This is to certify that the

dissertation entitled

THE EFFECTS OF A SIX-MONTH, INCENTIVE-BASED, WORKSITE EXERCISE PROGRAM ON ADHERENCE AND WORK CAPACITY

presented by

Jonathan Isaac Robison

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in the Department of
Physical Education and Exercise Science

William W. Hewsner
Major professor

Date May 10, 1991

THE EFFECTS OF A SIX-MONTH, INCENTIVE-BASED, WORKSITE EXERCISE PROGRAM ON ADHERENCE AND WORK CAPACITY

By

Jonathan Isaac Robison

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Physical Education and Exercise Science

1991

ABSTRACT

THE EFFECTS OF A SIX-MONTH, INCENTIVE-BASED, WORKSITE EXERCISE PROGRAM ON ADHERENCE AND WORK CAPACITY

By

Jonathan Isaac Robison

The purpose of this study was to evaluate the effects of a behavior treatment package on adherence and dropout during a six-month worksite exercise program.

One hundred and thirty seven participants in six different worksites on a university campus (five experimental and one comparison site) completed six months of a minimally supervised, incentive based endurance exercise program. All participants in the experimental group contracted to engage in at least four bouts of 30 minutes of verified aerobic exercise within a prescribed target heart rate range each week for the duration of the program. Forty dollars deposited at the beginning of the program served as a response cost which could be lost as a result of failure to fulfill the weekly contracts. Individuals in the comparison group participated in a similar six month program but without the contracts and response cost strategies. Weekly adherence for both groups was strictly defined as verified fulfillment of all four bouts of exercise. Adherence for the experimental group was 97% by this definition and adherence for the comparison group was 19% ($p<0.01$). $\dot{V}O_2$ max increased 2.6% ($p< 0.01$), and treadmill test time increased 16% ($p< 0.01$) in the experimental group after the six-month program.

Heart rates and ratings of perceived exertion at all submaximal workloads during treadmill exercise testing were reduced at six months in the experimental ($p < 0.01$) group. Recovery heart rates at 2 and 4 minutes post exercise were significantly lower at six months in the experimental group but not in the comparison group. These data provide evidence that adherence to a six-month endurance exercise program can be improved significantly through the use of well conceived behavior management strategies. In addition, the increased adherence results in significant improvements in cardiovascular efficiency and work capacity.

ACKNOWLEDGMENTS

The author wishes to thank Dr. William W. Heusner for his guidance and for acting as thesis director. Thanks also are given to the other members of the guidance committee: to Dr. Wayne D. Van Huss and Dr. Marc A. Rogers (Department Of Physical Education and Exercise Science), and to Dr. Brian E. Mavis (Department Of Psychiatry). In addition, gratitude is expressed to Dr. Bertram E. Stoffelmayr and Dr. Thomas Stachnik for guidance in the application of their behavioral package for use in this study. Thanks also to David Anderson for assistance in drawing the figures.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

There is evidence to suggest that adherence to exercise may be related to various environmental (94,106,112,114,136), personal (32,77,111,112,137), and program (49,89,112,127,139) factors. However, in spite of nearly ten years of study, it still is not possible to discern with any degree of consistency who will or will not adhere to an exercise program (63,93,113,143). Martin and Dubbert (94) suggest that research emphasis be directed towards attempts to ensure compliance through the development of treatment packages consisting of a variety of behavioral and cognitive behavior strategies. Strategies including stimulus control (23,88,105,151,155), contingency contracting (46,70,104,110,151,153,164), incentives (46,73), competitions (73), cognitive behavior modification (12,26,74,93,150,157), and social support (6,62,73,74,154,157), separately and in various combinations, have shown promise in improving adherence to exercise programs. Unfortunately, it is difficult to accurately evaluate the results of these studies largely due to inconsistencies in the definition and measurement of adherence (41,92,109,111). Other problems in the adherence literature have included short treatment length and lack of follow-up of maintenance activity levels (92,93,94), inability to separate effects of various behavioral components applied simultaneously on adherence (93,109), and the lack of control groups to substantiate

improvements (38,40,113). These problems seriously have hindered the development of optimal interventions that may assist beginners in the task of maintaining regular exercise habits. Ultimately this results in poor adherence and high dropout rates for most programs.

Need For The Study

Exercise and chronic disease. The benefits of physical activity for the prevention and treatment of the major chronic diseases of our time, as well as for physiological and psychological quality of life, are well documented.

The relationship between physical activity and the development of cardiovascular disease, the number one contributor to mortality in the United States for the past 30 years, is well established (17,42,54,85,103,106,119,139). Exercise is considered to be an important part of the treatment for coronary artery disease resulting in improved cardiovascular function, increased anginal threshold, and enhanced thrombolytic activity (14,50,135). Physical activity also has been shown to have positive effects on many of the risk factors for cardiovascular disease including hypertension (59,60,99,23), abnormal lipid and lipoprotein profiles (161,162), obesity (65,71,91,125), and diabetes (14,42).

Population studies have indicated a significantly decreased risk for colon cancer in men and breast cancer in women who are engaged in high as opposed to low levels of occupational activity (14,119). Similarly, cancer incidence has been found to be inversely correlated with fitness level (17). An increase in weight-bearing physical activity also has been suggested as a potential treatment as well as a preventative measure for osteoporosis. Premenopausal

well as a preventative measure for osteoporosis. Premenopausal bone loss appears to be related to physical activity in women (2), and a number of studies have demonstrated the efficacy of exercise for slowing or even reversing bone loss particularly in post-menopausal women who constitute the group at highest risk for the disease (3,30,78).

Not only has physical activity been of benefit for physiological health, but The National Institute of Mental Health has concluded that physical fitness is positively associated with mental health and well-being (101). The strongest evidence in this area indicates that physical activity can help decrease the symptoms associated with mild to moderate depression (101,102,149). Exercise also is associated with reduced anxiety and increased self-concept (52,122,149).

Inactivity in the United States. Despite the wide dissemination of knowledge concerning the positive effects of physical activity on both physiological and psychological quality of life, physical activity in the United States remains well below desirable levels. Leisure time physical activity has probably increased some over the last 20 years (148), but advances in technology and increased mechanization have resulted in a progressive decline in occupational activity levels in the United States since World War II (148). Durnin has commented that "work plays almost no part in the lives of a very large proportion of the population as far as physical activity is concerned" (44). Although the quality and quantity of physical activity which imparts the most benefit in terms of cardiovascular fitness and overall health have been described (5), it generally is

reported that more than 70% of adults still are not participating in a regular program of appropriate physical activity and that less than 10% are participating at the levels suggested by the 1990 Physical Fitness Exercise Objectives established by the Public Health Service (14,22,28). These objectives recommend that greater than 60% of adults between the ages of 18 and 65 should be participating regularly in vigorous physical activity (28). Despite the apparent "fitness boom" of the last 10 years, and a tremendous growth in the number of fitness programs offered where individuals work (16,20,32,57), there appears to have been a leveling off of participation in physical activity, and most Americans remain sedentary (42).

Statement of The Problem

Clearly, the many benefits that accompany increased activity are to be obtained only if individuals initiate and maintain appropriate exercise regimens over time (5,14, 92). Poor adherence and high dropout rates are major obstacles facing fitness programs in all types of environments. Separate extensive reviews conducted by Dishman (38), Martin and Dubbert (93), and Oldridge (110) have provided parallel conclusions: typically 50% of healthy individuals who begin an exercise program discontinue by the end of the first six months. This first six-month period seems to be critical in terms of adherence, as the dropout rate decreases during the next six months. Results have been remarkably similar with fire fighters (128), police officers (58), students (37,45,75,165), children (48,47), sedentary young and middle-aged men and women (94,97,106,122,130,137, 155,158), and older men and women (73,78). Similar patterns have

been observed in both primary prevention studies (67,90,104,107, 133,136,150) and worksite settings (32,33,43,83,117,134,137,143, 162). Even in structured exercise programs where individuals have attempted to recover after myocardial infarction or coronary bypass, adherence has been disappointingly poor with dropout rates again averaging 40%-50% during the first six months (6,93,110,111,113, 114). Interestingly, the extent and pattern of dropout from exercise is similar to the non-compliance seen with a variety of other health-related programs including those targeted at addictive behaviors and those prescribing regimens of medication (38,84,91,103,118). It is clear from the preceding information that more effective approaches to solving the exercise adherence problem are needed if the benefits of physical activity are to be experienced by a significant number of people.

The use of behavior management techniques has been suggested as a possible solution to the exercise adherence problem (95,110,112, 113,114). A wide variety of techniques have been used successfully to increase compliance with other health-related behavior changes such as weight loss (24,25,31) and smoking cessation (80,146). In general, the application of these techniques to exercise has resulted in significant improvements in adherence (93,94). However, the lack of standardized measurements of adherence, the typically short duration of programs, and the use of small and/or self-selected samples without adequate replication have hindered the generalization of results. Furthermore, lack of follow-up evaluations and difficulty in separating the effects of individual treatment techniques have made definitive conclusions concerning their

effectiveness impossible (93,94,95,110). The need in this area has been expressed by Martin and Dubbert (93) in a recent review of behavior management strategies for improving exercise adherence. "The most critical need at this point would appear to be the development and refinement of specific strategies and interventions that serve to significantly enhance adopting and maintaining of physical fitness as a lifestyle." They suggest the development of optimal treatment packages "suitable for individual tailoring that will produce acceptable adherence to both home and institutional structured exercise programs" (95).

Purpose of the Study

The primary purpose of this study was to evaluate the effects of a behavior treatment package on adherence and dropout during a six-month worksite exercise program. The six-month time period was chosen because this is when most individuals typically drop out of exercise programs (38). The package used in the present study was derived from the successful incentive-based, worksite behavior modification template that was developed by Stoffelmayr and Stachnik (146) for smoking cessation programs and was modified by Mavis (96) for weight-loss programs.

Changes in cardiovascular responses to submaximal and maximal exercise were monitored and related to adherence. The parameters that were considered included: heart rate response to and ratings of perceived exertion for submaximal work, maximal oxygen consumption ($\dot{V}O_2$ max), duration of a maximal graded-exercise treadmill test, and recovery heart rates following exercise.

Hypotheses

The following research hypotheses were tested during the conduct of this investigation: a) the use of an appropriate behavioral intervention will significantly increase adult adherence to a six-month worksite exercise program and b) increased adherence will result in significant improvements in the cardiovascular responses to submaximal exercise along with increased maximal oxygen consumption and exercise tolerance.

Research Plan

Data for use in this study were collected from 137 university employees, at six worksites on the campus of Michigan State University, who volunteered to participate in exercise programs as part of a worksite wellness demonstration project. Subjects in five of the buildings (n=117) received the behavior intervention package and became the experimental group. Participants at the sixth site (n=20) acted as a comparison group, receiving a program similar in all aspects to the experimental program but without the behavior management strategies.

All participants performed a maximal graded exercise test (GXT) on a treadmill to determine which subjects could safely participate in an exercise program and to provide information for the development of appropriate individualized exercise prescriptions. Treadmill tests were repeated at the end of the six-month exercise program. Maximal oxygen consumption was determined for each participant as were the heart rate and blood pressure responses to submaximal

exercise. Recovery heart rates at 2, 4 and 6 minutes postexercise also were obtained.

An individualized exercise prescription was generated from the GXT. This prescription required each participant to perform aerobic activity four times per week for a minimum of 30 minutes per session. All exercise was performed by the participants individually or in small groups, but not as part of a centrally located program directly supervised by project staff.

One-hour program meetings took place weekly at all worksites for the first eight weeks and bi-weekly during the remainder of the six months for a total of 15 one-hour sessions. Physical activity was not a part of the weekly meetings at the worksites. The first part of each meeting was spent in discussion of exercise-related problems which may have developed during the previous week and in evaluation of team standings (experimental group only). The remainder of each meeting comprised the educational component of the program.

The experimental group received the behavioral management package which included contingency contracting, monetary incentives, social support, self-monitoring and verification, and team competition. The participants were required to "bet on themselves" by investing $40 (placed in escrow) at the beginning of the program. For each week that an individual did not succeed in adhering to his or her contract, 50% of that individual's money was forfeited to members of those teams on which everyone had met their contracts for the week. Adherence (or compliance) was defined as verified fulfillment of all four contracted bouts of exercise per week.

A variety of additional incentives were employed. The team with the most money at the end of the six months received an additional $150 bonus. Individuals accrued chances for $50 cash lotteries held at the end of the program dependant upon the number of weeks they successfully fulfilled their contracts. A $50 cash lottery also was conducted to encourage attendance during the first four or five weeks of the program.

The exercise program for the comparison group was exactly the same as the program for the experimental group except for the exclusion of the behavioral package. Program leaders, contact time, exercise testing and prescription, and education were all similar for both groups. The goal of four 30-minute exercise sessions per week was also the same. The comparison group participants were asked to keep an exercise diary so that exercise adherence could be quantified during the six-month program. The program leader informed the group that the diaries would be collected and reviewed periodically.

Limitations

Due to the demonstration nature of the project, random assignment of worksites to treatment conditions was not feasible. Each site was a unique environment with specific problems demanding individualized intervention strategies. The five experimental sites included four academic units (Plant and Soil Science, Plant Biology, Animal Science, and Chemistry), plus the MSU Department of Public Safety. The comparison site was the MSU Credit Union. This site was chosen for the comparison group because it appeared to have a high degree of administrative support and encouragement for the exercise program and, therefore, an exercise

program might be expected to be relatively successful there even without the behavior management techniques. Because good adherence in this type of supportive atmosphere might be expected, any large differences between this group and the experimental group would strengthen the argument for behavioral intervention.

All participants in the study were volunteers. Therefore, those who enrolled at the various worksites may not have constituted a representative sample of the total population at those sites. However, worksite exercise programs universally are comprised of persons who volunteer to participate, and comparisons of the findings from the present investigation with those of other studies in the literature seem to be appropriate.

Definitions

Adherence. Definitions of adherence have varied widely in the literature. In the present study, adherence was defined as fulfillment of contractual goals. This consisted of performance of four 30-minute exercise sessions per week. Adherence was self-monitored, self-recorded, and verified by others in writing.

Compliance. The term compliance generally is used in the context of following a medical regimen prescribed by a physician. For the purposes of this paper compliance will be considered to be synonymous with adherence. These two terms are used interchangeably in most of the exercise adherence literature (38,110,113).

Dropouts. Individuals who verbally communicated that they were discontinuing the program or who ceased to hand in their verification forms were considered to be dropouts.

Worksites. For the purposes of this study, each campus building was considered to be an individual worksite. Any university employee who worked in a particular building was considered to be a part of that worksite.

Behavioral Package. The overall behavioral intervention (contingency contracting, monetary incentives, social support, monitoring, verification, team competition) is referred to as the behavioral package.

Contingency Contracting. The use of a written agreement specifying behavioral goals as well as rewards and/or punishments to be applied upon fulfillment or nonfulfillment of those goals is called contingency contracting.

Response Cost. The behavior change technique, often used in conjunction with contracting, which involves having the client deposit money or some other valuable which is then returned or forfeited depending on whether or not stated goals are reached is called response cost.

Incentives. Rewards or punishments which are designed to assist in the process of behavior change are referred to as incentives. Although it is true that contracts, social support and competitions also can provide "incentives" for change, these are discussed as separate behavioral techniques.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter presents a review of the literature pertaining to exercise adherence. Exercise adherence research can be divided somewhat arbitrarily but not unreasonably into two broad topical areas which will form the major sections of this chapter. The first section concerns the identification of determinants which can potentially explain and possibly predict individual exercise adherence and/or dropout. The next section, and the major focus of the present investigation, concerns the use of behavior management strategies as interventions to improve exercise compliance. This second section will begin with a short discussion of the theoretical foundations of behavioral intervention. The specific interpretation of these behavioral techniques by Stoffelmayr and Stachnik in their development of the "behavioral template" used in the present study then will be described. The remainder of the section will be devoted to a detailed examination of the research concerning the behavioral management of exercise adherence. Studies will be grouped according to the particular strategies employed: a) stimulus or antecedent control, b) consequent or reinforcement procedures, and c) cognitive self-control strategies. Finally, limitations of the research to date will be discussed.

Determinants of Adherence

Many possible determinants of exercise adherence have been suggested. These include personal characteristics of subjects, environmental factors, and factors relating to the activity programs themselves. In recent reviews, Dishman (38) and Martin and Dubbert (93) identify problems with research in this area. Most of the data come from either large-population surveys or small-group investigations in clinical or community settings. The former studies suffer from questionable measurements of physical activity and the predominance of either cross-sectional or retrospective designs. The latter, while often prospective in nature, typically suffer from lack of proper control conditions and difficulty in generalizing the results.

Only a few variables have correlated consistently with exercise adherence and have been shown to have the capacity for predicting adherence to and/or dropout from programs (93,110). Obesity, lack of motivation, blue-collar status, and smoking have been the most commonly identified personal characteristics directly related to decreased adherence and increased dropout (6,32,77,110,112,134). However, not all studies have agreed with these findings. Ward and Morgan (160) failed to find differences in body weight or percentage of body fat between adherent and nonadherent men and women in a 32-week university health and fitness program. Similarly, Sallis et. al. (130) failed to find a significant relationship between maintenance of physical activity and body mass index in a community sample of 1400 adults who were followed for a one-year period.

Of the environmental factors studied, the degree of social support obtained by program participants, particularly from family members, has been shown to be the most highly correlated with exercise adherence (7,41,94,103,107,113,139).

A number of characteristics of the exercise program itself seem to be correlated with adherence. The perceived convenience of the exercise setting and its closeness to the home or the workplace have been demonstrated to positively related to exercise adherence (6,26,113,139,153), though not in all situations (140). Examination of the relationship between adherence and the intensity of exercise has shown that increased participation and adherence generally occur when more moderate activities are involved (48,89,127).

To summarize, there are some indications that individuals at greatest risk for dropping out of exercise programs tend to be overweight, blue-collar workers who smoke and are not highly motivated to participate. In addition those who lack substantial social support for their desired changes and those who engage in vigorous activities at a considerable distance from their home or workplace also appear to be at increased risk (43,93,95,113). Despite nearly ten years of study in this area, it still is not possible to predict with any degree of consistency who will and will not adhere to a given exercise program (57,63,114,144).

Behavioral Management Strategies To Improve Exercise Adherence

The principles of behavioral management have developed over the past century from a number of different psychological lines of investigation, all of which have been concerned with the process of acquisition or learning of behaviors in animals and humans. Three

major models which attempt to explain the acquisition of behaviors have been proposed: a) classical or respondent conditioning, b) operant conditioning, and c) social learning theory.

Classical or respondent conditioning as developed by the Russian physiologist Pavlov (123) suggests that learning is primarily a result of reflex responses to environmental stimuli. Thus a dog automatically will salivate (unconditioned response) when food (unconditioned stimulus) is placed nearby. Pavlov showed that if the food then is paired repeatedly with a stimulus which does not ordinarily elicit salivation, such as the ringing of a bell, the dog will learn to salivate in response to this new stimulus even if the food is not present. Watson and Rayner (161) provided a famous example of the significance of classical conditioning in their study of fear reaction in an eleven-year-old boy. The boy was innately fearful of a loud noise but exhibited no fear of playing with a white rat. When the appearance of the rat was paired a number of times with the loud noise, the boy became frightened of the rat. This fear eventually was elicited even when the noise was not presented. Furthermore, the fear generalized to other similar objects such as a rabbit and a ball of cotton. Classical conditioning has been used to treat a variety of compulsive habits, the most common of which is probably chronic alcohol abuse. A drug which causes nausea is paired repeatedly with the sight, smell and taste of alcohol until the beverage itself elicits the unpleasant sensation. Abstinence from alcohol is often the result in the short term; however, the treatment does not work well with unmotivated subjects, and the effects of the noxious stimulus seem to disappear over time (85).

Operant conditioning as developed by B.F. Skinner (142) and others over the past 40 years suggests that the frequency of the occurrence of a behavior is determined by antecedents or events which immediately precede as well as by consequences or events that immediately follow that behavior. This involves more complicated processes than the reflex responses discussed previously, and the basic tenets of operant conditioning form the foundation for many of the most widely used behavioral management techniques. We stop for a red light in the middle of the night on a deserted road even though the chance of getting a traffic ticket or of hitting another car is almost nonexistent. The red light is responsible for this behavior by acting as a cue or antecedent stimulus that reminds us of a set of rules and regulations which we have learned. According to operant conditioning, behaviors also are established through the process of positive and negative reinforcement. That is, a behavior is reinforced by the presentation or removal of an immediately subsequent event which increases the likelihood of that behavior being repeated in the future. The child who learns that a temper tantrum will result in an immediate increase in family attentiveness is learning through positive reinforcement. Taking pain medication is negatively reinforced in a chronic pain patient because the medication removes unpleasant feelings. The removal of the pain is a positive experience which often will cause the patient to continue to take the medication long after the pain is actually gone.

