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*South Dakota State University*

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Evaluation of a Simple Intervention to Increase Self-Efficacy for Independent Exercise in  
Cardiac Rehabilitation Participants

By

Sherry A. Barkley

A dissertation submitted in partial fulfillment of the requirements for the

Doctor of Philosophy

Major in Biological Sciences

South Dakota State University

2008

Evaluation of a Simple Intervention to Increase Self-Efficacy for Independent Exercise in  
Cardiac Rehabilitation Participants

This dissertation is approved as a credible and independent investigation by a candidate for the Doctor of Philosophy degree and is acceptable for meeting the dissertation requirements for this degree. Acceptance of this dissertation does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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Matthew Vukovich, Ph.D.  
Dissertation Advisor      Date

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Head, Biological Sciences      Date

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## Abstract

### Evaluation of a Simple Intervention to Increase Self-Efficacy for Independent Exercise in Cardiac Rehabilitation Participants

Sherry A. Barkley

April 1, 2008

**Purpose:** While benefits of exercise after a cardiac event are well documented, participation in and adherence to cardiac rehabilitation (CR) programs is often low. The purpose of this study was to test the effectiveness of a self-efficacy coaching intervention (SCI): a simple theory-based behavioral intervention to increase self-efficacy for independent exercise as well as independent exercise behavior in CR patients. It was hypothesized that persons receiving the SCI treatment (T) would have higher levels of self-efficacy for exercise and greater participation in independent exercise than participants in an attention control (C) group. **Methods:** People referred to a hospital-based CR program by their physician were invited to participate in the study ( $N = 65$ ). Participants were assigned to either T or C groups which had been randomly designated by class time. The SCI was administered approximately every two weeks by CR staff as a supplement to standard CR care. Patients in the T group received coaching about independent exercise, patients in the C group received coaching matched for time and technique but covering information about healthy eating. Self-efficacy for independent exercise was assessed at the beginning and end of the supervised CR program with an Exercise Self-Efficacy (ESE) scale and a Barriers Self-Efficacy (BARSE) scale.

Participation in independent exercise was determined by self-report with activity logs.

Outcome differences between T and C groups were analyzed through one-way ANOVA.

**Results:** Mean change scores for the T group were larger than those seen in the C group, but differences between groups were not statistically significant ( $p > .10$ ). Significant difference between change scores for ESE, BARSE and independent exercise were noted when interaction effects between SCI treatment and previous exercise were considered.

**Conclusions:** This study adds to the limited body of knowledge about theory-based interventions in cardiac rehabilitation programs and takes an important step in translating self-efficacy theory into a simple, practical application that will promote maintenance of lifestyle changes in this population.

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## List of Abbreviations

<u>Abbreviation</u>	<u>Meaning</u>
AP	Angina Pectoris
BARSE	Barriers Self-Efficacy Scale
BMI	Body Mass Index
CABG	Coronary Artery Bypass Graft
CECGM	Continuous Electrocardiographic Monitoring
CHD	Coronary Heart Disease
CR	Cardiac Rehabilitation
CVD	Cardiovascular Disease
ESE	Exercise Self-Efficacy
GXT	Graded Exercise Test
MI	Myocardial Infarction
PA	Physical Activity
PTCA	Percutaneous Transluminal Coronary Angioplasty
SCI	Self-Efficacy Coaching Intervention
TPB	Theory of Planned Behavior

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## CHAPTER 1

### INTRODUCTION

Heart disease continues to be a major cause of death and disability in the United States (US) and around the world (American Heart Association [AHA], 2008). The AHA reports that over 80 million American adults are affected by cardiovascular diseases (CVD) and, of these people, nearly 50% are older than 60 years. Each year millions of people experience a myocardial infarction (MI), suffer from angina, and/or are hospitalized for cardiovascular surgery or other procedures. Of those hospitalized, over 60% are age 65 years or older. Cardiac rehabilitation (CR) programs represent standard care following a cardiac event or treatment procedure. These programs, which focus on both treatment and secondary prevention, have been shown to result in decreased morbidity and mortality, improved health outcomes, and decreased healthcare costs (Joliffe et al., 2006). Traditional CR programs apply a multidimensional approach to education and counseling of patients to encourage regular exercise and risk factor modification as part of a healthy lifestyle (AHA; Pollock, Wilmore, Fox, 1984). Unfortunately, it is estimated that only 15-30% of eligible patients attend or complete CR programs and that up to 50% of those completing the programs discontinue independent exercise within 6-12 months (Dorn, Naughton, Imamura, & Trevisan, 2000; King, Humen, Smith, Phan, & Teo, 2001; Oldridge, 1988).

While it has been suggested that CR programs need to address psychological issues related to behavior change (American Association of Cardiovascular and Pulmonary Rehabilitation [AACVPR], 2004; Joliffe et al. 2006; Jungbauer, 2002), it is

recognized there is no consensus on the theoretical model that can best be used to facilitate those changes (Lau-Walker, 2006). One behavioral theory that has been proposed for use in the CR setting is Bandura's theory of self-efficacy (Lemanski, 1990). Self-efficacy is defined as "a belief in one's capabilities to organize and execute the course of action required to manage prospective situations" (Bandura, 1994a). Self-efficacy is task specific and can differentiate between a person's confidence in the ability to exercise and the ability to exercise in the face of barriers. The theory is based on four constructs: mastery, vicarious experience, verbal persuasion, and understanding of physiological states. These constructs lend themselves well to application in the CR setting. Mastery, which refers to performance accomplishment, is the most important construct of self-efficacy. Mastery is reinforced as the CR patient increases exercise tolerance and experiences success through participation in the exercise program. Vicarious experience contributes to self-efficacy when a person's own confidence for completing a task is increased by observing the success of similar others. CR programs typically make use of group settings for exercise where participants observe the successes of others on a regular basis. Verbal persuasion occurs when another person promotes a belief in one's capabilities. The role of the CR staff members is to encourage participants, to help them to set appropriate goals, and to structure situations that result in success. Staff members also address the fourth construct of self-efficacy as they help participants understand the normal physiological responses to exercise.

Research has shown that self-efficacy can be a mediator for adoption and maintenance of exercise as well as a consequence of participation in an exercise program

(Carroll, 1995; McAuley et al., 1991; 1993b; 1993c; 2003a; 2003b; Oman & King, 1998; Robertson & Keller, 1992; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002; Vidmar, 1991). However, theory-based interventions designed to increase exercise adherence are limited. Intervention studies in the CR setting have involved labor intensive and expensive strategies such as frequent telephone monitoring, use of heart rate monitors, and weekly support groups to enhance adoption and maintenance of exercise programs (Allison & Keller, 2004; Carlson et al., 2001; Moore et al., 2006; Yates, Anderson, Hertzog, Ott, Williams, 2005). In two of these studies, the intervention began late in the course of CR treatment, possibly missing those participants who were inclined to drop out early (Yates et al., Moore et al.)

The purpose of this study was to test the effectiveness of a simple theory-based intervention to increase self-efficacy for independent exercise as well as independent exercise behavior in CR patients. The research examined the outcomes of a self-efficacy for independent exercise intervention which supplements standard care. The intervention began early in the course of Phase II participation, and required a minimal amount of extra time by CR personnel. The primary aims of the study were (a) to determine the effects of a self-efficacy coaching intervention (SCI) on self-efficacy for exercise participation and on self-efficacy for exercise in the face of potential barriers, and (b) to determine the effects of the SCI on participation in independent exercise apart from the structured program. It was hypothesized that patients receiving SCI would have higher levels of exercise self-efficacy, higher levels of barrier self-efficacy, and greater participation in independent exercise than patients in an attention control (C) group.

Because self-efficacy for exercise may also have an impact on a person's health status, a secondary aim of the study was to explore the relationship between the self-efficacy variables, independent exercise participation and health status as measured by the MOS 36-Item Short-Form Health Survey ([SF-36] Ware & Sherbourne, 1992).

## CHAPTER 2

### REVIEW OF THE LITERATURE

This chapter provides a review of the literature discussing the impact of heart disease, the role of CR, and the application of behavioral theories in promoting health behavior change. The role of self-efficacy in exercise behavior and its use in the CR setting is examined. Finally, intervention studies involving the application of behavioral theory for exercise in CR are evaluated. Observations about how this literature has informed the present study are incorporated throughout the review.

#### Impact of Heart Disease

Heart disease continues to be a major cause of death and disability in the US and around the world. Based on the most recent data available, the AHA reports that CVD affects over 80 million American adults, representing 37% of those 20 years and older. Of these people, 47% were older than 60 years (AHA, 2008). Coronary heart disease (CHD) accounts for 52% of the cardiovascular diseases, and includes diagnosis of MI and angina pectoris (AP). Prevalence data from 2005 indicated that 8.1 million people had experienced an MI, and 9.1 million suffered from stable angina. In addition, over 6 million Americans were hospitalized with a first diagnosis of CVD and 6.9 million cardiovascular operations and procedures were performed. Sixty-three percent of those hospitalized were 65 years or older. Post-event care for CHD events includes stabilization followed by CR.

#### Cardiac Rehabilitation

Standard CR programs are designed to help the person who has experienced a cardiovascular event or procedure to achieve optimal physiological, psychological, social, and vocational functioning (AACVPR, 2004). A multidimensional approach is used in the education and counseling of patients regarding exercise, risk factor modification, and maintenance of healthy lifestyles (AHA, 2008; Pollock et al., 1984). Traditionally, CR programs are divided into several phases. Phase I programs are delivered while the patient is still in the hospital. The focus is on self-care activities, ambulation and other low level exercises. Patient and family education is included. Phase II is an outpatient program initiated upon discharge from the hospital. Education and exercise classes are used to facilitate gains in functional status and quality of life. The emphasis of phase II is on lifestyle changes that will reduce risk factors for CHD. Exercise is supervised and participants are typically monitored with continuous electrocardiographic monitoring (CECGM). Phases III and IV are home- or community-based programs promoting maintenance of a healthy lifestyle through provision of an opportunity for continued exercise (Fardy, Yanowitz, & Wilson, 1988). The phases may also be referred to as inpatient, outpatient, and maintenance phases (AACVPR).

The outcomes of exercise-based cardiac rehabilitation programs include decreased morbidity and mortality, improved health, and lower healthcare costs. In a recent review of the effects of exercise-based rehabilitation for CHD, Joliffe et al. (2006) report that the pooled effect size estimate for total mortality reduction from exercise-only CR was a 27% decrease in all cause mortality. The decrease in all cause mortality for comprehensive cardiac rehabilitation programs was slightly less. Similarly, total cardiac

mortality was reduced by 31% in the exercise-only CR groups and by 26% for participants in comprehensive CR (Joliffe et al.) However, the authors also point out that, in addition to exercise-based interventions, the effectiveness of educational and psychosocial interventions in CR should be standard outcome measures.

In an effort to promote consistent quality of care, the AACVPR established standards for certification of CR programs. Documentation and reporting of outcome measures in the clinical, health, and behavioral domains are required for certification and are used to demonstrate program effectiveness (AACVPR, 2004). The AACVPR has a national database for outcome reporting (Jungbauer, 2002). The database software allows programs to track results and to compare outcomes with other programs in the US. Outcomes in the clinical domain include easily quantifiable, objective measures such as heart rate (HR), body weight, and blood pressures (BP). Psychosocial health outcomes include perceptions of quality of life, typically measured through questionnaires such as the SF-36 Health Survey (Gandek, Sinclair, Kosinski, & Ware, 2004). The behavioral domain focuses on the patient's ability to make and sustain lifestyle changes including physical activity, healthy eating, tobacco cessation and stress management (Jungbauer, 2002).

The importance of exercise for all Americans, including those with chronic conditions such as CHD, is emphasized in recent reports on physical activity and public health (Haskell et al. 2007; Nelson et al., 2007). In CR programs, secondary prevention of CHD is an overarching goal and regular exercise facilitates achievement of that goal. Unfortunately, estimates indicate that only 15-30% of eligible patients attend or complete

CR programs (King et al., 2001). Oldridge (1988) reported dropout rates of 30% between 3 months and 6 months, and up to 50% at 12 months for those who do choose to participate. Dorn et al. (2000) reported that, for MI patients, compliance with exercise programs decreased over time and individuals at high risk for repeat events were least likely to adhere to the program. In order for CR patients to reap the benefits of exercise, the behavior must be maintained after completion of the supervised program. Physical activity behavior change requires a plan which integrates exercise science and behavioral techniques (American College of Sports Medicine [ACSM], 2006; Jungbauer, 2002). Unfortunately, programs of exercise and education do not always address the behaviors needed to make and maintain lifestyle changes, and theory-based behavioral interventions are needed (Beswick et al., 2005; Graham, 2003; Lau-Walker, 2006; Sallis, 1998).

### Behavioral Theories

A number of theories describe the process of health behavior change. The Health Belief Model (HBM), proposed in the 1950's, suggests that people will take action to prevent or control ill-health conditions if they regard themselves as susceptible to the condition (Janz, Champion, & Strecher, 2002). Components of the model include perceived susceptibility to a condition, perceived severity of a condition, perceived benefits to taking action, perceived barriers to taking action, cues/strategies to take action, and self-efficacy. These components combine to influence a person's motivation to take action to improve the health condition (Woodard & Berry, 2001).

The Theory of Reasoned Action (TRA), introduced by Fishbein in 1967, suggests that the most important determinant of behavior is intention, and intention is influenced

by a person's attitude toward the behavior and beliefs about whether others approve of the behavior (Montano & Kasprzyk, 2002). Later, Azjen and colleagues proposed the Theory of Planned Behavior (TPB) as a modification of the TRA. They added the construct of "perceived behavioral control" to the model. These control beliefs are described as being comparable to self-efficacy beliefs and are affected by a person's perceptions of his abilities to make a change in spite of the barriers that may be encountered (Azjen & Driver, 1991; Azjen and Madden, 1986).

The Transtheoretical Model (TTM) proposes that a person goes through six stages of change (pre-contemplation, contemplation, preparation, action, maintenance, and termination) in the process of lifestyle changes. People may move back and forth through the stages, and a number of variables affect movement between stages. Those variables include decisional balance (weighing of pros and cons), self-efficacy (confidence) and 10 cognitive, affective and behavioral processes of change (Prochaska, Redding, & Evers, 2002).

