A STUDY OF THE RELATIONSHIP OF PARTICIPATION IN AN EXERCISE PROGRAM TO THE DEVELOPMENT OF CARDIOVASCULAR FITNESS

by

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CHAPTER I

INTRODUCTION

Heart disease ranks first among the leading causes of death in 12 of the highly industrialized nations of the world, namely the United States of America, Canada, West Germany, France, The United Kingdom, Switzerland, Denmark, Sweden, Australia, The Netherlands, Norway and Finland. (5) In the United States, heart and blood vessel disease accounted for 1,048,383 deaths in 1968. Cancer with 318,547 deaths and accidents with 114,864 deaths were listed as second and third causes of death. (1)

It is currently estimated that 27 million Americans are afflicted with cardiovascular disease. Of these, more than 21 million are afflicted by hypertension, 3,750,000 by coronary heart disease, 4,650,000 by rheumatic heart disease and 1,600,000 by stroke. (1)

Heart attack, or myocardial infarction, claimed 674,747 lives in 1968. The attack, frequently sudden and without warning, has a mortality rate of 40 per cent for the victims of the very first attack either immediately or within six weeks Nearly one out of five of these victims die within the first hour. (2)

While the heart attack is frequently sudden in onset and rapidly fatal, the factors which are generally associated with its development

have been shown to exist for 10 or 20 years and even a lifetime. A mild hereditary influence has been shown in the development of cardiovascular disease. (2) Hereditary factors become statistically significant when relatives have died from heart disease between the ages of 40 and 60. This same significance is not shown when relatives have died from heart disease beyond the age of 60. Some authorities account for as much as 80 per cent of the familial tendency toward heart disease by such habits and tendencies as obesity, hypertension, excessive blood cholesterol, diabetes, heavy smoking and inactivity. (2)

Many current studies attempt to identify associated factors of arteriosclerotic heart disease which circumvent the implications of causation. (33) Those associated factors, or risk factors, predispose the individual to the development of coronary artery disease but may or may not be causally related. From the point of view of prevention, however, there is reason to believe that manipulation of these factors may alter the future development of coronary artery disease. (33)

History is rife with situations which clearly demonstrate that control of various epidemic diseases is possible before their causes are fully understood. For example, Edward Jenner was unable to identify the virus that caused smallpox but through his epidemiological efforts, the control of smallpox was begun. Semmelweis and Lister also began the control of contagious disease without a complete knowledge of the causative factors. In a similar manner, the high incidence

of cardiovascular disease might also be reduced.

The associated risk factors most often enumerated in the incidence of heart disease include: elevated concentrations of serum cholesterol and triglycerides, hypertension, smoking, obesity, physical inactivity, diabetes mellitus, hereditary hypercholesterolemic xanthomatosis, myxedema and hypothyroidism and certain social and psychological factors. (33, 39)

The Framingham study demonstrated that the incidence of coronary artery disease rises progressively as risk factors are combined. Evaluations of serum concentrations of cholesterol, blood pressure level and the presence or absence of left ventricular hypertrophy were conducted among more than 5,000 men and women aged 30 to 62 years. Abnormality in respect to one of these characteristics was associated with three times the incidence of heart disease found when all three characteristics were normal. Abnormality of two of these risk characteristics increased the incidence of heart disease six times that found when all three characteristics were normal. (11)

The morbidity ratio for all forms of coronary heart disease for those who were high on two of these three characteristics was 16 times higher than those who were low on all three characteristics. Though the magnitude of the increase in risk varies depending on which factors are combined, there is an augmentation of risk when more than one factor is present. There is little doubt that absence of risk factors

is distinctly advantageous since there is relatively low incidence of coronary heart disease without them. (7)

The control of any disease depends upon knowledge of the nature of the problem. Coronary disease is, as far as is known, a chronic non-infectious disease. It begins in childhood and progresses with age. The mortality rate from this disease has been increasing steadily in the United States over the years. Statistical studies have shown a very high immediate mortality from an acute heart attack as well as a shortened life span for those who do survive the initial high mortality period. It then becomes obvious that every effort should be made to prevent at least the clinical manifestations of the disease process if not the process itself. (7)

Prevention is the ultimate aim in any control program. This should include prevention of the disease in persons before it ever appears (primary prevention) and prevention of recurrent disease in persons who have already suffered one or more manifestations of the disease (secondary prevention).

The importance of this problem has been clearly stated by Steinfeld, the Surgeon General of the United States Department of Health, Education and Welfare, in the following words. (34)

> Attitudinal and behavioral change based upon a sound knowledge about the impact of the personal environment of health could produce a significant improvement in the health status of the Americans--and this includes physical fitness, nutrition, smoking, alcohol and drug abuse. . . I want to

> point out that health professionals and other leaders concerned with health status cannot assume total responsibility for an individual's health status. . . . The individuals must seek and act upon health information.

Steinfeld further emphasized the effect of health on society in the following words.

> Health status affects an individual's way of life and his ability to deal with life's experiences. The health status of a nation's citizens also affects the strength and moral fiber of the nation. Society must make the required efforts to provide access to, and availability of, health care.

In 1972, the estimated economic costs of cardiovascular disease alone in the United States represented an expenditure of 17.3 billion dollars. (1) Hospital and nursing home services costs were 6.4 billion. Physician and nursing services accounted for 2.0 billion. Lost wages represented a total cost of 6.9 billion. Another 2.0 billion dollars were spent on medications, research and other associated costs. Without consideration of the many other factors involved, the economic hardship of heart disease should be enough to direct the attention of all Americans to the solution of this problem.

The promotion of good health habits in the prevention as well as treatment of disease has been identified as a specific role of the nurse. (25) The widespread and serious proportions of heart disease should therefore stimulate the nurse actively to promote, encourage and participate in those practices which can be shown to lessen the incidence of heart disease. This role can also be extended to include

the encouragement and promotion of activities which have been demonstrated to maintain or improve the physical condition of those already affected by heart disease.

Review of the Literature

Vast research has been directed toward the study of exercise as it is related to the development of cardiovascular disease. For the purposes of this study, the review of the literature included a survey of recent research in regard to exercise as a means to improving heart function as well as a discussion of the stress test and other various measurements used to estimate cardiovascular function and body fitness.

In regard to recent research involved with exercise as a means to improving heart function, the studies of Morris and collaborators have contributed greatly to focusing attention on the relationship between physical activity and coronary heart disease. (23, 24) The general hypothesis they advance states, "Physical activity of work is a protection against coronary (ischemic) heart disease." Major findings of these studies revealed that men in physically active jobs had less coronary heart disease during middle-age than the less physically active men. When coronary heart disease did develop, it appeared much later in the lives of the more active men and was less severe. Morris contends that coronary heart disease represents a deprivation

syndrome in the sense that the body is deprived of an ingredient essential in the maintenance of optimum cardiovascular fitness. This is in contrast to the usual description of heart disease as a syndrome of excesses especially in regard to diet, fat consumption and smoking. Morris reached his conclusion because he was able to demonstrate that the hearts of sedentary workers with few physical demands show the same pathology as the hearts of heavy workers who were from 10 to 15 years older. The Morris study did not show the relationship of the other risk factors associated to the incidence of heart disease such as diet and smoking.

In assessing the effects of exercise on the structure and function of the heart, Ricci emphasized the Starling law which contends that the energy of the heart muscle contraction is determined by the length of the muscle fiber. (28) For this reason, if all other factors are held constant, the larger the amount of blood the ventricle can hold, the greater the strength of the contraction and the greater the amount of blood ejected into the circulation with each contraction (stroke volume). However, an increased heart rate also increases cardiac output. Ricci stressed that cardiac output is related also the ability of the ventricles to empty more completely during systole due to the increased contractility of the heart muscle. He then concluded that in the human organism, effective physical activity which results in cardiovascular pulmonary training produces a more muscular, better developed, and

slightly hypthertrophied heart with a significantly greater heart volume. (27)

Many studies have shown a relationship between physical activity and the occurence of heart disease. The evidence strongly suggests that those males who maintain a habitual level of physical activity have lower incidence of heart disease than those persons in sedentary occupations with low levels of physical activity. (7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 23, 28, 32) The "habitual" level of physical activity was of critical importance in these studies since sporadic efforts toward increasing physical activity or those attempts at physical activity that had long since been discontinued proved ineffective in producing a lower incidence of heart disease. The activity demands of occupation were essential in the development of reduced incidence of heart disease since the voluntary selection of recreational activities tends toward the less physically demanding as age increases. The Framingham study also showed that "least active" males had more than three times the risk of death from heart attacks than those males classified as "most active." (11)

The literature regarding tests to estimate cardiovascular function revealed that validation of the bicycle ergometer as a stress test has been accomplished through use in many clinical situations. The World Health Organization technical report contains the collective views of an international group of experts and recognizes the bicycle

ergometer as a desirable stress test for various reasons. (39) Most desirable in the bicycle ergometer stress test is the ease in measuring applied power. Other factors such as the ease of instrument calibration, ease of obtaining a high maximal oxygen uptake of the subject and ease of breathing for the subject being tested are also considered desirable and obtainable with the bicycle ergometer.