The proper use of reinforcement techniques is essential if learning is to be facilitated. Reinforcement can take a wide variety of forms

and is not necessarily synonymous with reward. The scolding received by the attention-starved child as a result of the temper tantrum may actually serve to increase rather than decrease the frequency of the unwanted behavior. Furthermore, the timing of the potential reinforcing event is critical for ensuring the desired effect. Praising a child for cleaning his room while he is watching television may result in an increased frequency of television watching rather than an increase in the frequency of room cleaning because the praise is delivered during the act of television watching and not during the act of room cleaning.

While operant conditioning suggests that behaviors are established as a result of direct consequences in the environment, social learning theories like that proposed by Bandura (9) take into account other processes which are relevant particularly with respect to human learning. These theories do not disregard the significance of immediate environmental consequences in the shaping of behavior patterns, but they stress the importance of cognitive aspects of the learning process. Thus thoughts, beliefs and perceptions play an important role in the learning process. The "placebo effect" is an example of this type of process. Patients who receive medication which they are told will relieve their pain may perceive the expected results even if the medication is inactive. Similarly, self-monitoring often effects behavior simply because it forces the individual to spend more time thinking about the behavior. Social learning and other cognitively oriented theories also stress the importance of self-control and self-efficacy in the development of human behavior. Attainment of goals can lead to increased positive feelings towards

self which can act as a strong internalized type of reward. The advantage of the social learning theories are that they allow the integration of many different pathways to learning and thereby permit the understanding of a large variety of simple and complex human behaviors.

The goal of all of these techniques is to assist with the termination of undesired behaviors and the acquisition of desired behaviors. In the long term, however, the success of these procedures may depend on the ability of individuals to establish personal self-management and control over their behaviors. The process of acquisition of behaviors via self control generally is assumed to be similar to the learning of behaviors in any situation. Many of the strategies suggested by the learning theories described in the foregoing discussion have been effectively self-applied by individuals in order to achieve desired ends (94,110).

Behavioral Template

Human learning appears to be a complex phenomenon involving components of each of the major models. The behavioral template used in this study, and described in detail in the next chapter, was developed by Stoffelmayr and Stachnik (146) in an attempt to combine the most effective elements of behavioral management theory into a coherent package which will facilitate health-related behavior change. Components of operant conditioning and social learning theory were combined in an effort to create a template which could be applied in a variety of behavior-change settings, not only to facilitate specific behavior change but also to teach principles of self control for life-long use. The template has been used

successfully by these researchers for smoking cessation (146) and stress management (147) and has been adapted for use in weight-control programs by Mavis (96).

Strategies for Behavioral Management of Exercise

A large number of strategies derived from the previously discussed principles have been used to improve the behavioral management of exercise in a variety of settings and with a variety of populations.

Stimulus Control. The manipulation of events which act as cues for physical activity is referred to as stimulus control. This technique, which utilizes the presence of a stimulus to affect subsequent behavior, has been used effectively in a number of studies. Brownell, Stunkard, and Albaum (23) increased the exercise activity in a shopping mall by placing a colorful poster coaxing people to use the stairs instead of the escalator. Stair climbing more than doubled during the two-week period in which the poster was displayed and gradually reverted back to original levels after the poster was taken down. In another study, Lipsker and colleagues (89) studied the effects of various stimulus control procedures on the attendance of a group of adults to a community exercise program. Making preparations for their attendance the night before class and placing printed reminders in visible locations both resulted in consistency of attendance which exceeded that of a control group which did not benefit from these procedures. Keefe and Blumenthal (71) combined stimulus control with other behavioral techniques to increase exercise activity (walking and jogging) in three overweight males over a two-year period. The stimulus control procedures

included having the subjects exercise at the same time and in the same setting each day and by having them warm-up for 10 minutes before each activity session. Nelson, et al. (106) investigated the use of predesignated activities as a means of cuing increased exercise adherence. Female undergraduate students were asked to rate a list of activities such as "going for a walk", or "chewing gum", on a frequency scale ranging from "do very, very frequently", to "never do at all". Subjects who were instructed to perform three of these self-selected, low-frequency activities prior to each exercise session showed increased adherence over those who did not perform such activities. Wankel and her associates (157) studied female dropouts from a commercial health club. Dropouts were more successfully re-recruited and subsequently demonstrated increased maintenance of activity when prompting phone calls were combined with persuasion to write down the potential positive benefits of rejoining the club prior to rejoining. Lastly, Oldridge and Jones (111) successfully increased exercise adherence among cardiac patients by having them sign a written agreement before beginning participation in an exercise program.

Consequent Control. Providing consequent control in the form of reinforcement or punishment for exercise adherence or nonadherence has been accomplished by researchers through the use of contracts, incentives, competitions, and social support.

Contracting. The technique of contracting has been shown to be an important tool, for increasing attendance and for promoting behavior change, in a variety of health-related contexts including weight control, smoking cessation and stress management programs

(68,146,147). The technique, often referred to as contingency or behavioral contracting, is defined as a written agreement stipulating specific behaviors and contingencies (rewards and/or punishments) designed to promote behavior change (46,76). Individuals are asked to develop specific goals which they then will monitor for a period of time. Rewards and or punishments for adherence or nonadherence are typically agreed upon beforehand between the individual and the program leader or between the individual and significant others.

Behavioral contracting has been used successfully to increase the frequency of activity and to decrease the frequency of droping out of exercise programs (45,70,105,111,154,155,165). This type of intervention has been utilized by a number of researchers in a case study format to increase the exercise activity of individuals. In an early example, contingency contracting was used to increase adherence of a 26-year-old woman to an individualized physical activity regimen (154). The subject's self-report indicated a high level of adherence to the program, and physiological evaluation showed significant improvements in cardiovascular fitness as a result of a six-week program. A five-month follow-up assessment indicated continued improvement. In another group of studies by the same researchers, rewards and punishments were based on a point system. Individuals chose a number of commodities or activities which they deemed rewarding and established a point total necessary to acquire each. Points then were awarded for each successful contract fulfillment and could be "cashed in" for appropriate rewards. Individuals who engaged in unwanted behaviors or missed exercise sessions were punished with a loss of

points and, therefore, with decreased likelihood of obtaining rewards (155). Contingency contracting was used in another study to successfully increase an individual's exercise behavior (70). In this study the contract was made between the participant and her husband, and the husband was responsible for controlling the rewards and punishments.

Cuff (34) compared the effectiveness of a contingency contracting package, a self-monitoring package, and a purely informational package for increasing adherence to a jogging program. The contracting package produced significantly higher adherence, less dropout, and greater physical activity than did either of the other two packages. Similarly, Macfarlane (99) compared a group receiving contingency contracting strategies to a lottery group and to a no-treatment control group with regard to attendance at an aerobic dance class. One of these strategies was assigned to each of three aerobic dance classes. Adherence in the contracting group was significantly greater than that in the other two groups, although the authors pointed out the need for replication of the study using random assignment of participants to treatments.

Wysocki and his associates (165) investigated the use of contracts to increase the exercise activity of college students. In this study participants deposited items of personal value such as books, jewelry, and checks made out to charitable organizations, which then could be earned back by the accumulation of a predetermined number of points each week. Seven of eight individuals significantly increased their aerobic activity levels during the 10 weeks after contract implementation, and a twelve-month follow-up evaluation

after program termination indicated successful maintenance of program activity for all seven of these individuals.

Epstein and Wing (45) examined the use of contracts to increase the attendance of college students at quarterly aerobic exercise sessions. In this study a technique known as "response cost" provided the consequences attached to the contract signing. Thus, at the start of the program, the experimental group deposited money which then was returned weekly upon fulfillment of the contractual agreement. Individuals using the contracting procedures had a 64% attendance rate as compared to a 40% attendance rate for the noncontracting control group, even though all participants received academic credit for attending the sessions.

There have been a few other studies which have compared the effects of contracting techniques on adherence to and dropout from exercise programs. Oldridge (111) randomly assigned cardiac rehabilitation patients to two groups. Both groups participated in identical six-month exercise programs; however, only those individuals in the experimental group were asked to sign an agreement to adhere to the program and to self-monitor their adherence for the six-month period. Of the 63 subjects in the experimental group, 48 agreed to sign the contract. Even without the use of contingencies attached to fulfillment or nonfulfillment of the written agreement, 65% of those who signed adhered to their exercise goals; only 20% of those who did not sign adhered. Within the control group, 42% of the individuals adhered to their programs. The dropout rate for those who did not sign the agreement was 85%, whereas the rate for those who signed the agreement was only 35%.

In a recent study, contracting was used in a large urban health promotion program to increase adherence to exercise participation (105). All individuals were asked to exercise at least three times per week for a minimum of 20 minutes per session. Exercise classes were offered, but individuals also could exercise on their own. Participants who signed contracts were eligible to win a small prize at the end of the program if they fully adhered to their contractual obligations. Only those signing contracts attended the offered classes, and 88% of those who signed contracts returned for a six-month follow-up assessment. Only 24% of those who did not sign returned.

In summary, the use of contingency contracting is associated with significantly increased adherence to and decreased dropout from exercise programs. The research to date has not identified the particular mechanisms involved, and more work needs to be done concerning the specific benefits contributed by the various components of the procedure.

Incentives. A variety of incentive procedures have been used for the purpose of increasing the likelihood of behavior change with respect to activity. Libb and Clements (87) used token reinforcement to successfully increase stationary cycling in three of four geriatric patients in a psychiatric hospital. Increased use of the cycle was rewarded with tokens which later could be exchanged for candy, cigarettes, etc. Similarly, Allen and Iwata (1) succeeded in increasing exercise activity among mentally retarded adults by making game-time (playground activities such as running relays, tag, and ball passing) contingent upon completion of 15 minutes of calisthenics.

The technique of "response cost" described earlier has been used in a variety of settings to improve attendance and fulfillment of contract goals with weight loss (13,61,68), smoking cessation (80,146), and stress management (147). Epstein and Wing (45) used this technique to improve attendance of females at a university aerobic dance program. Persons who deposited money at the beginning of the program, and received part of it back for each session attended, participated in significantly more sessions than did those in a control group who deposited no money.

Lotteries also have been used as a means of increasing attendance and adherence to behavior change regimens. One study examined the use of a lottery to reduce personal driving of employees of a consulting firm (55). Individuals in the experimental group were rewarded for decreases in unnecessary driving mileage by being given chances at four small weekly lotteries and one large lottery at the end of the four-week program. The participants in the lottery group decreased their mileage by 11.6% during the program, while the control group increased their mileage by 21.2% during the same period. Stachnik (146) used an attendance lottery as part of an incentive-based behavior management package to encourage abstinence from cigarette smoking in three worksite wellness programs. More than 80% of the participants in the three programs were abstinent after six months. Mayer and Geller (97) employed a lottery system in conjunction with other techniques to increase bicycle traffic on a university bicycle path. In a study involving a variety of behavior management techniques, Epstein et al. (45) showed a lottery procedure to be equal to a contracting procedure

for increasing attendance at an exercise program. Individuals who contracted to attend 20 exercise sessions over a four-week period and individuals who participated in a lottery attended 76% of the exercise sessions compared to individuals in a no treatment control group who attended 56% of the sessions.

Not all uses of lotteries, however, have been associated with positive results. Martin and Dubbert (94) found that a lottery added to an exercise program which combined personalized feedback and reinforcement techniques did not increase compliance to the program. The authors hypothesized that the effects of the positive reinforcement provided by the enthusiastic program leaders may have obviated the use of the lottery procedure in this instance.

Incentives have been used in recent years by a growing number of businesses as an integral part of their wellness programs. Generally described as policies, practices, or awards that are designed to incite people to action, incentives range from large cash awards to T-shirts for involvement in lifestyle improvement activities. Incentives have been employed to facilitate participation in smoking cessation, weight loss, stress management, and exercise programs (11,21,51,74,146,147).

Competitions. The use of competitions between groups of individuals to encourage health behavior change has become popular in the last 15 years, both in business and community settings. Though properly controlled studies are rare, competitions appear to foster lower attrition rates and superior behavior change results; furthermore, they appear to be cost effective when compared to other intervention programs (25). Competitions have been used

most often to facilitate weight loss and smoking cessation (24,25,31,146) and less frequently for increasing adherence to exercise programs. King et al. (74) used group competitions to increase recruitment to a worksite fitness program for blue collar employees of a university. The percent of the total population which participated (23%) was higher than that usually reported for such programs. Individuals who participated also showed an average 15 beat decrease in one-minute recovery heart rate following a step test as compared to nonparticipants who typically showed no change in recovery heart rate. Unfortunately, the competitions were only one aspect of the program, and thus their effects on could not be distinguished from those of other components.

Social Support. Social support from both fellow participants and significant other nonparticipants has been shown to be an important factor in reinforcing attempts to adhere to physical activity programs (78,94,156,158). Heinzelmann and Bagley (64) found that 90% of the adult men in their study expressed a preference for exercising with a partner or in a small group as compared to training alone. Similarly, data from a study comparing individual to group activities for a cohort of middle-aged business men suggests a strong preference for the latter (139), although these authors and others point out that some individuals may have preferences for exercising on their own (58,74,139,158). King and Frederickson (75) organized women into jogging groups of three or four individuals and fostered social support within these groups through the organization of teams and by requesting that individuals jog with at least one team member throughout the five-week program. Women in this program

reported twice as many jogging episodes as did control subjects who did not engage in the structured social support strategies. Wankel (156) instituted a social support intervention package with a group of female participants in an aerobic exercise program and compared their 10-week class attendance with that of a randomly assigned control class that was conducted without the package. Attendance was significantly higher in the experimental group. Other research also has suggested that exercise partners or "buddies" encourage continued participation (159).

The support of "significant others", particularly spouses, has been associated with increased adherence to exercise in a variety of settings. During an 18-month exercise program which was conducted with a university population, men's adherence patterns were directly related to their wives' attitudes about the program (64). Whereas 80% of the men with wives having positive attitudes towards the program had good or excellent adherence patterns, only 40% of the men with wives having neutral or negative attitudes had similar patterns. Ehrling and Oldridge (49) obtained similar results in a study involving cardiac rehabilitation patients. Program dropout rates were reduced by about 50% with the inclusion of spouses as program participants. Likewise, in a study of 728 coronary heart disease patients, the dropout rate of individuals whose spouses were supportive of their involvement was one-third that of those whose spouses were not supportive (6).

In the case of worksite fitness programs, supervisor support also has been shown to be associated with program involvement. The results of a study involving blue-collar university employees in a 16-

week exercise program at work showed that the group with the most supportive supervisor had the highest participation rates (74). Similarly, in a worksite fitness program provided for federal employees by the National Aeronautics and Space Administration, supervisor's attitude towards the program was associated positively with employee adherence (43).

Finally, support from program leaders has been widely reported to be a key factor of successful adherence to exercise programs in all types of environments (43,58,110,113,121,158). Studying attendance at 10-week aerobic dance classes, Wankel (159) compared the effects of a strong leader support intervention with a strong leader support component, decision balance-sheet intervention and nonintervention. The support intervention group had significantly better attendance than did either of the other two groups, and subjects questioned at the end of the study concerning various components of the programs indicated that their most positive feelings were related to leader support. Martin et al. (94) had exercise leaders jog with participants in an exercise class in an effort to increase attendance. One-half of the participants were given further support by the leaders in the form of immediate feedback and praise during the jogging, while the other half were given only group feedback after each activity session. The group receiving immediate personalized feedback attended more classes and reported better maintenance of activity three months following completion of the program. In a study of more than 700 male postcardiac patients involved in a long-term exercise program, Andrew and his co-workers (6) found that, as compared to the

results obtained with individualized attention from program leaders, lack of such attention resulted in a doubling of the dropout rate.

Cognitive Behavior Modification. Bandura (10) has suggested that cognitive alterations are essential in order to maintain behavior change. Some combination of cognitive and behavioral strategies may be the most effective method of exacting behavior change (8,84,144). What individuals think about before, during, and after exercise has been shown to have effects on the formation of positive exercise habits. In this context, a number of researchers have looked at the relationship between participants' perceptions and their adherence to exercise programs. Thompson and Wankel (152) studied the effects of perceived activity choice on the attendance of women over a six-week period at a private health club. New recruits were matched according to activity preferences obtained at an initial meeting and then randomly assigned to one of two groups. The experimental group was lead to believe that their exercise program was determined on the basis of their activity preferences, while the comparison group was told they were being given a standard exercise prescription. In reality, the programs of both groups were based on their initially expressed preferences. By the fifth and sixth week, the attendance of the perceived choice group was significantly higher. In a similar vein, Martin and Dubbert (94) studied adults enrolled in a three-month exercise program involving walking and jogging for three days per week. Participants who were permitted to develop their own distance goals attended 83.7% of the sessions, while those who were given a set of prescribed goals attended only 67.8% of the time. Furthermore, at a three-month follow-up

assessment, 47% of those who had practiced flexible goal setting reported maintenance, while only 28% of those who had their goals rigidly prescribed reported that they were continuing to exercise.

The use of a decision balance-sheet has been shown to be effective as a means of increasing adherence to exercise via cognitive change in a variety of settings (159). This technique involves having participants provide an interviewer with a written systematic exploration of potential benefits and problems which might be associated with their involvement in a particular behavior change program. The interviewer is responsible for reinforcing the positive statements and not reinforcing the negative ones in the hope of influencing the participant to proceed with the behavior change. Hoyt and Janis (66) investigated the use of this procedure with faculty, faculty spouses, and students enrolled in a ten-week university fitness program. The subjects were randomly assigned to one of three groups. The experimental group received a balance-sheet related to the exercise program. The other two groups received either an irrelevant balance-sheet concerning smoking or no balance-sheet. Attendance was almost twice as high in the experimental group as in the other groups. A similar study looked at the effect of the balance-sheet technique on participation of females in activities at a private health club (159). Both the decision balance-sheet and a positive-only balance sheet resulted in more frequent exercise activity than was observed in a no-balance-sheet control group. A decision balance-sheet intervention also was associated with improvements in attendance during a five-week community-based fitness program (156).

A number of researchers have examined the effects of different cognitive strategies during exercise both on adherence and on the actual performance of activities. Martin and Dubbert (94) explored the effect of two opposing cognitive strategies on adherence to a three-day-per-week walking/jogging program in sedentary healthy adults. One group was instructed in the use of distraction- or dissociation-based cognitive strategies which involved setting small mental goals and thinking about the external environment such as smells and sights during activity. The other group was taught to use associative strategies such as challenging themselves to push harder to accomplish their goals while concentrating on the bodily sensations which normally accompany physical exertion. During the program, attendance and adherence were significantly higher in the group using the distraction strategies, as was continued maintenance at three- and six-month follow-up reporting sessions. The authors hypothesized that the associative strategies may have increased the discomfort and stress of the program for many of the beginning exercisers thus leading to the decreased adherence. A number of other researchers have had similar results with dissociative cognitive strategies (102,124). However, it has been noted that associative techniques may be more beneficial for elite athletes and high risk cardiac patients, both of whom may need to constantly monitor their performance during exercise (93).

Recently, the relapse prevention theories of Marlatt and Gordon (91) have been proposed as possible means of improving exercise adherence and reducing dropout. These theories suggest that the ability of individuals to maintain a desired behavior (e.g., abstinence

from alcohol or participation in regular exercise) depends on how they cope cognitively and behaviorally with situations that increase the risk of discontinuance of their newly acquired behaviors (26). King and Frederiksen (75) demonstrated increased activity levels of previously sedentary undergraduate women who were given one session of relapse prevention training involving practice in identifying and dealing with high risk situations. No such effect was observed in a control group not receiving the training. In a two-month follow-up report, 80% of the group receiving the special training, but only 40% of the control group, indicated that they stillwere exercising regularly. Belisle et al. (12) investigated the use of relapse prevention training with members of a university community during a 10-week exercise program and at a three-month follow-up evaluation. The 350 participants were assigned to exercise groups of approximately 30 individuals each which then were chosen randomly to receive either the relapse prevention program or a placebo program without the relapse training intervention. Adherence was significantly higher in the intervention group, as was maintenance at the three-month follow-up session. Martin and Dubbert (94) used similar techniques with a group of previously sedentary adults in an attempt to improve maintenance of exercise behavior acquired in a 12-week program. Relapse prevention training added to other forms of cognitive and behavioral intervention did not significantly improve maintenance three months after program termination. The authors suggested a number of methodological problems which may have biased the results of their study including the fact that the instructor of the group which did

not receive the relapse training continued meeting with his group after the program had officially ended. More work needs to be done to more accurately evaluate the efficacy of this technique for increasing adherence to exercise programs.

