/ /	/ /	/ /
EXERCISE TOLERANCE					
HEART RATE	REST				
	SUB-MAXIMAL*				
	MAXIMAL				
	RECOVERY**				
BLOOD PRESSURE	REST				
	SUB-MAXIMAL*				
	MAXIMAL				
	RECOVERY**				
REASON FOR STOPPING					
PRP/100					
FAI					
MEDICATIONS / COMMENTS					

* Recorded at 3 minutes of Level 1.
** Recorded at 5 minutes of Recovery.

PRP/100 = (max HR x max SBP) ÷ 100
FAI = Functional Aerobic Impairment

SUMMARY SHEET FOR PSYCHOLOGICAL DATA

Number:

Sex:

Date entered CAPRI program:

Age:

Date of original testing:

BDI

STAI x-1 = x-2 =

Date of first re-test:

BDI

STAI x-1 = x-2 =

CONSENT FOR HUMAN RESEARCH PROJECT

I, _____, herewith agree to serve as a subject in the investigation named, Physiological and Psychological Effects of a Cardiac Rehabilitation Exercise Training Program, conducted by Marian C. Erbele, under the supervision of May Rawlinson, Ph.D. The investigation aims at finding what physiological and psychological improvements occur during 36 exercise training sessions in a cardiac rehabilitation program named Cardio-Pulmonary Research Institute (CAPRI).

It is my understanding that I will be required to answer questions on two short tests. The questions relate to psychological measures of mood states. The time required of me is about twenty minutes. The required exercise tolerance test will take about one hour of my time.

All information that I give will be handled confidentially. My annonymity will be maintained on all documents, which will be identified by means of code numbers.

I may not receive any direct benefits from participating in this study but understand that my contribution will help expand the degree of knowledge in regard to the rehabilitation of persons who have coronary artery disease.

Dick Frederick or Marian Erbele, at the Seattle and Portland CAPRI sites, have offered to answer any questions I might have about the tasks required of me in this study.

I understand that I am free to withdraw from participation in this investigation at any time without this decision otherwise affecting my participation in CAPRI; or my treatment at the CAPRI program.

I have read the above explanation and agree to participate as a patient in the study described.

Signature _____

Witness _____

Date: _____

APPENDIX B

Data Collection Instruments

A-State Scale - Form x-1
A-Trait Scale - Form x-2
Beck Depression Inventory

SELF-EVALUATION QUESTIONNAIRE

Developed by C. D. Spielberger, R. L. Gorsuch and R. Lushene

STAI FORM X-1

NAME _____ DATE _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *feel* right now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	①	②	③	④
2. I feel secure	①	②	③	④
3. I am tense	①	②	③	④
4. I am regretful	①	②	③	④
5. I feel at ease	①	②	③	④
6. I feel upset	①	②	③	④
7. I am presently worrying over possible misfortunes	①	②	③	④
8. I feel rested	①	②	③	④
9. I feel anxious	①	②	③	④
10. I feel comfortable	①	②	③	④
11. I feel self-confident	①	②	③	④
12. I feel nervous	①	②	③	④
13. I am jittery	①	②	③	④
14. I feel "high strung"	①	②	③	④
15. I am relaxed	①	②	③	④
16. I feel content	①	②	③	④
17. I am worried	①	②	③	④
18. I feel over-excited and "rattled"	①	②	③	④
19. I feel joyful	①	②	③	④
20. I feel pleasant	①	②	③	④

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SELF-EVALUATION QUESTIONNAIRE

STAI FORM X-2

NAME _____ DATE _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	①	②	③	④
22. I tire quickly	①	②	③	④
23. I feel like crying	①	②	③	④
24. I wish I could be as happy as others seem to be	①	②	③	④
25. I am losing out on things because I can't make up my mind soon enough	①	②	③	④
26. I feel rested	①	②	③	④
27. I am "calm, cool, and collected"	①	②	③	④
28. I feel that difficulties are piling up so that I cannot overcome them	①	②	③	④
29. I worry too much over something that really doesn't matter	①	②	③	④
30. I am happy	①	②	③	④
31. I am inclined to take things hard	①	②	③	④
32. I lack self-confidence	①	②	③	④
33. I feel secure	①	②	③	④
34. I try to avoid facing a crisis or difficulty	①	②	③	④
35. I feel blue	①	②	③	④
36. I am content	①	②	③	④
37. Some unimportant thought runs through my mind and bothers me	①	②	③	④
38. I take disappointments so keenly that I can't put them out of my mind	①	②	③	④
39. I am a steady person	①	②	③	④
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	①	②	③	④

BECK DEPRESSION INVENTORY

This is a questionnaire. On the questionnaire are a number of groups of statements. You are to read all the statements in a group and then circle the number corresponding to the one statement that best describes the way you feel today, that is, right now. Remember, read all the statements in a group before choosing the one that best describes you.