Self-efficacy is considered one of the strongest predictors of behavior change and the construct is included as a mediator of change in many theories. As such, Bandura proposed the theory of self-efficacy as an overall model for describing behavior change. Self-efficacy is defined as "a belief in one's capabilities to organize and execute the course of action required to manage prospective situations" (Bandura, 1994a). Thus, self-efficacy indicates a person's confidence in the ability to succeed at a specific task in specific difficult situations. Bandura (1977) also suggested that the strength of that confidence influences whether a task is attempted, how much effort is expended to

complete the task, and how persistent a person will be when faced with obstacles.

Because self-efficacy perceptions are task-specific, individuals may have a high level of confidence in one area, such as eating a low-fat diet, but have low self-efficacy for another task, such as maintaining a regular exercise program.

There are four major constructs in the theory of self-efficacy: mastery, vicarious experience, verbal persuasion, and cognitive interpretation of physiological states (Bandura, 1994b). Mastery refers to feelings of accomplishment experienced by the person who succeeds at a given task. Vicarious experience promotes confidence by encouraging someone to pay attention to the successes of similar others. Verbal persuasion is used when another individual (the “coach”) provides words of encouragement to reinforce a person’s capabilities and accomplishments. The coach can also promote self-efficacy by setting up situations in which the person can experience success. Finally, the understanding of normal physiological responses to a situation, such as an increase in heart rate during an exercise session, will allow a person to see these responses as positive reasons to continue the task rather than debilitating reasons to quit. These constructs are determinants of a person’s confidence to perform a given task. The theory of self-efficacy was used as the basis of the intervention in the present study because of its strong impact on behavior change and the easy application of the constructs of the theory in the CR setting.

### Self-Efficacy and Exercise Behavior

The concept of self-efficacy can be used to explain exercise behavior (McAuley & Blissmer, 2000; Lau-Walker, 2006). Research has shown that self-efficacy can act as

both a determinant of physical activity participation and a consequence of such behavior. Additionally, different types and sources of self-efficacy may be important at different times of behavioral adoption and maintenance. Bandura (1986) differentiates between self-efficacy expectations (confidence in the ability to achieve a specific level of performance) and outcome expectations (an individual's evaluation of the consequences of the behavior) as well as self-regulatory self-efficacy (the ability to perform a task under challenging conditions). Bandura suggests that outcome expectations may dictate whether one attempts a given task regardless of confidence level for completing the task. Others use the terms task self-efficacy and scheduling or barrier self-efficacy to differentiate between confidence to exercise appropriately and confidence to exercise when it is not convenient (Maddison & Prappavessis, 2004; Rodgers et al., 2002).

The role of self-efficacy as a mediator for adoption and maintenance of exercise behaviors has been examined across a variety of age groups. In a study of young adults, Rodgers et al. (2002) investigated the impact of task and scheduling self-efficacy as two distinct predictors of exercise behavior. Investigators hypothesized that task self-efficacy (confidence in the ability to exercise appropriately) would be an indicator for intention to exercise while scheduling self-efficacy (confidence to exercise when it is not convenient) would be related to maintenance of the exercise behavior. After confirming the validity of their self-efficacy assessment scales in a study involving 589 students attending exercise classes at two separate universities, investigators evaluated 243 young adults (mean age  $30 \pm 11.14$  years) from exercise classes in community based programs. Results suggested that task self-efficacy has a significant effect on behavioral intention

but not exercise behavior, where scheduling self-efficacy was significantly related to exercise behavior and maintenance ( $\eta^2 = 35.40, p = 0.02$ ). Additionally, scheduling self-efficacy was more predictive of exercise behavior than was exercise intention. In the proposed study, we will examine the role of task and barrier (scheduling) self-efficacy as it applies to independent exercise in a population of older, CR participants.

McAuley, Courneya and Lettunich (1991) examined the self-efficacy perceptions of 81 sedentary, middle-aged males and females (age 45-65 years) before and after graded exercise testing (GXT) conducted prior to and following a 20-week supervised exercise program. Participants demonstrated increased task self-efficacy for three types of exercise: sit-ups ( $F[3,70] = 27.34, p < .01$ ), cycling ( $F[3,66] = 26.71, p < .01$ ), and walking ( $F[3,70] = 31.70, p < .01$ ) after both acute (GXT) and chronic exercise. Upon completion of the program, an adherence efficacy scale was used to assess confidence in the individual's capability to continue exercise on a regular basis. Forty-four individuals (26 females, 18 males) were available for testing in a follow-up study conducted nine months later (McAuley, Lox and Duncan, 1993c). Fifty percent of the follow-up subjects indicated that they had complied with the exercise prescription that was given them at the end of the supervised exercise program, while the other 50% did not adhere to the prescribed program. Those who were most likely to adhere to the prescribed program were those with higher attendance during the formal program, those with greater aerobic capacity, and those with higher self-efficacy for continued exercise. In the follow-up analysis, although exercise self-efficacy had declined during the time period of no formal exercise, it was shown again that an acute bout of physical activity in the form of a GXT

can elevate self-efficacy beliefs. Researchers also determined that self-efficacy was the only variable to significantly predict adherence to exercise during the 9-month follow-up period after completion of a 20-week exercise program ( $R^2 = .11, p < .05$ ).

In another study of middle aged adults ( $N = 63$ , mean age  $56.2 \pm 4.2$  years), Oman and King (1998) examined the relationships among self-efficacy, changes in self-efficacy, future exercise adherence and program format (class-based vs. home-exercise) over a two-year period. Researchers found that self-efficacy had a significant effect on adherence to exercise during adoption (months 2 to 6;  $F = 12.87, p < .01$ ) and early maintenance phases (months 7 to 12;  $F = 13.89, p < .01$ ) of exercise behavior regardless of exercise format or whether or not the subject had previously participated in an exercise program. However, for long-term maintenance (during year two), self-efficacy was significantly associated only with adherence to a supervised home exercise format ( $p < .05$ ). Authors concluded that the home-exercise format was helpful in promoting self-efficacy because of its flexibility and convenience. These two studies inform our intervention because we believe that it is important for the cardiac patient to sustain independent exercise after CR in order to maintain the benefits they have achieved. Building self-efficacy for independent exercise is necessary and should be an integral part of treatment. By initiating an intervention early in the outpatient setting, we expect that participants will gain confidence needed to continue with an exercise program on their own after completion of the formal program.

Exercise self-efficacy in older adults was examined in a 6-month randomized controlled trial with an 18-month follow-up. McAuley, Jerome, Marquez, Elavsky, and

Blissmer (2003b) noted that self-efficacy for exercise increased during the first two months of a structured exercise program for 174 healthy older adults (mean age  $65.5 \pm 5.35$  years) who had been formerly sedentary. However, self-efficacy to overcome barriers decreased between 4 and 6 months as exercisers faced the prospect of continuing exercise on their own ( $p > .10$ ). In the follow-up analysis, investigators examined the relationships between self-efficacy, exercise-induced affect, social support and value judgments in predicting long-term exercise behavior. Five different models were used to evaluate the impact of various predictors on long-term physical activity behavior. The best fitting model accounted for 40% of the variance in long-term physical activity maintenance. The model showed that attendance, social support, and a positive experience contributed to self-efficacy at program end, and that this self-efficacy contributed unique variance (25%) to long term maintenance over and above the effects of past behavior. It was determined that high self-efficacy at program end resulted in higher levels of exercise participation at 6- and 18-month follow-up, and that frequency of exercise, social support, and the positive affects of exercise were predictive of higher self-efficacy ( $p < .05$ ). The authors concluded that self-efficacy plays a fundamental role in long-term exercise behavior (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003a). In the proposed study, the emphasis on building self-efficacy will begin early in the course of a formal CR program. In addition, the intervention is designed to build self-efficacy to cope with barriers as participants face the prospect of needing to maintain an independent exercise program. We believe that the CR setting will provide the social support and positive affects of exercise needed to build self-efficacy by program end.

### Self-Efficacy in the Cardiac Rehabilitation Setting

Cardiac rehabilitation programs focus much attention on exercise both as a means of treatment after a cardiac event and as part of a healthy lifestyle aimed at preventing the progression of heart disease. The exercise program is often a new behavior, and, for benefits to continue, it must be maintained. Although some CR programs offer Phase III/IV maintenance exercise after patients graduate from the CECGM program, not all individuals are able to take advantage of this option and must participate in independent exercise. In order for patients to be prepared for the multiple obstacles of behavioral adherence, it is very important for CR patients to gain self-efficacy in their ability to exercise independently after program participation and to overcome barriers to that behavior.

The four constructs of the self-efficacy theory lend themselves well to application in a cardiac rehabilitation setting. Mastery refers to performance accomplishment or actual success at a task. It is considered the strongest component of self-efficacy (Bandura, 1977). As the cardiac rehabilitation patient increases exercise tolerance through participation in the program, there is a sense of accomplishment and confidence in the ability to do exercise. This confidence is the result of behavioral mastery as accomplished through small, meaningful, and progressive stages. Vicarious experience is behavioral learning accomplished through imitation. It is based on the idea that observing the success of similar others will increase one's own confidence in the ability to perform a task. Cardiac rehabilitation participants typically exercise in a group setting where they can see the progress and successes of others on a regular basis. Verbal

persuasion is achieved when another person promotes belief in one's capabilities. While this is not the strongest source of self-efficacy, it stresses the importance of staff interactions with patients as a means of improving their self-efficacy. When applying self-efficacy theory, it is the role of the CR staff person to help the patient set appropriate goals and structure situations that bring success. Thus, mastery is reinforced through performance accomplishment. Finally, self-efficacy is affected by a person's interpretation of physiological and emotional responses to a situation. The CR staff plays an important role in teaching the patient how to accurately interpret the physiologic responses to exercise (such as increased heart rate or blood pressure) and to assuage the fear that often coincides with experiencing a cardiac event.

Self-efficacy has been applied in the cardiac rehabilitation setting. In a cross-sectional study of graduates of a Phase II cardiac rehabilitation program, Vidmar (1991) examined both barriers self-efficacy and total self-efficacy. A total of 138 people responded to the survey which assessed exercise compliance, barriers self-efficacy and total self-efficacy. In this group, barriers self-efficacy was found to be the most significant predictor of exercise maintenance after participation in a formal program ( $p < .01$ ). Total self-efficacy was also significant ( $p < .01$ ). In the proposed intervention, we will attempt to build exercise self-efficacy as well as barrier self-efficacy for program participants.

Robertson and Keller (1992) examined the role of self-efficacy in patients with coronary artery disease (CAD) who had undergone coronary artery bypass graft (CABG) or percutaneous transluminal coronary angioplasty (PTCA). In this sample of 51

subjects, aged 37 to 84 years, researchers used five instruments to collect information on variables related to exercise benefits, exercise barriers, perceived severity of disease, self-efficacy, and activity level. Variables studied were derived from the Health Belief Model and the theory of self-efficacy. Results indicate that perceived barriers ( $\beta = -0.37, p = 0.04$ ) and self-efficacy ( $\beta = 0.29, p = 0.04$ ) contributed 31% to the variance in exercise adherence. Those with lower barriers scores (meaning they did not perceive barriers to be a problem) demonstrated higher adherence to exercise, as did those with higher self-efficacy scores ( $r = -.04, p < .01$ ). Similarly, Carroll (1995) found that self-efficacy was predictive of exercise participation ( $p < .01$ ) at 6 and 12 weeks after surgery in a group of 133 subjects (101 men and 32 women) ranging in age from 65 to 87 years (mean age  $71.8 \pm 4.8$  years).

Both of these studies demonstrate that exercise can improve self-efficacy and that self-efficacy, in turn, is an important mediator in a person's ability to adhere to an exercise program. They also demonstrate that barriers self-efficacy and total self-efficacy may play different roles during different stages of exercise adoption and maintenance. However, none of the studies included any behavioral intervention to help participants improve self efficacy. In order to facilitate improvements in short- and long-term adherence to exercise, exercise leaders must develop strategies to address self-efficacy for adherence as well as for overcoming obstacles to participation in a prescribed program. This is true not only when working with healthy adults, but in the cardiac rehabilitation setting as well.

### Behavioral Theory Applied to Exercise and Cardiac Rehabilitation Interventions

In an early study, McAuley, Courneya, Rudolph, & Lox, (1994) designed a theory-based intervention to improve self-efficacy of participants in a 20-week walking program. In this study, 114 participants were randomly assigned to either an adherence-intervention group or an attention-control group. Subjects were sedentary, middle aged adults, aged 45-64 years who did not have known heart disease. Researchers applied self-efficacy by using verbal persuasion to provide subjects in the intervention group with information promoting mastery, vicarious experience, and interpretation of physiological states. Results showed that subjects in the intervention group attended more sessions of exercise, spent more time engaged in exercise, and walked greater distances than the control group,  $F_s(1,112) = 6.48, 5.32, \text{ and } 7.22$  respectively,  $ps < .01$ . Although an increase in exercise self-efficacy was not observed, pre-existing self-efficacy played a significant role in predicting exercise participation ( $R^2 = 10.23, p < .01$ ). Since a primary goal of CR programs is to encourage exercise as part of a healthy lifestyle, it is important to consider theory-based interventions as a means of promoting such behavior.

A literature search for recent theory-based interventions to increase CR exercise adherence and maintenance revealed a limited number of studies published between 2000 and 2007. Blanchard, Courneya, Rodgers, Daub, & Knapik (2002a) used the TPB to evaluate exercise intention and behavior during phase II CR. In this study, participants were asked to complete theory-based questionnaires before and after participation in a formal CR program. Eighty-one patients, including 57 men and 24 women (mean age  $59.6 \pm 11.49$  years) completed both surveys. Researchers reported that intentions account

for 23% of the variance in exercise adherence and that women had a larger increase in task and barrier self-efficacy than men did. Conversely, Sniehotta, Scholz, & Schwarzer (2005) argued that while TBP may be useful for predicting intention to exercise, intention alone does not necessarily translate to maintenance. In this study, 307 CR participants (245 men, 62 women) ranging in age from 31 to 82 years (mean age  $59 \pm 9.98$  years) completed questionnaires at two and four months after completion of the CR program. Results indicated a “gap” between intention and behavior and researchers concluded that interventions should focus on improving participants’ skills in planning and controlling their actions and in improving maintenance self-efficacy. While these studies of exercise maintenance were based on theories of behavior change, they did not include any intervention to enhance long-term exercise behavior. The proposed study will include an intervention aimed at building self-efficacy to bridge the gap between intention and behavior.