Summary

Adherence to exercise has been studied in many different environments and with a variety of populations. The literature as a whole reveals similar adherence rates and dropout patterns between supervised and unsupervised programs as well as across community, worksite, and medically oriented programs aimed at either primary or secondary prevention of cardiovascular disease (39). Due to the difficulty in consistently and accurately predicting adherence to and/or dropout from programs, behavior management has been suggested as a potentially beneficial approach for dealing with the exercise adherence problem (95,110,113,114). Exercise studies which have utilized behavior management techniques have reported improvements in adherence rates of 50 to 100%; however, most programs have been of short duration and there are many definitional and methodological problems (38,93,94,110).

It has been suggested that the workplace may be an ideal location for the implementation of lifestyle change programs (16,32,131), but there have been few studies examining the use of the advantages of the workplace in combination with behavioral management strategies for improving exercise adherence.

Limitations Of Research in the Behavioral Management Of Exercise

There is general agreement that behavior management techniques provide potential methods for increasing exercise adherence

(41,42,77,110), and current research findings indicate that programs incorporating these strategies can yield adherence data that are at least 50% higher than those obtained from standard programs (93,95). There are, however, a number of limitations of the research to date which prevent the drawing of definitive conclusions. One of the most pervasive problems is the lack of consistency in the definition and measurement of adherence which is defined as attendance in some studies, as retention in other studies, and as varying rates of participation in still other studies (41,93,110,112). Reid and Morgan (128) in their six-month investigation of firefighters, considered adherence to be the percentage of subjects exercising two or more times per week who increased their maximal oxygen consumption by at least 9.5%. On the other hand, adherence was defined by Martin and Dubbert (94) simply as the performance of three prescribed aerobic exercise sessions per week. In a study of males with coronary heart disease, Oldridge and Jones (111) defined adherence as attendance at 60% of all scheduled and supervised exercise sessions, with dropout being designated separately as nonattendance at eight consecutive sessions. The accumulation of aerobic points was employed to define adherence by Wysocki et al. (165) in their study of the effects of contracting with college students. Each participant signed a contract stating a proposed number of aerobic points to be earned weekly. Adherence then was determined by adding the total number of aerobic points per week and comparing the total to the contracted amount. Deposited valuables were returned to individuals upon successful fulfillment of the weekly contracts.

In investigations which have involved activity outside of a supervised environment, the problem of measurement of adherence has been further complicated by the use of self-report techniques. These types of measures are susceptible to considerable inaccuracy and even purposeful falsification (93). A number of researchers have shown self-recorders to be less reliable than independent observers (88,129). Furthermore, it has been difficult to validate self-report measures due to lack of a "gold standard" for the measurement of activity in free-living populations (41).

Another problem in interpreting exercise adherence literature is that the majority of studies have been of short duration, and long-term follow-up of the effects of the various behavioral techniques on maintenance has been rare (93,94,95). These behavioral strategies may be effective only for relatively short periods of time. If that is the case, other techniques must be developed to encourage lifetime maintenance (93,95). To further complicate matters, many of the studies have used two or more strategies simultaneously and, therefore, have been unable to isolate the true source of any observed improvements in adherence (94,110). Furthermore, most studies have used small, self selected samples which, without numerous replications, makes the generalization of results tentative (38,93,94). Though some researchers have attempted to justify their research techniques by noting the difficulties (even impossibilities in some cases) associated with the proper use of randomization and/or control groups in clinical studies of human behavior (21,53), the lack of application of these accepted principles of scientific investigation weakens the potential impact of the positive findings (38,40,114).

Finally, the significance of the use of behavioral techniques in combination with the unique environment of the workplace is only beginning to be addressed as most emphasis to date has been given to substantiating the economic and physiological benefits needed to justify the costs of these programs.

CHAPTER III

METHODS

The purpose of this investigation was to evaluate the impact of a behavior management treatment package on adherence and dropout during a six-month worksite exercise program. The study was designed to examine the direct effect of the treatment on adherence and dropout rates as well as the subsequent indirect effects on changes in cardiovascular fitness over the course of the program. The hypotheses to be tested were that the use of this package would result in improved adherence and, therefore, increased cardiovascular fitness as measured by responses to submaximal exercise, improvements in exercise tolerance, and increased maximal aerobic capacity.

Aside from the delivery of the behavior modification treatment package to the experimental subjects, all participants (both experimental and control) received programs that were similar in regard to program length, contact time, group leaders, exercise testing and prescription, and education. Adherence was defined to be participation in a minimum of four 30-minute aerobic exercise sessions per week. Dropout was defined as a verbal request to discontinue the program or failure to hand in the weekly verification forms. The participants exercised on their own time and were not under the direct supervision of the program staff. A form for self-monitoring was handed in weekly by each participant. This included

the mode and duration of the activity performed as well as a signature from a witness to verify each session.

Subjects

The study population (n=137; 60% male, 40% female) consisted of university faculty (17%), staff (60%), and graduate assistants (23%) in six buildings (worksites) at Michigan State University. The study was approved by the University Human Studies Committee. Following an explanation of the purposes and procedures of the investigation, all interested participants provided written informed consent (see Appendix A).

Recruitment. The subjects initially were recruited at each worksite with a widely publicized, voluntary health fair at which blood pressure measurements, cholesterol determinations, and cardiovascular disease risk appraisals were provided free of charge to all building personnel. Typically 50% of each worksite participated in the health fair. All participants received counseling to discuss the results of the tests and to explain the purpose and nature of the exercise intervention to follow. Interested persons were encouraged to attend one of a number of orientation meetings for more specific information about the program. Approximately one-half of the individuals participating in the health fair at each site attended at least one of these orientation meetings. On the average slightly more than half of the individuals who attended these orientation meetings, or about 15% of each building paid for and joined the programs.

Individual interviews and a questionnaire (see Appendix B) were used to determine the initial exercise training status of each person

who volunteered to participate. The subjects were asked to estimate their activity levels by describing mode, frequency, duration, and intensity of both occupational and leisure-time physical activity during the previous two months. All persons reported having jobs which required minimal amounts of physical activity. Individuals who participated in fewer than two sessions of leisure aerobic activity per week were considered to be sedentary (67%); individuals exercising two times a week were classified as moderately active (15%); those exercising more than two times a week were considered to be active (18%).

Worksites. The worksites were defined as separate university buildings. The six sites included four academic buildings, a building housing university public safety personnel, and the university credit union. The sites were all part of a large campus health-promotion project. The four academic buildings were chosen on the basis of relative equality of size, faculty-to-staff ratio, and number of academic governing units. The other two sites were chosen on the basis of expressed requests for service. The subjects at five of these buildings (n=117) acted as the experimental group and received a worksite exercise program including a behavioral management package adapted from Stoffelmayr and Stachnik (146) and Mavis (96). Participants at the sixth site (n=20) acted as a comparison group, receiving a program similar in all aspects to that of the experimental group, but without the behavioral management component. The five experimental buildings received the treatment program between December 1987 and March 1989. All experimental programs began between December and March, and lasted

approximately six-months. One exercise physiologist conducted three of these programs and was responsible for supervising two graduate students who conducted the remaining two programs. The control program began in August of 1989 and was conducted by the exercise physiologist. Due to the demonstration nature of the project, it was not possible to control for the seasonal variations that potentially could have resulted from the differences in starting time between the experimental and control groups.

Exercise Testing and Prescription

All those wishing to enter the exercise program were required to fill out a Physical Activity Readiness Questionnaire (PAR Q) which identifies more than 80% of those with possible contraindications for exercise (29). Individuals over 45 years of age or who answered yes to any of the PAR Q questions were required to see their personal physician for medical clearance prior to entering the program.

All participants performed a maximal graded exercise test (GXT) on a treadmill to determine which subjects could safely participate in an exercise program, and also to provide data to assist in the development of appropriate individualized exercise prescriptions. A Naughton-Balke walking protocol, as modified by Van Huss, was followed with increases in intensity level occurring every two minutes at the rate of approximately one MET per level (4). Details of this protocol are given in Appendix C. Heart rate was monitored electrocardiographically, blood pressure was determined by auscultation, and ratings of perceived exertion according to the Borg Scale were recorded at each stage of the test (19). All of the exercise

tests were either symptom limited or terminated due to subject fatigue.

To determine maximal oxygen consumption ($\dot{V}O_2$ max), expired air was collected in meteorological balloons. The gas volume was determined by pumping it through a calibrated dry gas meter (American Meter Co., Singer model DTM115) at a rate of 100 liters per minute. The gas composition was determined using an Applied Electrochemistry Oxygen Analyzer (model-S-3A) and an Applied Electrochemistry Carbon Dioxide Analyzer (model Cd-3A). The analyzers were calibrated with known gases quantified by the Haldane technique. The exercise tests were repeated at the end of six months. Maximal oxygen consumption was determined for each participant based on achievement of at least one of the following two criteria: a) the leveling off of $\dot{V}O_2$ with increasing workloads or b) a respiratory exchange ratio (RER) of 1.10 or higher. If neither of these objective criteria were met, $\dot{V}O_2$ during the treadmill test was considered to be peak $\dot{V}O_2$ and, therefore, not a true $\dot{V}O_2$ max value. Peak $\dot{V}O_2$ data were not included in the analysis of the $\dot{V}O_2$ max data.

Body fat percentage was estimated by the Durnin-Rahaman formula using the sum of triceps, biceps, suprailliac, and subscapular skinfolds. Three measurements were taken at each site using the Lange skinfold caliper, and the average value was used for the determination of skinfold thickness. (The body fat assessment form can be found in Appendix D).

An exercise prescription was generated from the GXT. This prescription required each participant to perform aerobic activity at least four times per week for a minimum of 30 minutes per session.

Exercise intensity was determined using the Karvonen procedure to calculate a target heart rate range (THRR) for each person (69). Although the use of the mask for collecting expired gases during the treadmill test may result in an elevated heart rate and thus a slightly conservative intensity prescription, this was not deemed a problem, as attaining target heart rate was not part of the determination of adherence. A moderate intensity of 60% to 80% of the THRR was suggested. The use of the exercise prescription was explained, and the nature and benefits of aerobic exercise were discussed with each individual by an exercise physiologist. Each subject was encouraged to select modes of aerobic training which best fit his or her lifestyle. The largest number of persons in most buildings chose walking, but there were also many individuals who ran, cycled, or swam to meet their contracted goals. All exercise was performed by the participants on their own or in small groups but not as part of any program that was directly supervised by the program leaders. Many participants exercised on campus at one of the indoor recreational sports facilities or on existing walking paths. During inclement weather individuals also walked during their lunch hours in the halls and up and down the stairs within their own buildings. Still other individuals reported exercising at home either outside or inside using home exercise equipment.

Behavioral Package

The behavior management techniques that were used are based on a template originally developed by Stoffelmayr and Stachnik (146) for smoking cessation and later adapted for weight loss by Mavis (96). One-hour program meetings took place weekly at the

worksite for the first eight weeks and bi-weekly during the remainder of the six months, for a total of 15 one-hour sessions. These 15 hours over six months were the only work time required by the program. The meetings were held during the noon hour so that release time from work was not a major problem.

At the first meeting, the exercise physiologist/program leader asked the subjects at each worksite to divide themselves into teams of four to six members to facilitate implementation of the incentive system. A behavioral contract form was distributed, and the participants were asked to write out the specific aerobic exercise programs which they intended to follow for the next six months using the guidelines provided to them following their GXT's. (A copy of the contract can be found in Appendix E.) Individual prospective programs were discussed and modified in consultation with the exercise physiologist facilitating the group. The participants were asked to be specific and realistic concerning their contract goals, and the inclusion of a variety of exercise modes was encouraged by the facilitator. Each contract also included the names of people who would verify as witnesses each of the exercise bouts that were reported by the participant. Whenever possible, the verifications were by "significant others" in the lives of the participants. Special verification forms were handed out each week to be signed by the witnesses and brought to the next meeting as proof of adherence. Adherence was defined as verified fulfillment of all four contracted bouts of exercise per week. Credit was not given for any week in which there were fewer than four verified exercise sessions. Attendance at weekly meetings was strongly encouraged but was not

tied to successful fulfillment of the subjects' contractual obligations, provided that verification sheets were returned weekly to the group leader.

Financial Incentives. There was no cost for the exercise program itself, although there was a nominal $25 charge for the exercise test. The participants were required to "bet on themselves" by investing $40 (placed in escrow) at the beginning of the program. Each time an individual did not succeed in fulfilling his or her contract, 50% of that individual's remaining money was forfeited to the members of those teams, in the same worksite, on which everyone had met their contracts for that week. Partial financial credit was not given for fulfillment of fewer than four exercise sessions in one week, and only those people who reported the full four bouts in one week with proper verification were considered to be adherent. Individuals could lose only part of their own money if they were not successful in a given week. However, all members on a team had to be successful during that week in order to obtain any money forfeited from other teams. Therefore, in the interest of fairness, teams of similar size were utilized whenever possible. If all teams had at least one member who failed to meet his/her contract in a given week, the forfeited money went into a pool to be used in a similar manner the next week. Therefore, individuals who were successful during every week of the program would have their original 40 dollars returned and also could receive some of the money lost by members of other teams who did not succeed every week. The only exceptions to the adherence criteria were made for individuals who missed one or more exercise sessions during a week due to a sickness

or injury. The absence was verified in writing in the same manner that was used to verify the activity sessions. Sick or injured individuals were encouraged not to continue with their programs until warranted by their health status. Money was not forfeited in these cases, and the individuals were not penalized for missing sessions. Charts displaying team and individual standings were developed at each site with input from the program participants. These were displayed at the weekly meetings as an additional incentive. Money did not actually change hands until the end of the six-month period.

A variety of additional incentive schemes were employed. The team with the most money at the end of the six months received $150 to split amongst the team members. Individuals accrued chances for $50 cash lotteries held at the end of the program dependant upon the number of weeks they successfully fulfilled their contracts. Individuals who attended all of the first four or five program meetings also were eligible for a chance at a $50 cash lottery. These extra incentive monies were provided via a grant from the W.K. Kellogg Foundation.

Weekly Group Meetings. All meetings were held at the individual worksites at times decided upon by negotiation within the group. An attempt was made to accommodate the schedules of as many of those interested as possible. Physical activity was not a part of the weekly group meetings. The first part of each meeting consisted of a discussion of individual problems which may have arisen that week in relation to the participants' exercise sessions. This initial discussion was followed by an evaluation of team

standings. The remainder of each meeting comprised the educational component of the program. A wide range of topics was covered including: exercise and blood pressure; exercise and cardiovascular disease; exercise and osteoporosis; exercise, nutrition and weight loss; etc. A sample list of possible topics (see Appendix F) was provided by the facilitator, and the participants were encouraged to add topics of interest to themselves. Other than a few standard sessions, the weekly subject matter for this component of the program was dependant on the needs and desires of the participants and was decided upon by negotiation within the group.

Comparison Group Program

The overall program for the comparison group differed only by the exclusion of the behavioral package including: contracts, verification procedures, incentives, and team competition. Program leaders, duration of program, contact time, exercise testing and prescription, and education were similar in the two groups. The goal of four 30-minute exercise sessions per week also was the same, and comparison group participants were asked to keep an exercise diary, including exercise mode, frequency, and duration, to facilitate quantification of their adherence over the six-month period. They were told that the diary would be checked from time to time by the group leader in order to ascertain compliance levels. In practice, the group leader asked to see the exercise diary every two or three weeks during the six-month program. Subjects were not penalized if they failed to produce their diary during a particular session, but instead were asked to bring it in to be verified at the following meeting.

Statistical Analysis of Data

Mean differences within groups before and after the six-month program were analyzed using one-tailed, dependent t-tests. Initial differences between groups were tested using two-tailed independent t-tests. Final between-group differences were evaluated using one-tailed, independent t-tests. Adherence values, which are expressed here as percentages, were normalized by the usual arcsine transformation prior to data analysis.

Correlations were determined using Spearman's rank-order correlation coefficient. The physiological variables that were measured included weight, resting heart rates and blood pressures, submaximal heart rates and blood pressures during the GXT, maximal oxygen consumption, and treadmill exercise test time. Only data from individuals who did not drop out and who completed the pretest and the posttest were analyzed. Differences were considered to be significant at the $p < 0.05$ level. Data are expressed as means $\pm$ SE.

CHAPTER IV

RESULTS AND DISCUSSION

Subject Characteristics

Table 1 shows the initial characteristics of the program participants at the six worksites. Thirty seven of the 117 individuals who actually completed the experimental program did not return for the final treadmill test due to a combination of reasons including illness, change of job, and difficulties in scheduling. The remaining subjects in the experimental group included 56 males and 24 females with an average age of 39.8 ± 1.3 years. Of the original 20 individuals enrolled in the control group, 14 returned for testing at the end of the program, including 4 males and 10 females. While data from all participants who did not dropout were used to calculate adherence, only the data from the 80 experimental subjects and 14 control subjects who returned for testing are presented in Table 1. There were no significant initial between-group differences in age, height or weight (Table 1). This was also true when women were compared separately. The average age of the women in the experimental group was 39 years and the average age of the women in the control group was 32 years. The average height and weight of the women in the experimental group was 160 cm. and 67 kg. respectively. Values for the same parameters in the control group were 163 cm. and 62 kg. When men were compared separately, age and height were not significantly different between groups.

However, the four men in the control group weighed significantly more than the men in the experimental group (exp. = 79 kg., con. = 99 kg.).

Table 1. Initial characteristics of the subjects.

	Experimental	Comparison
Age (yr)	39.8 ± 1.3 (range = 22-73)	35.4 ± 2.9 (range =21-54)
Height (cm)	172.7 ± 1.7	168.1 ± 2.5
Weight (kg)	75.1 ± 1.3	73.0 ± 5.4

Values are means ± SE
Experimental group n = 80 (56 males, 24 females)
Comparison group n = 14 (4 males, 10 females)

Adherence and Dropout

Experimental and control group adherence rates are presented in Figure 1. Mean adherence rates at each of the worksites are expressed as the percentage of time during the six-month program in which the participants met the adherence criterion of four times per week as determined by their verification forms (experimental group) or by their exercise logs (control group). The overall adherence rate for the experimental group (comprised of sites A-E) was 97.3%. This was significantly higher than the adherence rate of 19.2% for the comparison group ($P < 0.05$). There was little difference between the values at the various experimental worksites (93.1-99.6%) which indicates a high level of adherence throughout all buildings. It should be noted that the adherence rate for the 37 individuals who

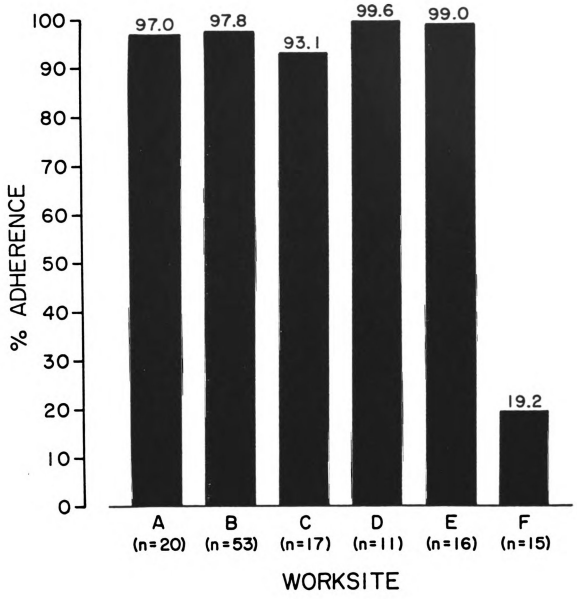

Figure 1. Adherence to the Six-Month Exercise Program.

did not return for final exercise testing (96.3%) was not different from the overall adherence rate for the experimental group. Therefore, their exclusion from the final calculations did not affect the adherence results.

Because of the large gender difference in number of subjects between the experimental and control groups, within-group adherence rates for each sex were calculated and compared. Adherence rates for the women were 96.4% in the experimental group and 23.6% in the control group. Adherence rates for the men were 98.0% in the experimental group and 9.7% in the control group. These values were similar to the adherence rates for the entire experimental group (97.3%) and the entire control group (19.2%); therefore, only the overall adherence results at each worksite are reported in Figure 1.

Two persons from the experimental group were forced to discontinue the program for medical reasons, and one individual dropped out for personal reasons. Five individuals of the initial 20 in the control group dropped out for personal reasons. Results from individuals who dropped out were not incorporated in the statistical analyses. Had these data been included, the between-group differences in adherence would have been even more striking.