The international group of experts also listed such undesirable factors inherent in the upright bicycle ergometer testings as the high cost of the instrument, the occurrance of local muscle fatigue at high exercise levels and the need for neuromuscular-skeletal co-ordination of the subject. They also cited the difficulty in providing emergency care to subjects being tested on the bicycle should this become necessary. (39)

Almost all methods of assessing submaximum performance are based on the assumption that there is a relatively linear relationship between heart rate and either a steady state oxygen consumption or equivalent work rate, ranging from a certain minimum level of effort to a level of maximum aerobic work. (32) In order to determine this relationship, measurements should be made at several widely spaced levels of submaximum effort. The lowest such level should be at a pulse rate of more than 120 beats per minute and the highest should be as near the maximum as is consistent with safety and other appropriate considerations. (32)

Maximum testing involves exercise of increasing severity until no further increase of oxygen use occurs. In practical terms, this means the test continues until generalized exhausting fatigue, dyspnea or angina are achieved. It is highly recommended that all maximum testing be undertaken with the supervision of a physician and trained staff equipped to meet any medical emergency including cardiac arrest. (31) Proponents of maximal testing indicate that maximal testing is more accurate in assessment of risk for future ischemic heart disease and in diagnosis of atypical chest syndromes. Thus assessment of aerobic capacity in terms of the level of cardiovascular fitness or its complement, the degree of cardiovascular impairment, is readily accomplished with maximal testing but cannot be adequately assessed with sub-maximal testing. (21)

However, proponents of sub-maximal testing, such as Hellerstein, recognize the increased risk involved with stressing the middle-aged American to the ultimate of his cardiovascular limits. (17) It is their contention that if exercise severity is limited to levels just short of maximal, the same inferences regarding normality of coronary vessels may be drawn, although to a reduced degree of certainty. Hellerstein's work also indicates that the maximum test results in prolonged after effects of exercise stress and that post-exercise hypotension was occasionally produced. (17)

Other studies also indicate that most individuals, unless specially

trained, are unwilling or unable to exercise to maximum. (36) It would appear that psychological limits are far below the physiological limits. Thus, when untrained subjects are tested to the maximum, the question must then arise, were these maximal tests of the psyche or the physique?

Factors which may have bearing on the results of stress testing include former training, the need to excel, former athletic experience, enjoyment or fear of testing and the fear of coronary problems as well as the motivation of subjects. Other factors such as emotion and phychological stress affect heart rate as do such external factors as temperature of the room, humidity and noise. (36)

Oxygen cost per heart beat is related to the size of the left ventricle, the pressure which the ventricle develops during contraction and the rate of pressure development. Ricci emphasizes that stress testing is based on the assumption that myocardial oxygen requirement is determined by the product of oxygen cost per beat multiplied by the heart rate per minute. (28) The heart rate in exercise commonly increases as much or more than 100 per cent. Heart rate is the easily determined index of increasing myocardial oxygen requirements during exercise. (28) Thus the conclusion follows that one who can sustain maximum myocardial oxygen demands without demonstrating electrographic or symptomatic evicence of myocardial hypoxia probably has coronary circulation which is normal or nearly so. (28)

The second major assumption proposed by advocates of stress testing is that trained persons perform a given work load with a lower heart rate than persons who are not trained. (17) Hellerstein defines the difference between the trained and untrained person in the following manner. The untrained heart rate is approximately seven beats per minute higher at a standard work load as compared to the heart rate in those persons who exercise regularly. Hellerstein showed significant changes in heart rate in the subjects who trained from 2.2 to 3 hours per week. Less significant changes were recorded in those persons who trained from 1.0 to 2 hours per week. (17)

Johnson and Stolberg further describe the attribute of physical fitness as the capacity to carry out reasonable vigorous physical activities. (19) They also stress the importance of those qualities related to health and well being as opposed to merely the skill required in the performance of specific motor skills. Circulo-respiratory fitness in this sense requires the use of the body's large musculature. For a given increase in heart rate during exercise, the energy cost per beat is inversely proportional to the muscle mass being used. When the body is able to continue the use of these large muscles for long periods of time, Johnson and Stolberg define that person as physically fit. (19)

The literature regarding measurement of the proportion of body fat to lean body mass revealed the use of the tricep skin-fold area as

a determinant for obesity. (26) While tables defining the normal limits of variations of weight for height are available and widely publicized, no such standards were available for obesity until Behnke's extensive field studies in this area were completed. (4) The relation of skin-fold thickness to body fat content is virtually independent of height, permitting the establishment of a single value for each sex and age as the lower limit of obesity. The measurement of the skin-fold thickness is obtained by using a suitable caliper on selected sites and has been shown by comparison with results of other methods to give a good indication not only of subcutaneous fat (about 50 per cent of the total fat) but also of total body fat. The accepted national recommendation for the skin-fold calipers is one which exerts a pressure on the caliper face of 10 grams per square millimeter and with a contact surface of 20 to 40 millimeters.

While various sites for skin-fold measurement are acceptable, The Committee on Nutritional Anthropometry of the National Research Council has recommended the triceps and the subscapular skin-folds as good indexes of an individual's over-all fatness. (6) Because of accessibility, the triceps skin-fold site is most often preferred.

The triceps skin-fold is located at the back of the right upper arm midway between the acromion and olecranon processes. The midpoint can be marked with the aid of a steel tape. Because of the gradation of subcutaneous fat thickness from shoulder to elbow,

location of the midpoint is somewhat critical. According to Seltzer and Mayer, the triceps skin-fold is the most representative of total body fatness and no special advantage is gained in utilizing any other skin-fold in addition to the triceps skin-fold. (30)

Extensive data on the distribution of triceps skin-fold values have been obtained and show a normal variation in skin-fold values in the Caucasion population. (26, 38) This distribution of fatness within the general population represents a continuum and any cutoff point would be a practical rather than a theoretically based selection. Obesity in these terms is then described as that condition which exists when the individual's triceps skin-fold measurement exceeds the mean by more than one standard deviation. (30)

Studies conducted by Selzer and Meyer indicate that the triceps skin-fold measurement increases gradually for the first 30 years of life. At the age of 21 the minimum measurement of 17 millimeters indicates obesity while at the age of 30 the minimum measurement is 23 millimeters. From age 30 to age 50 there is no further increase in the minimum standard for obesity. (30) This suggests that further weight gain after the age of 30 represents a gain in fat tissue and may increase the risk of heart disease for the individual. (2)

Finally, it must be recognized that not all aspects of physical activity nor their effects can be readily or easily assessed. A study by Ismail and Trachtman (18) was concerned with the shift in

personality seen in men as they change from habits of inactivity to habits of heavy physical exercise. Most notable in their findings was the development of a more self-sufficient, resolute, emotionally stable and imaginative individual through exercise. Their study was not designed to determine the specific causes of these changes but rather to establish that they did indeed occur.

The study suggested two very general theories about the cause of these personality changes. 1) A physiological cause theory which holds that there are relatively direct effects of the physiological and biochemical changes of exercise such as increased circulation to the brain, thus increasing glucose to the brain, thus increasing the amount of glucose available to the brain's nutrition. 2) A general psychological theory which holds that as a man confronts a psychologically difficult challenge and overcomes it, he gains a sense of accomplishment, independence and a sense of control of his own life that he may never have had before. Whether these two causes function independently or coordinately as yet has not been suggested nor confirmed. (18)

The Purpose of the Study

The importance of the prevention of heart disease has been recognized by many authorities in the health field. Therefore the purpose of this study was to assess one of the associated risk factors

of heart disease, namely physical inactivity, and the effect of its alternative, physical activity, on the development of cardiovascular fitness. Physical activity was considered as a preventative measure as well as a rehabilitative factor in this assessment.

The opinions of many authorities cited through the literature that the individual's level of physical fitness can be evaluated through certain objective measures were accepted. This study also accepted the premise stated in the literature that the level of physical fitness is related to cardiovascular fitness and that both types of fitness may be improved through specific, endurance-type exercise. Good cardiovascular fitness was considered a desirable objective for physical exercise because of its reported associated inverse relationship to the occurrence of heart disease.

The basic concerns of this study were 1) at what level of cardiovascular fitness does the American male function, 2) what changes in the level of cardiovascular fitness can be achieved through a structured exercise program and 3) can the American male maintain whatever improvements that may have occurred following participation in a structured exercise program when he no longer attends that program?

Determination of the physical changes in men who participated in an adult fitness program for various periods of time were attempted by repeated measures of the resting and exercise pulse rates, resting blood pressures, sub-maximal bicycle ergometer test, height and

weight and skin-fold measurements.

Of interest in this study was also whether other habits considered harmful to health were affected by the change in activity level of the participants. Whatever changes that might occur in regard to diet, smoking, alcohol consumption and leisure and recreational activities were identified by use of a questionnaire. However, the questionnaire represented the evaluations on these measures as given by the subjects themselves and no validation of the information was attempted. Description of changes in life style in regard to physical activity were also attempted through the assessment of physical changes or status when former participants of an adult fitness program no longer attend that program.

CHAPTER II

METHODOLOGY

A program specifically designed to improve the physical and cardiovascular fitness of the adults in the Portland metropolitan area has been operational for more than seven years at a local state university. Until the time of this study, however, evaluation of the effects of the program on the cardiovascular fitness levels of its participants had not been conducted. It was through the permission of the director of the program and with the cooperation of the medical consultant that this study was undertaken. The study, through the comparison of groups by objective physical measurements both before participation in the exercise sessions and after, was designed to describe the physical changes that occur in the participating program members over varying lengths of time. The term, fitness, as used in this program and consequently in this study refers to the ability of the heart muscle to maintain adequate circulation under a standard work load. The expected differences between the heart rate of the individual physically trained through endurance type exercise would be approximately seven beats per minute less under the same work load than the untrained individual as defined by Hellerstein. (17) A questionnaire which was given at the time of retesting to obtain the subject's evaluation of

changes he had made in regard to diet, smoking, alcohol consumption and leisure and recreational activities.

The Program

In order better to understand the design of this study, a description of the program on which it was based is considered appropriate at this time. The program was conducted by the state university as a non-credit elective activity class specifically directed to the adult in the business community. With a physician's recommendation, it included post-myocardial infarction patients and others with related cardiovascular problems. However, the majority of participants were classified as healthy normal adults. The program was co-educational in enrollment but only males were included in this research because most of the related studies utilized data only from males.

Exercises, as utilized by the program, included walking, jogging, swimming and calisthenics on a gradually progressive basis. Participants were urged to begin on a low to moderate level which was not excessively taxing. They were encouraged gradually to increase the exercise work load over a long period of time (three months). Competition with and comparison to other members in the program were discouraged. Regular reminders to participants to check their pulse rates at frequent intervals throughout the activity period were given.

The program attempted to demonstrate the benefits of regular

exercise of a rhythmic nature which was sufficient to raise the pulse rate high enough and long enough to promote cardiovascular fitness in the individual. The recommended exercise pulse rate was individually determined from the age of the participant and his fitness level. Calisthenics were used to promote mobility and flexibility of joints and muscles, to promote muscle tone and to improve posture.