Allison & Keller (2004) designed a self-efficacy intervention (SECI<sub>E</sub>) which was delivered by nursing staff via telephone at two-week intervals during the CR program. The SECI<sub>E</sub> protocol was designed to increase patient confidence for PA using a script which reinforced the four constructs of self-efficacy theory. An attention control group (AC<sub>E</sub>) received phone calls every two weeks asking about progress in CR and independent PA, but the four components of the self-efficacy intervention were not included in the conversation. A third group (UC<sub>C</sub>) received usual care with patient teaching and discharge planning but no telephone support. The cardiac rehabilitation participants who completed the study included 57 men and 26 women, aged 65 to 80

years (mean age  $71.8 \pm 4.38$ ). There were 28 participants in the SECI<sub>E</sub> treatment group, 27 in the AC<sub>E</sub> group, and 28 in the UC<sub>C</sub> group. Researchers found that physical activity (PA) measures increased in the treatment group by a greater percent compared to AC<sub>E</sub> and UC<sub>C</sub> groups over time, although MANOVA did not show a direct effect of the intervention on outcome variables. Correlation analysis showed that self-efficacy scores at 6 and 12 weeks were highly correlated ( $r = .58, p < .01$ ) and PA measures were significantly correlated with self-efficacy for PA at program completion ( $r = .62, p < .01$ ). The proposed study will also make use of a script to deliver a self-efficacy based intervention. However, it will be incorporated as part of routine CR care and will not require the staff to put in additional time and effort to make phone calls.

Carlson et al. (2000; 2001) suggested that CECGM of traditional CR programs may promote dependence on staff and facilities of supervised exercise programs; and that this dependence would negatively impact patient self-efficacy for independent exercise. Researchers designed a modified program of independent exercise for low-risk CR patients (mean age  $59 \pm 10$  years) based on self-efficacy theory. Participants were assigned to either a traditional program (TP,  $N = 38$ ) or modified program (MP,  $N = 42$ ) of CR. The first four weeks of the 25-week program was identical for both groups. Beginning at week 5, participants in the MP group no longer received CECGM but instead self-monitored exercise heart rates using a personal heart rate monitor. The number of supervised exercise sessions was reduced to two times/week, then to one session/week at week 11, and to one session every two weeks beginning at week 18. Exercise was supplemented with weekly group education and support meetings which

reinforced self-efficacy for independent exercise using the four components of the Bandura's self-efficacy theory. Repeated measures MANOVA indicated that patients in the MP group showed higher self-efficacy for exercise without ECG monitoring than those in the traditional CR program ( $p < .05$ ). In the proposed study, we will attempt to build self-efficacy for independent (non-monitored) physical activity outside of the formal CR setting.

Other investigators examined interventions to promote maintenance of exercise after phase II CR participation. Yates et al. (2005) examined the effects of a booster intervention based on self-efficacy theory. Phone-call follow-up of CR patients ( $N = 24$ , mean age  $66.7 \pm 9.4$ ) at 3 and 9 weeks after CR participation showed a positive, though non-significant effect on adherence to prescribed exercise. Moore & Charvat (2002) and Moore et al. (2006) described results of a CHANGE (Change Habits by Applying New Goals and Experiences) intervention based on self-efficacy theory and the TTM. Participant included 250 patients (119 in the intervention group, 131 receiving usual care) from three different outpatient CR programs. The intervention consisted of nurse-led small-group sessions administered during weeks 10, 11, and 12 of phase II CR and at 1 and 2 months after discharge from the program. Sessions focused on self-efficacy, problem-solving, and relapse-prevention skills to enhance exercise maintenance. Exercise in the maintenance phase was tracked with a heart rate (HR) monitor. Difference in exercise levels between participants receiving the intervention and those in the control groups were analyzed using ANOVA. Results indicated that participants in the usual-care group were 76% more likely to stop exercising in the year following

discharge from CR than the participants in the CHANGE group although no differences were found in the amount ( $p = .36$ ) or frequency ( $p = .37$ ) of exercise between the two groups. Researchers concluded that behavior change strategies can be helpful in reducing the exercise drop-out rate following CR programs, but that improvements are needed in the CHANGE intervention.

While these intervention studies show improved self-efficacy and/or PA participation for subjects in the intervention groups, there are inherent limitations to their practical application in a CR setting. Extra phone calls, group sessions, and the use of HR monitors can put an extra burden on a busy staff with limited resources. The last two studies reviewed were both initiated late in the course of treatment, potentially missing those participants who were inclined to non-adherence. In order to successfully translate theory-based research into practice, behavioral interventions in the CR setting should be (a) implemented early in the course of treatment in order to impact the greatest number of participants, and (b) designed so that the implementation procedures require a minimal amount of staff time.

## CHAPTER 3

### METHODS

This chapter details the study methodology, including the design, setting and subjects, measures, intervention development and protocol. Data management and analysis is also described.

#### Study Design

The purpose of this study was to test the effectiveness of a theory-based intervention designed to increase self-efficacy for independent exercise as well as independent exercise behavior in a group of cardiac rehabilitation patients. The primary aims of the study were (a) to determine the effects of the SCI on self-efficacy for exercise participation and on self-efficacy for exercise in the face of potential barriers, and (b) to determine the effects of the SCI on participation in independent exercise apart from the structured program.

A quasi-experimental design was used to examine the effects of a self-efficacy coaching intervention that supplemented standard CR care. Six class times were offered each day and a coin flip was used to determine which 3 classes would be designated for the treatment (T) intervention and which would be designated for attention control (C). Participants chose their class time without knowledge of which group they were assigned to. Outcome measures were collected at baseline and at exit from the program which could last up to 3 months depending on the patient's progress through the program. The T intervention supplemented scheduled reviews of participant goals and progress in physical activity. Staff members followed a script based on the constructs of self-efficacy to incorporate the SCI into the standard plan of care. Participants in the T group

received coaching to build self-efficacy for independent exercise. The C intervention used the same approach but focused on the topic of healthy eating. The CR staff was trained on the study design and coaching methods. Details of the interventions are included later in the chapter. Scheduled CR program review happens during CR sessions 6, 12, 18, 24, and 30.

It was hypothesized that patients receiving SCI would have higher levels of exercise self-efficacy, higher levels of barrier self-efficacy, and greater participation in independent exercise than patients in the C group. Because self-efficacy for exercise may also have an impact on a person's health status, a secondary aim of the study was to explore the relationship between the self-efficacy variables, independent exercise participation and health status.

#### Setting and Subjects

This study took place at the Cardiac Rehabilitation program at Sanford USD Medical Center (Sanford) in Sioux Falls, SD. Inclusion criteria were CR participants who were aged 21 years or older with a diagnosis of CABG, MI, percutaneous coronary intervention (PCI), congestive heart failure (HF), or stable angina. Exclusion conditions were (a) inability to speak English, and (b) neurological or musculoskeletal disorders that limited mobility.

Prior to recruitment, a power analysis was performed to estimate the number of participants needed to test the hypothesis. Allison and Keller (2004) used .30 as an estimated effect size for the test of a self-efficacy intervention for CR participants. A meta-analysis of physical activity interventions also suggested that a moderate effect size

of .30 could be expected (Dishman & Buckworth, 1996). Using the one-way analysis of variance (ANOVA) test and effect size of .30, it was estimated that a total sample size of  $N = 60$  would be needed to achieve a power of .80 at the .10 alpha level of significance. The significance level of .10 was chosen to reduce the risk of type II error for this new and innovative intervention. Over-sampling by at least 20% to allow for potential attrition meant that a minimum of 72 participants, 36 per group, were recruited.

Seventy-five patients who were referred to the phase II CR program by their physicians between March 15, 2007 and September 15, 2007 consented to participate in this study and completed baseline data collection. Forty-eight males and 27 females (mean age  $64.9 \pm 13.9$  years) were assigned to either the SCI treatment (T) group ( $n = 35$ ) or attention control (C) group ( $n = 40$ ) based on their chosen exercise time as described in the protocol.

### Outcome Measures

The primary dependent variables in this study were self-efficacy for exercise participation, self-efficacy for exercise in the face of potential barriers, and participation in independent physical activity. Self-efficacy for exercise participation was measured with the Self-Efficacy for Exercise Scale ([ESE], McAuley et al., 2003b). The instrument is a modification of a tool originally developed by McAuley (1993a) and uses eight questions to evaluate a subject's self-efficacy for continued exercise participation (defined as three times per week, for 40+ minutes, at moderate intensity) over incremental one-week periods for 2 months. Participants are asked to indicate degree of confidence for each scale item on a scale from 0% (no confidence at all) to 100%

(completely confident) in 10-point increments. The confidence scores are then summed and divided by the total number of items, giving a possible range of 0-100. In a study with older adults, the ESE was shown to be predictive of exercise behavior ( $r = .52, p < .05$ ) and internally consistent ( $\alpha = .95$ ).

Self-efficacy for exercise in the face of commonly identified barriers was assessed with a second measure, the Barriers Self-Efficacy Scale (BARSE), also developed by McAuley (1992a). The BARSE is a 13-item questionnaire which also shows a high level of internal consistency ( $\alpha = .92$ ). Scoring of the BARSE scale is the same as for that of the ESE scale. McAuley et al. (2003b) combine the two measures to assess self-efficacy with respect to exercise behavior. Overall exercise efficacy is determined by summing all of the confidence ratings and dividing by the by the total number of items in the combined scales. McAuley (1992b) reports that Bandura has provided guidelines for the development of tools to measure self-efficacy. By following these guidelines in creating the ESE and BARSE questionnaires, content validity of the scales was strengthened. Evidence of construct validity was reported by McAuley et al. (1993c) who found that self-efficacy measures were significantly correlated with program attendance ( $r = .42, p < .01$ ) and maintenance ( $r = .43, p < .01$ ). A copy of the instruments is included in Appendix A.

Participation in independent physical activity was documented during the scheduled review sessions (every 6<sup>th</sup> visit) and at exit. Self-report of physical activity participation is a method that has been used by others with this population (Brubaker et al., 2000; Carlson et al., 2001; Oman & King, 1998; McAuley, 1993a; McAuley et al.,

1993b). For this study, participants in the T group were asked specifically about the frequency and duration of independent exercise outside of CR. Weekly minutes of exercise were verbally confirmed and then recorded by the staff on the intervention log along with activity goals for the next two weeks. Participants in the C group were simply asked whether or not they did any physical activity outside of rehab, and then healthy eating goals were discussed. Minutes of independent exercise were later correlated with six-minute walk results, an objective measure of physical capacity assessed by the CR staff as part of standard care.

. Outcome data routinely collected by the staff of the Sanford CR program is based on guidelines from the AACVPR (2004). Baseline data collected through surveys on the first day of a patient's participation in the CR program includes the SF-36 and self-reported minutes of physical activity outside of rehabilitation.

The SF-36 measures health concepts that are considered relevant to functional status and well being. It is a questionnaire which uses multiple response scales to measure eight generic health concepts including physical functioning and general health perceptions. An evaluation of the SF-36 among elderly and disabled Medicare recipients ( $N = 177,714$ ) showed internal consistency between 0.83 and 0.93 for the eight scales (Gandek et al., 2004). Ware (2004) reports that experience with the SF-36 has been documented in nearly 5000 publications. Reliability estimates for physical and mental summary scores usually exceed .90 and the scales have been shown to achieve about 80-90% of their criterion validity relative to the longer Medical Outcomes Study (MOS) that it was designed to reproduce. Evidence of content, concurrent, criterion, construct and

predictive validity is strong. Because the quality of life outcomes assessed by the questionnaire are directly affected by disease and treatment, this tool is recommended by the AACVPR as a measure of program outcomes in CR programs across the US (Jungbauer, 2002).

The six-minute walk is a functional measure of physical capacity. Steffan, Hacker, and Mollinger (2002) report that the test has estimated construct validity through correlation with peak oxygen consumption in patients with heart failure and pulmonary disease ( $r = .63$  to  $.79$ , respectively). Test-retest reliability of the test is reported at  $r = .94$  to  $.96$  among patients with cardiovascular disease as well as in community-dwelling older adults. Protocol for use of the six-minute walk in CR programs is described by Jungbauer (2002, [Appendix B]).

For the purposes of this study, data collected as part of program protocol through use of the SF-36 Health Survey, and the six-minute walk were examined for trends.

### Intervention

The program director voiced support for the development and testing of a new approach to increasing home based physical activity for CR participants in that setting. Standard care protocols were reviewed to see how to best implement the SCI effectively without adding undue burden to the staff members. An intervention log that was used by the CR staff to track patient progress on a regular basis was modified (Appendix C) and an accompanying script (Appendix D) was developed as a means to implement the SCI as a supplement to standard care. Next, the primary investigator (PI) held an in-service education for CR staff members introducing the idea of theory-based interventions to

promote behavior change. The theory of self-efficacy and its constructs were explained, and details of the proposed SCI were presented. The staff was asked to evaluate the SCI for feasibility using a six-item Likert scale questionnaire (Appendix E). Questions and concerns were addressed and the protocol was adjusted until the staff agreed that the intervention could be delivered consistently and as intended.

The SCI was designed to be a simple intervention, supplementing scheduled reviews, and requiring minimal staff time. The structured coaching sessions were administered approximately every 2 weeks (every 6<sup>th</sup> visit) for the duration of the patient's participation in the program (up to 36 sessions). Participants in the T group received coaching designed to increase self-efficacy for independent exercise. The script prompted the staff to reinforce each of the four constructs of the self-efficacy theory (mastery, vicarious experience, verbal persuasion, and physiological states), focusing on self-efficacy for exercise, overcoming barriers, and participating in independent exercise. The relationship of the theoretical constructs with the components of the SCI for the treatment is shown in Table 1. Participants in the C group received an alternative coaching intervention matched for time and technique but focusing on making healthy changes in eating habits rather than emphasizing independent physical activity. Color-coded intervention logs were placed on each patient's chart to remind staff members when chart review was due, and to help them know at a glance which coaching intervention script should be followed. Coaching sessions took place in an exercise room with other participants in close proximity making it highly likely that one patient would overhear the intervention being discussed with a classmate.