A.

1. I do not feel sad.
2. I feel blue or sad.
3. I am blue or sad all the time and I can't snap out of it.
4. I am so sad or unhappy that it is quite painful.
5. I am so sad or unhappy that I can't stand it.

B.

1. I am not particularly pessimistic or discouraged about the future.
2. I feel discouraged about the future.
3. I feel I have nothing to look forward to.
4. I feel that I won't ever get over my troubles.
5. I feel that the future is hopeless and that things cannot improve.

C.

1. I do not feel like a failure.
2. I feel I have failed more than the average person.
3. I feel I have accomplished very little that is worthwhile or that means anything.
4. As I look back on my life all I can see is a lot of failure.
5. I feel I am a complete failure as a person (parent, husband, etc.)

D.

1. I am not particularly dissatisfied.
2. I feel bored most of the time.
3. I don't enjoy things the way I used to.
4. I don't get satisfaction of of anything anymore.
5. I am dissatisfied with everything.

E.

1. I don't feel particularly guilty.
2. I feel bad or unworthy a good part of the time.
3. I feel quite guilty.
4. I feel bad or unworthy practically all the time now.
5. I feel as though I am very bad or worthless.

F.

1. I don't feel I am being punished.
2. I have a feeling that something bad may happen to me.
3. I feel I am being punished or will be punished.
4. I feel I deserve to be punished.
5. I want to be punished.

G.

1. I don't feel disappointed in myself.
2. I am disappointed in myself.
3. I don't like myself.
4. I am disgusted with myself.
5. I hate myself.

H.

1. I don't feel I am any worse than anybody else.
2. I am critical of myself for my weaknesses or mistakes.
3. I blame myself for my faults.
4. I blame myself for everything bad that happens.

I.

1. I don't have any thoughts of harming myself.
2. I have thoughts of harming myself but I would not carry them out.
3. I feel I would be better off dead.
4. I feel my family would be better off if I were dead.
5. I would kill myself if I could.

J.

1. I don't cry any more than usual.
2. I cry more now than I used to.
3. I cry all the time now; I can't stop it.
4. I used to be able to cry but now I can't cry even though I want to.

K.

1. I am no more irritated now than I ever am.
2. I get annoyed or irritated more easily than I used to.
3. I feel irritated all the time.
4. I don't get irritated at all at the things that used to irritate me.

L.

1. I have not lost interest in other people.
2. I am less interested in other people now than I used to be.
3. I have lost most of my interest in other people and have little feeling for them.
4. I have lost all my interest in other people and don't care about them at all.

M.

1. I make decisions about as well as ever.
2. I try to put off making decisions.
3. I have great difficulty in making decisions.
4. I can't make any decisions at all any more.

N.

1. I don't feel I look any worse than I used to.
2. I am worried that I am looking old or unattractive.
3. I feel that there are permanent changes in my appearance and they make me look unattractive.
4. I feel that I am ugly or repulsive looking.

O.

1. I can work about as well as before.
2. It takes extra effort to get started at doing something.
3. I don't work as well as I used to.
4. I have to push myself very hard to do anything.
5. I can't do any work at all.

P.

1. I can sleep as well as usual.
2. I wake up more tired in the morning than I used to.
3. I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
4. I wake up early every day and can't get more than 5 hours sleep.

Q.

1. I don't get any more tired than usual.
2. I get tired more easily than I used to.
3. I get tired from doing anything.
4. I get too tired to do anything.

R.

1. My appetite is no worse than usual.
2. My appetite is not as good as it used to be.
3. My appetite is much worse now.
4. I have no appetite at all any more.

S.

1. I haven't lost much weight, if any, lately.
2. I have lost more than 5 pounds.
3. I have lost more than 10 pounds.
4. I have lost more than 15 pounds.

T.

1. I am no more concerned about my health than usual.
2. I am concerned about aches and poins or upset stomach or constipation.
3. I am so concerned with how I feel or what I feel that it's hard to think of much else.
4. I am completely absorbed in what I feel.