Some attempts were made to provide health teaching in regard to smoking, diet and other health measures related to the development of cardiovascular fitness but the major emphasis of the program was on activity. Each session was approximately three months in length and met for one hour three times weekly. The class size was generally about 120 men and women with ages ranging from 23 to 69 years. The cost of enrollment which included exercise clothes (except shoes), towel service, dressing room and shower facilities, and a submaximal bicycle stress test (on initial enrollment) was thirty dollars.

Michael W. Tichy, Ed. D. initiated and directed the program. The medical consultant, James E. Morris, M. D., conducted the individual stress tests. Eugene McNally, Ed. D. assisted with the program. All three persons actively participated in the exercises and provided guidance to members throughout each session as individual needs became apparent. Brief introductory lectures about basic elements in the program and general health measures as well as the role of the new participant in the activities were presented by the professionals.

Individualized counseling was provided by Dr. Morris following each stress test.

In the usual program session of three meetings each week for a 12 week period, the participants at a 70 per cent attendance level had approximately 2.1 hours of exercise training activity per week. This was described in the literature as the minimal time period that would be likely to show significant improvement in cardiovascular fitness. (17) No effort was made in this study to evaluate objectively the physical activity levels of the subjects outside of the scheduled sessions.

An understanding of how the population of the fitness group differed from the general population was considered important in the development of this study. The greatest proportion of members of the program were in the 30 to 55 year old age group. Usually they were successful business and professional persons who were highly motivated to accomplish whatever task they imposed on themselves. Their education was considerably higher than the general population as was their risk for heart attack. They were knowledgeable enough to recognize the value of prevention and were willing to spend time, money and effort to accomplish it.

Subjects

Description of the total available population for this study was necessary to develop a further understanding of the methods used in

the selection of the sample. A review of the roster for the adult fitness program during the winter term (1972) revealed that from a total population of 140 members, 20 individuals enrolled but did not come to any sessions; 56 exercised in the program less than 70 per cent of the scheduled time. The remaining 64 individuals participated at least 70 per cent of the scheduled time. As stated earlier, the 70 per cent attendance level was considered essential to the study since no change in physical or cardiovascular fitness could be expected with less than 2.1 hours per week spent in exercise. (17)

Review of the rosters in determination of the subjects also revealed a general pattern of attendance. It was found that those who attended for less than 70 per cent of the session time seldom continued for more than three months. Those who participated at the 70 per cent level or better were more likely to continue indefinitely. Consequently when using this criterion for inclusion in the study, it was difficult to devise a grouping based upon various lengths of time in the program which would illustrate the progression of physical changes presumed to occur as a result of participation in an exercise program.

The following general criteria were then established for the purpose of selecting the sample for inclusion in this study:

1. Only males in the adult fitness program at a designated state university.
2. Minimum participation in the program at the 70 per cent

attendance level. (Further reference to participation in this study will mean participation at the 70 per cent attendance level.)

3. Enrollment in the program within the two year period of January, 1971 to January, 1973.
4. Willingness to comply with demands of the follow-up study, i.e. keeping an appointment for testing and completing a questionnaire.

Design

From a total of 52 subjects who met the above criteria, a sample of 21 participated in this study. The subjects were then classified into four groups. Group I was composed of six individuals randomly selected from the total of 28 persons who had participated in the program for more than six months and had continued to participate actively. A six month participation period was arbitrarily selected for the two following reasons: 1) the effects of regular exercise on the individual's cardiovascular fitness should have been evident after that period of time, 2) at least six months time period was necessary for the establishment of a habit pattern of exercise in a formerly non-exercising individual.

Group II was composed of four persons who had participated for only six months and were currently in the program. One individual

who qualified for this group was dropped from the study when he consistently failed to report for scheduled testing appointments.

Group III was composed of six individuals who had participated for a three month period and were currently active in the program.

Group IV was composed of five persons from a pool of 13 individuals who had participated in the program for a six month period but who had not been enrolled in the program for at least three months prior to the initiation of the study. The purpose of this group was to determine if a change in exercise habits could be achieved through participation in an adult fitness program. If improvement in cardiovascular fitness could be demonstrated following regular attendance in the activities, could individuals maintain this level of fitness when they no longer attended the program?

Many of the individuals in Group IV stated that they had left the program because of changing demands of their work situation. There was, therefore, great difficulty encountered in contacting and retesting these persons. Attempts to contact three individuals by mail and telephone were unsuccessful. Among those in which contact was possible, a variety of reasons prevented them from participating in the follow-up study. One individual was unavailable because of shipboard duty at the mouth of the Columbia River at the time of retesting. One individual was unavailable because of an African business

journey, and three individuals failed to keep various scheduled appointments for re-testing.

Comparison of ages showed that Group I, or those who had been in the program for more than six months, had a range which extended from 43 to 57 years and a mean of 51 years. Group II, or those who had been in the program for only six months, had a range which extended from 27 to 59 years and the mean was 46 years. Those who had been in the program for only three months, or Group III, had a range which extended from 37 to 57 years with a mean of 42 years. Group IV which consisted of individuals who had been in the program for six months and then dropped out for at least three months, had a range of 29 to 56 years and a mean of 46 years. While Group I represented a consistently older group with a range of only 14 years, the mean age of all groups was comparable. The means and standard deviations are illustrated in Table 1.

Table 1. Age of the Participants in the Adult Fitness Study

Item	Group I	Group II	Group III	Group IV
Number	6	4	6	5
Range	43-57	27-59	34-57	29-56
Mean	51	46	42.5	46.4
Median	52.5	49	40.5	49
Standard Deviation	6.16	14.37	8.4	11

The occupations of the various individuals in the groups were also comparable. Groups I, II and IV were composed entirely of individuals whose work could be classified as sedentary. The majority were salesmen or otherwise involved with the managerial aspects of retail sales; included were two engineers, one banker and one administrator. Group III included two individuals who occupational descriptions led to some uncertainty as to the amount of activity involved. One individual listed "lumber" as his occupation but on further questioning, it was found that this work was concerned with the survey of timber areas and provided activity in the form of walking but was not as physically demanding as the cutting or trimming of timber would be. Another individual described his occupation as "foreman." On further questioning, he stated that his activities were primarily supervisory in nature so his occupation was also sedentary. Therefore, with the exception of one individual in Group III whose occupation demanded some degree of walking, all subjects were considered to be sedentary in their work.

Instruments and Stimulus Materials

There was no need to establish the validity of height, weight, blood pressure and pulse rate measurements in as much as these measures have been validated through years of use and acceptance. The scales used for this study for determination of height and weight

were "Health-O-Meter Scales" by Continental Manufacturers which are used routinely in health care facilities. These scales were checked regularly for accuracy by authorized persons. The right arm was used for blood pressure measurements which were always determined by use of the Baumanometer mercury sphygmomanometer with stethoscope. This is the standard type of instrument commonly used and considered reliable. The radial pulse on the left arm of the subject was recorded as the resting pulse rate following blood pressure determination. It must also be noted that age as some effect on blood pressure and pulse rate. Blood pressure tends to rise and pulse rate tends to decrease with age. (3) The calipers used in this study for the determination of tricep skin fold thickness met the criteria as described in Chapter I and were manufactured under the trade name of "Lange Calipers" by the Cambridge Scientific Industries.

Validity of the submaximal stress test as it was conducted by the program was somewhat controversial as indicated in the review of the literature. However, based on the advice of many experts in the field and through consultation with Dr. Morris, the submaximal stress test was used by the program and therefore was also utilized by this study. The bicycle stress test was conducted on a Monark ergometer manufactured by a Swedish firm. Each test was conducted at a standard resistance of 900 kilograms per minute and a pedaling rate of 50 revolutions per minute. Pulse rate was determined by an

electronic sensing device built and calibrated by Mr. Peter Temple, Veteran's Administration Hospital, Portland, Oregon.

The questionnaire used was designed for this study and submitted for evaluation to James Morris, M.D. and Michael Tichy, Ed.D. Following modifications as suggested by Dr. Morris and Dr. Tichy, the questionnaire was pre-tested by participants of the program who were not included in the study. Their responses were clear and complete and they did not express any difficulties in using the questionnaire. In keeping with the expressed purposes of this study, the questionnaire was designed to obtain subjective information related to the subject's health habits and no validation of the responses was attempted.

Most items in the questionnaire were semi-structured. This allowed the respondants to use the "other" category when answers provided were inappropriate for them. Item 1 was used to ascertain the subject's period of participation in the adult fitness program. Items 2 and 3 were designed to elicit the participant's reasons for entering or leaving the program. Items 4 and 5 were open-ended to permit subjective evaluations of the beneficial and harmful effects resulting from participation in the program. Items 6 through 12 related to personal habits in regard to diet, smoking, alcohol consumption, physical activity, recreational and leisure activities.

The questionnaire was administered prior to the stress test and took 10 to 15 minutes to complete. All questionnaires were returned before the subjects left the laboratory. The subjects did not discuss the questions with each other or with the investigator. However, the investigator was available for clarification of items if necessary. A copy of the questionnaire items is placed in Appendix B.

Procedure

After determination of the sample, a letter was sent to all potential subjects describing the study and soliciting their cooperation. A copy of the letter is in Appendix A. The subjects' acceptance to participate in the study was obtained and appointments made for testing, measurement and completion of the questionnaire. The data used in this study include age, height, weight, blood pressure, resting and exercise pulse rates, skin-fold measurements, submaximal bicycle stress test, time in the program, time out of the program and responses to the questionnaire. Records of measures listed above taken before participation in the program were available for comparison with data obtained in the study. In most cases however, these data obtained on initiation to the program and used for comparison were collected by a different individual than the post participation data.

Data were collected before and after participation in the program. Because of the timing of the study however, blood pressure

values were recorded both before and after participation only from Group III. Blood pressure was obtained from the other three groups as a measure after participation. Pulse rates designated as "resting pulse rates" were recorded from the subjects following completion of the written questionnaire. This allowed each subject to sit quietly for approximately 10 minutes before the resting pulse rate and blood pressure were recorded. Resting pulse rates were obtained on all subjects only as a measure after participation. Certain uncontrolled environmental factors which could alter resting pulse rate and blood pressure were expected to occur randomly in all groups.