Table 1

Theoretical Constructs and Operationalization of Variables for Treatment (T) Group

Theory Based Mediators of Self-Efficacy	Theory Based Mediators of Self-Efficacy	Expected Outcomes
Mastery	Staff member points out the number of minutes of exercise that the patient has achieved during CR and/or independent exercise sessions, includes congratulatory comments to reinforce success.  Patients keep a log of daily minutes of independent exercise.	? ESE ? independent exercise participation
Vicarious Experience	Staff member points out progress/successes of other participants in the class, reminds patient “you can do it too.”	? ESE
Verbal Persuasion	Staff works with patient to set realistic goals for days/minutes of home exercise to be completed out of rehabilitation.  Staff asks: “on a scale of 1-10, how confident are you that you can do this?”  Staff helps to identify barriers to exercise by asking: “what gets in the way of having a confidence level of 10?”  Staff talks with patient to plan strategies to overcome barriers to exercise.	?ESE ?BARSE
Physiological State	Staff reviews patient’s HR and RPE during monitored exercise, reminds patients about appropriate RPE for exercise.  Staff asks patients about feelings during exercise and whether there are any concerns (then addresses these appropriately).	?ESE

*Note:* ESE=exercise self-efficacy, BARSE=self-efficacy to overcome barriers.

Because patients in the program sign up to come at a consistent class time, intervention contamination was controlled for by assignment of T vs. C by class time rather than by individual participants. A coin flip determined that the treatment intervention was to be delivered during the 9:15 a.m., 1:00 p.m. and 3:15 p.m. classes. Participants attending at 8:30 a.m., 11:00 a.m., and 2:15 p.m., received the attention control intervention.

### Procedures

Institutional Review Board approval for this study was obtained from South Dakota State University and Sanford Health System prior to implementation. In addition, all CR staff members completed NIH human subjects training. All eligible patients entering the Sanford CR program between March 15, 2007 and September 15, 2007 were invited to participate in the study. Because the SCI intervention was incorporated into the CR program protocol, all participants received either T or C intervention depending on their chosen class time, but only those who gave consent to participate had their results included in the study analysis. A copy of the consent form is included in Appendix F. When a patient gave consent to participate in the study, the name was added to the tracking checklist where completion of various components of the intervention were recorded (Appendix G).

On a patient's first day in the CR program, the participant had a one-on-one meeting with a staff member who reviewed program goals, completed initial paperwork, administered the initial Outcome Survey for Cardiac Rehabilitation (including SF-36 survey and self-reported minutes of independent exercise) as well as the ESE and

BARSE questionnaires. Measures of resting HR and BP were recorded, the patient was oriented to exercise equipment and the six-minute walk was completed. BP was measured during and following exercise, HR and rhythm were monitored by CECG, and the patient was instructed in the use of the RPE scale for monitoring exercise intensity. The patient was encouraged to participate in the usual course of treatment, attending exercise and education sessions three times per week at the scheduled class time. The ESE and BARSE questionnaires were unique to the intervention, all other procedures were part of standard care.

On the patient's 6<sup>th</sup> visit, a recording form on the patient's chart prompted a scheduled review of goals and progress by the staff member. Charts in the T classes had the intervention log for physical activity (PA) coaching, those in the C classes included the intervention log for healthy eating (Appendix H). The recording forms were color-coded (pink for the exercise intervention, and green for the healthy eating intervention) to help ensure that staff followed the appropriate intervention script and avoided mixing the treatment and control interventions. The staff member talked with the patient during exercise to fill in the appropriate data on the form. In the discussion of patient goals, the staff member worked with individuals in the T group to set appropriate short term goals, attempting to build task and barrier self-efficacy for independent PA. The script, presented through verbal persuasion, very intentionally included comments for mastery reinforcement, recognition of vicarious experience, and interpretation of physiological responses. The patient was asked to rank personal confidence in the ability to achieve the goals on a 1-10 scale. Each participant was also asked about possible barriers to goal

achievement, and ways to surmount those challenges were discussed. This effort was intended to help build self-efficacy to cope with barriers. Participant in this group were specifically encouraged to try to incorporate independent PA into their treatment program and to record their progress on activity logs. Participants in the C group also discussed progress with staff. This intervention was matched for time and attention but the conversation focused on information about healthy eating. Regarding home exercise, persons in this group were simply told that exercise outside of rehab is a good idea and that they should think about including it in their routine. Formal review of goals and progress was repeated at visits 12, 18, 24, and 30. The SCI scripts for the T group during these visits were slightly modified to reinforce accomplishments, set new goals, continue to build SE for independent PA, and to record actual minutes of independent exercise. This scheduled review of progress every sixth visit was standard protocol for the program. Intentional coaching about independent exercise for the T group, and conversation about healthy eating with the C group, were the components unique to this intervention.

On a patient's final day of participation in the CR program, final outcome surveys were administered, the 6-minute walk was repeated, and post-phase II exercise options were explained. Minutes of independent exercise were recorded, and, for those in the T group, mastery of independent exercise was reinforced. The patient was also told that follow up surveys would be sent again at dates 6 and 12 months after their initial visit to the program.

Throughout the course of the study, the PI visited the CR program on a weekly basis to record data, to answer questions, and to assure that the intervention protocol was being delivered as intended. Color-coding the intervention logs helped the staff to remember which intervention each participant was to receive.

#### Data Management and Analysis

When patients consented to participate in this study, initial ESE and BARSE surveys were administered by the staff and stored in a file in the Sanford CR Department. The survey results and other pertinent data from patient charts were then recorded on individual data sheets which were completed by the PI. After verifying accuracy of the data, information was transferred to a computer spread sheet and the information sheets were stored in a locked cabinet. Confidentiality of records was assured by using subject numbers rather than names for patient identification. Data analysis was performed with SPSS for Windows, version 12.

The characteristics of the study population were evaluated with descriptive statistics, frequency distributions, and univariate analysis. One-way ANOVA and one-sample *t*-tests were used to analyze between- and within-groups change in study outcomes of ESE, BARSE, and independent exercise. The influence of covariates was analyzed with MANCOVA and equations from the general linear model. Finally, correlation analysis was used to compare study outcomes with data routinely collected as part of the program protocol: the SF-36 and six-minute walk results.

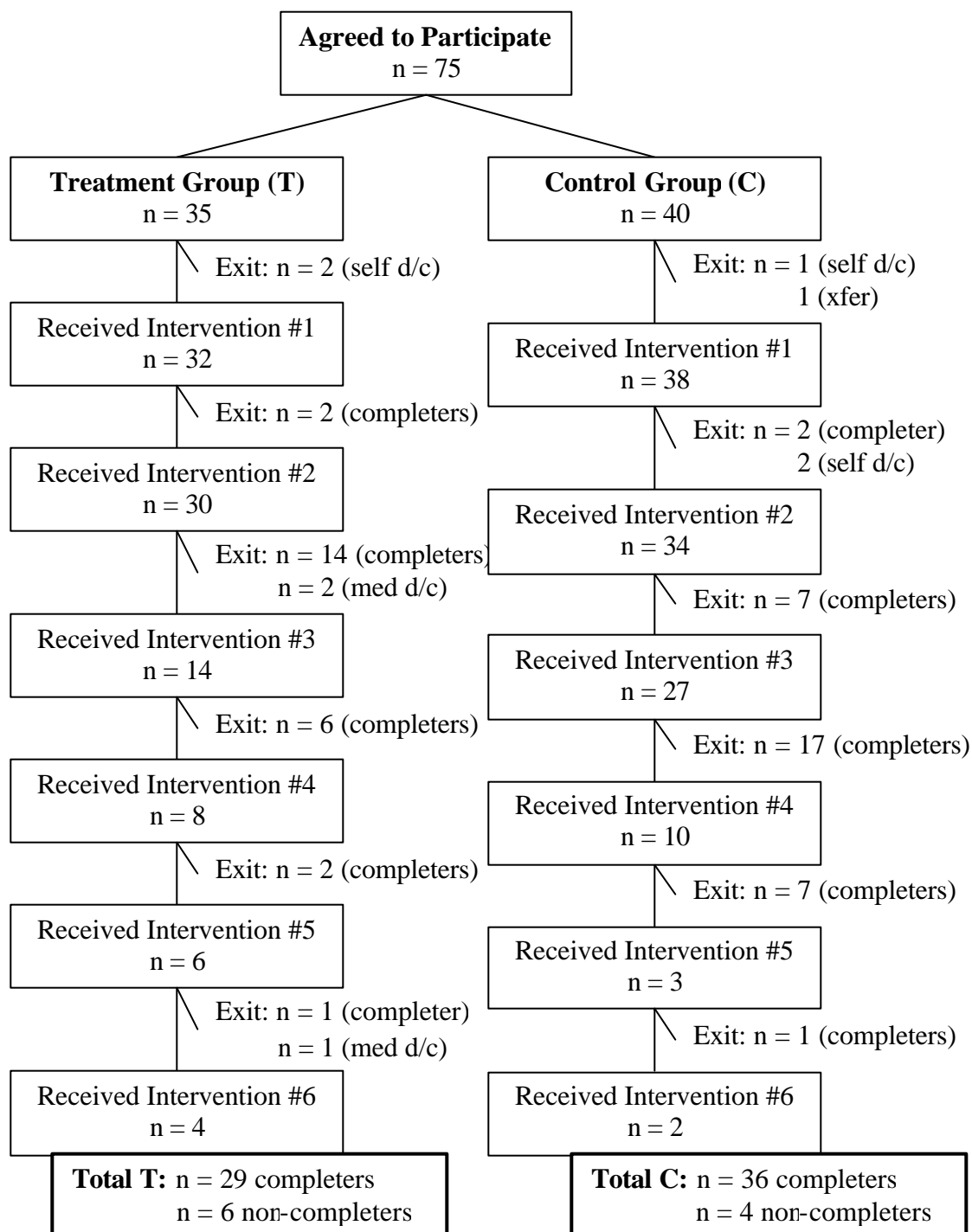
## CHAPTER 4

### RESULTS

This chapter provides a comparative description of study participants and a detailed analysis of study outcomes. Demographic and baseline data for study completers and non-completers is described. Baseline comparisons of treatment and control groups are also presented. Analysis of outcome data related to the study hypotheses is discussed in detail. Finally, correlation between the study dependent variables and data collected as standard outcome measures for the CR program is used to examine trends in the relationships between these outcomes.

#### Study Participants

Of the 75 participants who gave informed consent to participate in this study, initial and final data were collected on 29 members of the T group and 36 members of the C group (final  $N = 65$ , 87% of enrollees). Primary diagnoses for the participants were classified as “surgical” ( $n = 22$ , includes CABG and/or valve replacement) or “non-surgical” ( $n = 43$ ). The non-surgical diagnoses included MI ( $n = 20$ ) and CAD/Angina ( $n = 23$ ). Four patients experienced an MI in addition to CABG surgery, five had valve replacement along with coronary bypass. Other intervention procedures included stent ( $n = 42$ ) and PCI ( $n = 2$ ). The attrition rate in the study was 13%, which was lower than expected. Explanation for dropout included medical discharge ( $n = 3$ ), transfer to another facility ( $n = 1$ ), and self-discharge ( $n = 6$ ) for reasons including return to work, lack of transportation, or non-insurance (Figure 1). Chi-square tests (for categorical data) and  $t$ -tests (for interval data) were used to determine if differences existed between study

Figure 1. Flow Chart of Participation at Each Intervention Session

Note: d/c = discharge, xfer = transfer to another facility

completers ( $n = 65$ ) and those lost to attrition ( $n = 10$ ). There were no statistically significant differences between completers and non-completers on the variables of gender, primary diagnosis, age or any of the initial measures of study-related outcomes (Table 2).

Table 2

Baseline Comparison of Study Completers and Non-Completers

Variable	Completers ( $n = 65$ )	Non-Completers ( $n = 10$ )	$\chi^2$ or $F$ (1 d.f.)	$p$
Gender (male/female)	42/23	6/4	.08	.78
Diagnosis: (Surgical/Non-Surgical)	22/43	2/8	.92	.34
Age (years)	$66 \pm 14$	$61 \pm 14$	.19	.29
Height (cm)	$173.0 \pm 9.5$	$174.2 \pm 9.9$	.03	.70
Weight (kg)	$87.3 \pm 22.6$	$94.2 \pm 33.7$	4.42	.55
BMI ( $\text{kg/m}^2$ )	$29 \pm 7$	$30 \pm 8$	1.71	.55
ESE	$84 \pm 20$	$91 \pm 13$	2.12	.29
BARSE	$70 \pm 22$	$75 \pm 26$	.69	.58
Indep Ex (min/wk)	$44 \pm 85$	$60 \pm 56$	.68	.57

*Note:* Surgical includes coronary artery bypass graft and valve replacement, non-surgical includes myocardial infarction, coronary artery disease, angina, and stent; BMI = Body Mass Index; ESE = exercise self-efficacy score; BARSE = barriers self-efficacy score; Indep Ex = total weekly minutes of independent exercise. Values are Mean  $\pm$  SD.

Baseline characteristics of the final study population are presented in Table 3.