Resting Physiological Measures

Initial Between-Group Comparisons. Table 2 shows resting cardiovascular measures and body composition values for both groups. Only data from the 80 experimental subjects and the 14 control subjects who returned for the final testing are included. Initial percentages of body fat and initial resting heart rates differed

significantly between the two groups ($P < 0.05$). However, lower body fat percentages and resting heart rates were expected in the experimental group due to the greater proportion of men in that group. When the women were compared separately, mean between-group resting heart rates (exp. = 74 bpm, con. = 81 bpm) and percentages of body fat (exp. = 30.4%, con. = 30.5%) did not differ significantly. Because the number of men in the control group who had two acceptable treadmill tests was so small, between-group comparisons of males were not made for any of the dependant variables.

Table 2. Resting cardiovascular measures and body composition data before and after six months of the exercise program.

	Experimental (n = 80)		Comparison (n =14)	
	Initial	Final	Initial	Final
HR (bpm)	71 ± 1#	66 ± 1†#	77 ± 3	74 ± 2
SBP (mmHg)	118 ± 1	114 ± 1†	116 ± 3	112 ± 4
DBP (mmHg)	73 ± 1	70 ± 1†#	73 ± 2	76 ± 1
Body Fat (%)	23.2 ± 0.7#	21.6 ± 0.8†#	29.3 ± 0.7	29.0 ± 1.3
Body Weight (kg)	75.1 ± 1.3	73.5 ± 1.3†	73.0 ± 5.4	71.4 ± 5.3

Values are means ± SE
HR = heart rate
SBP = systolic blood pressure
DBP = diastolic blood pressure
†p < 0.01 within-group comparison
# p < 0.05 between-group comparison
body fat % estimated from skinfolds

Within-Group Comparisons. For the individuals in the experimental group, heart rates measured after five minutes of quiet supine rest were reduced significantly by an average of 5 beats per minute (bpm) following six months of exercise (Table 2). Systolic and diastolic blood pressures were reduced by 3 to 4 mmHg ($P<0.01$). Body weight and percentage of body fat also decreased significantly in the experimental group as a result of the six months of training ($P<0.01$). There were no statistically significant differences between the pre- and post-program resting measures in the control group, although interpretation of some of these results may have been confounded by the relatively small sample size.

Final Between-Group Comparisons. Percentage of body fat and resting heart rate were significantly different between the two groups at the end of the six-month program ($P < 0.05$). However, neither percentage of body fat (exp. = 29.3%, con. = 29.4%) nor resting heart rate (exp. = 72, con. = 75) were significantly different when women were compared separately, indicating a gender-based rather than a treatment-based effect. Resting diastolic blood pressure was significantly higher in the control group after the six-month period ($P< 0.05$), although both values were well within the normal range for healthy populations.

Responses to Submaximal Exercise

Initial Between-Group Comparisons. Analyses of the responses to submaximal exercise indicated that there were significant between-group differences for the heart rate response at stages one and two of the treadmill test (Figure 2) and for RPE (Figure 3) at stages three and four ($P < 0.05$). These differences were not

significant when women were compared separately, again indicating a gender-based effect. For females, heart rates at stages one and two of the treadmill test were 151 bpm and 161 bpm for the experimental group and 151 bpm and 165 bpm for the control group. Ratings of perceived exertion at stages three and four of the treadmill test were 13.8 and 15.1 for the experimental group and 14.8 and 16.6 for the control group.

Within-Group Comparisons. Heart rates during submaximal exercise (Figure 2) at stages 1 through 4 of the graded exercise test were lowered by approximately 10 bpm for the participants in the experimental group following the six months of exercise ($P< 0.01$). This reduction persisted when the women were compared separately. Ratings of Perceived Exertion (Figure 3) also were reduced in the experimental group ($P<0.01$). For the comparison group, heart rates were lower after training by about 5 bpm at stages 1, 2 and 3 of the graded exercise test ($P< 0.05$), and ratings of perceived exertion were decreased at stages 2, 3 and 4 ($P< 0.05$). As in the experimental group, the significance of these changes remained the women were compared separately.

Final Between-Group Comparisons. Heart rates at all four submaximal treadmill levels were significantly different between groups after the six- month program. When the women were compared separately, these differences between the two groups were no longer significant. Heart rates at levels one thru four of the treadmill test for the women were 138 bpm, 149 bpm, 160 bpm, and 175 bpm in the experimental group and 143 bpm, 153 bpm, 167 bpm, and 181 bpm in the control group. As Figure 2 indicates, the

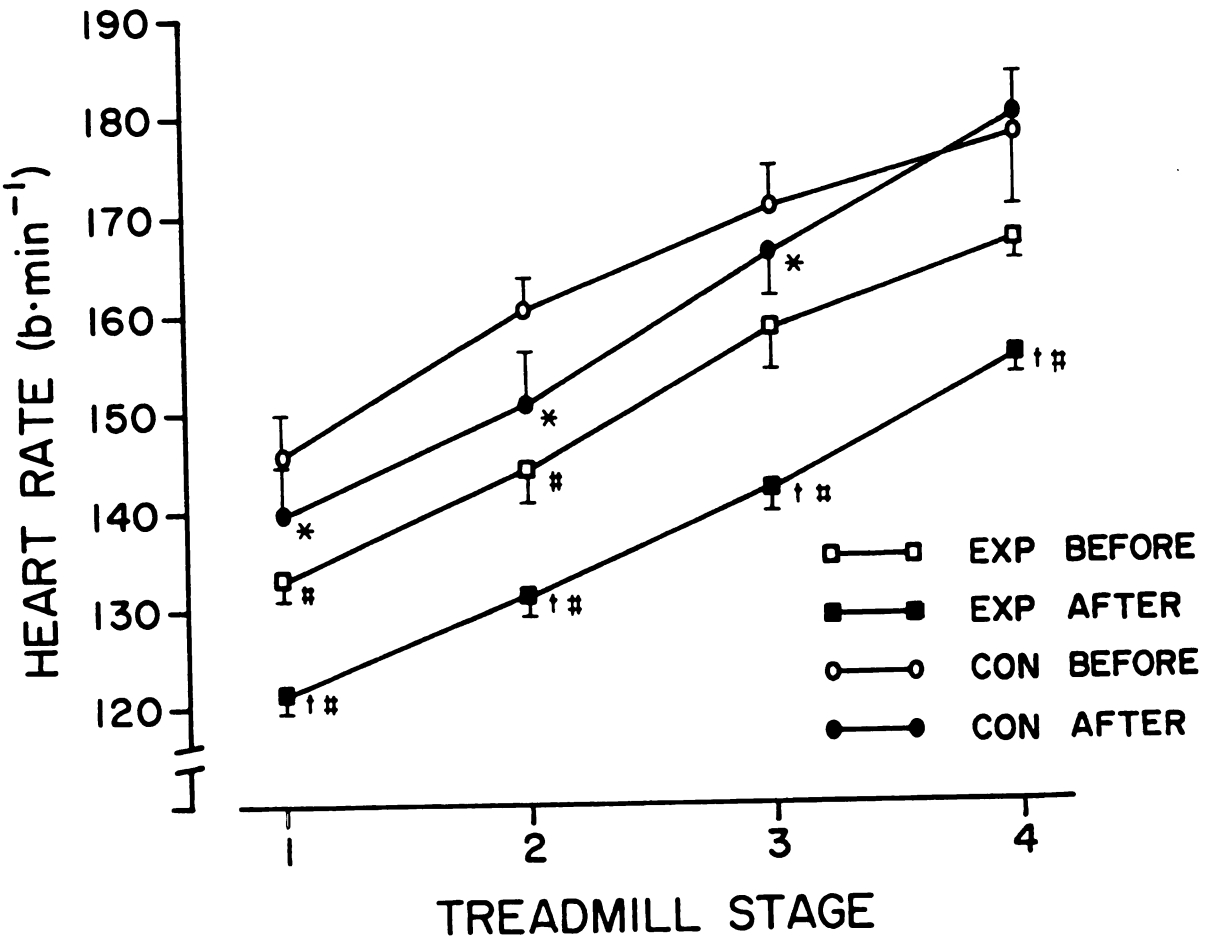

Figure 2. Heart Rate Response To Submaximal Work Before and After Six Months of Endurance Training. (Values are means ± SE. †P< 0.01 vs. initial, *P< 0.05 vs. initial, #P< 0.05 vs. control)

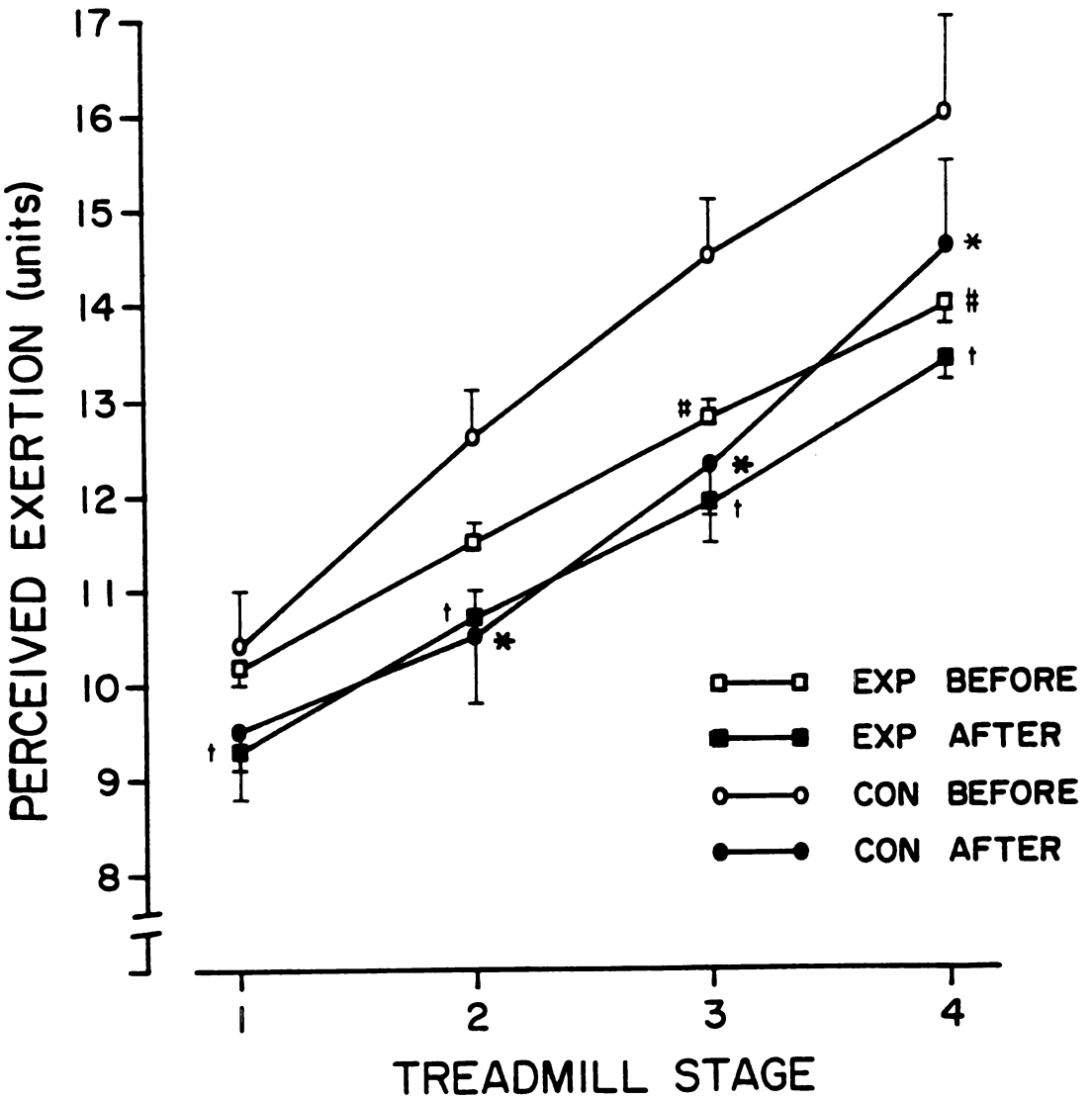

Figure 3. Ratings Of Perceived Exertion in Response To Submaximal Work Before and After Six Months of Endurance Training. (Values are means ± SE. †P< 0.01 vs. initial, *P< 0.05 vs. initial, #P< 0.05 vs. control)

changes in heart rate response to submaximal work that occurred within both groups on the first two levels of the treadmill test diminished at the higher intensity levels in the control group but not in the experimental group. Ratings of perceived exertion during the final treadmill test were not statistically different between groups as a whole or when the women were compared separately.

Responses to Maximal Exercise

Initial Between Group-Comparisons. Of the 80 individuals in the experimental group who completed the two testing sessions, 57 obtained results in both tests which satisfied the objective criterion established for determining $\dot{V}O_2$ max. Only the data from these individuals were reported as $\dot{V}O_2$ max values pre and post. The experimental subjects had a mean $\dot{V}O_2$ max before the program of 38.6 ± 0.3 ml kg-1 min-1 (range 20.7-54.6) which indicates a basically sedentary group (see Table 3).

Only data from the five control subjects who had two tests which met the criterion established for determining a maximal test were used in comparisons with the experimental group. The initial V_{O_2} max for the control subjects was 29.6 ml kg-1 min-1, also indicating a basically sedentary group. The physically inactive nature of both groups was further corroborated by the results of the activity interview which indicated that approximately 70% of the individuals in each group were sedentary at the beginning of the program.

The initial $\dot{V}O_2$ max difference between the two groups was statistically significant ($P < 0.05$) which was not surprising due to the larger proportion of men in the experimental group (Table 3). When the women in the experimental group were compared independently

with the the women in the control group, however, differences in $\dot{V}O_2$ max were not significant (exp. = 32.1 ml kg^{-1} min^{-1}, con. = 28.7 ml kg^{-1} min^{-1}).

Table 3. Responses to the maximal treadmill exercise test before and after six months of exercise training.

	Experimental (n = 57)		Comparison (n =5)	
	Initial	Final	Initial	Final
$\dot{V}O_2$ max	38.6 ± 0.3 #	39.6 ± 1.0†#	29.6 ± 0.53	32.1 ± 1.7
RER (units)	1.03 ± 0.01	1.07 ± 0.01†	1.05 ± 0.02	1.12 ± 0.02
Max Heart Rate (bpm)	187.2 ± 1.9	181.8 ± 2.4	188.0 ± 2.1	186.± 4.8
Treadmill test time (min)	12.3 ± 0.6	14.2 ± 0.4†#	11.5 ± 0.74	13.0 ± 1.11

Values are means ± SE
$\dot{V}O_2$ max = maximal oxygen consumption ($ml*kg^{-1}*min^{-1}$)
RER = respiratory exchange ratio
†p < 0.01 within-group comparison
# p < 0.05 between-group comparison

Initial treadmill time did not differ significantly between the groups. This was true both when the overall groups were considered and when the women were compared separately (exp. women = 11.0 min., con. women = 11.7 min.).

Initial recovery heart rates at 2, 4 and 6 minutes post exercise did not differ significantly between groups (Figure 4). This also was true when the women were compared separately. Initial recovery heart rates for the women in the experimental and control groups at

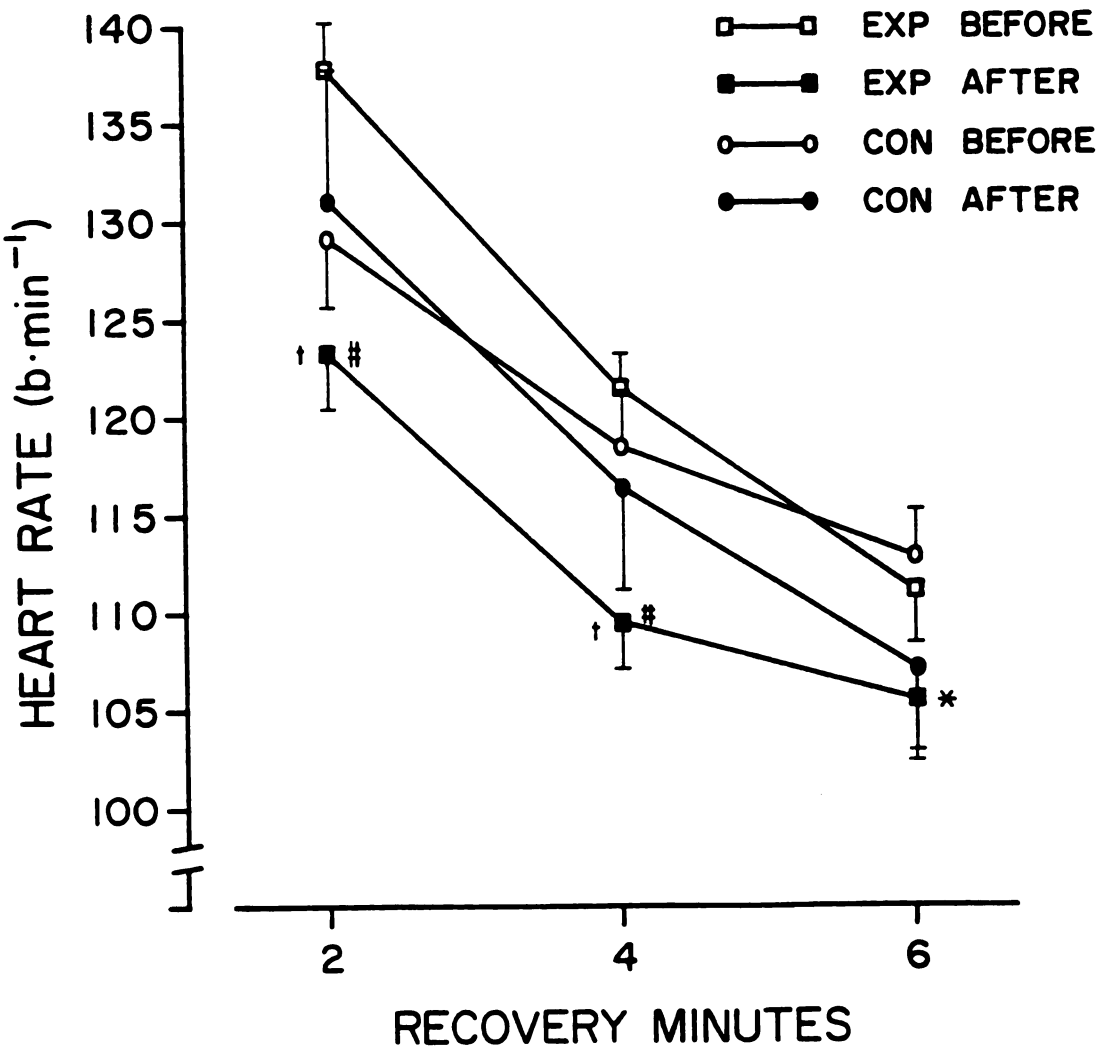

Figure 4. Recovery Heart Rates Following Maximal Treadmill Exercise Before and After Six Months Of Endurance Training. (Values are means ± SE. †P< 0.01 vs. initial, *P< 0.05 vs. initial, #P< 0.05 vs. control)

2, 4 and 6 minutes were 139 bpm and 131 bpm, 123 bpm and 121 bpm, and 106 bpm and 116 bpm respectively.

Within Group-Comparisons. Only the data from the 57 experimental subjects and 5 control subjects who had two maximal tests were used for purposes of within-group comparisons. Maximal oxygen consumption in the experimental group increased 2.6% from 38.6 to 39.6 ml kg^{-1} min^{-1} ($P< 0.01$) as a result of the six-month endurance exercise program (Table 3). In the control group there was an 8.4% increase in the $\dot{V}O_2$ max from 29.6 to 32.1 ml kg^{-1} min^{-1} which did not reach statistical significance due to the small sample size. Two motivated control subjects had high adherence and achieved increases in $\dot{V}O_2$ max of 18% and 25% which accounted for most of the change in this small group. When peak $\dot{V}O_2$ values in the control group were compared before and after six months of the program, the 2.4% increase in $\dot{V}O_2$ max was not significant.

Exercise tolerance (Table 3) in the experimental group improved as is shown by the significant increase in treadmill exercise test time from 12.3 to 14.2 minutes ($P< 0.01$). This also was true for the women separately. Exercise tolerance was not significantly increased by the six-month program in the comparison group.

Recovery heart rates were reduced significantly ($P<0.01$) by approximately 15 bpm at 2 and 4 minutes post exercise, and by 6 bpm at 6 minutes post exercise following the six-month program in the experimental group (Figure 4). The change was significant when the women were compared separately at both 2 and 4 minutes post exercise. Recovery heart rates did not differ significantly for the comparison group before and after the six-month period; however,

the small number of subjects increased the probability of making a Type II error to ß = .78 at 6 minutes post exercise when the 6 bpm difference was similar quantitatively to the value in the experimental group.