The bicycle ergometer stress test was administered to all subjects before and after participation in the program. These tests were conducted by Dr. James Morris with Mrs. Geraldine Appleby assisting. The men were instructed on the day of their stress test to come directly to the laboratory. No exercise prior to the stress test was allowed. During both tests the men were dressed in shorts, shoes and stockings and were shirtless to minimize the effect of heat build-up on the pulse rate. The bicycle was adjusted for the height of the individual and then, with no resistance, the participant was instructed to pedal in time with a metronome set at 50 beats per minute. Each beat represented one full revolution of the pedal. After one minute warm-up, the stress load was added according to the design of the bicycle and the test was begun. After each minute of pedaling for a

period of six minutes, the pulse rate was recorded. The exercising pulse rate was determined by the average of the last two minutes of exercise. If the subject recorded a pulse rate of 170 beats per minute or more, the test was terminated whether or not the six minutes had been completed. This was done for the safety of the subject since serious arrhythmias most often occur at the very rapid heart rates. (17)

Treatment of Data

For those data obtained before and after participation, the amount of change in the objective measures and submaximal stress test experienced by the subjects in the various groups were compared. These data were tabulated, analyzed by means of multiple regression technique and interpreted. Pre and post participation age, weight and exercise pulse rate, time in the program and time out of the program were the most standardized and controlled measures in this study and therefore were used for the statistical analysis.

Information gathered through the use of the questionnaire was considered descriptive data and presented as frequency counts. Relevant data from the questionnaire were related to the data obtained from the objective measures and submaximal stress test of each subject where possible. This was an attempt to correlate current health habits to the level of cardiovascular fitness.

CHAPTER III

RESULTS

The adult fitness program utilized in this study has as its main purpose the improvement of physical and cardiovascular fitness of the participants. The data obtained in this study reflect in a limited way the physiological effects of exercise as well as the effects of the program on certain health habits of the participants. The first data to be presented are those related most directly to the physical changes observed in the participants. Data related to the changes in the health habits of the subjects will follow.

One of the physical factors associated with the occurrence of heart disease is obesity. In this regard, weights of the subjects on examination were compared to those obtained when they entered the program. The actual changes in weight as recorded by observers showed that Group III had the greatest change since participation in the program with a mean difference of a minus 5.83 pounds. Group II had a mean difference of positive 2.25 pounds and Group I recorded the least amount of change in a mean difference of a positive .16 pounds. Group IV showed a mean difference of positive 1.4 pounds since their initial measurements. However, this merely reflects their total weight gain or loss over a period of time and is not related in a

particular manner to their previous participation in the program.

Analysis by means of the multiple regression technique reveals no statistical significance in the changes in weight observed in all subjects. Therefore, the conclusion reached from these data is that the fitness program in itself had little effect on the weight of the participants. The changes in weight recorded from participants on their initial and subsequent evaluations are listed in Table 2.

Table 2. Changes in Weight in Pounds Since Participation in the Adult Fitness Program

Item	Group I	Group II	Group III	Group IV
Number	6	4	6	5
Range	-9 to +14	-1 to +5	-16.5 to +2	-10 to +14
Mean	+.16	+2.25	-5.83	+1.4
Standard Deviation	8.33	1.8	5.96	4.81

When entering the program, 11 of the 21 subjects recorded weights within five per cent of the desirable weight for the American male of a similar height. (22) Ten subjects recorded weights above this level. Group I had five individuals who were within five per cent of the desirable weight for their height. All other groups had only two individuals who were within this standard. After participation in the program, ten subjects recorded weights within five per cent of the

desirable weight for the American male of similar height. Eleven subjects recorded weights above this standard. This also would seem to indicate that, over all, the program had little effect in bringing the weights of the participants within the desirable weight limits for their height.

The second physical measurement observed in this study was blood pressure. Since blood pressure measurements were initiated in the program for the purposes of this follow-up study, only the individuals who were participants for three months (Group III) had blood pressure readings prior to and following participation in the program. Members of all other groups had blood pressure readings only on evaluation following participation in the program.

Changes in blood pressure readings recorded on admission to the program and after three months participation did not reveal a consistent pattern. There was a mean systolic gain of 2.1 millimeters of mercury following participation in the exercise program and a drop in the diastolic mean pressure of five millimeters of mercury following participation. The blood pressures recorded from Group III both before and after participation in the program are shown in Table III.

Table 3. Recorded Blood Pressures of Members of Group III Prior To and Subsequent To Participation in Adult Fitness Program For Three Months

Individual	Systolic		Diastolic	
	Before	After	Before	After
A	122	128	84	86
B	130	130	88	88
C	148	160	90	80
D	122	106	86	66
E	114	114	76	86
F	160	170	102	102
Mean	132.5	134.6	88	83
Median	126	129	87	86
Standard Deviation	21.75	25.3	8.5	11.83

The relationship of the mean blood pressures between the groups following different periods of participation in the program was interesting. Group I (longest participants) showed a mean systolic of 131 millimeters of mercury and a diastolic of 75. Group II (six months) showed a mean systolic of 130 millimeters of mercury and a diastolic of 81. The three month participants, Group III, had a mean systolic pressure of 135 and a mean diastolic of 83 millimeters of mercury. Group IV (non-participants) had a mean systolic of 136 and a mean diastolic of 89 millimeters of mercury. Due to the small sample and one very high pressure recorded for Group I, the mean is therefore distorted and does not truly represent the typical blood pressure

of the group. Grouo I had a median pressures of 117 systolic and 70 diastolic. The pressures in the other three groups were normally distributed.

As described by Rusher, blood pressure is expected to increase normally in the older person because of the aging process. (29) Group I, with the highest mean age of 51 and with all members above the age of 43 had a mean pressure of 131/75. Groups II and IV were comparable in age and the blood pressures for these two groups were nearly equal. Group III, with a mean age of 42.5, had a mean pressure of 135/83. The systolic and diastolic pressures of all groups following their periods of participation in the program are shown in Table 4. The age of each subject is also shown.

The third physiological measure oberserved in this study was the estimated maximal oxygen uptake capacity. Oxygen uptake capacity refers to the body's ability to take in, transport and deliver oxygen to the working muscles. (3) This measure is derived on the basis of a standard work load imposed on an individual over a specific period of time. In prolonged exercise, there is a high correlation between maximal oxygen uptake and total work output or maximal aerobic capacity. The maximal oxygen uptake increases with age up to 20 years. Beyond this age there is a gradual decline so that the sixty-year old individual attained about 70 per cent of his maximum at 25 years. (3)

Table 4. Age and Blood Pressures of 21 Males Recorded at Rest Following Participation in Adult Fitness Program

Individual	n = 6 Group I			n = 4 Group II			n = 6 Group III			n = 5 Group IV		
	Age	Sys.	Dia.	Age	Sys.	Dia.	Age	Sys.	Dia.	Age	Sys.	Dia.
A	57	138	64	59	132	80	46	128	76	49	120	86
B	43	104	70	27	106	66	38	130	88	43	146	94
C	57	116	60	55	140	96	57	160	80	56	136	96
D	44	110	70	43	142	84	34	106	66	55	138	90
E	52	200	108				37	114	86	29	140	78
F	53	118	78				43	170	102			
Mean	51	131	75	46	130	81	42.5	135	83	46.4	136	89
Median	52.5	117	70	49	136	82	40.5	129	83	49	138	90
Standard Deviation	6.2	35.5	17.3	14.4	16.6	12.4	8.4	23.7	12.2	11	9.7	6.4

Two factors contribute to the gradual decline in maximal oxygen uptake capacity with age: inactivity and decreased maximal heart rate. Inactivity reduces the stroke volume and perhaps the efficiency of the regulation of the circulation during exercise. Therefore, the maximal oxygen uptake is probably the best laboratory measure of a person's physical fitness providing the definition of physical fitness is restricted to the ability of the individual for prolonged heavy work. (3)

The decreased maximal heart rate is related to the high energy cost of the very rapid heart rate. Astrand describes the gradual decline in maximal heart rate with age as an inherent protective device in the heart muscle. (3) The lower rate protects the heart muscle from hypoxia produced from an excessive work load.

In this follow-up study, the subjects were tested by a submaximal stress test and the maximal oxygen uptake capacity was estimated from these data. A bicycle ergometer was used as the stress test and was most closely regulated. Although in this study the equipment was standardized and calibrated, certain factors over which there was no control may have affected results. For example, no means for regulating room temperature or humidity were available for either test. However, the room used for testing was a basement room and thus was less susceptible to extremes in temperature than other locations in the building.

The highest oxygen uptake both before and after participation in the program was recorded by Group I. The initial mean was 27 milliliters per kilogram of body weight (low average) and rose to 31.5 (high average) following participation in the program. The initial mean for Group II was 26 milliliters per kilogram of body weight (fair) and this improved slightly to 26.7 (fair) following six months participation. Group III (three months participation) had an initial mean of 24 milliliters per kilogram of body weight (fair) and a final mean of 27.3 (low average). Group IV, which no longer participated, had an initial mean of 25.4 milliliters and a subsequent mean of 26.2 (both fair). Group I showed an oxygen uptake gain of 4.5 milliliters per kilogram of body weight and Group III gained 3.3.

In the mathematical computation of oxygen uptake, the individual's weight is used as a devisor of the total score. Thus, one who gains weight is penalized and one who loses weight may improve his score merely on the basis of weight rather than on the basis of change in cardiovascular fitness. For this reason, the weight change from each subject is recorded with the uptake capacity. The data showed no correlation between weight change and uptake capacity changes recorded in this study.

Motivation to participate in the program was an individual matter and was expected to affect the results of the program to some degree. The peak of interest and desire for success were assumed

to be contained in Group III since these individuals were just embarking on the exercise program. Three individuals showed no change in their maximal oxyten uptake capacity after three months. The other three individuals in Group III demonstrated a mean gain of 6 milliliters of oxygen per kilogram of body weight. These individuals had a mean gain that was greater than that recorded by any other group including Group I who had participated the longest. The oxygen uptake capacity of the participants on their initial examinations and at the time of the follow-up examinations for this study are shown in Table 5.