Table 3

Baseline Characteristics of the Study Population

Variable	Treatment Group ( <i>n</i> = 29)	Control Group ( <i>n</i> = 36)	$\chi^2$ or <i>F</i> (1 d.f.)	<i>P</i>
Gender (male/female)	20/9	24/12	.07	.89
Age (years)	70 $\pm$ 12	63 $\pm$ 15	1.04	.04
Height (cm)	173.9 $\pm$ 10.1	172.8 $\pm$ 9.1	.32	.95
Weight (kg)	80.2 $\pm$ 16.3	93.0 $\pm$ 25.4	3.98	.02
BMI (kg/m <sup>2</sup> )	27 $\pm$ 4	31 $\pm$ 7	4.87	.01
ESE	83 $\pm$ 23	84 $\pm$ 19	.15	.79
BARSE	68 $\pm$ 21	72 $\pm$ 23	.26	.39
Indep Ex (min/wk)	43 $\pm$ 77	44 $\pm$ 92	.01	.67
6 MWK (ft)	1075 $\pm$ 225	1132 $\pm$ 260	.56	.94
SF36	39 $\pm$ 9	38 $\pm$ 9	.09	.88

*Note:* BMI = Body Mass Index, ESE = exercise self-efficacy, BARSE = barriers self-efficacy score, Indep Ex = total weekly minutes of independent exercise, 6 MWK = distance covered during 6 minute walk, SF36 = score on short-form 36 health survey. Values are Mean  $\pm$  *SD*.

Significant differences ( $p < .05$ ) between the T and C groups were noted in age, weight, and BMI. Mean age of the T group was greater than the C group. The impact of age and BMI as covariates was considered in the final analysis and found to have non-significant influence on study outcomes. Independent samples *t*-tests revealed no baseline differences between groups in study outcome variables (ESE, BARSE, or minutes of

independent exercise) or in the outcome data collected as standard procedure for the CR program (6-minute walk and SF-36).

### Study Outcomes

It was hypothesized that patients receiving the SCI intervention (T group) would achieve higher levels of ESE, higher levels of BARSE, and greater participation in independent exercise than patients in an attention control (C) group. To examine whether there were group differences in these variables after participation in CR, change scores (i.e., exit value minus baseline value) were compared between the T and C groups. Results for the study completers ( $N = 65$ ) are presented in Table 4. Differences between groups did not reach the significance level of  $p \leq .10$  designated for this study. Within-group change was determined to test whether the change was significantly different from zero. Significant changes were noted in BARSE change ( $t = 2.332, p = .03$ ) and independent exercise ( $t = 4.355, p < .001$ ) for the T group. For the C group, the change in independent exercise also was significant ( $t = 2.800, p = .008$ ).

Table 4

ANOVA Results for Differences in Change in Outcome Variables for Total Study Population

Variable	Treatment ( <i>n</i> = 29)	Control ( <i>n</i> = 36)	<i>F</i> (1 d.f.)	<i>p</i>	$\eta^2$
	Mean change ( <i>SD</i> )	Mean change ( <i>SD</i> )			
Change in ESE	2.2 (19.7)	0.1 (27.0)	.113	.738	.002
Change in BARSE	11* (24)	2 (29)	1.399	.241	.022
Change in Independent Exercise	78* (97)	50* (106)	1.259	.266	.020

*Note.* ESE = Exercise Self-Efficacy, BARSE = Barriers Self-Efficacy, *p* = probability,  $\eta^2$  = effect size.

\* = significantly different from zero (*p* < .05)

Impact of Covariates on Study Outcomes

Because the *SD* for independent exercise was larger than the mean scores, frequencies and percentiles for this variable were analyzed. It was found that 69% (*n* = 45) of the study participants reported no independent exercise prior to CR. One participant reported 10 minutes of exercise per week; two participants reported 20 minutes per week. These 48 subjects were designated as a “sedentary” subset of participants. For the other 17 participants, reported minutes of independent exercise prior to their cardiac event ranged from 60 to 420 minutes per week. This group was designated as “non-sedentary.” The impact of previous levels of exercise on the outcome

variables was evaluated by using the category of sedentary and non-sedentary as a covariate.

The mean ( $\pm SD$ ) number of intervention sessions received by members of the T and C groups were 2.9 ( $\pm 1.5$ ) and 3.1 ( $\pm 1.1$ ) respectively. Four participants completed the program after one SCI session, six participants received the maximum number of six treatment interventions. In order to evaluate the impact of treatment “dose,” the number of SCI sessions received was considered as a covariate. Age and BMI were also evaluated as possible covariates because of differences between groups at baseline. Finally, gender was added as a covariate because other researchers (Blanchard et al., 2002a; McAuley et al., 1991) indicate that there are differences in the self-efficacy perceptions of males and females.

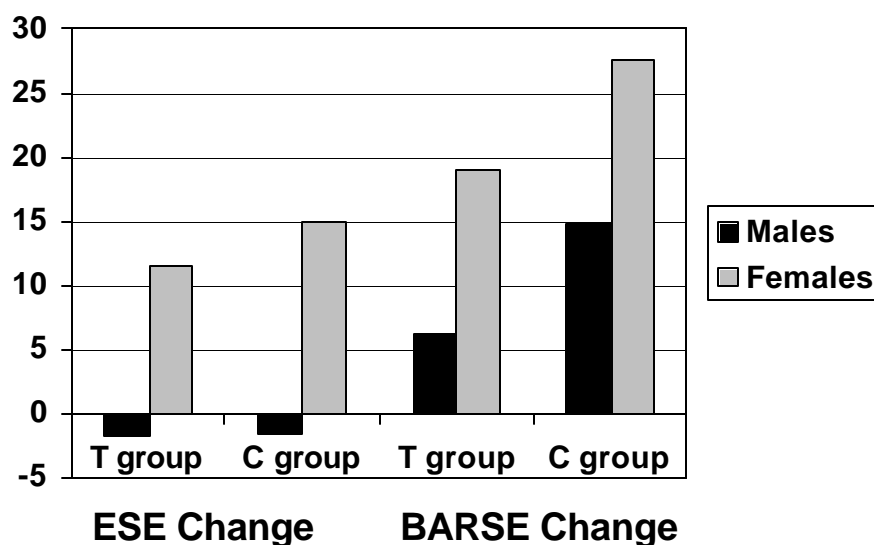
Multiple analysis of variance (MANCOVA) was used to evaluate the impact of each of these covariates on study outcomes. Results showed significant independent effects of gender on ESE change ( $F = 4.345$ ,  $df = 1$ ,  $p = .04$ ,  $\eta^2 = .070$ ) and BARSE change ( $F = 3.062$ ,  $df = 1$ ,  $p = .08$ ,  $\eta^2 = .050$ ). Previous level of exercise had a significant effect on change in independent exercise participation ( $F = 19.576$ ,  $df = 1$ ,  $p < .001$ ,  $\eta^2 = .252$ ). There was no effect of age, BMI, or number of treatment sessions on any of the outcome variables and no interaction effect between treatment and any of the covariates ( $p > .20$  for all variables).

The effects of gender and previous levels of exercise on study outcome variables were further evaluated by using general linear models. Female participants had greater ESE and BARSE changes ( $p = .042$  and  $p = .085$  respectively) than males regardless of

treatment condition (Figure 2), and non-sedentary participants had greater change in independent exercise than sedentary participants ( $p < .001$ , Figure 3).

Figure 2

Effect of Gender on ESE and BARSE Change\*:



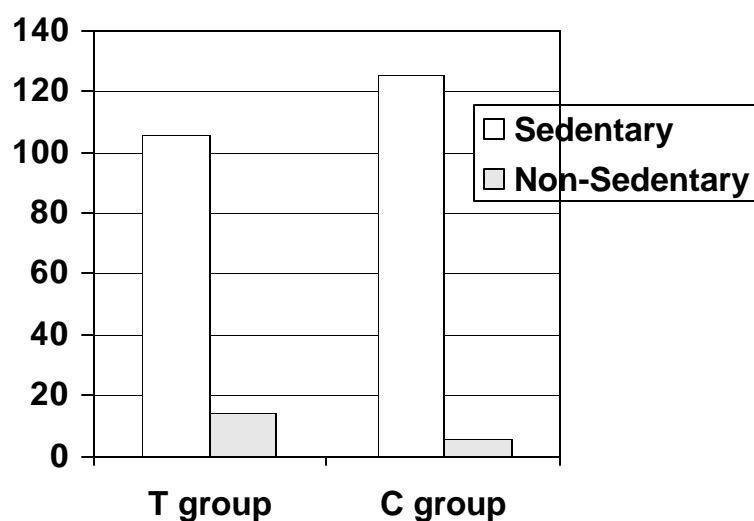
\* means calculated from equations based on general linear models

#### Correlation of Study Outcomes and CR Program Outcomes

A correlation matrix (Table 5) was created to examine trends in the relationships between baseline and change scores in the study dependent variables (ESE, BARSE, and independent exercise) and data collected as standard outcome measures for the CR program (6-minute walk and SF-36). For all variables except the 6-minute walk, initial scores for each variable were inversely correlated ( $p < .01$ ) with the corresponding change score, indicating that subjects with the lowest score at baseline had the largest changes. Baseline ESE was correlated with initial BARSE and inversely correlated with

BARSE change, indicating that subjects with high self-efficacy (based on ESE score) also had high self-efficacy to face barriers, and those with initially lower self-efficacy had the largest changes in BARSE scores. BARSE change also was correlated with ESE change ( $p < .01$ ). No relationships were noted between study outcome data and designated program outcomes.

Figure 3: Effects of Previous Exercise on Independent Exercise Change\*



\* means calculated from equations based on general linear models

Table 5

Pearson's Product-Moment Correlation Matrix of Study Dependent Variables and Program Outcome Measures (N=65)

**Correlations**

		ESE 1	ESE Change	BARSE 1	BARSE Change	Indep Ex 1	Indep Ex Change	6-min walk 1	6 min walk Change	SF36 1
ESE Change	<i>r</i>	-.580**								
BARSE 1	<i>r</i>	.506**	-.374**							
BARSE Change	<i>r</i>	-.443**	.716**	-.660**						
Indep Ex 1	<i>r</i>	.139	.022	.109	.082					
Indep Ex Change	<i>r</i>	.003	.020	-.033	-.033	-.657**				
6-min wk 1	<i>r</i>	-.064	.135	-.200	.138	-.025	.238			
6-min wk Change	<i>r</i>	.162	-.019	.074	.012	-.107	-.016	-.088		
SF36 1	<i>r</i>	-.144	.068	-.023	.088	.123	-.001	.403**	-.093	
SF36 Change	<i>r</i>	.088	-.038	-.061	-.065	-.110	-.089	-.091	.243	-.674**

\*\* Correlation is significant at the 0.01 level (2-tailed).

### Chapter Summary

Statistical analysis indicated that members of the treatment and control groups were different in age, weight and BMI at baseline, but did not differ significantly in measures of the study outcomes. When age and BMI were analyzed as covariates, no significant interactions with study outcomes were noted. Study results indicated that there were no differences between groups on change scores for the outcome variables. The change in BARSE score was significantly greater than zero among the treatment group, but not among the control group. Both the treatment and control groups had significant increases in independent exercise over the study period. Large variances in minutes of independent exercise prompted analysis of this factor as a categorical variable when including it as a covariate. Gender and number of SCI treatment sessions received by participants were also included as categorical covariates. Results suggested an independent effect of gender on change in ESE and BARSE scores, and an independent effect of previous exercise on exercise change. The number of treatment sessions did not affect study outcomes. No relationship was noted between study outcomes and standard outcome data collected as part of CR program participation. A discussion of the study results and their implications are presented in Chapter 5.

## CHAPTER 5

### DISCUSSION AND SUMMARY

This chapter will include a discussion of results, the limitations of our study, and suggestions for further research. A summary of the project is also included.

#### Discussion

This study adds to the limited body of knowledge about theory-based interventions in CR programs and takes an important step in translating self-efficacy theory into a simple, practical application that will promote maintenance of lifestyle changes in this population. Our intervention was designed to increase self-efficacy and participation in independent exercise for CR patients. The intervention was implemented as a supplement to standard phase II CR care without requiring a lot of extra time and effort by the CR staff. It was hypothesized that participants in the T group would achieve higher levels of ESE, higher levels of BARSE and increased participation in independent exercise compared to those in the C group. While differences between groups did not reach the expected level of significance, within groups changes were noted in measures of BARSE and independent exercise. These findings were encouraging and lead to discussion about the study design and outcome measures of this intervention.

#### Study Design

Our intervention was designed to reinforce the four constructs of self-efficacy theory in order to improve participation in independent exercise for participants in the T group. Although we were very careful to keep the intervention protocol for the T group distinct from the attention control intervention received by members of the C group, it is

possible that treatment received by the two groups was not different enough to show differences in study outcomes. Allison and Keller (2004) noted a similar challenge in their intervention study. They divided participants into 3 groups (self-efficacy treatment, attention control [AC], and usual care) and found that PA outcomes for the treatment group were not significantly different than the other two groups, suggesting that the AC group may have served as a treatment group. In our study, participants in the C group did attend exercise sessions up to three times per week and would have seen progress in their exercise tolerance during the phase II program. This could have reinforced mastery of the ability to exercise. In addition, members of the C group exercised as part of a group and would have had the benefits of vicarious experience by watching other members of the group make progress in their exercise programs. Recording of HR and BP during exercise, part of standard CR care, may have reinforced an understanding of the physiological responses to exercise. While day-to-day interaction with the staff did not include specific reinforcement of each of these constructs of self-efficacy, it may have served as a means of social support for these participants. McAuley et al. (2003a, 2003b) suggest that social support within the context of exercise produces positive affects which in turn enhance self-efficacy for exercise for older adults. Thus, the social aspects of phase II CR participation for the C group may have contributed to the non-significance of our findings. Our results may have been strengthened had we also included a control group which received usual CR care and no self-efficacy intervention of any kind.

A second challenge in our study design is the fact that not all participants completed an equal number of sessions of CR. While some insurance companies allow

up to 36 sessions of supervised rehab, program length will vary based on such variables as severity of disease, complexity of treatment, initial functional capacity, attainment of individual goals, or return to work. In our study, participants attended a mean ( $\pm SD$ ) of  $19.3 \pm 7.2$  sessions of rehab, with a range of 8-36 sessions. This meant that participants received between one and six (mean =  $3.0 \pm 1.3$ ) intervention treatments. McAuley et al. (1994) found that self-efficacy generated during the first month of an intervention program was not strong enough to have a direct effect on subsequent efficacy, but that efficacy at two months had increased and was predictive of exercise adherence. Our participants were in the program for an average of approximately six weeks, and no direct effect of the SCI was noted in ESE and BARSE change. While the impact of number of treatment sessions as a covariate was non-significant, results may have been strengthened if the intervention had lasted longer or if SCI sessions had been delivered more frequently.