APPENDIX C

Statistical Data

Individual Scores for Correlation Matrix

SUBJECT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	51	2	2	9	3	36	27	30	27	39	30	39	487	465	88	315	315	70	102	99	97
2	68	1	1	7	9	28	32	42	20	42	42	30	390	501	221	147	146	69	85	110	125
3	63	2	2	6	1	35	36	26	40	31	31	30	375	388	123	196	209	83	96	98	102
4	53	1	1	13	6	37	44	34	40	38	33	35	480	375	105	324	302	47	80	63	83
5	58	1	1	5	9	26	30	29	31	32	34	28	316	360	154	246	256	80	56	66	110
6	53	1	1	8	5	33	54	47	37	46	41	35	340	404	174	231	224	63	56	68	112
7	54	1	1	6	3	33	25	24	31	24	27	27	360	360	110	103	90	57	61	61	100
8	43	1	1	21	22	29	28	40	18	48	56	22	112	218	216	196	252	126	20	32	112
9	65	1	1	16	13	33	42	46	26	47	47	30	487	463	86	214	230	86	100	95	95
10	41	1	1	5	2	33	39	52	17	31	36	25	525	593	178	274	283	79	74	83	109
11	62	1	2	21	25	26	60	62	28	62	57	35	222	180	68	250	220	40	44	36	88
12	46	1	1	11	18	23	36	36	30	48	49	29	409	400	101	306	340	104	62	61	99
13	59	1	1	2	0	32	22	27	25	23	20	33	587	660	183	288	280	62	109	122	113
14	62	1	1	6	6	30	52	47	35	42	37	35	430	480	160	243	237	64	85	94	109
15	63	1	2	1	2	29	23	37	16	22	20	32	540	567	137	341	288	17	109	113	104
16	44	2	2	10	12	28	52	23	59	46	38	38	180	313	243	279	253	44	44	66	122
17	54	1	2	4	0	34	38	34	34	35	34	31	470	529	169	295	333	108	80	90	110
18	50	1	2	3	7	26	34	33	32	33	30	33	351	335	94	206	142	6	56	54	98
19	48	1	1	4	2	32	25	25	30	32	26	36	549	575	145	215	273	128	85	91	106
20	56	1	1	14	2	42	65	34	61	34	32	32	410	420	120	216	234	88	73	75	102
21	43	2	1	13	4	39	38	20	48	38	35	33	306	520	324	320	301	51	64	98	134
22	61	1	2	4	1	33	20	20	30	20	20	30	405	455	160	270	263	63	76	90	114
23	59	1	1	5	6	29	30	24	36	43	40	33	347	381	144	156	161	75	64	72	108
24	50	1	1	6	3	33	41	24	47	35	28	37	510	600	200	228	281	123	82	99	117
25	54	1	1	5	9	26	47	26	51	33	31	32	450	540	200	304	264	30	76	92	116
26	54	1	1	9	6	33	46	41	35	43	39	34	354	329	85	270	200	0	60	56	96
27	31	2	2	9	2	37	46	48	28	52	43	39	418	429	121	278	216	8	72	74	102
28	58	2	1	8	9	29	25	23	32	32	36	26	180	378	308	203	277	142	58	83	125
29	54	1	1	0	0	30	43	34	39	33	34	29	526	591	175	153	156	73	88	100	112
30	63	1	1	4	4	30	46	35	41	29	24	35	540	540	110	305	270	35	109	108	99

AN ABSTRACT OF THE CLINICAL INVESTIGATION OF

MARIAN ERBELE

for the Master of Nursing

Date of Receiving this Degree: June 9, 1978

Title: PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF A CARDIAC REHABILITATION EXERCISE TRAINING PROGRAM

Approved: _____
Professor in Charge of Clinical Investigation

The purpose of this investigation was to study the physiological and psychological effects of exercise training on subjects with coronary heart disease. These subjects were participants in CAPRI, a community rehabilitation program that was supervised by medical and nursing personnel.

The study sample represented 30 subjects who completed 36 exercise training classes during this nine-month study. The study was descriptive and longitudinal in design. One group, serving as their own control, was tested before and after exercise training.

The focus of the study was the utilization of the independent variable, exercise training, as described by the CAPRI program. The dependent variables were divided into two categories, encompassing physiological and psychological measurements. The physiological variables were further divided into exercise tolerance time, pulse-rate product, and functional aerobic impairment. All physiological measurements were obtained from a maximal exercise tolerance test, both pre-post exercise training. The

three psychological dependent variables considered were state anxiety, trait anxiety, and depression. The psychological data were also collected immediately prior to training and at the completion of 36 exercise training sessions by the use of two instruments, the Beck Depression Inventory (BDI) and the State-Trait Anxiety Inventory (STAI). The paired t-test and the correlation matrix was used to analyze the data.

Comparisons of pre-post physiological test scores showed that exercise training significantly increased the exercise tolerance time, or work capacity, of the subjects. Further comparisons of the subjects in the present study to a normal population revealed a significant reduction in functional aerobic impairment following exercise training. The changes in the pulse-rate product between pre and post testing were insignificant.

Psychological test scores confirmed that most subjects entering the CAPRI exercise training program had little or no depression, consequently changes in pre-post test scores were minimal. Trait anxiety test scores improved significantly following 36 training sessions. Although state anxiety scores remained below the level of significance, a definite trend in improvement was evident from the data. Examination of the intercorrelation of changes in the pre-post test scores revealed that no significant correlation existed between the physiological and psychological variables.