The time intervals between the stress tests for each subject varies from two months to five years. For the convenience of the reader, data related to the time factor between stress tests are placed in Table 7.

Individual A in Group I and individual E in Group IV illustrated a rather interesting progression in the development of maximal oxygen uptake capacity over a period of time. Fifteen months following his initial stress test, individual A in Group I had a subsequent stress test and revealed a gain in oxygen uptake capacity of 5 milliliters of oxygen per kilogram of body weight. The stress test for this study was conducted 18 months after the interim test and showed a further gain of 6 milliliters of oxygen per kilogram of body weight. This represented a total gain of 11 over a period of three years, two months.

Table 5. Weight Change and Estimated Oxygen Uptake Capacity in Milliliters per Kilogram of Body Weight Subsequent to Participation in Adult Fitness Program

Subject	N = 6 Group I				N = 4 Group II			N = 6 Group III			N = 5 Group IV			
	Wt Chg	Pre	Mid	Post	Wt Chg	Pre	Post	Wt Chg	Pre	Post	Wt Chg	Pre	Mid	Post
A	- 9	21	26	32	5	20	21	- 4	21	21	14	28		37
B	- 5	32		31	-1	35	34	-12	24	29	2	26		27
C	- 6	26		28	2	23	24	-16	20	28	-10	19.7		18
D	14	33		35	3	26	28	- 3	24	24	1	25.4		21
E	3	27		35				- 2	32	38	0	28	33	28
F	4	23		28				2	24	24				
Mean	.16	27		31	2.25	26	27	- 5.83	24	27	1.4	25.4		26
Median	- 1	26.5		31.5	2.5	24.5	26	- 3	24	26	1.5	27		27
Standard Deviation	8.33	4.72		3.16	1.8	6.48	5.6	5.96	4.24	6	4.81	3.93		6.56

In a similar manner, individual E in Group IV was retested fourteen months after his initial stress test while still in the program and recorded a gain of 5 milliliters of oxygen per kilogram of body weight. However, following a period of twelve months during which he did not participate in the program, retesting for this study showed the loss of the initial 6 milliliter gain. Thus, after one year of non-participation, this individual's maximal oxygen uptake capacity was the same as he exhibited before participation in the program. It may be that he not only made improvement through participation in an exercise program but also, unfortunately, that he was unable to maintain an adequate level of daily physical activity without support of a structured program. It may also illustrate the fact that physical or cardiovascular fitness is not something built up over a period of time and then drawn upon on a continuing basis. It needs to be constantly replenished or else it will not be maintained.

Pulse rate both at rest and during exercise were taken in attempt to evaluate the changes in the pumping efficiency of the heart muscle following various periods of participation in the exercise program. The resting pulse rates recorded from Group I were again the lowest rates per minute. Increased pulse rates throughout the groups were noted as periods of participation in the program decreased.

The lowest resting pulse rate of 54 beats per minute was recorded in Group I (longest participants) and the highest pulse rate of

102 was found in Group IV (non-participants). More than 83 per cent of Group I (five out of six subjects) had resting heart rates below 70 beats per minute. Only one individual in each of the other groups could illustrate this same rate. The resting pulse rates of individuals in each group as well as the group mean are illustrated in Table 6.

Improvement of the ability of the heart muscle to meet the body's oxygen needs was observed in the changes recorded in the exercise pulse rate following participation in the fitness program. Considering that the same stress as well as similar conditions were provided for each test, a decrease in the pulse rates for each group was noted. However, those individuals who showed no change in their oxygen uptake capacity also showed little change in their exercise pulse rate since the former is based on the latter.

Age must be considered in regard to pulse rate since expected maximal pulse rates decrease with advancing age (36). For example, the predicted maximal heart rate for a 20 year old male is 197 beats per minute. This decreases at the rate of approximately two beats per minute for every five years increase in age. Thus, Group I with a mean age of 51 years would have a predicted maximal heart rate of 184 while Group II and IV with a mean age of 46 would have a predicted rate of 187 and Group III with a mean age of 43 years would have a predicted maximum heart rate of 188 beats per minute. The predicted differences in maximal heart rate between Group I and III

according to age thus would be four beats per minute.

This study did not determine the maximal heart rates of the subjects, however. A standard work load was imposed on all individuals and the pulse rate recorded. The differences in the exercise pulse rates seen between Group I and all other groups far exceeds the expected differences due to age. Group I showed the greatest decline in mean difference in exercise heart rates with a negative 13 beats per minute following their period of training. Group II recorded a negative 4 beats per minute; Group III, negative 10 beats and Group IV, negative 5 beats per minute.

When the data were analyzed by the multiple regression technique, the exercise pulse rate prior to participation was seen as the best predictor of the exercise pulse rate following participation. However, length of time in the program does produce a significant ($t = 2.65$) lowering effect on the pulse rate and accounts for 10 per cent of the variability. Both the recorded exercise pulse rate of the individuals before they began the exercise program and after varying periods of participation are illustrated in Table 7. The time intervals between the stress tests are also illustrated in Table 7.

Two rather interesting factors were noted in the review of these data. First of all, Group I had not only the lowest exercise pulse rate following their participation in the program, but they also reveal the lowest exercise pulse rate on initiation into the program.

Table 7. Exercise Pulse Rate in Beats Per Minute Before and After Participation in Adult Fitness Program

Subject	N = 6 Group I				N = 4 Group II			N = 6 Group III			N = 5 Group IV			
	Time	Pre	Mid	Post	Time	Pre	Post	Time	Pre	Post	Time	Pre	Mid	Post
A	3 yr	158	138	122	5 mo	159	154	3 mo	138	139	5 yr	139		120
B	2.5 yr	131		135	5 mo	142	144	2 mo	162	144	1 yr	146		147
C	1 yr	140		132	5 mo	150	144	2 mo	160	134	5 yr	164		167
D	2 yr	132		126	5 mo	149	138	2 mo	162	161	1.5 yr	---		154
E	1 yr	138		122	5 mo			2 mo	152	152				
F	1 yr	149		132	5 mo			2 mo	152	152				
Mean	1.8 yr	141		128	5 mo	150	146	2.1 mo	152	142	2.4 yr	152		147
Median	1.5 yr	139		128	5 mo	149.5	145	2.1 mo	156	141.5	3 yr	148.5		150.5
Standard Deviation	.92	10.4		5.57	0	7	6.63	.5	11.7	12.86	2.04	11.96		17.51

A study as to why this low rate occurred could be interesting. Many questions may be raised regarding the life style of these individuals including their habits of exercise and activity. The fact that their pulse rates were lower suggested that the response of their heart muscles to work were better than the other groups and it also appeared to be better at rest. Although one individual exhibited severe hypertension, their blood pressures generally reflected sub-normal values for their age group. What hereditary factors as well as environmental factors contributed to these values would be worthwhile to explore.

Additional data related to presence or absence of obesity was attempted in this study through the use of the triceps skin fold measurement. However, doubt as to the reliability of the data was raised since profound variations in the measurements did not relate in any way to any other data. For example, in a six month time period, one subject exhibited a seven millimeter gain in measurement (indicating an increase of fat tissue in the body) when no change in weight was observed. The variations were seen to be the result of a difference in technique between the two examiners and the critical nature of the point of measurement. Therefore no attempt was made to analyze the data produced from skin fold measurements.

Summary of Physiological Parameters

From the preceeding data certain changes in physiological measures were observed. The group which exhibited the lowest exercise and resting pulse rates was Group I (longest participants). This group also recorded the greatest gain in estimated maximal oxygen uptake capacity. In each group there was a gradual increase in the blood pressure, resting and exercise pulse rates and a gradual decrease in the estimated maximal oxygen uptake capacity as the periods of exercise decreased.

One physical measure which could not be correlated to the exercise program was the body weight. Group III exhibited the greatest loss in weight; Group I exhibited a slight loss. However, Group II and IV both recorded weight gains.

Attitudes toward the Program

In addition to the changes recorded in the objective measures in this study, certain subjective evaluations were made by the subjects themselves. Of particular interest was why the individuals entered the fitness program originally. Most participants of the study indicated more than one reason for joining the program. The total number of reasons cited was 59. It was notable that the reason "feel better when active" was cited 13 of the 59 responses or more

than 22 per cent of the total. "Getting fat or flabby" was the next most common answer with ten or nearly 17 per cent of the total responses. Both "a friend's recommendation" and "a desire to prevent heart disease" were mentioned nine times or more than 15 per cent of the total. It was also noted that "a physician's recommendation" was cited as the motivating factor only four times or less than seven per cent of the total. Possible reasons for this lack of physician involvement might include: the physician's unawareness of the program and its purpose, their lack of conviction as to the prophylactic aspects of exercise, or their lack of contact with the presumedly normal, healthy individuals interested in exercise. Table 8 lists the stated reasons why the members of all groups originally entered the fitness program.

Table 8. Original Reasons for Joining Adult Fitness Program

Reason	N = 6 Group I	N = 4 Group II	N = 6 Group III	N = 5 Group IV	Total*
Feel better when active	5	2	2	4	13
Getting fat or flabby	2	2	2	4	10
Friend's recommendation	2	2	3	2	9
Want to prevent heart disease	2	0	4	3	9
Once active and want to continue	0	2	2	3	7
Physician's recommendation	1	0	2	1	4
Newspaper or other publicity	1	1	0	1	3
Comradeship or social experience	0	0	0	2	2
Other	1	0	0	1	2
Total*	14	9	15	21	59

*Some respondents indicated more than one reason for joining.

The question regarding the reasons for quitting the adult fitness program pertained only to those who no longer were members of the exercise class, that is Group IV. Five of this group indicated that schedule changes or work demands were their only reason for quitting. One individual who listed family responsibilities as his reason for leaving has subsequently rejoined the class.