### Outcome Measures

The primary outcomes for this study were measures of ESE, BARSE, and participation in independent exercise. While the SCI did not demonstrate significant differences between groups on change in ESE, BARSE, or participation in independent exercise, we did see significant increase in BARSE within the T group as well as significant increases in independent exercise participation in both the T and C groups. In other intervention studies with CR patients, Carlson et al. (2000, 2001) and Allison and Keller (2004) also looked at self-efficacy measures and PA participation. These authors measured self-efficacy through the use of a self-efficacy questionnaire. PA participation

was assessed with exercise logs or activity questionnaire and cross-validated with measures of functional capacity obtained by six-minute walk or graded exercise test. Yates et al. (2005) and Moore and Charvat (2002) also used the theory of self-efficacy to promote PA participation. These investigators used self-report of activity minutes and exercise adherence to monitor PA participation, but did not measure self efficacy. Our findings would be similar to those of Yates et al. and with Allison and Keller who reported that their interventions produced results that were “positive but not statistically significant.” In an intervention study with non-cardiac patients, McAuley et al. (1994) found that self-efficacy was predictive of exercise behavior, but were unable to show a direct effect of their intervention on measures of self-efficacy. The authors suggest that other factors besides self-efficacy may have an influence on exercise behavior.

In our study we did note some unanticipated factors that may have influenced our results. First, while there was no difference between the T and C groups in any of our outcome variables at entry into the program, the high levels of initial ESE and a large variance in minutes of self-reported independent exercise may have had an impact on the outcomes. Mean baseline ESE scores for the T and C groups were 82.8 and 84.2 respectively. The highest possible score was 100. Frequency analysis of baseline ESE scores indicated that 34% of the participants reported scores of 100, and only 29% had initial scores lower than 80. Thus the potential for improvement was limited. In a study of sedentary older adults participating in a 6-month exercise program, McAuley et al. (2003a) noted that baseline self-efficacy scores ( $M = 69.91$ ) were “inordinately high” and suggested that this could create a ceiling effect on potential improvements. Our baseline

ESE scores were higher than those of McAuley and no improvements were noted for this variable in our study. Gender may have also had an influence on self-efficacy change scores. McAuley et al. (1991) saw larger increases in task self-efficacy for women compared to men in a 20-week structured exercise program. Blanchard et al. (2002b) found that baseline self-efficacy scores were significantly lower and increases in self-efficacy scores were significantly higher when comparing females to male participants in phase II CR programs. In our study, we saw the same pattern. Of the 19 baseline ESE scores that were lower than 80, females accounted for the six lowest scores and only five scores belonged to males. Analysis of covariance indicated that gender had a significant effect on ESE and BARSE outcomes regardless of treatment group. Since females made up only 35% of our study population, it is possible that improvements related to the intervention were masked by the male's responses.

Baseline data for independent exercise indicated that 75% of the participants in our study were designated as formerly sedentary. This is not unexpected since less than 50% of the adult population in the US does not meet the physical activity recommendations established by the Center for Disease Control (CDC) and the ACSM, and in the population of those over 65 years of age, the prevalence of exercise participants drops to 39% (Haskel et al. 2007). Our non-sedentary participants reported independent exercise participation ranging from 60 to 420 minutes per week. Because calculations of effect size include variance in the denominator, the large variance would limit the effect size of our results. Although there was no difference between groups for change in independent exercise participation, when previous levels of exercise were

evaluated as a covariate, we found a significant change in exercise participation independent of treatment condition. Results indicated that sedentary participants experienced the greatest increases in independent exercise. This would suggest that both the treatment and attention control interventions were effective in promoting independent exercise for these subjects. These results are consistent with those reported by McAuley et al. (1994) who found a direct effect between a self-efficacy based treatment intervention and exercise frequency for formerly sedentary participants.

In contrast, non-sedentary participants in both T and C groups in our study did not show increases in independent exercise. Eight of 17 non-sedentary participants reported that they did not reach pre-program levels of this variable by the time they exited from the program. This raises some interesting questions. Social cognitive theory (Bandura, 1986) would suggest that an individual's past experience is the most influential source of self-efficacy, and this in turn influences exercise behavior. While there is evidence that past exercise can be a significant predictor of exercise participation (McAuley & Blissmer, 2000; Oman & King, 1998), most studies have not looked specifically at exercise interventions for cardiac patients and therefore would not have considered the unique barrier effect that a cardiac event may have created. Blanchard et al. (2002b) used a barriers scale specific to CR. These authors found that barriers self-efficacy increased during participation in phase II CR and was predictive of exercise adherence, but they did not differentiate between previous exercisers and sedentary participants. The authors also suggested that when patients had not previously experienced barriers specified on the scale, efficacy judgment may have been over- or underestimated. Allison and Keller

(2004) have also suggested that an older adult's confidence level after a cardiac event may have limited use in explaining future exercise behavior. McAuley et al. (2003a) found a decrease in barriers self-efficacy for older adults during the last two months of a structured exercise program. These authors suggest that confidence decreased as the participants faced the prospect of exercising on their own. In our study, members of the treatment group did have significant increases in self-efficacy to face barriers, but non-sedentary participants did not increase levels of independent exercise. This may suggest that the non-sedentary members of our study recognized their cardiac event as a potential barrier to exercise and that the SCI did impact self-efficacy for these participants, but that more time is needed for them to achieve previous levels of independent exercise.

#### Limitations and Future Directions

This study does have some limitations. Participation by the C group in structured CR may have effectively served as an alternative treatment protocol. It would be helpful to include a control group of cardiac patients who participated in usual CR care without any self-efficacy intervention. Not all participants in this study received the same number of treatment interventions. Future studies might consider a minimal attendance level to allow time for intervention effects to occur. The tools used to measure ESE and BARSE were not designed specifically for a cardiac population; high baseline ESE scores may indicate that this scale was not appropriate for CR participants. In addition, the small number of women in the study may have limited the ability to account for the influence of gender on this outcome. Reliance on self-report of PA to measure independent exercise participation may have introduced recall bias into this measure.

Correlation with a more objective measure of PA would have strengthened the results. Finally, this study did not examine long term maintenance of study outcomes. It is suggested that future studies include follow-up after graduation from the supervised CR program to see if self-efficacy for and participation in independent exercise is maintained on a long-term basis. The results and limitations of this short-term study can help inform the planning of a long-term follow-up study.

### Summary

A primary goal of CR programs is to have participants adopt and maintain a healthy lifestyle which includes regular exercise. While it has been suggested that these programs need to address the psychological issues related to behavior change, there is no consensus on what theoretical model can best facilitate those changes. In response to this need, we developed the SCI, an intervention based on Bandura's theory of self-efficacy and its four constructs: mastery, vicarious experience, verbal persuasion, and physiological states. The intent was to develop a protocol that could be easily implemented into routine CR care while requiring a minimal amount of extra time and effort on the part of CR staff members. The primary aims of the study were to (a) determine the effects of the SCI on self-efficacy for exercise participation and on self-efficacy for exercise in the face of potential barriers, and (b) to determine the effects of the SCI on participation in independent exercise apart from the structured CR program. Our experience with the SCI was that it was well-received by patients and easily implemented by staff members. Analysis of the results showed that there was no difference between groups in change of ESE, BARSE and independent exercise, although

significant within groups changes (compared to no change) were seen for BARSE change in the T group, and for independent exercise change in both groups. Further study is needed to see if these changes translate into maintenance of independent exercise participation after completion of a formal CR program.

## CHAPTER 6

## MANUSCRIPT

In addition to exercise, a variety of medications are commonly used in the treatment of cardiovascular diseases. While exercise may provide the benefit of increasing ones metabolism, the effects of some of these medications could potentially lower metabolism. This in turn could lead to weight gain, increased risk for high blood pressure and diabetes, and increased cardiovascular risk. This chapter contains the results of a study that was designed to look at the impact of a common cardiac medication on resting metabolism. The manuscript has been prepared in a format to meet the requirements for submission to the Journal of Cardiopulmonary Rehabilitation and Prevention.

## Title

A Comparison of the Effects of Medications Used to Treat Cardiac Conditions on  
Resting Energy Expenditure

## Abstract

**PURPOSE:** This study compared the resting energy expenditure (REE) of persons taking a calcium (Ca<sup>++</sup>)-channel blocking medication, amlodipine (AM), with that of a group taking a beta (β)-blocking medication, metoprolol (MET), and with a third group of control (CON) subjects taking neither medication.

**METHODS:** Twenty-eight individuals ( $n = 13$  males/15 females, mean age  $56.9 \pm 7.2$  years) volunteered to participate in the study. Subjects were recruited from the staff of a local university, the staff of a local hospital, and from a cardiac rehabilitation program at a local medical facility. Participants were assigned to one of three groups based on the medication regimen recommended by their personal physician: AM ( $n = 7$ ), MET ( $n = 9$ ), and CON ( $n = 12$ ). Subjects reported to the laboratory after a 12-hour overnight fast with no caffeine and no alcohol consumption or exercise 48 hours prior. Resting caloric consumption was measured through indirect calorimetry. Body composition was assessed and dietary  $\text{Ca}^{++}$  intake was determined. The measured resting caloric consumption was used to calculate 24-hour caloric consumption and this number was divided by lean body mass (LBM) to determine relative daily caloric requirements ( $\text{kcal} \cdot \text{day}^{-1} \cdot \text{kg}^{-1}$ ). Group means and standard deviations were analyzed using one-way ANOVA.

**RESULTS:** Mean ( $\pm SD$ ) REE for CON ( $24.8 \pm 3.70 \text{ kcal} \cdot \text{day}^{-1} \cdot \text{kg}^{-1}$ ) was less ( $p < .05$ ) than that of AM ( $27.9 \pm 0.33 \text{ kcal} \cdot \text{day}^{-1} \cdot \text{kg}^{-1}$ ) and of MET ( $27.7 \pm 3.30 \text{ kcal} \cdot \text{day}^{-1} \cdot \text{kg}^{-1}$ ). No significant difference was found between groups for variables of age, 24-hour kcal consumption,  $\text{Ca}^{++}$  intake, and LBM.

**CONCLUSION:** There was a difference in REE between persons taking AM or MET compared to CON. However, due to the small N in this study, it is recommended that the cause of these differences be further evaluated.

## Introduction

Dietary calcium intake has been shown to have a direct, positive effect on fat oxidation (Loos et al., 2004; Melanson, 2003; Zenel, 2004). The increased metabolism associated with calcium intake could be beneficial in control of obesity and type 2 diabetes. This in turn can help in decreasing risks for cardiovascular disease (CVD) which affects over 80 million American Adults (American Heart Association [AHA], 2008).  $\text{Ca}^{++}$  channel blockers are often used in the treatment of CVD and its symptoms such as high blood pressure and arrhythmias. The action of the medication is thought to inhibit calcium ion influx across cardiac and smooth muscle cells thus decreasing the oxygen demand and load on the heart (Nursing Drug Handbook, 2001). However, if these medications have a similar impact on skeletal muscle, the result could be a decrease in overall metabolism, weight gain, and other corresponding non-desirable side effects. The purpose of this pilot study was to do a one-time analysis of resting energy expenditure (REE) of persons taking a specific  $\text{Ca}^{++}$  channel-blocking medication (amlodipine) and to compare the values with those of age-matched controls. Results were also compared with a group of subjects taking a beta ( $\beta$ )-blocking medication (metoprolol), another medication commonly used in the treatment of cardiovascular diseases. It was hypothesized that those persons taking  $\text{Ca}^{++}$  channel-blocking medications would have REE values that were different than the values observed in persons who did not take the medication.

## Methods

A description of this project was sent by e-mail to the faculty and staff of Augustana College in Sioux Falls, SD asking for volunteers for this study. A similar notice was sent to the staff of Avera McKennan Hospital, also in Sioux Falls. Finally, flyers were used to invite participation by patients in the cardiac rehabilitation department at Avera McKennan. Thus, potential subjects could initiate discussion about participation in the project, and no medical records were accessed for subject recruitment. Persons who expressed interest in participation were contacted by phone to determine their suitability for participation in the study. Inclusion criteria required that participants be between the ages of 45 and 75 years and taking either amlodipine (AM), metoprolol (MET) or not taking any  $\text{Ca}^{++}$  channel- nor  $\beta$ -blocking medication (control group: CON). Because of possible influence on metabolism, exclusion conditions were (a) nicotine use, (b) regular exposure to illegal drugs, and (c) diabetes. Persons with chronic obstructive pulmonary disease were also excluded due to the potential difficulty of needing to breathe through a mouthpiece during data collection. Twenty-eight individuals volunteered and met the criteria for participation in this study. Participants were assigned to one of three groups based on the medication regimen recommended by their personal physician: AM (n = 3 males/4 females), MET (n = 4 males/5 females), or CON (n = 6 males/6 females). Due to the nature of the study, some individuals had a diagnosis of cardiovascular disease and/or hypertension and were under a physician's care.

Institutional Review Board approval for this study was obtained from South Dakota State University, Augustana College, and Avera McKennan Hospital prior to

implementation. Data collection took place in the Human Performance Lab at Augustana College. Subjects reported to the lab after a 12-hour overnight fast with no caffeine. They had also been instructed not to exercise or consume alcohol for 48 hours prior to testing. After being allowed to void, study procedures were explained, written consent was obtained, the subject's weight was measured to the nearest 10 g with a balance beam scale, and height was measured to the nearest 0.6 cm on a stadiometer. After 15 minutes of quiet rest in a recliner, resting metabolism was measured through indirect calorimetry using the Parvo Medics TrueOne 2400 Metabolic Measurement System (Sandy, UT). Subjects were fitted with a rubber mouthpiece connected to a non-rebreathing valve, a nose clip was applied to prevent nasal breathing, and expired gases were collected and analyzed for the next 15 minutes using the Hans Rudolph 3818 pneumotachometer (Kansas City, MO) to measure ventilation rates. Data from the last three minutes of this period were used to estimate 24-hour REE. This method has been validated against the criterion standard of collecting expired gases in a Douglas bag, and found to be not significantly different ( $p < .05$ ; Bassett, Howley, Thompson, King, Strath, McLaughlin & Parr, 2001). Flowmeter calibration and gas calibration of the testing instruments was performed each morning prior to testing.