Final Between-Group Comparisons. As expected, between group differences in V_{O_2} max were still significant following the final treadmill test (Table 3). As with the initial between-group relationship, $\dot{V}_{O_2}$ max did not differ significantly when the women were compared separately (exp. = 32.3 ml kg^{-1} min^{-1}, con. = 30.4 ml kg^{-1} min^{-1}). The test time of the experimental group was significantly greater than that of the control group ($P< 0.05$), but this difference was not statistically significant when the women were compared separately (exp. = 12.8 min., con. = 13.0 min.).

Recovery heart rates between groups were significantly different at 2, 4 and 6 minutes post exercise ($P< 0.05$), indicating decreased recovery time in the experimental group (Figure 4).

Discussion

Adherence. Typically, 50% of adults who begin an exercise program are non-adherent within the first six months. While Martin and Dubbert (93) have suggested that 80-85% adherence may be maximal for structured exercise programs during the first three months, exercise adherence in this study exceeded 95% for a six-month endurance program that resulted in cardiovascular adaptations to exercise training. This value is higher than any found in the literature to date. These data take on even greater significance in light of the fact that the majority of the exercise programs considered by Martin and Dubbert (94) involved directly

supervised activities and a considerable amount of professional contact time.

Six-month exercise adherence data have been reported in the literature ranging from 13% to 87% (38,39,42,95,110,136). A major problem in interpreting adherence data from these studies is the lack of a standardized definition and measurement of adherence. Adherence has been defined as compliance, attendance, lack of dropout, participation rate, etc.; and the criterion for each of these measures has varied depending on the study in question. Martin and Dubbert (42,94) suggest that tracking of an individual's compliance with a clearly specified prescription should form the basis for the determination of adherence. In keeping with the behavioral focus of the present investigation, the contract, monitoring, and verification components of the treatment package follow this recommendation by objectively defining adherence as fulfillment of a contractual agreement. Thus, engaging in and verifying four contracted bouts of aerobic exercise each week was considered adherence, and anything less with the exception of medical contraindication was considered non-adherence. Although Martin and Dubbert suggest direct observation as the best method of quantifying adherence, they do include monitoring of exercise performed outside of the program setting (95). The majority of studies in the literature have been characterized by supervised exercise sessions which are easily monitored. Those that have included unsupervised activities often have relied on exercise diaries for substantiation of the fulfillment of prescribed activity regimens (58,105). Self-report procedures of this nature typically result in decreased accuracy when compared to

information provided by independent observers and may be associated with an increased incidence of purposeful falsification (88,93,129).

Measurement of adherence in the present study also depended on self-report, a technique which clearly has a number of inherent problems. Although the monetary incentives and team competition in the experimental programs may have increased motivation to adhere, these factors also may have increased the incidence of false reporting. The use of independent witnesses for verification of each reported exercise session was an attempt to minimize the possibility of fraudulent reporting. This technique has been used successfully in stress management and smoking cessation programs (146,147) as well as in the context of exercise programs (165).

When the programs were completed, anonymous questionnaires (Appendix G) were sent to 94 participants to evaluate their truthfulness in reporting adherence (165). Of the 79 individuals who returned the questionnaires, 73% reported being truthful 100% of the time, 23% acknowledged they were truthful 90% of the time, 3% reported that they were truthful 80% of the time and 1% stated they were truthful 70% of the time. These data suggest a reasonably high degree of accuracy in the self-monitoring of adherence.

Attendance. Some researchers have suggested the use of other backup measures as independent corroborators of exercise adherence. For programs revolving around weekly exercise sessions, attendance has been used as a measure of adherence, although the validity of this procedure has been disputed by a number of investigators (48,63,93,125). Attendance itself may not provide

accurate information concerning duration or intensity of exercise, and decreased attendance at a formal program may not reflect exercise engaged in by an individual independently or at other programs.

In this study, since weekly meetings did not include actual activity, attendance may have been of less importance. Attendance at weekly meetings averaged about 70% for both the experimental group and the control group. There was no correlation between contract adherence and attendance at weekly meetings in either the experimental group or the control group. This appears to suggest that the weekly meetings were of limited importance in promoting adherence. However, it also may be that the social support provided by the worksite setting and the weekly verification sheets was sufficient to cancel the potentially negative impact of the relatively small number of missed sessions.

Physiological Changes. Assessments of exercise-induced, fitness-related physiological changes (heart rate, blood pressure, exercise tolerance, $\dot{V}O_2$ max,etc.) also have been suggested as important back-up indicators of exercise adherence (42,48). Substantiation of exercise behavior change via outcome measurement may take on added importance when direct observation of activity is not possible. However, a number of researchers have called attention to the limitations associated with using physiological outcomes as parameters for measuring behavior change (63,93). Individuals complying with inactive (placebo) and active interventions often have shown similar outcome improvements, which suggests that factors unrelated to the treatment may be effective. With respect to

exercise programs, genetic differences and changes in body weight are known to be confounding factors affecting the relationship between adherence and measurement of fitness related-variables (48,81). Furthermore, changes in physiological parameters often provide little information related to the intensity of exercise (125). This is of special relevance to unsupervised programs during which the monitoring of intensity is particularly difficult.

In general, the changes in the physiological parameters measured in this study suggest that a cardiovascular training effect occurred in the experimental group. The decreases in resting heart rate, body weight, and percentage of body fat are expected outcomes with increased endurance ex exercise training. The significant increase in exercise tolerance, reduction in the submaximal heart rate response to exercise, and decrease in recovery heart rates 2 and 4 minutes post exercise seen in this group are further indications of improved cardiovascular function.

Improvements in responses to submaximal exercise in the control group were likely due to those individuals in this group who actually did increase their physical activity during the program. In fact, five previously sedentary individuals in the control group increased their activity levels to an average of 2 times a week. This improvement was not fully reflected in the adherence values due to the rigorous use of four exercise sessions per week as the criterion for adherence. It is not unreasonable to expect some small improvement in the response to sub-maximal exercise even with only moderate increases in activity exhibited by these individuals. There was, for example, a significant decrease in sub-maximal heart rate response in the

control group at three stages of the treadmill test. Figure 2 shows, however, that the positive effects of training in this group seemed to diminish as the intensity of exercise increased. The lesser improvement in the control group may have been due to the poorer adherence as compared to the experimental group and/or to a generally lower intensity of exercise achieved. Furthermore, it is important to remember that the majority of individuals in the control group did not significantly increase their activity levels, and that 25% actually dropped out of the program.

The differences between the experimental and the control groups with respect to changes in $\dot{V}O_2$ max are less clear. Typical increases in $\dot{V}O_2$ max with regular, vigorous endurance training in healthy individuals range from 10-20% (132). However, most endurance training studies are closely monitored and the training stimulus is usually increased as the subjects adapt to the demands of the training program. Such was not the case in the present six-month study in which the participants were asked to follow an exercise prescription in a situation that provided no direct supervision of their exercise sessions. Increases were smaller than this in both the experimental group (2.6%) and the control group (8%) and reached statistical significance only in the experimental group. The apparent increase in the control group was due to a combination of factors. Two highly motivated female subjects in that group increased their $\dot{V}O_2$ max by 18% and 25%, and there were only five individuals in that group who had acceptable maximal exercise tests both before and after the six month-program. Furthermore, 25% of the

individuals in the control group dropped out of the program, and the majority of individuals did not improve their $\dot{V}O_2$ max.

The lack of a more physiologically significant improvement in $\dot{V}O_2$ max in the experimental group is interesting. The increased physical activity levels may not have reached the intensity necessary to induce the cardiovascular adaptations that could have produced significant changes in $\dot{V}O_2$ max during the six-month period. The increase in treadmill time does indicate, however, that the exercise training increased endurance capacity. Endurance generally is considered to be a function of the respiratory capacity of skeletal muscle, with improvements being related to increases in muscle capillarization, size and number of mitochondria, and activity of oxidative enzymes (18). The result is an enhanced utilization of fat and a decreased use of muscle glycogen for energy during submaximal exercise. Increases in the respiratory capacity of muscle leading to increased endurance performance have been demonstrated to occur without corresponding improvements in $\dot{V}O_2$ max (116,132). Furthermore, in terms of everyday quality of life for those not engaging in competitive activities, improvements in endurance and work capacity may be just as important as increases in aerobic capacity. Most daily activities do not require an intensity which approaches $\dot{V}O_2$ max, and thus improvements in submaximal exercise response may be of more practical importance.

Confounding Factors. Because it was not possible to randomly assign individuals within worksites to treatments groups, there were some initial differences between the control and experimental groups which could have confounded the reported findings. While age of the

subjects was not significantly different between the two groups, the majority of the experimental group was composed of men whereas there were mostly women in the control group. The adherence rate for the women in the experimental group was 99%, and the adherence rate for the women in the control group was 16%. Comparison of these values with the overall rates of 97% for the experimental group and 19% for the control group suggests similar adherence responses for the men and women. Changes in the heart rate response to submaximal work, recovery heart rate, and treadmill test time for women in the experimental group also were not different from changes in the overall group. Again the suggestion is that the observed differences between groups were not the result of their initial gender compositions.

Behavioral Package. Factors affecting exercise adherence have been studied extensively and reviewed (38,95,110,160). Profiles developed to identify potential dropouts and poor adherents generally have proven to be unsuccessful as a means of targeting high-risk individuals. It has been suggested that behavioral management strategies may provide a valuable method of enhancing adherence (95,110,112). Many of the techniques used in the present study are similar to those which have been demonstrated previously to change a variety of health-related behaviors (13,24,38,77,146, 147).

A unique aspect of this study was the combination of a variety of techniques into a behavioral package for the purpose of enhancing exercise adherence. There have been few attempts to develop a complete package for the behavioral treatment of exercise

adherence. Martin and Dubbert have done the most work in this area. In a series of studies (94) over a number of years, they examined different combinations of strategies for enhancing adherence to a series of three-month exercise programs. In this series of studies, the techniques included feedback and praise during exercise, goal setting, lottery reinforcement, cognitive strategies during exercise, and relapse prevention training. The authors concluded that the combination of personalized feedback and praise during exercise, flexible exercise goals set by the individual, and training in cognitive dissociation could result in maximal adherence rates of 80%-85% for three-month programs. These studies of Martin and Dubbert differ from the present investigation in that programs were three months as opposed to six months long and the majority of training periods were supervised directly by program staff. Furthermore, all classes were held at a central location, not at the participant's place of employment as in the present study, which minimized the potential impact of prolonged peer support. The present study adds to the work of Martin and Dubbert by incorporating a number of additional strategies which have been shown to be powerful behavior change tools. The behavioral template of Stoffelmayr and Stachnik (146), originally developed for smoking cessation and then modified by Mavis (96) for weight management, was used in an effort to develop a complete package for increasing adherence to exercise programs. Important components of this template include behavioral contracts, monetary incentives, verified self monitoring, social support, and team competition. In addition, the power of the intervention was

enhanced by holding the program at the workplace. Most adults spend a large portion of their time at the workplace, and the communication and social support networks which already exist in work settings provide for an almost ideal setting for health promotion programming (16,131).

Despite the apparent advantages of worksite exercise programs, the results from the control group demonstrate the importance of the behavioral intervention. The adherence rate of only 19% in the control group was somewhat lower than that reported in other studies and probably was due to the strict definition of adherence as being no less than four exercise sessions per week. No other worksite exercise adherence study has incorporated as rigorous a definition by which to judge adherence.

It also should be noted that three (2.5%) of the experimental subjects and five (25%) of the control subjects dropped out of the program. The dropout rate for the experimental group is very low for a six-month exercise program, while the dropout rate for the control group is comparable to that seen in the first three to six months of many exercise programs. Individuals who dropped out apparently were not completing their weekly exercise sessions as they failed to return the required exercise logs; nevertheless, their data were not included in the adherence results. Dropouts often are classified as nonadherents even though there is evidence which suggests that some individuals may continue exercising on their own (38,93,114). It is common practice not to include dropout data in the statistical analyses of adherence, although this clearly could produce a bias in the final results. In this study the inclusion of the dropouts

would have had little effect on the adherence rate of the experimental group, but it would have substantially decreased the adherence rate of the control group to further strengthen the findings.

The omission of the behavioral package from the control program appears to have been primarily responsible for the large decrease in the adherence rate compared to that of the experimental group. All other aspects of the control program were similar to the experimental program and were designed to maximize effectiveness by using the same advantages of the worksite, professional exercise prescription, well-trained enthusiastic program leaders, and participant input in the educational component and scheduling of group meetings. It is interesting to note that the control site was characterized by an exceptionally high degree of management support for the fitness program. Individual program fees were paid, and release time was granted for all who wished to participate. A free, four-times-a-week aerobics dance class, not directly affiliated with the exercise program, also was paid for and instituted on site by the management. The participants in the study were permitted to use attendance at these classes to fulfill their four-times-a-week exercise obligations. These types of supports and opportunities were not equalled at the experimental sites and might have been expected to produce an increased adherence rate in the control group. The behavioral interventions combined with the on-site implementation are, therefore, likely to have accounted for the exceptional results in the experimental group.

The relatively small time commitment for participants (15 hours at the worksite over the course of six months) and the minimal resource investment needed also are attractive features of the program. First, the limited amount of time taken from work should make this program appealing to both management and union decision makers. Second, because participants exercise on their own time and at locations of their own choosing, expensive onsite fitness facilities and intensive use of professional staff time are not necessary. These features can help to reduce the cost of the program, create participant ownership and control, and hopefully increase the likelihood of maintenance when the program ends. This format is particularly applicable to the worksite where individuals spend much of their time, where peer interaction is an important part of the environment, and where time and money are important factors.

CHAPTER V

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FUTURE STUDY

Though the physiological and psychological benefits of physical activity are well known, the overwhelming majority of Americans continue to lead relatively sedentary lives. Poor adherence and high dropout rates typically characterize exercise programs in all types of environments. Efforts to develop methods for predicting who will and will not adhere to exercise regimens generally have been unsuccessful. Researchers have begun to experiment with the use of established behavior change techniques for improving adherence to exercise.

In the present study a behavioral package of techniques (contracting, monetary incentives, team competition and social support) which have been used successfully in other behavior change endeavors was employed in an effort to improve adherence to a six-month, worksite exercise program. One hundred and thirty seven employees of Michigan State University participated in exercise programs as part of a campus health promotion project. Seventy percent of the subjects (60% male, 40% female) were sedentary at the beginning of the program. The hypotheses were: (a) that the behavioral intervention would result in an increase in adherence over that typically seen in exercise programs and (b) that the increased adherence would result in an increase in cardiovascular fitness. The six-month exercise program, including the behavioral

treatment, was offered at a number of experimental worksites. The same exercise program was offered at another control site without the inclusion of the behavioral treatment package.

Adherence, defined as verified fulfillment of a contractual agreement to exercise aerobically four times a week for at least 30 minutes, was unusually high (greater than 90%) at all the experimental sites. Only three individuals (2.5%) dropped out of the experimental group. Five subjects (25%) dropped out of the control group. Adherence as determined by exercise log was significantly lower (less than 20%) at the control site. Resting heart rate, heart rate response to submaximal work, and ratings of perceived exertion were reduced significantly after six months in the experimental group. In addition, endurance capacity increased by 15% and recovery heart rates were significantly lower after the exercise program.

Several individuals in the control group did increase their activity levels during the program, and since it was a small number of subjects, there were significant changes in the control group in relation to heart rate response to submaximal work and ratings of perceived exertion. The majority of the individuals in the control group, however, either dropped out or did not increase their activity levels and, therefore, could not be expected to obtain the physiological benefits which accompanied the high adherence in the experimental group.

Conclusions

With regard to the original hypotheses, the conclusions which may be drawn from this study include the following:

1. The behavioral package used with the experimental group resulted in a significantly higher adherence to exercise.

2. The behavioral treatment appears to have been responsible for the significantly lower drop-out rate than that generally reported for exercise programs of this length.

3. The participants at the experimental sites experienced measurable improvements in cardiovascular function which indicated a significant training effect as a result of the six-month program.

The relatively small time and resource commitment necessitated by the present program make the results even more impressive, particularly with respect to possible implementation in worksite environments. Expensive on-site facilities and direct supervision of exercise were not necessary in order to achieve high adherence, low dropout, and improvements in physiological responses to exercise.

Recommendations

The results of this study point to a number of areas which demand further investigation. Which components of the behavioral package, separately or in combination, were responsible for the remarkable adherence rates that were observed in the experimental group is not clear. From experience and from anecdotal information, it seems likely that an interaction of all of the various components of the template contributed to the positive results. When questioned about which part of the program provided the greatest impetus for

adherence over the six-month period, the participants' responses covered the whole range of behavioral interventions (monetary incentives, verified monitoring, team competition, etc.). Because the impact of the different components may vary depending on the characteristics of the population involved in the program, dismantling research in a variety of settings is needed to separate the relative contributions of the various components of the package.

Another area which needs to be addressed, and which is crucial to the effectiveness of any behavior change program, is long-term maintenance. Follow-up studies need to be done to ascertain the success of these programs over several years. Some type of continuing worksite support probably will be necessary to ensure a climate which will promote the maintenance of behavior changes achieved during the initial six-month period.

Although the adherence of subjects at the experimental sites was high, the recruitment rate at most sites was about 15%. Most participants were sedentary and, therefore, able to benefit from increases in physical activity; however, recruitment rates must be increased if the potential benefits of successful programs are to be obtained by large numbers of people.

Lastly, the question of whether or not the high rate of adherence will generalize to other environments and participant populations needs to be addressed. Adherence rates reported in the literature have been remarkably similar in a wide variety of settings with divergent populations. The "something for everyone" nature of the present behavioral treatment package may hold the promise of improving adherence in a variety of situations. Optimal adherence to

endurance exercise training via the methods used in the present study may eventually contribute to improvements in the psychological and physiological quality of life.

APPENDICES

APPENDIX A

WRITTEN INFORMED CONSENT

FROM HEALTHY U ... TO YOU

WORKSITE WELLNESS
Michigan State University
B416a West Fee Hall
353-3734

ESCROW AGREEMENT

I, _____, have elected to participate in the WORKSITE WELLNESS PROGRAM. I hereby acknowledge that I have had the rules explained to me, understand them, and agree to abide by them for the period of this program, _____ to _____.

I also acknowledge that the decision as to whether or not I violated a rule during the course of the program will be made by the WORKSITE WELLNESS staff, specifically _____ in his/her sole and unfettered discretion, and I agree to abide by her/his decision in all cases.

As witness my hand and seal, affixed this _____day of _____, 1990.

_____ Signature (Seal)

_____ Witness Signature

_____ Name (Please Print)

_____ Witness Name (Please Print)

FROM HEALTHY U ...

INFORMED CONSENT

1. I have freely consented to participate in this program sponsored by WORKSITE WELLNESS. I understand that this program is sponsored by Michigan State University.

2. I understand that specific health promotion programs will be offered when there is sufficient interest to warrant a program, and subject to the availability of WORKSITE WELLNESS staff and resources.

3. I understand that I am asked to deposit $40 with the program leader, and that I will have a chance to receive money for my participation. All monies will be awarded at the conclusion of the programs, except as indicated by the program leaders. I must be present at the time of the awards to receive any money due me, or make prior arrangements with the program leader for the awarding of any money due me.

4. I understand that I am free to discontinue my participation in the program at any time. However, if I decide not to continue I understand that the $40 deposit will be forfeit.

5. I understand that the results of the program will be strictly confidential. Only group results will be reported. No individuals will be identified.

6. I understand that my participation in the program does not guarantee any beneficial results to me.

7. I am not aware of any medical conditions which limit my participation in the program or increase my risk. Should this change during the course of the program, I will immediately notify my program leader.

8. My progress in the program will be judged by the program leader according to the criteria specified in my personal program contract. The program leader is the final arbiter of my success or failure in reaching my program goals. I agree to abide by his or her judgement.

9. I understand that upon request I can receive additional explanation of the program or group results after my participation is completed.

10. I understand that if I am injured as a result of my participation in this program, Michigan State University will provide emergency medical care if necessary; but these and any other medical expenses must be paid from my own health insurance program.