Correlation of the reasons for joining the program with the benefits the participants felt they had gained from the program was interesting. More than 42 per cent of the responses indicated that the participant "felt better" as a result of the program. More than 27 per cent stated that they had increased "endurance" as a result of the exercise sessions. Clearly, the participants expected to feel better when they joined the program and obviously they did. Whether these persons were more aware of the physiological changes which occur in the body as a result of exercise is not clear and has not been established by this study. However, as suggested by Ismail and Trachtman, not all values of physical activity can be readily assessed even though they apparently occur and are recognized in a subjective manner (18). The benefits gained from participation in the adult fitness program as listed by the subjects are shown in Table 9.

Table 9. Benefits Gained from Participation in Adult Fitness Program.

Benefit	N = 6 Group I	N = 4 Group II	N = 6 Group III	N = 4 Group IV	Total*
Feel better	3	3	4	2	12
Increased endurance	2	2	3	1	8
Enjoyment	1	0	1	1	3
Better able to do physical work	1	0	0	1	2
Improved physical condition	0	1	0	1	2
Motivation to exercise	0	0	1	0	1
Learn how to judge effectiveness of exercise	0	0	0	1	1
Total*	7	6	9	7	29

*Some respondents indicated more than one benefit.

Only one incidence of harmful effects from participation in the program was cited. This harmful effect was described as a "slight ankle ache occasionally." Thus, more than 95 per cent of the participants in this study stated they incurred no harmful effect from their activities in the program.

Health Habits

The health habits of the subjects were also of interest in the study, particularly those health habits associated with the occurrence of heart disease. It was recognized that these data relative to health habits were entirely dependent upon the subject's power of recall and therefore were highly subjective in nature. In keeping with the general thrust of this study weight was considered relevant. Physicians

frequently use an individual's ideal weight at age 25 as a basis for a lifelong norm. For this reason, the difference between the participant's stated weight at age 25 and the present weight was determined. The mean difference of Group I was a negative 3.16 pounds, Group II recorded a mean difference of a positive 25.5 pounds. Groups III and IV recorded mean differences of positive 16.1 and 14.5 pounds respectively. This suggests that Group I, who have a long term habit of regular physical activity showed less change in weight though their mean age (51 years) was the oldest for all groups. Group II, while active for six months, had the greatest mean difference (positive 25.5 pounds) of all groups and a mean age of 46 years. The difference between the reported weight of the participants at age 25 and their present weight are shown in Table 10.

Table 10. Difference in Pounds Between Present Weight and Reported Weight at Age 25.

Subject	N = 6 Group I	N = 4 Group II	N = 6 Group III	N = 5 Group IV
A	+ 3	+43	+10	+22
B	+ 4	+ 1	+15	0
C	0	+40	+26	+14
D	+24	+18	+12	+ 3
E	-50		- 4	+32
F	0		+38	
Mean Difference	-3.16	+25.5	+16.1	+14.5

Dietary changes as reported through the questionnaire were difficult to evaluate. Nearly 48 per cent (10) of the participants reported no change in diet since enrollment in the program. A wide variety of dietary changes occurred since participation in the program for the remaining 11 subjects. Eight of these included in some way the reduction in total amount of fat and/or calories. Only three individuals reported an increase in any food component in their diet.

Ten individuals reported no change in caloric intake. Five of these persons lost weight and five gained weight. Nine subjects reported a decrease in their caloric intake, but only six demonstrated a weight loss since participation in the program. Three subjects showed a weight gain in spite of their reported decreased caloric intake. One individual reported an increase in caloric intake and showed a weight gain. Another reported both an increase and a decrease in dietary intake and also showed a weight gain.

If caloric intake remains the same and activity increases, there will be a weight loss as noted in some individuals. However, some individuals reported no change in diet and presumedly had increased their activity through the program but still recorded a weight gain. This leads to the assumption that subjective evaluation of caloric intake may be an inaccurate means of assessment of the actual diet. The changes that were reported by the participants in caloric intake and the weight changes observed are shown in Table 11.

Table 11. Reported Caloric Changes and Observed Weight Changes from Participants.

Subject	N = 6 Group I Diet	Wt	N = 4 Group II Diet	Wt	N = 6 Group III Diet	Wt	N = 5 Group IV Diet	Wt
A	0	-	0	+	0	-	0	+
B	-	-	0	-	-	-	+	+
C	0	-	-	-	-	-	-	-
D	-	+	-	+	-	-	0	+
E	0	+			0	-	-	+
F	-	+			0	+		

0 means no change in caloric intake.
- means decreased caloric intake.
+ means increased caloric intake.

A question concerning the smoking habits of the participants revealed that all members of all groups had smoked at some time in their lives. It was not surprising to find that cigarettes were the most popular form of tobacco used (nearly 59 per cent of the total reported use). The forms of tobacco by the subjects are illustrated in Table 12.

Table 12. Forms of Tobacco Used.

Tobacco Form	N = 6 Group I	N = 4 Group II	N = 6 Group III	N = 5 Group IV	Total*
Cigarettes	3	3	6	5	17
Cigars	3	0	1	2	6
Pipe	2	1	2	1	6
Total*	8	4	9	8	29

*Some respondents reported using more than one form of tobacco.

However, since participation in the program, nearly 67 per cent of the members no longer smoke. It could not be determined from the questionnaire whether they quit smoking because of the program or only that at this point in time they do not smoke. It was encouraging to note that less than 15 per cent now smoke cigarettes and that all members of Group IV reported that they were not currently smoking. Those who were currently smoking while participating in the program as well as the type of tobacco used are shown in Table 13.

Table 13. Smoking Habits of Participants.

Smoking Habit	N = 6 Group I	N = 4 Group II	N = 6 Group III	N = 5 Group IV	Total
Do not smoke	4	2	3	5	14
Smoke Cigarettes	1	1	1	0	3
Smoke Cigars	1	1	2	0	4
Total	6	4	6	5	21

Excessive alcohol consumption is a major health problem in the United States at this time and efforts are being directed toward a solution. Since this study was concerned with the health habits of the individual and what changes may occur in them following participation in an exercise program, data related to alcohol consumption were obtained. Alcohol consumption of varying degrees was reported by 15 members of the study. Six individuals in this study abstained

from alcohol entirely. Twelve of the fifteen respondents who did report consuming alcohol stated there had been no change in their drinking habits since participation in the fitness program. The remaining three of the fifteen respondents reported less consumption than before participation. The drinking habits of the respondents since participation in the adult fitness program are shown in Table 14.

Table 14. Drinking Habits of Respondents Since Participation in the Adult Fitness Program.

Drinking Habit	N = 6 Group I	N = 4 Group II	N = 6 Group III	N = 5 Group IV	Total
Do not drink	2	0	2	2	6
Less than before program	2	0	0	1	3
About the same as before the program	2	4	4	2	12
Increased consumption	0	0	0	0	0
Total	6	4	6	5	21

Since most participants in this study indicated their main reason for joining the program was because they "felt better when active" it would seem logical that they joined the program specifically to increase their level of daily activity. Contrary to this expectation, twelve of the 21 respondents reported no change in their level of daily activity. One participant even noted a decrease in his level of activity. The remaining eight respondents reported an increase in activity most often through increased walking, stair climbing and participation in active sports.

Perhaps through the influence of the American business and industrial communities, there exists a constant impetus toward doing more work with less and less expenditure of body energy. The attitude reflected by many participants in this study seems to be that exercise is something one signs up for and participates in only during certain times of the day just as one works or sleeps. To achieve an increased level of physical activity in the daily pattern of life, thought and planning are necessary to find and use opportunities for exercise to the best advantage. The habit of conserving physical energy must be replaced with the habit of expending physical energy in pleasant, relaxed and routine life experiences.

Respondents' attitudes toward leisure and recreational activities were considered important in this regard. To the respondents, "recreational activities" seemed to imply participation in active sports such as golf, hiking, skiing and handball as well as jogging. Only eight participants reported that they engaged in these types of activities from two to six hours each week.

In contrast, "leisure time" seemed to represent relaxing periods of time with passive activities such as watching television and reading being the most commonly mentioned. Seventeen participants in this study stated they found some time during the week for leisure. The amount of time spent on leisure activities varied from "very little" to more than 20 hours per week.

From these tabulations then, less than 39 per cent of the participants found time for active recreational activities. In contrast, 80 per cent of the participants reported having time to watch television or read. Thus the mode of relaxing through passive rather than physical activities becomes rather striking. Those who find leisure time and the activities during leisure time are shown in Tables 15 and 16.

Table 15. Participants Who Find Leisure Time.

Factor	N = 6 Group I	N = 4 Group II	N = 6 Group III	N = 5 Group IV	Total
No leisure time	2	1	0	1	4
Leisure time available	4	3	6	4	17
Total	6	4	6	5	21

Table 16. Activities During Leisure Time.

Activity	N = 6 Group I	N = 4 Group II	N = 6 Group III	N = 5 Group IV	Total*
Reading	3	1	2	2	8
Watching television	3	1	1	0	5
Gardening	0	1	3	2	6
Other passive activity	2	3	4	0	9
Other active activity	0	3	2	2	7
Total*	8	9	12	6	35

*Some respondents stated more than one activity.

Summary of Health Habits

Various changes in health habits were reported by the subjects in this study. Nine of the respondents (nearly 43 per cent) reported some reduction in the total amount of fat and/or calories in their diet. At this point in time, 67 per cent of the participants did not smoke but whether this was in response to the program cannot be determined from the responses to the questionnaire. Better than 14 per cent (3 subjects) reported a decrease in the amount of alcohol consumed and none reported an increase. Eight respondents (more than 38 per cent) reported increasing their level of daily activity. However, changes in their use of leisure and recreational activities could not be evaluated from the responses to the questionnaire.