After metabolic testing, measures of resting heart rate and blood pressure were recorded and body composition was assessed by an experienced tester using the skinfold technique with a Lange skinfold caliper (Cambridge Scientific Industries, Inc., Cambridge, MD). Skinfold thickness was measured on the right side of the body at the subscapular, triceps, biceps, midaxillary, suprailiac, abdominal, and thigh sites using

techniques described by Harrison et al. (1988). Measurements were taken twice in a rotational order, the average of the two values was used in determination of the sum of skinfold measurements. If the first two measures differed by more than 1 mm, a third measurement was taken. When this was necessary, the two closest measurements were averaged. The sum of seven skinfolds was entered into equations by Jackson and Pollock (1978) or Jackson, Pollock and Ward (1980) to determine body density. Body density was converted to percent fat using the equation by Siri (1961) and lean body mass (LBM) was calculated. Research has documented that body fat estimation by skinfold measurements is highly correlated ( $R = 0.85 - 0.87$ ) with percent fat values obtained by hydrostatic weighing (Jackson et al.). Estimated twenty-four hour REE was then divided by LBM to determine daily caloric requirements based on lean mass ( $\text{kcal} \cdot \text{day}^{-1} \cdot \text{kg}^{-1}$  LBM).

Usual calcium consumption was assessed by using a food frequency questionnaire (FFQ) specific for calcium (Pierre, 1997). Participants were given a list of 26 food items and asked how many servings of each had been consumed on the previous day. Each item had been assigned from one to three “quality calcium points” based on its calcium content. The number of servings was multiplied by the assigned point value and these scores were added to give a total calcium score. The total was then multiplied by 100 to give an estimate of the calcium consumption (in mg) for the previous day. Participants were given feedback regarding their results and how these compared to recommended daily values. Jain and McLaughlin (2000) assessed the validity of this type of tool and found a high correlation between FFQ and 7-day food records for both men and women

( $r = .72$ ,  $p = .01$  and  $r = .67$ ,  $p = .002$  respectively). These results were similar to those of others (Blalock, Norton, Patel, Cabral, & Thomas, 2003) who found that estimates of calcium intake from a short FFQ were significantly correlated ( $r = .66$ ,  $p < .001$ ) with the results for a 7-day food diary.

Group means and standard deviations were analyzed using one-way ANOVA. Significant effects were determined through LSD post-hoc analysis. The possibility of a confounding effect of dietary calcium on REE/LBM was analyzed through ANCOVA.

### Results

Descriptive characteristics of the study participants are presented in Table 1. Mean ( $\pm SD$ ) age of the CON group ( $53.9 \pm 5.3$  years) was slightly lower than that of the AM ( $59.3 \pm 9.7$  years) and the MET ( $59.1 \pm 6.6$  years) groups, but this difference was not significant,  $F(2,25) = 1.916$ ,  $p = .16$ . The weight of participants in the MET group ( $94.2 \pm 14.6$  kg) was higher than that of the AM ( $78.1 \pm 14.7$  kg) or CON ( $76.7 \pm 16.0$  kg) participants which resulted in a significant difference between groups in BMI (AM:  $28.4 \pm 4.2$ , MET:  $32.5 \pm 3.7$ , and CON  $25.5 \pm 4.2$ ),  $F(2,25) = 7.673$ ,  $p = .003$ . However, when LBM was calculated, there were no differences between groups,  $F(2,25) = .770$ ,  $p = .474$ . Mean values for LBM were  $55.0 (\pm 10.6)$  kg for members of the AM group,  $62.5 (\pm 11.4)$  kg for the MET participants, and  $57.7 (\pm 13.8)$  for the CON group.

Comparison of groups based on daily caloric intake and daily calcium consumption also revealed no significant difference between groups ( $p > .05$ ). Estimated daily caloric intake for the AM group averaged  $1552.3 (\pm 305.5)$  kcals/day. Values for the MET and CON groups were  $1718.1 (\pm 294.3)$  and  $1424.2 (\pm 370.7)$  kcals/day

respectively. Calcium intake, estimated by food frequency questionnaire, suggested a higher calcium intake by the CON group, but the difference did not reach statistical significance,  $F(2,25) = 2.774$ ,  $p = .082$ . Average calcium intake ranged from 655.5 to 1170.8 ( $\pm 386.8$  to 739.3) mg/day.

When REE was divided by LBM to determine daily caloric consumption relative to lean mass, mean values for the CON group were statistically lower than the other two groups,  $F(2,25) = 3.444$ ,  $p = .048$ . REE/LBM for the CON group was  $24.8 \pm 3.7$  kcal·day<sup>-1</sup>·kg<sup>-1</sup>; values for AM and MET groups were  $27.9 \pm 0.33$  and  $27.7 \pm 3.3$  kcal·day<sup>-1</sup>·kg<sup>-1</sup> respectively (Figure 1).

An ANCOVA test was used to partition out the potential influence of calcium intake on REE analysis. Calcium intake was not found to have a significant influence on our results (Table 2).

### Discussion

This study was designed to analyze the REE of persons taking a Ca<sup>++</sup> channel-blocking medication (amlodipine) and to compare the values with a group of control subjects. A comparison was also made with REE of persons taking a  $\beta$ -blocking medication (metoprolol). It was hypothesized that those persons taking Ca<sup>++</sup> channel-blocking medications would have REE values that were different than the values observed in persons who did not take the medication. If Ca<sup>++</sup> channel-blocking medications are associated with a decreased metabolic rate, this could have negative implications for cardiac patients taking these medications.

REE is an indicator of metabolic rate. Typical values range from 1200 to 2400 kcals/day. REE can be affected by age, gender and lean body mass. Metabolism tends to slow down with age, males tend to have a higher metabolic rate than females, and a higher amount of lean tissue will result in higher overall metabolism (Wilmore & Costill, 2004). Calcium consumption has been shown to have a positive effect on metabolism (Loos et al., 2004; Melanson et al., 2003; Zenel, 2004). In our study, estimates of daily REE ( $M = 1424$  to  $1718$  kcals/day) were within the expected range. Differences between groups in terms of age, gender, LBM, and calcium consumption were non-significant. However, when REE was expressed relative to LBM, mean values for the CON participants were found to be significantly ( $p < .05$ ) lower than those of both AM and MET participants.

Because of the small  $N$  in our study, these findings are speculative at best. More subjects need to be added to verify differences

In summary, our results showed that persons taking the  $\text{Ca}^{++}$  channel-blocker, amlodipine, had relative REE that was not different than that of persons taking the  $\beta$ -blocker, metoprolol, but was higher than that of persons taking neither of these medications. Thus, the  $\text{Ca}^{++}$  channel-blocker did not have a negative effect on metabolism. However, due to the small  $N$  in this pilot investigation, it is recommended that these causes of these findings are further evaluated with a larger group of participants.

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## Tables

Table 1.

Descriptive Characteristics of Study Participants: Means (SD) and ANOVA

Variable	Group			<i>F</i> (2 d.f.)	<i>p</i>
	AM (n = 7)	MET (n = 9)	CON (n = 12)		
Age, years	59.3 (9.7)	59.1 (6.6)	53.9 (5.3)	1.916	.162
Height, cm	165.8 (7.3)	170.0 (8.3)	172.6 (11.9)	1.055	.363
Weight, kg	78.1 (14.7)	94.2 (14.6)	76.7 (16.0)	3.790	.037
BMI	28.4 (4.2)	32.5 (3.7)	25.5 (4.2)	7.673	.003
LBM, kg	55.0 (10.6)	62.5 (11.4)	57.7 (13.8)	.770	.474
Kcals/day	1552.3 (305.5)	1718.1 (294.3)	1424.2 (370.7)	2.009	.155
Daily Ca++, mg/day	878.6 (739.3)	655.5 (386.8)	1170.8 (404.21)	2.774	.082

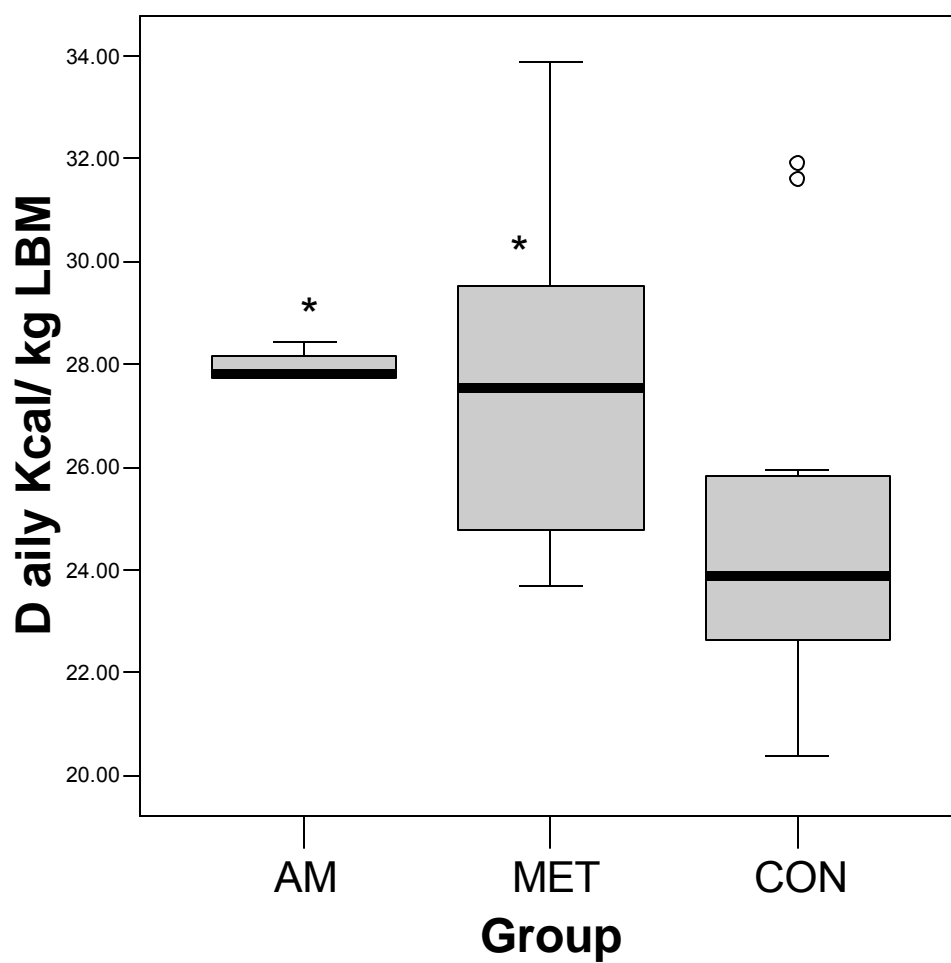
Table 2

Analysis of Calcium as a Source of Covariance on REE/LBM

Group	d.f.	Mean Square	<i>F</i>	<i>p</i>
AM	1	.695	2.305	.189
MET	1	1.224	.099	.762
CON	1	.158	.010	.921

## Figures

Figure 1

Groups Comparison of Daily Caloric Expenditure Based on LBM

Note: \*  $p < .05$ , AM = Amlodipine, MET = Metoprolol, CON = control. Bars represent mean  $\pm$  SD.

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Appendix A  
**EXERCISE SELF-EFFICACY SCALE**

The items listed below are designed to assess your beliefs in your ability to exercise three times per week at moderate intensities. Using the scales below, please indicate how confident you are that you will be able to continue to exercise in the future.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
<b>NOT AT ALL CONFIDENT</b>				<b>MODERATELY CONFIDENT</b>					<b>HIGHLY CONFIDENT</b>	

For example: if you have complete confidence that you will exercise 3 times per week at moderate intensity, you would circle 100%. However, if you have no confidence that you would exercise for this recommended amount, you would circle 0%. If you have some confidence, choose a number in between these two extremes. **Mark your answer by circling a %.** Please answer as honestly and accurately as you can, but remember that there are no right or wrong answers.

**I am confident that I am able to continue to continue to exercise 3 times per week at a moderate intensity:**

1. for the NEXT WEEK.

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

2. for the NEXT TWO WEEKS.

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

3. for the NEXT THREE WEEKS.

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

4. for the NEXT FOUR WEEKS.

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

5. for the NEXT FIVE WEEKS.

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

6. for the NEXT SIX WEEKS.

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

7. for the NEXT SEVEN WEEKS.

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

8. for the NEXT EIGHT WEEKS.

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

---

"Self-efficacy Scale for 40 Minutes": Sum all items and divide by 8. McAuley, E. (1993)

### BARRIERS TO SELF-EFFICACY FOR EXERCISE

The following items reflect situations that are listed as common reasons that keep people from participation in exercise sessions or, in some cases, cause people to drop out of an exercise program. Using the scales below, please indicate how confident you are that you could exercise in the face of these common obstacles.

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

**NOT AT ALL  
CONFIDENT**

**MODERATELY  
CONFIDENT**

**HIGHLY  
CONFIDENT**

For example: in question #1, if you have complete confidence that you could exercise “even if the weather was very bad”, you would circle 100%. However, if you have no confidence at all that you could exercise, you would circle 0% (meaning you are confident that you would *not* exercise). If you have some confidence, choose a number in between these two extremes. **Mark your degree of confidence to exercise in the face of the following situations by circling a %.** Please answer as honestly and accurately as you can, but remember that there are no right or wrong answers.

---

**I believe that I could exercise 3 times per week for the next 3 months even if:**

1. the weather was very bad (hot, humid, rainy, cold).