Signed:_____

Date:_____

WORKSITE WELLNESS
Michigan State University
B416a West Fee Hall
353-3734

... TO YOU

APPENDIX B

ACTIVITY INTERVIEW QUESTIONAIRE

WORKSITE WELLNESS ACTIVITY EVALUATION - Date - _____

Name: _____ Age: _____

Sex: ____ Site: _____ Time Frame: _____

INTERVIEW: Are you currently doing any regular physical activity or would you classify yourself as sedentary? (if not sedentary, continue to questions)

1. What type of activities?

2. How many times a week on the average for each activity?

3. For how many weeks, months, or years have you been doing this?

4. What is the duration of the exercise on the average? (time and or distance)

5. Describe the intensity - (use perceived exertion scale - compare to treadmill)

6. What type of physical activity does your job demand?

   a. describe -

   b. times/week -

   c. # of weeks/months/etc. -

   d. perceived exertion -

7. What did you think about the results of your GXT?

APPENDIX C

MODIFIED NAUGHTON-BALKE TREADMILL PROTOCOL

Stage	Speed (mph)	Grade
1	3	5.0
2	3	7.5
3	3	10.0
4	3	12.5
5	3.4	14.0
6	3.75	14.0
7	3.75	16.0
8	3.75	18.0
9	3.75	20.0

APPENDIX D

BODY FAT ASSESSMENT FORM

MICHIGAN STATE UNIVERSITY
CENTER FOR THE STUDY OF HUMAN PERFORMANCE

Body Fat Assessment

Name_____ Date_____

Weight_____kg Height_____ BMI_____ $\frac{WT(kg)}{HT(m^2)}$ Tech_____

Study_____ _____

Skinfold	Trial 1	Trial 2	Trial 3	Average
Triceps	_____	_____	_____	_____
Biceps	_____	_____	_____	_____
Subscapular	_____	_____	_____	_____
Suprailiac	_____	_____	_____	_____
			Sum (4)	_____
Umbilical	_____	_____	_____	_____
Front Thigh	_____	_____	_____	_____
Chest	_____	_____	_____	_____

Table 6. Percentages of fat corresponding to the total value of skinfolds at four sites (biceps, triceps, subscapular and suprailiac).

(Durnin and Rahaman, Br. J. Nutr. 21:681, 1967.)

Total Skinfold	Fat (% body weight)			
mm	Men	Women	Boys	Girls
15	5.5	----	9.0	12.5
20	9.0	15.5	12.5	16.0
25	11.5	18.5	15.5	19.0
30	13.5	21.0	17.5	21.5
35	15.5	23.0	19.5	23.5
40	17.0	24.5	21.5	25.0
45	18.5	26.0	23.0	27.0
50	20.0	27.5	24.0	28.5
55	21.0	29.0	25.5	29.5
60	22.0	30.0	26.5	30.5
65	23.0	31.0	27.5	32.0
70	24.0	32.5	28.5	33.0
75	25.0	33.5	29.5	34.0
80	26.0	34.0	----	----
85	26.5	35.0	----	----
90	27.5	36.0	----	----
95	28.0	36.5	----	----

APPENDIX E

EXERCISE CONTRACT

FROM HEALTHY U ...

WORKSITE WELLNESS
Michigan State University
B416a West Fee Hall
(517) 353-3734

PROGRAM CONTRACT

NAME:_____ **DATE:**_____

PROGRAM GOAL: Define your goal as specifically as possible.

ACTIVITIES:_____

FREQUENCY:_____

DURATION:_____

TARGET HEART RATE:_____

COMMENTS:_____

METHOD OF VERIFICATION TO BE USED:_____

... TO YOU

CONTRACT CONTINGENCIES

I, _____, UNDERSTAND AND AGREE TO THE FOLLOWING CONTINGENCIES.

1. **EACH WEEK THAT I SUCCEED IN FULFILLING MY CONTRACT BY COMPLETING 4 BOUTS OF AEROBIC EXERCISE AND TURNING IN MY SIGNED VERIFICATION FORM TO THE PROGRAM FACILITATOR, I WILL . . .**

   a. **receive a token with my name on it which I can deposit in the "fish-bowl" as a chance at drawings for financial rewards which will be held at the end of the program.**

   b. **enable my team to win monies from other teams in which individuals have not successfully fulfilled their contracts for that week.**

   c. **increase my team's chances of winning a financial reward for the team with the most money at the end of the program.**

2. **EACH WEEK THAT I AM NOT SUCCESSFUL AT FULFILLING MY CONTRACT OBLIGATIONS AS DESCRIBED ABOVE, I WILL . . .**

   a. **forfeit 1/2 of my deposited money to other teams in which all individuals have been successful during that week (or to the "pot" if no team has been 100% successful).**

   b. **prevent my team from winning any money from other teams in which members have not been successful for that week.**

Signed_____ **Date**_____

Witnessed _____

APPENDIX F

SAMPLE LIST OF EDUCATIONAL TOPICS

EDUCATION MENU

WORKSITE WELLNESS EXERCISE AND FITNESS PROGRAM

1. EXERCISE MYTHS
2. AEROBIC EXERCISE - GETTING STARTED
3. STRETCHING AND FLEXIBILITY
4. CHOLESTEROL - WHAT IT IS AND HOW IT CAN BE CONTROLLED
5. EXERCISE AND BLOOD PRESSURE
6. RISK FACTORS FOR CARDIOVASCULAR DISEASE
7. ACUTE AND CHRONIC EFFECTS OF EXERCISE
8. SPECIFICITY OF EXERCISE
9. EXERCISE AND AGING
10. OSTEOPOROSIS - MAINTENANCE OF BONE INTEGRITY
11. EXERCISE AND WEIGHT CONTROL
12. EXERCISE AND THE ENVIRONMENT
13. PROPER STRENGTH TRAINING TECHNIQUES
14. PROPER FOOTWEAR FOR AEROBIC EXERCISE
15. THE THREE ENERGY SYSTEMS
16. _____
17. _____
18. _____
19. _____
20. _____

Please Suggest Other Topics Of Interest To You

APPENDIX G

VERIFICATION OF SELF-REPORT QUESTIONNAIRE

PLEASE DO NOT PUT YOUR NAME ON THIS FORM.

We are sending this survey to past participants of Healthy U Worksite Wellness Programs. We hope you will take five minutes to complete this survey. All of the information gathered is completely anonymous.

Please check the program in which you participated:

[ ] Exercise
[ ] Weight Control
[ ] Stress Management
[ ] Smoking Cessation

As part of the health promotion program in which you took part, you were asked to provide verification of your participation. Our typical program lasts for 24 - 26 weeks. We are interested in how honest you were with these weekly verification forms.

We know it is sometimes very difficult to complete all of the terms of the weekly contracts for the health promotion programs. For any number of reasons, despite best intentions, circumstances do not always permit complete adherence to program requirements, yet it is often difficult to acknowledge that the terms of the contract were not met. It is important for us to know how often this occurs so that we can improve our program and more effectively meet the needs of the participants.

On the scale below, please circle the number representing how honest you were in reporting the weekly contract requirements for your program.

If your verification forms always gave an accurate indication of your activities, circle 100;

If your verification forms almost always were accurate, you might circle 80 or 90;

If your verification forms were accurate about half of the time; circle 50, etc.

Please circle the number below which best reflects the accuracy of your weekly verification forms:

0 - 10 - 20 - 30 - 40 - 50 - 60 - 70 - 80 - 90 - 100

If the accuracy of your weekly verification forms was less than 100%, which reason below best accounts for the inaccuracies (please choose only one):

[ ] **I didn't want to disappoint my team members**

[ ] **I didn't want to disappoint my spouse or significant others**

[ ] **I didn't want to lose any of my money**

[ ] **I didn't want to disappoint the program leader**

[ ] **Other (please specify)** _____

Thank you !

APPENDIX H

RAW DATA

PHASE II - WORKSITE

SUBJECT	NAME	SITE	TIME	AGE	GENDER	HT	WT	RHR	RSBP	RDBP	BF	BF%	(6) HR	(6) SBP	(6) DBP	(6) VO2	(7) HR	(7) SBP	(7) DBP	(7) VO2	(8) HR	(8) SBP	(8) DBP	(8) VO2	(9) HR	(9) SBP	(9) DBP	(9) VO2	(6) RPE	(7) RPE	(8) RPE	(9) RPE
107	DEZACKS	PBL	PRE	60	2	170	91.3	74	106	78	86.5	35	150	160	80		155	202	80										13			
			POST				84.4	60	124	[illegible]	71.5	[illegible]	133	180	80		150	190	90										11	15		
105	NAPIER	PBL	PRE	46	1	173	82.9	60	122	72	64.3	23	99	176	70		107	150	80		115	220	70		136	224	70		7	8	9	11
							83.4	60	126	78	69.5	17.8	88	170	64		100	164	68		107	192	64		125	230	70		9	10	12	14
106	CLINE	PBL	PRE	41	2	172	77.5	66	126	74	74.0	33	130	174	80		143	190	76		158	184	78		167	180	70		9	12	14	16
							77.4	66	120	82	73.5	33	115	170	80		125	160	90		156	178	78		158	180	70		8	11		15
101	BEST	PBL	PRE	36	2	161	49.7	66	94	62	23.3	21	125	130	74		125	128	70		136	132	70		167	134	68		9	10	11	13
							49.7	60	98	[illegible]	24.5	[illegible]	115	138	70		127	138	74		143	144	78		163	140	76		9	11	12	11
111	J HART	PBL	PRE	52	1	183	83.6	72	118	70	70.5	24.5	111	190	90		125	198	94		143	210	90		152	216	90		10	13	14	15
							80.7	72	120	80	64.3	24.0	115	110	84		125	192	94		130	240	88		143	210	86		8	9	11	[illegible]
108	P HART	PBL	PRE	42	1	176	73.3	64	120	86	46.7	11.0	115	180	[illegible]		128	170	90		136	174	80		150	180	84		11	12	12	13
							71.4	54	116	80	48.5	19.0	117	170	[illegible]		128	164	80		140	170	74		150	174	76		9	9	11	12
101	BEST	PBL	PRE	36	2	160	49.7	66	99	62	22.2	21.0	125	130	74		128	128	70		136	132	70		167	134	68		9	10	11	[illegible]
							49.7	60	98	68	21.5	18.3	115	138	70		127	138	74		143	144	78		165	140	70		9	11	11	14
113	E DAVIS	PBL	PRE	34	2	162	61.1	72	104	74	65.7	24.5	158	150	70		176	154	78		180	152	76		188	154	80		13	14	14	16
							59.1	76	108	74	64.5	24.5	160	130	74		167	174	70		179	130	70		187	138	66		13	13	14	15
118	AMSTERDAM	CEM	PRE	31	1	165	58.5	78	116	80	72.0	24.5	150				167	96	104		176	150	74		188	164	92		8	11	14	16
							56.7	84	116	72	70.5	22.0	143	142	44		154	[illegible]	104		167	160	76		188	140	80		7	9	11	13
[illegible]	HUNTER	CEM	PRE	46	1	178	75.2	72	116	78	[illegible]	20.0	126	[illegible]	[illegible]		[illegible]	200	[illegible]		150	198	84		176	208	78		11	12	13	14
							75.4	60	114	78	[illegible]	19.0	107	[illegible]	[illegible]		111	200	88		170	202	90		150	210	92		10	11	12	13
102	LIANG	CEM	PRE	48	1	165	64.4	72	100	86	53.8	24.8	143	120	70		154	132	80		167	180	80		180	180	80		9	12	13	15
							65.7	66	108	62	52.5	24.5	111	140	76		125	170	80		136	180	84		150	194	84		9	11	12	13
104	FARNUM	CEM	PRE	55	1	173	81.7	60	114	76	58	21.9	120	154	82		130	174	70		136	178	78		152	190	78		11	12	13	14
							74.7	66	122	60	46	18.7	107	154	80		111	170	96		122	172	70		143	180	80		10	12	13	13
112	POLANSKI	CEM	PRE	27	2	171	68.5	78	108	[illegible]	53	24.5	140	139	[illegible]		150	176	70		167	152	78		176	158	74		10	11	12	14
							68.0	66	110	76	57	28.0	140	148	[illegible]		150	176	84		167	[illegible]	70		177	152	70		10	11	12	13
110	DAVIS (W)	PBL	PRE	36	1	172	71.3	60	122	78	20.0	19.3	107	130	70		118	130	70		125	160	80		143	170	80		7	9	10	13
							71.3	60	122	78	[illegible]	18.5	130	140	[illegible]		136	154	72		130	[illegible]	[illegible]		138	176	80		9	9	11	13

Phase II Worksite

#	Name	Site	T	AGE	Sex	HT	WT	RHR	RSBP	RDBP	BF	BF%	(6) HR	(6) SBP	(6) DBP	(6) W	(7) HR	(7) SBP	(7) DBP	(7) W	(8) HR	(8) SBP	(8) DBP	(8) W	(9) HR	(9) SBP	(9) DBP	(9) W	RPE		K/E	
																													6	1	8	1
116	Herrera	Chan	Pre	28	1	174	88.9	66	108	68	73	24.5	69	180	70	-	162	164	70	-	178	188	72	-				-	8	8	13	[illegible]
			Post	29	1	174	88.0	66	122	66	64	23	107	164	70	-	115	170	80	-	136	180	80	-	167	190	–	-	11	12	14	16
103	B.Geyer	PLB		56	1	174	98.4	60	138	88	87	27	128	156	92	-	149	156	90	-	156	180	80	-	162	186	80	-	11	13	15	[illegible]
	(no meds [illegible])	[illegible] use		56	1	174	96.9	78.4	148	90	90.5	28	115	190	88	-	136	182	80	-	150	200	78	-	167	194	70	-	9	10	13	[illegible]
	Ken Raff	PLB		49	1	187	76.9	72	112	70	46.5	19	100	140	90	-	111	150	90	-	120	160	88	-	143	160	83		7	[illegible]	1	[illegible]
				49	1	187	78.3	64	108	64	49.5	19.8	100	162	84	-	107	140	90	-	115	168	90	-	125	168	83		6	7	1	1
~~108~~	~~Pat Hunt~~	PLB		42	1	176	73.3	64	120	86	47	19.5	115	156	80	-	126	170	90	-	140	174	80	-	150	180	84	-	11	12	12	[illegible]
							71.4	54	116	80	49	19.0	117	170	80	-	120	164	90	-	136	170	74	-	150	160	76	-	9	9	11	[illegible]
~~106~~	~~[illegible]~~	PLB		41	2	171	72.5	66	120	76	79	33.0	118	172	70	-	130	174	80	-	143	180	76	-	158	184	78		9	9	[illegible]	[illegible]
						171	72.4	66	120	82	74	33.0	107	140	76	-	115	170	80	-	125	160	80	-	136	178	78		7	8	11	14
~~115~~	~~Mike Hudson (Slog)~~	~~CEM~~		~~31~~	~~1~~	~~178~~	~~95.9~~	~~78~~																								
						~~178~~	~~95.9~~	~~78~~																								
111	Guo Liu	CEM		26	1	164	52.5	66	104	62	45	18.5	139	132	70	-	155	140	70	-	175	150	74		185	154	60		10	12	[illegible]	[illegible]
						164	52.7	60	106	58	40	17.0	125	120	74	-	138	130	70	-	154	150	70		176	146	70		9	10	12	[illegible]
105	Bob Hanken	CEM		27	1	179	95.1	72	116	82	73	25.0	104	142	86	-	110	186	86	-	118	168	88	-	127	170	88		9	10	[illegible]	[illegible]
						179	94.6	66	112	78	63	22.5	92	-	-		103	170	90		107	160	100		120	160	90		9	9	[illegible]	14
022	Lee Jacobs	PSS		44	1	180	87.2	72	130	78	82	26.0	113	140	70		173	164	76		182	168	70		184	172	74		12.5	14	15.5	17
							80.9	66	108	68	80	25.0	125	144	74		134	152	74		150	174	72		158	170	74		9	11	13	15
102	Russell Freed	PSS	[illegible]	43	1	169	84.5	60	112	72	74	24.9	137	180	94		14[illegible]	170	80		147	190	78		150	200	82		12	13	14	14
							83.8	60	110	80			107	178	78		110	162	86		124	176	90		136	220	86		18	12	13	14
129	Edward Smucker	PSS	[illegible]	47	1	176	82.2	72	112	68	33.0	20.5	110	170			126	200	80		141	212	80		156	216	60		7	16	12	13
							82.0	54	108	62	44.5	19.8	113	174	60		125	190	64		126	200	70		154	204	60		9	11	13	14
128	Susan Kawin	PSS	Pre	28	2	169	72.0	72	128	76	87.0	35.0	150	154	74		158	170	70		179	180	60		188	160	60		11	13	14	15
							72.2	72	126	78	82.5	34.5	136	164	80		150	174	74		162	174	60		170	170	70		12	13	15	15
121	Boyd Ellis	PSS	Pre		2																											
101	Robert Lucas	PSS	Pre	73	1	175	75.3	72	130	78	48.5	17	118	172	90		170	172	90		90	180	92		152	180	88		12	14	16	17
							75.1	72	144	66	41.0	17	107	182	90		125	190	88		88	200	98		154	174	86		13	15	17	18

Recovery Data

PHASE II - WW (CONT)

Subject	VO2 max	Time	RQ/max	RPP 6	RPP 7	RPP 8	RPP 9	RPP max	2 min post HR	2 min post BP	4 min post HR	4 min post BP	6 min post HR	6 min post BP	MAX HR
118 Glandon	37.0	14.8	1.10	19.3	–	22.7	26.1	30.9	125	140/60	111	126/64	107	100/60	195
	38.4	17.1	1.09	15.7	17.0	18.9	26.4	28.6	107	136/50	97	120/54	88	–	182
116 Longstroth	44.7	15.5	1.15	13.8	16.6	16.0	22.2	33.8	134	126/70	125	124/62	100	100/48	188
	42.1	16.0	1.13	11.4	13.6	15.5	19.9	33.8	152	140/60	113	142/50	111	114/66	188
105 Zeifeng	36.2	13.5	1.06	26.6	26.5	29.0	32.1	32.1	180	152/80	148	122/50	–	–	178
	37.0	16.0	1.12	24.6	27.1	31.6	32.0	34.4	150	144/	125	134/52	120	104/	200
114 Becker (B)	–	10.0	1.01	25.6	28.4	–	–	30.1	143	164/88	120	132/76	115	114/70	177
	–	9.2	1.16	24.5	27.1	–	–	30.7	115	160/74	111	130/68	107	110/64	167
114 Frebs	45.8	16.0	1.04	27.0	30.6	31.0	33.0	41.0	140	164/76	122	134/	118	124/70	200
	43.4	17.6	1.06	21.2	19.5	21.4	28.4	42.0	111	154/64	104	110/64	97	110/60	200
125 McCown ?	41.7	13.2	1.05	21.5	[illegible]	30.4	31.6	38.9	158	160/80	180	[illegible]	136	134/48	200
	36.1	14.5	1.16	16.9	[illegible]	34.0	29.7	33.0	148	154/80	150	146/78	143	130/76	194
124 Teichmann	38.3	12.0	1.12	21.5	28.7	26.8	31.1	38.5	160	140/60	150	136/54	–	124/46	214
	39.4	14.0	1.07	15.2	19.2	21.4	23.4	30.7	136	130/70	127	106/	115	112/48	192
117 Royal Faber (101 kg) →	41.8	19.0	1.01	22.9	25.7	28.7	33.1	42.4	158	164/80	143	140/64	150	128/64	[illegible]
	–	20.3	1.05	19.4	24.7	23.2	30.2	41.6	125	174/60	111	[illegible]	107	124/60	[illegible]
115 Sweeney	–	12.0	.99	20.0	28.1	34.2	37.6	42.0	158	164/80	140	142/70	[illegible]	134/70	200
	–	14.0	1.03	26.6	[illegible]	24.5	28.5	42.0	[illegible]	180/70	115	[illegible]	115	128/80	200
120 Funze	34.3	10.0	1.03	23.0	25.7	30.0	34.1	36.7	111	170/80	107	146/80	–	140/100	167
	33.8	11.0	1.06	21.6	24.2	24.9	27.4	24.1	115	176/64	107	124/74	92	128/70	167
122 Prichard	–	8.3	.89	24.5	27.0	26.2	–	26.3	[illegible]	122/80	115	122/78	[illegible]	92/50	188
	–	9.0	–	19.2	16.0	19.0	–	19.6	107	114/80	94	114/64	91	90/60	172
110 Offenberg	–	–	–	–	–	–	–	–	115	126/100	111	120/76	107	140/100	158 ?
	–	–	–	–	–	–	–	–	70	100/80	75	100/70	91	–	136

PHASE II WW (CONT)