Use of Medications

Interesting information in the use of drugs was discovered through responses to the questionnaire. In this regard, all members of Group I reported that they were not now taking any physician prescribed medication. One individual in Group II reported taking presamine, 25 milligrams, three times daily. Presamine is an antidepressant drug which is thought to cause a blocking of norepinephrine uptake at the nerve endings. Certain cardiovascular reactions have been reported in the literature and include hypo and

hypertension, tachycardia, arrhythmias and heart block but these are unusual in occurrence (27). Another individual in Group II reported taking inderal and another antiarrhthmatic drug. Inderal is a drug which decreases heart rate and cardiac contractility and reduces myocardial oxygen requirements (27). Consideration of the effect of this and the other unnamed drug on the heart during stress testing was given since the drug does slow the rate of the heart beat. Since both of these individuals reported taking these drugs at the time of their initial stress tests as well as at the time of the subsequent stress tests the results of both were included in the tabulation. It was assumed that the effects of the drugs were present during each evaluation. One individual of Group III reported taking trilafon which is an antipsychotic drug and is sometimes used as a tranquilizer. While the drug may produce hypo or hypertension and tachycardia in susceptible or sensitive individuals, this was not described as a serious or common side effect from normal doses of the drug (27). The effect of this drug on the subsequent stress test was not determined. One individual in Group IV reported taking tetracycline for a mild skin infection. This drug is described as having no cardiovascular reactions and thus would not affect the results of the stress test.

Summary

The effects of participation in an adult fitness program encompass many aspects of the individual. Not only the physiological responses to exercise should be measured but also the subjects' evaluation of his personal life style including those high risk habit patterns as smoking, stress and over-eating.

The general pattern of participation and physiological change seemed to reflect an early (three month) period of intense motivation for at least 50 per cent of the Group (Group III). This was then followed by a period of decreasing motivation reflected in decreasing physiological values in nearly all aspects examined (Group II). If, at this time, the participants left the program, they most often continued their attitude of declining interest in activity and apparently found little time to exercise on their own (Group IV). Those who continued in the program (Group I) continued to improve or at least to show improvement on the values recorded. A considerable degree of self-motivation and will power was exhibited by the members of Group I, half of whom have been in the program for more than two years. For individuals willfully to undergo severe stress regularly in the form of hard continuous physical exercise represented motivation not commonly found in the adult American population. It would also seem, however strong this motivation was, the ability to keep

exercising outside of the structured program was difficult. The data show that most individuals did not maintain the level of fitness they apparently had gained through the exercise program.

CHAPTER IV

DISCUSSION

The data sought in this study were those relative to the physiological changes that occur as a result of participation in an adult fitness program. The purpose of this program was the development of cardiovascular efficiency and endurance. For purposes of the present study, the bicycle submaximal stress test was used to illustrate change in estimated maximal oxygen uptake capacity and resting and exercise pulse rates. A questionnaire, specifically designed for use in this study was utilized to obtain subjective data from the participant concerning his response toward the exercise program and to determine if the participant could recognize in himself any changes in those habits associated with the high incedence of heart disease, i. e. smoking, diet and inactivity.

The data to be considered first were the resting and exercise pulse rates. A significant change in pulse rates was noted in those subjects who had exercised the longest. This finding concurred with that reported by Hellerstein (16) who stated that persons in good physical condition performed a given work load with a lower heart rate than persons who are not fit. He reported a difference of approximately seven beats per minute lower in the trained individuals. This

study recorded a mean change of eight beats per minute across all groups. However, Group I, who had exercised the longest, had a mean average decrease of 13 beats per minute. The data also showed a lower resting pulse rate for those in Group I when compared to any other group.

The study by Haskell supports the theory of the relative benefits of exercise by the report that only 400-500 calories per day separate the inactive from the active. (15) This amount of energy expenditure is enough to reduce significantly the active groups predisposition to heart disease. Some studies even indicate that as little as 100 calories per day expenditure is enough to reduce by one half the risk for coronary heart disease. (10)

Skinner and others demonstrated that the prevalence of coronary heart disease was significantly less in the more active groups but that no difference in work capacity could be observed between the active and less active groups. (33) All the values of exercise at this point in time cannot be adequately measured and evaluated. However, from the statistical studies of morbidity and mortality, it can be seen that increased levels of physical activity reduce the incidence of heart disease. It seems evident from the data that the lower the oxygen requirement of the heart (during rest or any level of exercise), the lower the coronary flow rate can be and still be adequate. The ability of the heart to do equal amounts of work with a reduced heart rate

following periods of exercise training relates to the ability of the exercise to improve cardiac efficiency. (23, 24) Therefore the development of the lower pulse rate during rest and during exercise is a desirable result of exercise training.

The data in this study were not sufficient to illustrate changes in the structure of the heart. However, Ricci's contention that effective physical activity which results in cardiovascular-pulmonary training produces a more muscular, better developed and slightly hypertrophied heart with significantly greater heart volume is considered pertinent. (28) Lower heart rate at both rest and exercise would indicate that some factors improving the heart function must be at work in these individuals as they exercise. While the subjects in the present study were not hampered by obvious signs of coronary heart disease, response to exercise by those suffering from angina pectoris has been marked in other studies. Hellerstein demonstrated that following sufficient periods of exercise training, significant improvement as shown by the absence of angina pectoris at relatively high pulse rates was achieved. (16)

The effect seen in most of the individuals in Group IV who no longer participate and who showed no gain in cardiovascular fitness was in agreement with studies related to exercise and physical work. Sporadic efforts toward physical activity or those attempts long since discontinued appear to be ineffective in reducing the risk of heart

disease by improvement in cardiovascular fitness. However, activities of daily living need to be considered if a true picture of an individual's physical activity level is to be made. (10) This was not possible in the present study.

Data obtained from two individuals, namely subject A in Group I and E in Group IV provided some insight into what occurs as two persons pursue different habits in regard to exercise. Subject A in Group I had an estimated oxygen uptake capacity of 21 milliliters per kilogram of body weight on admission to the program. After 14 months participation in the program, he progressed to 26 milliliters per kilogram. At the time of this interim testing, he had lost 13 pounds from his initial weight. This amount of weight loss could mathematically improve his score. However, 20 months later when he had regained four and one-half pounds, his uptake capacity had further improved to 32 milliliters per kilogram of body weight. Thus over a three year period, Subject A had lost nine and one-half pounds and had improved his oxygen uptake capacity by 11 milliliters per kilogram of body weight presumably through the habit of exercise.

In contrast, Subject E in Group IV recorded a 28 milliliters per kilogram of body weight uptake capacity on admission to the program. After 14 months in the program, he lost two pounds and improved his uptake capacity to 33. He then dropped out of the exercise program and was retested following a period of six months of nonparticipation

for the purpose of the present study. At that time, his weight was the same as his initial weight and his uptake capacity was again 28. His net gain over a period of three years was zero. This individual had not acquired a habit of exercise except through the program. While he was active in the program, he showed improvement. When he left the group, his cardiovascular fitness returned to its original level.

The only individual in Group IV who showed a continued gain following his participation in the program was Subject A. Examination of his original reasons for joining the program showed that many factors motivated him. He enjoyed the comradship of the program, felt better when active and was once active and wanted to continue. He further stated that he was getting fat and flabby and also wanted to prevent heart disease. He was 41 years old and had left the program because of schedule changes in his work.

The data should not indicate age as a factor limiting improvement in maximum oxygen uptake capacity. Subject A in Group I who was cited as an example of continuing improvement in cardiovascular fitness over a three year period was 57 years old.

The mean values of blood pressure as seen across all groups was relevant to the desired goal in the reduction of risk from coronary artery disease. There was a trend toward lower pressures in Group I especially apparent in the systolic and diastolic medians. It was evident from the data of the present study that blood pressure changes

were not as early in occurrence nor were they as apparent as some of the other changes seen in the subjects.

However, the importance of blood pressure as an associated factor in the occurrence of heart disease cannot be denied. As reported by Kannel, the multiplicity of factors in the appearance of heart disease symptoms is of critical importance and exerts considerable influence on the frequency with which it occurs. (11) As demonstrated by Morris, those who led sedentary lives have hearts with similar pathology as the hearts of heavy workers who are 10 to 15 years older. (23, 24)

Surprisingly, there was no general trend toward lower body weights following participation in the exercise program. It was noted that certain individuals in each of the groups did make considerable reductions in their body weights which was not reflected in the group mean. This would indicate perhaps, that exercise alone was not sufficient to produce weight loss and that some sort of dietary restriction should also be attempted when weight loss is desired.

While reliability of the objective measures was actively sought in the present study, two factors interferred with this goal. First of all, not all measures were taken on all individuals when they entered the program. This was due either to the lack of availability of the testing facilities if the participant entered the program in its early development stages or if the participant himself failed to keep his

scheduled appointment for testing. The adult fitness program at that time did not have a routine of retesting its members.

The second factor which interferred with the reliability of the objective measures was that original and subsequent measures were usually taken by two different observers. As discussed earlier, the results of variation in technique were most obvious in the skin-fold measurement.

Among the major factors associated with the occurrence of heart disease are inactivity, hypertension and obesity. (1, 2, 12) While the adult fitness program did not produce a significant reduction of weight in its participants, lower blood pressure values and significantly lower heart rates were demonstrated. Thus, in order to decrease the risk of coronary artery disease, exercise which is regular, frequent and of sufficient intensity to promote the development of cardiovascular fitness, was considered to be another habit worthy of cultivation in the normal, apparently healthy American adult.

While certain trends were observed, it must be noted that the subjects in this study were not selected on a random basis from a normally distributed population. Thus, the data obtained served primarily as a basis for further study and do not infer a cause and effect relationship.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to describe the physical changes which occur in men who participated in an adult fitness program for various periods of time. Some attempt was also made to describe, through the participants' responses to a questionnaire, what changes these individuals made in various habits related to their health following participation in the program. The changes as recorded in current participants were then compared to participants who were inactive in the program for at least three months. Since the number of subjects was small and they were drawn from a select population and considerable difficulty was encountered in producing standard conditions for all the objective measures, definitive conclusions cannot be drawn from the data. However, certain trends in the physical changes were observed and recorded.

The most reliable measure of the long term effects of exercise in the individual was seen through the submaximal stress test. The individual differences between the exercise pulse rate at the same work load and under the same conditions produced the following mean

differences in the individuals by Groups. Group I produced a mean difference of a negative 13 beats per minute after more than six months of program activities. Group II, after only six months participation, recorded a mean difference of negative 4.5 beats per minute. Group III recorded a mean difference of negative 9.3 beats per minute after only three months participation in the exercise program. Group IV though no longer in the exercise group recorded a mean difference of negative 5.5 beats per minute.