Prepared By
Approved By
Initials Date

	$\dot{V}O_2$ max	Time	RQ max	RPE 6	RPE 7	RPE 8	RPE 9	RPE max	HR	2 MIN POST BP	4 MIN POST HR	4 MIN POST BP	6 MIN POST HR	6 MIN POST BP		MAX HR	MAX PP
104 MAGEE		12.3 13.5	1.07	14.8	25.0 23.0	29.9 29.6	35.4 35.0	36.7 36.7	136 105	200/80 200/70	113 81	154/70 150/64	90 81	140/70 120/64		167 167	[illegible] 214
106 PRICE	35.0 40.8	13.0 15.6	1.02 .91	22.1 15.6	24.1 17.0	24.1 17.7	27.2 20.1	35.1 27.5	134 105	196/86 170/90	115 97	170/90 178/78	107 90	164/86 160/72		167 150	[illegible] 196
108 VANDER HAAR	44.4 45.2	16.0 17.5	1.05 1.03	20.3 20.2	23.1 22.9	26.4 25.2	27.4 29.2	34.8 34.4	138 130	130/60 160/56	125 127	140/80 130/66	120 115	122/60 120/60		200 188	174 [illegible]
102 DEGRE	35.3 32.7	14.0 16.0	1.04 1.13	21.5 14.7	25.5 16.8	28.5 20.7	29.9 23.2	31.0 27.4	115 97	154/66 134/66	100 94	126/70 120/60	88	120/68 100/60		176 167	176 164
105 FU	34.9 35.9	12.3 13.4	1.10 1.21						143 107	154/78 150/60	122 100	120/84 124/64	105 94	106/76 110/64		188 188	172 188
101 HOUSE	20.7 21.8	10.2 11.6	1.12 1.20	27.5 25.4	30.5 22.8	33.8 30.5	33.8 31.4	33.8 31.4	120 120	146/60 130/60	120 100	120/70 120/60	107 100	104/74 102/69		188 194	180 162
114 BUCHANAN (walking recovery)	40.2 39.4	13.4 13.7	1.10 1.15	25.0 22.1	26.3 21.7	26.7 26.5	30.1 32.1	34.2 36.8	158 150	112/64 80/[illegible]	125 156	100/70 138/52	125 156	132/60 150/58		170 200	180 184
103 DAHL	54.6 53.1	19.1 22.1	1.01 1.05	16.5 15.2	17.8 14.5	18.4 20.0	22.9 23.9	38.0 36.8	120 125	170/70 170/60	100 100	150/52 132/60	107 97	130/50 126/60		184 188	196 156
GIBSON	43.9 41.2	16.8 19.0	1.00 1.03	18.2 27.0	29.7 28.1	30.7 30.2	39.2 34.4	37.4 37.6	158 155	150/70 132/68	136 [illegible]	124/76 132/74	130 134	132/82		200 200	98 88
107 HRIBAR	23.0 22.5	8.6 9.0	1.21 1.14	29.2 25.5	40.0 30.4			32.3 32.0	150 125	167/60 164/80	125 103	140/68 140/64	115 94	128/68 120/70		188 176	72 182
101 CLUGSTON	37.5	14.3 16.6	1.18						111	170/80 170/70	103	160/76 152/70	100	142/66 144/64		188	[illegible]

PHASE II WORKSITE - CREDIT UNION

SUBJECT NAME	SITE	TIME	AGE	GENDER	HT	WT	RHR	RSBP	RDBP	BF	BF%	(c) HR	(c) SBP	(6) DBP	(6) VO2	(7) HR	(7) SBP	(7) DBP	(7) VO2	(8) HR	(8) SBP	(8) DBP	(8) VO2	(9) HR	(9) SBP	(P) DBP	(P) VO2	(6) RPE	(7) RPE	(8) RPE	(9) RPE
001 LOTT	CU	PRE	31	2	162	67.4	84	110	70	99.9	37	136	160	89	19.3	158	156	86	25.2	167	170	78	28.4	176	176	74	30.5	8	10	12	16
		POST	32	2		57.4	66	112	80	66.5	31	125	140	86	17.0	136	170	84	22.3	138	170	84	24.7	158	176	84	22.0	7	8	8	11
002 JOHNSON	CU	PRE	25	2	165	69.6	84	106	66	93.5	36	145	150	78	19.4	167	158	80	22.7	176	174	78	26.7	200			30.4	13	14	15	
		POST				70.7	78	90	60	95.5	36.5	136	[illegible]	70	18.2	150	150	68	22.0	158	142	68	24.9	158	142	80	28.1	13	14	15	17
003 DOWELL	CU	PRE	24	2	157	42.4	78	110	72	40.0	24.5	167	140	76	20.6	172	134	70	23.8	188	144	70	26.2					10	12	14	
		POST	25	2		45.8	80	110	62	56.9	21.0	167	122	70	18.6	176	128	68	20.8	188	170	60	24.1	192	128	62	27.2	8	9	12	15
004 FREVOR ((coffee))	CU	PRE	21	2	161	59.5	100	118	72	39.0	24.5	167	160	82	20.2	172	162	70	24.0	188	166	78	27.7	195	160	80	28.4	12	15		19
		POST	21	2		49.4	82	122	80	27.8	22.0	163	180	79	24.1	167	146	84	23.3	176	140	88	26.5	188	178	70	30.7	10	11	13	17
005 COEY (post-light)	CU	PRE	32	1	178	95.3	78	128	78	64.0	20.0	136	140	80	18.6	150	176	80	21.5	158	184	70	24.5	167	184	40	29.1	10	12	13	14
		POST	32	1		92.0	58	120	60	91.0	27.5	112	160	80	17.0	130	170	84	24.0	143	170	84	23.4	158	180	40	27.5	8	9	9	10
006 SCHWEIDER	CU	PRE	43	1	187	98.5	66	110	70	120	28.5	130	176	70	17.8	150	184	78	24.1	166	200	70	25.1		206	90	28.1	10	12	13	
		POST	43	1		95.6	78	132	70	99.3	31.0	145	172	80	17.2	167	[illegible]	86	24.0	176	190	84	24.7	188	190	84	28.6	9	11	13	17
007 RADOLFER (14 mg)?	CU	PRE	42	2	160	66.3	65	110	74	74.0	33	143	160	70	17.2	155	180	70	22.5	167	190	0	26.1					7	14	19	
		POST	42	2		68.0	74	110	80	82.7	31.5	130	170	80	17.8	150			24.1									13			
008 HAYDENBURGH	CU	PRE	52	2	164	67.2	72	116	78	52.8	34																	12	13		
		POST	52	2		66.7	78	100	58	93.0	36	136	170	70		150	170	70													
009 FISK (BP stopped-?)	CY	PRE	47	1	175	95.9	79	134	86	54.2	33																				
		POST	47	1		97	72	140	82	50	26																				
010 BELL (post 1 mg ?)	CU	PRE	54	1	185	118.2	79	140	80	91.5	28	125	174	76		136	160	70		143	180	60		150				11	13	15	
		POST	54	1		107	72	130	78			125	142	76		136	140	70										7	9	13	
011 KADLECSIK	CU	PRE	28	2	166	69.2	72	132	72	46	34	163	160	80	19.9	176	170	70	24.7	188	170	70	27.8					14	15	17	
		POST	28	2		67.7	84	100	64	45.5	25	158	150	72	21.4	167	156	70	22.2	176	174	64	27.1	188	160	60	31.0	10	11	12	16
014 ABBOTT	CU	PRE	30	2	166	55.7	64	108	64	55	27	139	146	78	17.6	172	150	80	21.7	158	152	70	23.6	180	150	70	29.5	8	11	13	15
		POST	30	2		55.5	72	102	60	49.3	27	130	128	70	17.6	150	140	80	21.4	167	154	70	24.4	188	164	72	27.6	7	8	10	13
016 [illegible] COOSTER ([illegible] (stopped [illegible]))	CU	PRE	27	2	165	81.7	76	118	70	85	37	143	170	80	17.9	167	180	70	22.2	176	170	80	25.0					13		15	
		POST	27	2		66	60	90	55	64.3	30	164	152	79	22.6	172	159	72	24.8	158	160	70	24.6	176	164	70	29.2	9	11	15	15
020 VAUGHN	CU	PRE	40	2	162	52.5	84	106	66	40	24.5	155	140	78		167	170	80		136	170	78						7	11	14	
		POST	40	2		53.5	78	112	68	27.3	24	150	132	70		158	154	76		167	154	76		176	154	60		13	15	17	

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Allen, L.D. and B.A. Iwata. Reinforcing exercise maintenance using existing high-rate activities. *Behav. Mod.* 4(3):337-354, 1980.

2. Aloia, J.F., A.N. Vaswani, J.K. Yeh and S.H. Cohn. Premenopausal bone loss is related to physical activity. *Arch. Intern. Med.* 148: 121-123, 1988.

3. Aloia, J.F., S.H. Cohn, J.A. Ostuni, R. Cane and K. Ellis. Prevention of involutional bone loss by exercise. *Ann. Intern. Med.* 89: 356-358, 1978.

4. American College Of Sports Medicine. Clinical exercise testing. In: S.N. Blair, P. Painter, R.R. Pate, L. Kent Smith, and C. Barr Taylor (Eds.), *Resource manuel for guidelines for exercise testing and prescription.* Philadelphia, PA: Lea and Febiger, 1988, pp. 205-222.

5. American College Of Sports Medicine. Position Stand on The Recommended Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory and Muscular Fitness in Healthy Adults. *Med. Sci. Sports Exerc.* 22(2): 265-274, 1990.

6. Andrew, G.A., N.B. Oldridge, J.O. Parker, D.A. Cunningham, P.A. Rechnitzer, N.L. Jones, C. Buck, T.Kavanagh, R.J. Shephard, and J.R. Sutton. Reasons for dropout from exercise programs in post-coronary patients. *Med. Sci. Sports Exerc.* 13: 164-168, 1981.

7. Andrew, G.M. and J.O. Parker. Factors related to dropout of post myocardial infarction patients from exercise programs. *Med. Sci. Sports Exerc.* 11: 376-378, 1979.

8. Atkins, C. J. and R.M. Kaplan. Behavioral exercise programs in the management of chronic obstructive pulmonary disease. *J. Consult. Clin. Psychol.* 52(4): 591-603, 1984.

9. Bandura, A., N.W. Adams and J. Beyer. Cognitive processes mediating behavior change. *Pers. Soc. Psychol.* 35: 125-139, 1977.

10. Bandura, A. Self-efficacy mechanism in human agency. *Amer. Psychol.*, 37(2): 122-147, 1982.

11. Baun, W.B. and E.J Bernacki. Who are corporate exercisers and what motivates them? In: Rod K. Dishman, (ed.), *Exercise Adherence, It's Impact On Public Health.*, Champaign IL: Human Kinetics Books, 1988, pp. 321-348.

12. Belisle, M., E. Roskies and J.M. Levesque. Improving adherence to physical activity. *Health Psychol.*, 6(2): 159-172, 1987.

13. Black, D.R. and J.G. Friesen. Deposit money: A component in a self-directed minimal intervention program for weight control *Behav. Ther.* 14: 333-340, 1983.

14. Blair, S.N. Exercise, health, and longevity. In: D.R. Lamb and R. Murray (eds.), *Perspectives In Exercise Science and Sports Medicine.* Indianapolis, Ind: Benchmark Press Inc., 1988, pp. 443-489.

15. Blair, S.N., N.N. Goodyear, L.W. Gibbons. and K.H. Cooper. Physical fitness and incidence of hypertension in healthy normotensive men and women. *J.A.M.A.* 252(4): 487-490, 1984.

16. Blair, S.N., P.V. Piserchia, C.S. Wilbur and J.C. Crowder. A public health intervention model for work-site health promotion. *J.A.M.A.* 255(7): 921-926, 1986.

17. Blair, S.N., H.W. Kohl, R.S. Paffenbarger, D. Clark, K.H. Cooper and L.W. Gibbons. Physical fitness and all-cause mortality - A prospective study of healthy men and women. *J.A.M.A.* 262(17): 2395-2401, 1989.

18. Blomqvist, C.G., and B. Saltin. Cardiovascular adaptations to physical training. *Ann Rev. Physiol.* 45: 169-189, 1983.

19. Borg, G.A.V. Psychophysical bases of perceived exertion. *Med. Sci. Sports Exerc.* 14:377-381, 1982.

20. Brennan, A.J. Health and fitness boom moves into corporate America. *Occupational Health And Safety.* July 1985, pp. 38-45.

21. Breslow, L., J. Fielding, A.A. Herrman, and C.S. Wilbur. Worksite health promotion: Its evolution and the Johnson and Johnson experience. *Prev. Med.* (19): 13-21, 1990.

22. Brooks, C. M. Adult participation in physical activities requiring moderate to high levels of energy expenditure. *Physician Sportsmed.* 15(4): 119-132, 1987.

23. Brownell, K.D., A.J. Stunkard and J.M. Albaum. Evaluation and modification of exercise patterns in the natural environment. *Am. J. Psychiatry.* 137: 1540-1545, 1980.

24. Brownell, K. D., R.Y. Cohen, A.J. Stunkard, M.R.J. Felix and N.B. Cooley. Competitions at the work site: Impact on weight, morale and cost-effectiveness. *Am. J. Health Promot.* 74 (11): 1283-1285, 1984.

25. Brownell, K. D. and M.R.J. Felix. Competitions to facilitate health promotion: Review and conceptual analysis. *Am. J. Health Promot.* 2(1): 28-36, 1987.

26. Brownell, K. D., G.A. Marlatt, E. Lichtenstein and G. Wilson. Understanding and preventing relapse. *Am. Psychol.* 41(7): 765-782, 1986.

27. Bruce, E.H., R. Frederick, R.A. Bruce and L.D. Fisher. Comparison of active participants and dropouts in capri cardiopulmonary rehabilitation programs. *Am. J. Cardiol.* 37:53-60, 1976.

28. Caspersen, C. J., G.M. Christenson and R.A. Pollard. Status of the 1990 physical fitness and exercise objectives - Evidence from NHIS 1985. *Pub. Health Rep.* 101(6): 587-592, 1986.

29. Chisholm, D.M., M. Collis, L. Kulak, W. Davenport and N. Gruber. Physical activity readiness. *Br. Colum. Med. J.* 17: 375-381, 1975.

30. Chow, R., J.E. Harrison and C. Notarius. Effect of two randomized exercise programmes on bone mass of healthy postmenopausal women. *Br. Med. J.* 293:1441-1444, 1987.

31. Cohen, R.Y., A.J. Stunkard and M.R.J. Felix. Comparison of three worksite weight-loss competitions. *J. Behav. Med.* 10: 467-479, 1987.

32. Cox, M.H. Fitness and lifestyle programs for business and industry: Problems in recruitment and retention. *J. Cardiac Rehab.* 4: 136-142, 1984.

33. Cox, M.H., R.J. Shephard and P. Corey. Influence of an employee fitness programme upon fitness, productivity, and absenteeism. *Ergon.* 24(10): 795-806, 1981.

34. Cuff, G. N. A comparison of behavior modification techniques designed to generate and maintain exercise behavior . Ph.D. Dissertation. *Abs. Inter.* 46(11): 4041-B,1986.

35. Dishman, R.D., J.F. Sallis and D.R. Orenstein. The determinants of physical activity and exercise. *Pub. Health Rep.* 100:158-171, 1985.

36. Dishman, R.K. and A.L. Dunn. Exercise adherence in children and youth: implications for adulthood In: Rod K. Dishman, (ed.), *Exercise Adherence, It's Impact On Public Health.*, Champaign IL: Human Kinetics Books,1988, pp. 155-202.

37. Dishman, R.K., and W. Ickes. Self-motivation and adherence to therapeutic exercise. *J. Behav. Med.* 4:421-438, 1981.

38. Dishman, R.K. Exercise. Compliance/adherence in health-related exercise. *Health Psychol.* 1: 237-267, 1982.

39. Dishman, R.K. Overview. In: Rod K. Dishman, (ed.), *Exercise Adherence, It's Impact On Public Health,* Champaign IL: Human Kinetics Books,1988, pp. 1-9.

40. Dishman, R.K. Determinants of participation in physical activity. In: C. Bouchard, R.J. Shephard, T. Stephens, J.R. Sutton, B.D. McPherson (eds.), *Exercise Fitness and Health,* Champaign Il., Human Kinetics Publishers, Inc., 1990, pp. 75-101.

41. Dishman, Rod K. Exercise adherence research: future directions *Am. J. Health Promot.* 3(1): 52-56,1988.

42. Dubbert, P.M., N.B. Rappaport and J.E. Martin. Exercise in cardiovascular disease. *Behav. Mod.*11(3): 329-347, 1987.

43. Durbeck, D.C., F. Heinzelmann, J. Schacter, W.L. Haskell, G.H. Payne, R.T. Moxley, M. Nemiroff, D.D. Limoncelli, L.B. Arnoldi and S.M. Fox. The National Aeronautics and Space Administration- U.S. Public Health Service health evaluation and enhancement program. *Am. J. Cardiol.* 30: 784-790, 1972.

44. Durnin, J.V.G.A. Asssessment of physical activity during leisure and work. In: C. Bouchard, R.J. Shephard, T. Stephens, J.R. Sutton, B.D. McPherson (eds.), *Exercise Fitness and Health,* Champaign Il., Human Kinetics Publishers, Inc., pp. 63-70.

45. Epstein, L. H., and R.R.Wing. Attendance and fitness in aerobics exercise - the effects of contract and lottery procedures. *Behav. Mod.* 4: 465-479,1980.

46. Epstein, L.H. and R.R. Wing. Behavioral contracting: health behaviors. In: C. M. Franks (ed.), *New Developments In Behavior Therapy*, Haworth Press, N.Y. 1984, pp. 409-449.

47. Epstein, L.H., R.R. Wing, R. Koeske, D. Ossip and S. Beck. A comparison of lifestyle change and programmed aerobic exercise on weight and fitness in obese children. *Behav. Ther.* 13: 651-665, 1982.

48. Epstein, L. H., R. Koeske and R.R.Wing. Adherence to exercise in obese children. *J. Cardiac Rehab.* 4: 185-195, 1984.

49. Erling, J. and N.B. Oldrige. Effect of a spousal-support program on compliance with cardiac rehabilitation. *Med. Sci. Sports. Exerc.* 17: 284, 1985.

50. Ferguson, E.W., L.I. Berbier, G.R. Banta, J. Yu-Yahira and E.B. Schoomaker. J. Effects of exercise and conditioning on clotting and fibrinolytic activity in men. *Appl. Physiol.* 62(4): 1416-1421, 1987.

51. Fielding, J.E. Health promotion and disease prevention at the worksite. *Ann. Rev. Pub. Health.* 5: 237-65, 1984.

52. Folkins, C. H. and W.E. Sime. Physical fitness training and mental health. *Am. Psychol.* 36(4): 373-389, 1981.

53. Follick, M.J., J.L. Fowler and R.A. Brown. Attrition in worksite weight-loss interventions: the effects of an incentive procedure. *J. Consult. Clin. Psychol.* 52: 139-140, 1984.

54. Folsom, A.R., C.J. Caspersen, H.L. Taylor, D.R. Jacobs, R.V. Luepker, O.G. Marin, R.F. Gillium and H. Blackburn. Leisure time physical activity and its relationship to coronary risk factors in a population-based sample. *Am. J. Epidem.* 121(4): 570-579, 1985

55. Foxx, R.M.,and Monica H. Schaeffer. A company-based lottery to reduce the personal driving of employees. *J. Appl. Behav. Anal.* 14(3): 273-285, 1981.

56. Fries, J. F., L.W. Green and S. Levine. Health promotion and the compression of morbidity. *Lancet.* March 4, 1989, pp.481-483.

57. Gebhardt, D. L. and C.E. Crump. Employee fitness and wellness programs in the workplace. *Am. Psychol.* 45(2): 262-272, 1990.

58. Gettman, L. R., M.L. Pollock and A. Ward. Adherence to unsupervised exercise. *Physician Sportsmed.* Vol. 11(10): 56-66, 1983.

59 Hagberg, J.M., D. Goldring, A.A. Ehsani, G.W. Heath, A. Hernandez, K. Schechtman and J. O. Holloszy. Effect of exercise training on the blood pressure and hemodynamic features of hypertensive adolescents. *Am. J. Cardiol.* 52: 763-768, 1983.

60. Hagberg, J.M., S.J. Montain, W.H. Martin and A.A. Ehsani. Effect of exercise training in 60-69-year-old persons with essential hypertension. *Am. J. Cardiol.* 64: 348-353, 1989.

61. Harris, M.B. and C.G. Bruner. A comparison of a self-control and a contract procedure for weight control. *Behav. Res. Ther.* 9:347-354, 1971.

62. Haskell, W. L. and S.N. Blair. The physical acitivity component of health promotion in occupational settings. *Pub. Health Rep.* 95(2): 109-118, 1980.

63. Haynes, R. B. Compliance with health advice: an overview with special reference to exercise programs. *J. Cardiac Rehab.* 4: 120-123, 1984.

64. Heinzelmann, F. and R.W. Bagley. Response to physical activity programs and their effects on health behavior. *Pub. Health Rep.* 85: 905-911, 1970.

65. Hill, J.O., P.B. Sparling, T.W. Shields and P.A. Heller. Effects of exercise and food restriction on body composition and metabolic rate in obese women. *Am. J. Clin. Nutr.* 46: 622-630, 1987.