Since no standard resting period was allowed prior to recording pulse rate and blood pressure, only a trend can be suggested from the data. Under the conditions of this test, there was a recognizable trend toward lower blood pressure and pulse rates for the subjects who had participated the longest in the exercise group. Group I (more than six months), although with the highest mean age, had the mean pressure of 135/75. However, because of the small sample and one very high pressure, the mean was distorted and does not truly represent the typical blood pressure of the group. The median blood pressure of Group I was 117/70. Group II (six months only) had a mean blood pressure of 130/81 mm of mercury and a median pressure of 136/82. Group III (three months only) had a mean blood pressure of 135/83 and a median pressure of 129/83. Group IV (non-participants) recorded a mean pressure of 136/89 and a median of 138/90.

The resting pulse rates of these groups also showed a slowing trend as length of time in the program increased. Group I had a pulse rate of 66.3 beats per minute, Group II had a pulse rate of 77.5. Group III, whose subjects had been in the program for only three months, had a resting pulse of 79 beats per minute. Group IV, whose members no longer participate, had the highest rate of 81.6 beats per minute.

Weight changes recorded in the participants since participation in the program were not significant when analyzed by the multiple regression technique.

Data which related to the subjective estimates by the subjects in regard to benefits gained from the participation in the program showed that 40 per cent of them "felt better" as a result of exercise. Twenty-seven per cent reported that they had increased endurance from the regular exercise sessions. Only one individual reported a harmful effect. Thus, more than 95 per cent of the participants indicated that they had no harmful effects from the exercise activities and 100 per cent stated they had some beneficial effect.

Health habits of some individuals were changed following participation in the fitness program. In regard to dietary habits, nine reported changes in regard to less calories and/or fats and ten reported no change. One individual reported being on a physician prescribed diet and the remaining person reported gains in caloric intake.

While all individuals in this study reported using tobacco in some form at some point in their lives, 14 did not smoke at the time of retesting. It was not determined in the change in habit was related to participation in the fitness program. Alcohol consumption was decreased in three of the subjects since participation in the program.

Daily activity level of 9 of the 21 subjects did increase following participation in the program. One individual reported a decrease in his activity level and 12 reported no change. The reported recreational and leisure time activities were minimal in spite of the fact that the most frequently stated reason for joining the program was that the subjects "felt better when active." Most individuals found time to read and watch television but they found little or no time for activities such as golf, gardening or other mobile and active leisure and recreational pursuits.

Conclusions

Trends toward desirable changes in physical findings such as lower blood pressure and lower resting and exercise pulse rates seem to be related to vigorous and continuing activity programs in adulthood. However, it appeared that the American males who participated in this study did not consistently find or make use of opportunities for increasing the level of activity throughout their daily lives including occupational and recreational pursuits.

Recommendations for Improvement of Study

As the data were collected for this study, certain changes necessary for improvement became obvious.

1. All data should be collected upon each individual or initiation into the program and at regular intervals throughout his enrollment. Whenever possible, data should be collected by the same individual at all testing periods. This would eliminate the difference in technique which confounded the results of this study.

2. Standardized rest periods should have been provided prior to blood pressure and resting pulse rate recordings to eliminate some of the variables associated with these factors.

3. Temperature and humidity should be recorded prior to each stress test since these two factors play and important role in the recorded exercise pulse rates of the subjects.

Recommendations for Further Study

Numerous studies could be an outgrowth of the present study such as:

1. Replication with a bigger number and more controls of variables.

2. Replication using women instead of men.

3. Evaluate the motivational factors of individuals already

participating in an exercise program in order to improve their attendance to the level at which at least minimal physiological changes can be achieved.

4. Examine the physiological, psychological and social factors which motivate individuals to continue participation in exercise and achieve a high level of cardiovascular fitness.

5. Examine the factors involved in the development of a habit of exercise so that when an individual no longer participates in a structured exercise program he can continue to pursue those activities that promote physical and cardiovascular fitness.

6. Determine what activities of the professional staff in an exercise program promote the development of cardiovascular fitness in the participants of that program.

7. Examine the means of providing information in regard to other health factors such as diet, smoking and leisure time activity which are effective in changing those habit patterns currently considered harmful to health.

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APPENDICES

APPENDIX A

Dear Sir:

The adult fitness program at Portland State University has been operational for approximately seven years. The main emphasis of the program has been to contribute to the fitness of the participants through exercise. Until now, there has been limited time, money and personnel available to objectively evaluate the results of the program.

At this time, a preliminary study on the effects of the program has just been undertaken and we would like to ask you to participate in this effort.

Your participation would require that you complete the enclosed questionnaire and return it promptly in the stamped, self-addressed envelope, and also, that you be available for an appointment within the next two months for a brief interview and a repeat of the testing you had during your initiation into the program.

As you remember, this testing includes pulse rate, blood pressure, height and weight, skin fold measurements and the bicycle test. Undoubtedly you know that this measurement can be quite valuable to you in knowing how efficiently your heart is functioning. You will be made aware of your test results and the results of the study. However, as a participant, you will remain anonymous in the study reports.

We are testing only a select group of individuals who have been in the program and you are an integral part of the overall plan. While we appreciate that this requires considerable effort on your part, we sincerely hope that you will be able to participate.

We would like to suggest for the success of the project, that you do not change any of your current daily habits.

Very truly yours,

Anna Mae Tichy
Michael W. Tichy, Ed.D.
James Morris, M.D.
P.S.U. Adult Fitness Program

APPENDIX B

QUESTIONNAIRE

Name_____Age_____Telephone No._____

Address_____Occupation_____

Please indicate any physician prescribed medications that you are taking now._____

1. When did you participate in the Adult Fitness Program at Portland State University? ___ am now, ___ less than 3 monts ago, ___ less than 6 months ago, ___ less than 2 years ago, ___ more than 2 years ago.

2. Check and/all answers that reflect your original reason(s) for joining the program.

___comradship or social experience
___feel better when active
___freind's recommendation
___newspaper or other publicity
___once active and want to continue
___want to prevent heart disease
_____other (please specify)

3. If you are no longer in the P.S.U. adult fitness program, check any/all answers that reflect your reason(s) for quitting the program.

___family responsibilities
___health reasons
___joined other program
___lack of enjoyment or interest
___moved away from area
___physician's recommendation (please indicate reason)_____
___schedule changes or work demands
___too time consuming
_____other (please specify)

4. What benefit(s) do you feel that you have gained from participation in the program?_____

_____

5. What harmful effects do you feel that you may have received from participation in the program? _____

_____

6. What did you weigh at age 25? ____lbs. Present weight? ____lbs. Did your weight ___ increase, ___decrease, ___remain the same during participation in the program?

7. Have you changed your diet in any way since participation in the program? ___ If yes, in what way?
___more ___less calories
___more ___less carbohydrates
___more ___less fats
___more ___less protein
___other (please specify) _____

8. Have you ever smoked?___Please indicate: ___cigars, ___pipe, ___ cigarettes.
If yes, do you smoke now? ___
If yes, do you smoke ___less than, ___more than, ___about the same amount as you did before participation in the program?

9. How much alcohol do you consume in a week? _____
Is this ___more than, ___less than, ___about the same as you consumed before your participation in the fitness program?

10. Have you changed your level of daily physical activity since participation in the program? ___ If yes, in what way? _____

---

11. Do you participate in any recreational activity for at least two hours a week? ___ If yes, what type and for how long?

Type _____ Length of time _____

12. Do you have any time in the week for leisure? (That is "lazy time" or unscheduled time?) ___ If yes, how much time? _____

What do you usually do during this time? _____

OMIT BELOW THIS LINE: FOR TESTING PURPOSES ONLY:

Height _____
Weight _____
Tricep skin fold _____
Blood pressure _____
Vo_2 max _____
Rating _____
Resting pulse rate _____

AN ABSTRACT OF THE FIELD STUDY OF

ANNA MAE TICHY

for the

DEGREE OF MASTER OF NURSING

Date receiving this degree: June 7, 1974

Title: A STUDY OF THE RELATIONSHIP OF PARTICIPATION IN AN EXERCISE PROGRAM TO THE DEVELOPMENT OF CARDIOVASCULAR FITNESS

APPROVED: [redacted]

The primary purpose of this study was to describe certain physical changes which occurred in men who participated in an adult fitness program. Physical measurements obtained in this study included age, weight, blood pressure, heart rate and maximal oxygen uptake capacity as estimated from a bicycle ergometer, submaximal stress test. Secondly, changes in the individual's health habits following participation in the adult fitness sessions were determined through the use of a two page questionnaire.

The sample population was obtained from the fitness program roster and categorized into four groups on the basis of length of time in the program. One group was made up of six individuals who had

exercised for more than six months. A second group was composed of five men who had exercised for only six months. Men who had participated only three months comprised the third group. Six individuals who had participated for at least six months but who had dropped out at least three months at the time of the study composed the fourth group.

Trends toward desirable changes in physical findings such as lower blood pressure and lower exercise and resting pulse rates suggest a relationship to a vigorous and continuing activity program in adulthood. When statistically treated by multiple regression analysis, the exercise pulse rate of those who had exercised the longest was significantly (P 0.5) lower than other subjects in the study. This trend suggested that improved cardiovascular response to work is developed following a long term participation in regular endurance-type exercise. However, there was no significant change in weight observed in the subjects.

Data obtained from the questionnaire revealed that 40 per cent of the subjects "felt better" as a result of exercise. Twenty-seven per cent reported increased endurance following the exercise training program. Fourteen of the subjects did not smoke at the time of the testing and only three of those who did, smoked cigarettes. Alcohol consumption decreased in three of the subjects. Nine subjects reported a decreased intake of calories and/or fats and ten reported

no change. Daily activity level of 9 of the 21 subjects reportedly increased following participation in the program.

Limitations of this non-experimental study were mainly those factors related to the retrospective nature of the data and certain uncontrolled variables in the environment as well as the sample size. The effects of exercise training were more apparent in the group who participated in the program for more than six months.