66. Hoyt, M.F. and I.L. Janis. Increasing adherence to a stressful decision via a motivational balance-sheet procedure: a field experiment. *J. Pers. Soc. Psychol.* 31: 833-839, 1975.

67. Ilmarinen, J. and P.S. Fardy. Physical activity intervention for males with high-risk of coronary heart disease: A three-year follow-up. *Prev. Med.* 6: 416-425, 1977.

68. Jeffrey, R.W., P.D. Thompson and R.R. Wing. Effects on weight reduction of strong monetary contracts for caloric restriction or weight loss. *Behav. Res. Ther.* 16: 363-369, 1978.

69. Karvonen, M., K. Kentala and O. Mustala. The effect of training on heart rate: a longitudinal study. *Ann Med. Exper. Biol. Fenn.* 35: 307-315, 1957.

70. Kau, M. L., and J. Fischer. Self-modification of exercise behavior. *Behav. Ther. Exper. Psych.* 5: 213-214, 1974.

71. Keefe, F.J., and J.A. Blumenthal. The Life Fitness Program: A behavioral approach to making exercise a habit. *J. Behav. Ther. Exper. Psych.* 11: 31-34, 1980.

72. King, A.C., B. Frey-Hewitt, D.M. Dreon and P.D. Wood. Diet vs exercise in weight maintenance: the effect of minimal intervention strategies on long-term outcomes in men. *Arch. Intern. Med.* 149: 2741-2746, 1989.

73. King, Abby C., A. Bohn, C.B. Taylor and W.L. Haskell. Adherence to physical activity in older adults: findings from a community-based clinical trial.presentation at the Behavior Therapy World Congress Edinburgh, Scotland, Sept. 1988.

74. King, Abby C., F. Carl, L. Birkell and W.L. Haskell. Increasing exercise among blue-collar employees: the tailoring of worksite programs to meet specific needs. *Prev. Med.* 17: 357-365, 1988.

75. King, A. C. and L.W. Frederiksen. Low-cost strategies for increasing exercise behavior. *Behav. Mod.* 8(1): 3-21, 1984.

76. Kirschenbaum, D. S. and R.C. Flanery. Behavioral contracting: outcomes and elements. *Prog. Behav. Mod.* 15: 217-275, 1983.

77. Knapp, D. N. Behavioral management techniques and exercise promotion.In: Rod K. Dishman, (ed.), *Exercise Adherence, It's Impact On Public Health,* Champaign IL: Human Kinetics Books,1988, pp. 203-235.

78. Kriska, A. M., C. Bayles, J.A. Cauley, R.E. Laporte, R.B. Sandler and G. Pambianco. A randomized exercise trial in older women: increased activity over two years and the factors associated with compliance.*Med. Sci. Sports Exerc.* 18(5): 557-562, 1986.

79. Krolner, B., B. Toft, S.P. Nielsen and E. Tondevold. Physical exercise as prophylaxis against involuntary vertebral bone loss: a controlled study. *Clin. Sci.* 64: 541-546, 1983.

80. Lando, H A. Successful treatment of smokers with a broad-spectrum behavioral approach. *J. Consult. Clin. Psychol.* 45(3): 361-366, 1977.

81. LaPorte, R.E., L.L.Adams, D.D. Savage, G. Brenes, S. Dearwater and T. Cook. The spectrum of physical activity, cardiovascular disease and health: an epidemiologic perspective. *Am. J. Epidem.* 120(4): 507-517, 1984.

82. Laporte, R.E., H.J. Montoye and C.J. Caspersen. Assessment of physical activity in epidemiologic research: problems and prospects. *Pub. Health Rep.* 100(2): 131-142, 1985.

83. Leatt, P., H. Hattin, C. West and R.J. Shephard. Seven year follow-up of an employee fitness program. *Can. J. Pub. Health* 79: 20-25, 1988.

84. Lee, C. and N. Owen. Exercise persistence: contributions of psychology to the promotion of regular physical activity. *Australian Psychol.* 21(3): 427-467, 1986.

85. Lemere, F. and WL Voegtlin. An evaluation of the aversion treatment of alcoholism. *Quart. J. Stud. Alc.* 11: 199-204, 1950.

86. Leon, A.S., J. Connett, D.R. Jacobs and R. Rauramaa. Leisure-time physical activity levels and risk of coronary heart disease and death: the multiple risk factor intervention trial. *J.A.M.A.* 258 (17): 2388-2395, 1987.

87. Libb, J.W. and C.B. Clements. Token reinforcement in an exercise program for hospitalized geriatric patients. *Perceptual and Motor Skills.* 28: 957-958, 1969.

88. Lipinski, D. and R. Nelson. The reactivity and unreliability of self-recording. *J. Consult. Clin. Psychol.* 42 (1): 118-123, 1974.

89. Lipsker, L. E. An Investigation of variables affecting exercise adherence. *Ph.D. Diss. Abs. Inter.* 44(4): 1222-B, 1983.

90. Mann, George V., H.L. Garrett, A. Farhi, H. Murray, and F. Billings. Exercise to prevent coronary heart disease- an experimental study of the effects of training on risk factors for coronary disease in men. *Am. J. Med.* 46: 12-27, 1969.

91. Marlatt, G. A., and J.R. Gordon. Determinants of relapse: implications for the maintenance of behavior change In: P. O. Davidson and S. M. Davidson, (eds.) *Behavioral Medicine: Changing Health Lifestyles,* New York, Brunner/Mazel, 1980, pp. 411-453.

92. Marston, A.R. and J. Criss. Maintenance of succesful weight loss: incidence and prediction. *Internat. J. Obes.* 8: 435-439, 1984.

93. Martin, J. E. and P.M. Dubbert. Adherence to exercise. In: R.L. Terjung (Ed.), *Exercise and Sports Science Review.* New York: MacMillan Co., 1985, pp. 137-167.

94. Martin, J. E., P.M. Dubbert, A.D. Katell, J.K. Thompson, J.R. Raczynski, M. Lake, P.O. Smith, J.S. Webster, T. Sikora and R.E. Cohen. Behavioral control of exercise in sedentary adults: studies 1 through 6. *J. Consult. Clin. Psychol.* 52(5): 795-811, 1984.

95. Martin, J, E. and P.M. Dubbert. Exercise applications and promotion in behavioral medicine: current status and future directions. *J. Consult Clin. Psychol.* 50(6): 1004-1007, 1982.

96. Mavis, B.E. The use of monetary incentives in a social context in the modification of weight loss. Ph.D. Dissertation, Michigan State University, East Lansing, Michigan, 1987.

97. Mayer, J. and E.S. Geller. Motivating energy efficient travel: a community-based intervention for encouraging biking. *J. Environ. Sys.* 12(2): 99-113, 1982.

98. McCready, M. L. and B.C. Long. Locus of control, attitudes toward physical activity, and exercise adherence. *J. Sport Psychol.* 7: 346-359, 1985.

99. McFarlane, B.L. Aerobic exercise compliance: the effects of self-reinforcement vs. lottery procedures. Ph.D. Dissertation. *Diss Abs. International.* 44,(5): 1343-A,1983.

98. Montoye, H.J., H.L. Metzner, J.B. Keller, B.C. Johnson and F.H. Epstein. Habitual physical activity and blood pressure. *Med. Sci. Sport Exerc.* 4(4): 175-181, 1972.

100. Morgan, W.P. and P.J. O'Conner. Exercise and mental health. In: R.K. Dishman, (ed.), *Exercise Adherence, Its Impact On Public Health.* Champaign Il., Human Kinetics Books, 1988, pp. 91-121.

101. Morgan, W.P., D.H. Hortsman, A. Cymerman and J. Stokes. Facilitation of physical performance by means of a cognitive strategy. *Cog. Ther. Res.* 7(3): 251-264, 1983.

102. Morgan, W.P. Involvement in vigorous physical activity with special reference to adherence. In: L.I. Gedvials and M.E. Kneer (eds.), *National College Of Physical Education Proceedings,* Office Of Public Service, University Of Illinois at Chicago, 1977, pp. 235-246.

104. Morris, J.N., R. Pollard, M.G. Everitt and S.P.W. Chave. Vigorous exercise in leisure time: protection against coronary heart disease. *Lancet* (6): 1207-1210, 1980.

105. Neale, A.V., S.P. Singleton, M.H. Dupuis and J.W. Hess. The use of behavioral contracting to increase exercise activity. *Am. J. Health Promot.* 4: 441-447, 1990.

106. Nelson, R.O., S.C. Hayes, R.T. Spong, R.B. Jarrett and D.L. McKnight. Self-reinforcement: appealing misnomer or effective mechanism? *Behav. Res. Ther.* 21: 557-566, 1982.

107. Oberman, A. Exercise and the primary prevention of cardiovascular disease. *Am. J. Cardiol.* 55: 10D-20D, 1985.

108. Oja, P., P. Teraslinna, T. Partanen, and R. Karava. Feasibility of an 18 months' physical training program for middle-aged men and its effect on physical fitness. *Am. J. Pub. Health.* 64(5): 459-464, 1974.

109. Oldridge, N.B. and N.L. Jones. Contracting as a strategy to reduce dropout in exercise rehabilitation. *Med. Sci. Sport Exerc..* 13: 125-126, 1981.

110. Oldridge, N. B. Adherence To Adult Exercise Fitness Programs. In: J.D. Matarazzo, S.M. Weiss (Eds.), Behavioral Health, *A Handbook of Health Enhancement and Disease Prevention.* New York: John Wiley and Sons, 1984, p.467-487.

111. Oldridge, N. B. and NL. Jones. Improving patient compliance in cardiac exercise rehabilitation: effects of written agreement and self-monitoring. *J. Cardiac Rehab.* 3: 257-262, 1983.

112. Oldridge, N. B. Compliance and dropout in cardiac exercise rehabilitation *J. Cardiac Rehab.* 4: 166-177, 1984.

113. Oldridge, N.B. Compliance and exercise in primary and secondary prevention of coronary heart disease: a review. *Prev. Med.* (11): 56-70, 1982.

114. Oldrige, N. B. Cardiac rehabilitation programme-compliance and compliance-enhancing strategies. *Sports Med.* 6: 42-55, 1988.

115. Optenberg, S. A., M.L. Lairson, C.H. Slater and M.L. Russell. Agreement of self-reported and physiogically estimated fitness status in a symptom-free population. *Prev. Med.* 13: 349-354, 1984.

116. Orlander, J., K. Kiessling, J. Karlsson and B. Ekblom. Low-intensity training, inactivity and resumed training in sedentary men. *Acta Physiol Scand* 101: 351-362, 1977.

117. Owen, C. A., E.F. Beard, A.S. Jackson, and B.W. Prior. Longitudinal evaluation of an exercise prescription intervention program with periodic ergometric testing: a ten-year appraisal. *J. Occup. Med.* 22(4): 235-239, 1980.

118. Owen, N. Facilitating maintenance of behavior change. In: E. Boberg, (ed.), *Maintenance of Fluency, Proceedings of The Baniff Conference*. New York, Elsevier, 1979, pp. 30-70.

119. Owen, N., L.L. Naccarella, H. Christina and K. Haag. Exercise by mail: a mediated behavior-change program for aerobic exercise. *J. Sport Psychol.* 9: 346-357, 1987.

120. Paffenbarger, R. S., R.T. Hyde, A.L. Wing and C. Hsieh. Physical activity, all-cause mortality, and longevity of college alumni. *N. Engl. J. Med.* 314(10): 605-613, 1986.

121. Pate, R. R., S.N. Blair. Physical fitness programming for health promotion at the worksite. *Prev. Med.* 12: 632-643, 1983.

122. Pauly, J.T., J.A. Palmer, C.C. Wright and G. Pfeiffer. The effect of a 14-week employee fitness program on selected physiological and psychological parameters. *J. Occup. Med.* 24(6): 457-463, 1982.

123. Pavlov, I.P. *Conditioned Reflexes*. London: Oxford University Press, 1927.

124. Pennebaker, J.W. and J.M. Lightner. Competition of internal and external information in an exercise setting. *J. Pers. and Soc. Psychol.* 39: 165-174, 1980.

125. Perkins, K.A. and L.H. Epstein. Methodology in exercise adherence research. In: R. K. Dishman (ed.), *Exercise Adherence, It's Impact On Public Health.* Champaign Il., Human Kinetics Books, 1988, pp. 399-416.

126. Perri, M.G., D.A. McAllister, J.J. Gange, R.C. Jordon, W. G. McAdoo and A.M. Nezu. Effects of four maintenance programs on the long-term management of obesity. *J. Consult. Clin. Psychol.* 56(4): 529-534, 1988.

127. Pollock, M. L., L.R. Gettman, C.A. Milesik, M.D. Bah, L. Durstine, and R.B. Johnson. Effects of frequency and duration of training on attrition and incidence of injury. *Med. Sci. Sports Exerc.* 9(1): 31-36, 1977.

128. Reid, E.L. and R.W. Morgan. Exercise prescription: a clinical trial. *Am. J. Pub. Health.* 69: 591-595, 1979.

129. Romanczyk, R.G., R.N. Kent, R.N. Diament and K.D. O'Leary. Measuring the reliability of observational data: A reactive process. *J. Appl. Behav. Anal.* 6: 175-184, 1973.

130. Sallis, J. F., W.L. Haskell, S.P. Fortmann, K.M. Vranizan, C.B. Taylor and D.S. Solomon. Predictors of adoption and maintenance of physical activity in a community sample. *Prev. Med.* 15: 331-341, 1986.

131. Sallis, J.F. Health behavior change at the worksite: cardiovascular risk reduction. *Prog. Behav. Mod.* 20: 161-196, 1987.

132. Saltin, B. and L.B. Rowell. Functional adaptations to physical activity and inactivity. *Fed. Proc.* 39: 1506-1513, 1980.

133. Sedgwick, A.W., J.R. Brotherhood, A. Harris-Davifson, R.E. Taplinn and D.W. Thomas. Long-Term Effects of physival training programme on risk factors for coronary heart disease in otherwise sedentary men. *Br. Med. J.* 2: 7-10, 1980.

134. Shephard, R.J. Exercise adherence in corporate settings: personal traits and program barriers. In: R. K. Dishman (ed.), *Exercise Adherence, It's Impact On Public Health.* Champaign Il., Human Kinetics Books, 1988, pp. 305-319.

135. Shephard, R.J., M. Cox and P. Corey. Fitness program participation: its effect on worker performance. *J. Occup. Med.* 23(5): 359-363, 1981.

136. Shephard, R.J. Exercise in coronary heart disease. *Sports Med.* 3: 26-49, 1986.

137. Shephard, R. J., P. Corey, P. Renzland and M. Cox. The influence of an employee fitness and lifestyle modification program upon medical care costs. *Can. J. Pub. Health* 73: 259-263, 1982.

138. Shephard, R. J. and J.F. Massie. Physiological and psychological effects of training. *Med. Sci. Sports* 3(3): 110-117, 1971.

139. Shephard, R. J., P. Morgan, R. Finucane and L. Schimmelfing. Factors influencing recruitment to an occupational fitness program. *J. Occup. Med.* 22(6): 389-398, 1980.

140. Siscovick, D. S., N.S. Weiss, A.P. Hallstrom, T.S. Inui and D.R. Peterson. Physical activity and primary cardiac arrest. *J.A.M.A.* 248(23): 3113-3117, 1982.

141. Siscovik, D.S., R.E. Laporte and J.M. Newman. The disease-specific benefits and risks of physical activity and exercise. *Pub. Health Rep.* 100(2): 180-188, 1985.

142. Skinner, B.F., *Science and Human Behavior.* New York: Macmillan, 1953.

143. Song, T.K., R.J. Shephard and M. Cox. Absenteeism, employee turnover and sustained exercise participation. *J. Sports Med.* 22: 392-399, 1982.

144. Sonstroem, R.J. Psychological models. In: R. K. Dishman (ed.), *Exercise Adherence, It's Impact On Public Health.* Champaign Il., Human Kinetics Books, 1988, pp. 125-154.

145. Spevak, P.A. Multi-strategy approach to the maintenance of personal fitness programs. Ph.D. Dissertation. *Diss. Abs. International* 42: 3445-B, 1982.

146. Stachnik, T. and B. Stoffelmayr. Worksite smoking cessation programs: a potential for national impact. *Am. J. Pub. Health* 73(12): 1395-1396, 1983.

147. Stachnik, T., B. Brown, W. Hinds, B. Mavis, B. Stoffelmayr, D. Thornton and L. Van Egeren. Goal setting, social support, and financial incentives in stress management programs: a pilot study of their impact on adherence. *Am J Health Promot.* 5(1): 24-29, 1990.

148. Stephens, T. Secular trends in adult physical activity: exercise boom or bust? *Res. Quart. Exerc. Sport* 58(2): 94-105, 1987.

149. Taylor, C. B., J.F. Sallis and R. Needle. The relation of physical activity and exercise to mental health. *Pub. Health Rep.* 100(2): 195-202, 1985.

150. Taylor, H.L., E.R. Buskirk, and R.D. Remington. Exercise in controlled studies of the prevention of coronary heart disease. *Fed. Proc.*32(5): 1623-1627, 1973.

151. Teraslinna, P., T. Partanen, A. Koskela and P. Oja. Characteristics affecting willingness of executives to participate in a physical activity program aimed at coronary heart disease prevention. *J. Sports Med. Phys. Fit.* 9: 224-229, 1969.

152. Thompson, C.E. and L.M. Wankel. The effects of perceived activity choice upon frequency of exercise behavior. *J. Appl. Soc. Psychol.* 10: 436 443, 1980.

153. Tsai, S. P., W.B. Baun, and E.J. Bernacki. Relationship of employee turnover to exercise adherence in a corporate fitness program. *Occup. Med.* 29(7): 572-575, 1987.

154. Turner, R.D., S. Polly and A.R. Sherman. A behavioral approach to individualized exercise programming. In: J.D. Krumboltx and C.E. Thoresen (eds.), *Behavioral Counseling: Cases and Techniques.* New York, Holt, Rinehart and Winston, 1969, pp. 349-359.

155. Vance, B. Using contracts to control weight and to improve cardiovascular physical fitness. In: J.D. Krumboltx and C.E. Thoresen (eds.), *Behavioral Counseling: Cases and Techniques.* New York, Holt, Rinehart and Winston, 1969.

156. Wankel, L.M., J.K. Yardley and J. Graham. The effects of motivational interventions upon the exercise adherence of high and low self-motivated adults. *Can. J. Appl. Sport Sci.* 10(3): 147-156, 1985.

157. Wankel, L. M. and C. Thompson. Motivating people to be physically active: self-persuasion vs. balanced decision making. *J. Appl. Soc. Psychol.* 7(4): 332-340, 1977.

158. Wankel, L. M. Involvement in vigorous physical activity: considerations for enhancing self-motivation. In: R. R. Danielson and K. F. Danielson (eds.), *Fitness Motivation: Proceedings of the Geneva Park Workshop.* Toronto, Orcol Publications, 1980, pp. 18-32.

159. Wankel, L M. Decision-making and social support strategies for increasing exercise involvement. *J. Cardiac Rehab.* 4: 124-135, 1984.

160. Ward, A. and W.P. Morgan. Adherence patterns of healthy men and women enrolled in an adult exercise program. *J. Cardiac Rehab.* 4: 143-152, 1984.

161. Watson, J.B. and R. Rayner. Conditioned emotional reactions. *J. Exper. Psychol.* 3: 1-14, 1920.

162. Wier, L. T., and A.S. Jackson. Factors affecting compliance in the NASA/Johnson Space Center Fitness Programme. *Sports Med.* 8 (1): 9-14, 1989.

163. Williams, P.T., P.D. Wood, W.L. Haskell and K. Vranizan. The effects of running mileage and duration on plasma lipoprotein levels. *J.A.M.A.* 247(19): 2674-2679, 1987.

164. Wood, P.D., M.L. Stefanick, D.M. Dreon, B. Frey-Hewitt, S.C. Garay, P.T. Williams, H.R. Superko, S.P. Fortmann, J.J. Albers, K.M. Vranizan, N.M. Ellsworth, R.B. Terry, and W.L. Haskell. Changes in plasma lipids and lipoproteins in overweight men during weight loss through dieting as compared with exercise. *N. Eng. J. Med.* 319(18): 1173-1179, 1988.

165. Wysocki, T., G. Hall, B. Iwata, and M. Riordan. Behavioral management of exercise: contracting for aerobic points. *J. Appl. Behav. Anal.* 12: 55-64, 1979.

166. Yarvote, P. M., T.J. McDonagh, M.E. Goldman and J. Zuckerman. Organization and evaluation of a physical fitness program in industry. *J. Occup. Med.* 16(9): 589-598, 1974.