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

2. I was bored by the program or activity.

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

3. I was on vacation.

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

4. I was not interested in the activity.

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

5. I felt pain or discomfort when exercising.

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

6. I had to exercise alone.

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

7. It was not fun or enjoyable.

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

8. It became difficult to get to the exercise location.

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

### BARRIERS TO SELF-EFFICACY FOR EXERCISE—p. 2

Using the scales below, please indicate how confident you are that you could exercise in the face of these common obstacles.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
	NOT AT ALL CONFIDENT				MODERATELY CONFIDENT				HIGHLY CONFIDENT			
<hr/>												
9. I didn't like the particular activity program that I was involved in.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
10. My schedule conflicted with my exercise session.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
11. I felt self-conscious about my appearance when I exercised.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
12. An instructor does not offer me encouragement.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
13. I was under personal stress of some kind.	0%	10%	20%	30%	40%	50%	60%	7%	80%	90%	100%	
<hr/>												

## Appendix B

### Six Minute Walk Protocol

#### Administration of the Six-minute Cardiac Distance Walk

The six-minute walk should be administered prior to or at the beginning of the first exercise session of the rehabilitation program and at the last exercise session of the program. Walks should take place at about the same time of day, at least two hours following a meal and should be the first activity of the exercise session. The walk is a valid and reliable test when the subject walks in a hall or around a track. It is suggested that a hallway be at least 100 feet long. At this time, the six-minute walk has not been validated for administration on a treadmill.

#### Protocol:

1. Explain to the patient: "The purpose of this test is to find out how far you can walk in 6 minutes. If you need to stop and rest at any time, you may do so. Just start again when you are ready. You will start from this point (indicate starting point) and I will keep track of the time and let you know when the 6 minutes are up. Walk at a pace that is comfortable for you."
2. Start the stop-watch when the patient starts walking. Do not stop the clock if the patient stops to rest. Record the distance covered (in feet) by the end of the 6 minutes.
3. The staff person will walk slightly behind the patient to avoid influencing the patient's pace. Offer words of encouragement such as "you are doing well," "keep up the good work," "good job," or "you are doing fine," but avoid trying to carry on a conversation as this may affect the patient's walking effort.
4. Tell the patient when 2, 4, and 6 minutes have elapsed.
5. Immediately following completion of the walking test, evaluate the patient for heart rate, blood pressure, rate of perceived exertion (Borg Scale), and total distance walked in feet. Allow for a brief cool-down period before the patient sits down.

Appendix C  
Intervention Log to be placed on Patient Chart—T group

Intervention Log for PA Coaching (front of page)

Session	6	12	18	24	30
Minutes per session					
MET level					
THR					
RPE					
BP Response					
weight gain/loss					
resistance training (start date)	/ /	/ /	/ /	/ /	/ /
rhythm					
education	RF -Y,N,NA ST -Y,N,NA Ex -Y,N,NA Diet-Y,N,NA	RF -Y,N,NA ST -Y,N,NA Ex -Y,N,NA Diet-Y,N,NA	RF -Y,N,NA ST -Y,N,NA Ex -Y,N,NA Diet-Y,N,NA	RF -Y,N,NA ST -Y,N,NA Ex -Y,N,NA Diet-Y,N,NA	RF- Y,N,NA ST -Y,N,NA Ex - Y,N,NA Diet-Y,N,NA
meds correct?	reviewed Y N	reviewed Y N	reviewed Y N	reviewed Y N	reviewed Y N
patient goals (min PA/day out of rehab)					
other?					
barriers to PA					
home activity	Y N	Y N	Y N	Y N	Y N
next dr visit/ stress test					
anticipated discharge date					
anticipated HEP after discharge					
employee initials					

(back of page)

**Goal Setting for Independent PA**

Date \_\_\_\_\_ Min. of home activity: \_\_\_\_\_ x/wk, \_\_\_\_\_ min/day = \_\_\_\_\_ min/wk

Independent PA goal for next 2 weeks: \_\_\_\_\_ x/wk, \_\_\_\_\_ min/day = \_\_\_\_\_ min/wk

Confidence to reach goal (1=none, 10=total) \_\_\_\_\_

Obstacles \_\_\_\_\_

Plans to address obstacles \_\_\_\_\_

\_\_\_\_\_

Date \_\_\_\_\_ Min. of home activity: \_\_\_\_\_ x/wk, \_\_\_\_\_ min/day = \_\_\_\_\_ min/wk

Independent PA goal for next 2 weeks: \_\_\_\_\_ x/wk, \_\_\_\_\_ min/day = \_\_\_\_\_ min/wk

Confidence to reach goal (1=none, 10=total) \_\_\_\_\_

Obstacles \_\_\_\_\_

Plans to address obstacles \_\_\_\_\_

\_\_\_\_\_

Date \_\_\_\_\_ Min. of home activity: \_\_\_\_\_ x/wk, \_\_\_\_\_ min/day = \_\_\_\_\_ min/wk

Independent PA goal for next 2 weeks: \_\_\_\_\_ x/wk, \_\_\_\_\_ min/day = \_\_\_\_\_ min/wk

Confidence to reach goal (1=none, 10=total) \_\_\_\_\_

Obstacles \_\_\_\_\_

Plans to address obstacles \_\_\_\_\_

\_\_\_\_\_

Date \_\_\_\_\_ Min. of home activity: \_\_\_\_\_ x/wk, \_\_\_\_\_ min/day = \_\_\_\_\_ min/wk

Independent PA goal for next 2 weeks: \_\_\_\_\_ x/wk, \_\_\_\_\_ min/day = \_\_\_\_\_ min/wk

Confidence to reach goal (1=none, 10=total) \_\_\_\_\_

Obstacles \_\_\_\_\_

Plans to address obstacles \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Appendix D

### Script for Self-Efficacy Coaching Intervention for Physical Activity—contact 1

Hello \_\_\_\_\_, it's time to make some notes about your progress in the cardiac rehab program.

(Entries 1-10 are reviewed according to standard protocol, staff can use the items as prompts to reinforce mastery and discuss physiological response to exercise.)

1. Looking at your chart, I see that you are up to \_\_\_\_\_ minutes of exercise per session. That's great!
2. Your MET level is now at \_\_\_\_\_. METs are a measure of how much energy it takes to do things. If 1 MET is a measure of resting energy, and you are at \_\_\_\_\_ METs, you should be able to do activities such as \_\_\_\_\_ (find examples from MET chart.)
3. Your target HR is prescribed at \_\_\_\_\_. You are exercising at \_\_\_\_\_ bpm, so that is \_\_\_\_\_ (just right, too high, too low—staff explains appropriate response.)
4. RPE is another way to judge how hard you are working. We talked about that on your first day. It's good to exercise at a level that feels "fairly light" to "somewhat hard", it usually matches up with a HR that is right for you, and the nice thing is that you can judge RPE even if you can't find your pulse, or your pulse is affected by medications. Your chart says you've been exercising at an RPE = \_\_\_\_\_. That's \_\_\_\_\_ (good, too high, could be higher).
5. BP during exercise has been \_\_\_\_\_. (Discuss)
6. Your weight is at \_\_\_\_\_. That's \_\_\_\_\_ (up/down) from when you started. Are you happy with that? Is there anything we should help you work on?
7. Resistance training is something that we encourage to supplement cardiovascular exercise. For some who has had \_\_\_\_\_ (specify patient's diagnosis), we usually start \_\_\_\_\_ weeks after you have been in the program. That means you could be starting on \_\_\_\_/\_\_\_\_/\_\_\_\_\_. I'm going to write that date down so we can get started on that when you are ready.
8. Heart rhythm has been \_\_\_\_\_. (discuss)
9. Which of the education tapes have you looked at? (record Y/N/NA for risk factors, stress management, exercise, diet) Do you have any questions? (staff member responds to questions)

10. Staff reviews patient's current list of medications, updates records as appropriate.

(Entries 11-13 are specific to the SCI for PA intervention).

11. We like to encourage participation in exercise on the days that you are not in rehab. Are you doing any exercise at home now? How many minutes are you doing?
12. What do you think is a realistic amount of exercise to do when you are not here? Can we write down a goal of     \*\*     for the next 2 weeks? I'm going to give you an activity log to keep track of the minutes you exercise at home along with your RPE during exercise. Do you have any questions about how to use this? We'll review it again in a couple of weeks. (\*\* set goal based on patient's current exercise duration)
13. On a scale of 1-10, how confident are you that you can reach your home exercise goal? What might get in the way of your having a confidence level of 10? Let's talk about what you can do to overcome those obstacles. (Discuss methods to overcome barriers, include "what others have done.")
14. I also want to write down the date of your next doctor visit and/or stress test.
15. Do you have a plan as to when you hope to complete the cardiac rehab program?
16. It's not too early to be thinking about how you will exercise after you have completed cardiac rehab. Have you thought about a plan for what to do for exercise after you graduate from the program?                      (phase III/ home exercise/other exercise/no plan yet)

*Script for Self-Efficacy Coaching Intervention for Physical Activity—contact 2-5*

Hello                     , it's time to make some more notes about your progress in the cardiac rehab program.

(Entries 1-10 are reviewed according to standard protocol, staff can use the items as prompts to reinforce mastery and discuss physiological response to exercise.)

1. Looking at your chart, I see that you are now up to                      minutes of exercise per session. That's great! Last time you were at                     . You are                      (making progress/at the recommended level).
2. Your MET level is now at             . Do you remember what the MET level tells us? (if not, re-explain) At your current MET level, you should be able to do activities such as                      (find examples from MET chart.) You are making progress!

3. Your target HR is prescribed at \_\_\_\_\_. You are exercising at \_\_\_\_\_ bpm, so that is \_\_\_\_\_(just right, too high, too low—staff explains appropriate response.)
4. Your chart says you've been exercising at an RPE = \_\_\_\_\_. That's \_\_\_\_\_(good, too high, could be higher).
5. BP during exercise has been \_\_\_\_\_. (Discuss)
6. Your weight is at \_\_\_\_\_. That's \_\_\_\_\_(up/down) from last time we talked. Are you happy with that? Is there anything we should help you work on?
7. We have \_\_\_\_/\_\_\_\_/\_\_\_\_ as the starting date for your resistance program. (If date is past, be sure that program has started, ask how things are going, respond to questions. If starting date is not past, remind that this is something to come)
8. Heart rhythm has been \_\_\_\_\_. (discuss)
9. At the last record you still hadn't seen the education tape on \_\_\_\_\_. Have you had a chance to see any more of these? (record Y/N/NA for risk factors, stress management, exercise, diet) Do you have any questions? (staff member responds to questions)

OR—you have already reviewed all of the education tapes, have you thought of any other questions that relate to risk factors, stress management, exercise or diet?

10. Staff reviews patient's current list of medications, updates records as appropriate.

(Entries 11-13 are specific to the SCI for PA intervention).

11. Are you doing sticking with your home exercise program? How many minutes are you doing now? Let's look at your home exercise log (discuss, give feedback and encouragement)
12. You \_\_\_\_\_ (met/did not) meet the goal that was set for independent exercise? (Give congratulations or ask about reasons for not reaching goal.) What would be a realistic goal for the next 2 weeks? \*\*\_\_\_\_\_Please continue to keep track of your minutes and RPE on your activity log. (\*\* set goal based on patient's current exercise duration)
13. On a scale of 1-10, how confident are you that you can reach your home exercise goal? What might get in the way of your having a confidence level of 10? Let's talk about what you can do to overcome those obstacles. (Discuss methods to overcome barriers, include "what others have done.")

14. Your doctor's visit/stress test is schedule for \_\_\_\_\_.
15. Are we still looking at a graduation date of \_\_\_\_\_?
16. Your plan for what to do for exercise after you graduate from the program was \_\_\_\_\_ (phase III/ home exercise/other exercise/no plan yet). Does this still seem realistic? Are you making plans to make sure that this can fit in your day? (Discuss transportation/time/cost/family support as appropriate.)

## Appendix E

### Staff Evaluation of Feasibility for Use of SCI in Cardiac Rehabilitation

The following statements will help us evaluate your readiness to use the Self-efficacy Coaching Intervention (SCI) as a supplement to standard care in the phase II cardiac rehabilitation program. Please indicate your level of agreement with each statement by circling the appropriate response.

1. The theory of self-efficacy is potentially useful to increase exercise adherence for cardiac rehabilitation patients.

Strongly Agree      Agree      Disagree      Strongly Disagree

2. I understand the role of the SCI to address each of the four components of self efficacy: mastery, vicarious experience, verbal persuasion, and physiological states.

Strongly Agree      Agree      Disagree      Strongly Disagree

3. The SCI will be easy to implement as part of my standard patient care.

Strongly Agree      Agree      Disagree      Strongly Disagree

4. The SCI can be implemented with a minimal amount of extra staff time.

Strongly Agree      Agree      Disagree      Strongly Disagree

5. The SCI scripts make a clear distinction between the interventions for the treatment and control groups.

Strongly Agree      Agree      Disagree      Strongly Disagree

## Appendix F

### Consent Form

#### **South Dakota State University/Sanford Health Consent Form**

This study is being coordinated by Sherry Barkley, MS, in partial fulfillment of the requirements for a Ph.D. in the department of Biological Science at South Dakota State University. She is working under the direction of Matthew Vukovich, Ph.D. The project has been approved by the Research and Utilization Committee at the Sanford USD Medical Center.

Please read or listen to the following information:

This is an invitation for you as a participant in the Sanford Health Phase II Cardiac Rehabilitation Program to participate in a research project under the direction of Sherry Barkley. The project is entitled "Evaluation of a simple intervention to increase self-efficacy for independent exercise in cardiac rehabilitation participants."

During your participation in the cardiac rehabilitation program at Sanford Health, a number of surveys are given and measurements are collected to follow your progress through the program. The department has recently adopted a new technique to help patients learn to practice healthy exercise and eating habits. The purpose of the study is to test the effectiveness of this coaching technique.

You do not have to do anything extra to participate in this study. Your consent simply allows us to include the results of your surveys and other measurements taken during cardiac rehabilitation as part of the group data that will be used to analyze the new coaching technique.

Your involvement in this study is completely voluntary. You may withdraw your consent for participation at any time without having any affect on your care. If you have any questions, please feel free to contact the project director or others listed below.

There are no risks to your participation in the study.

There is no direct benefit for your participation in the study. You will receive the benefits of the new technique through participation in the cardiac rehabilitation program whether or not you consent to participate. By letting the project director use your data you will help provide information about whether this technique is effective for encouraging cardiac rehabilitation patients to adopt healthy exercise and eating habits.

There is no compensation for your participation in the study.

The results of this study will be kept absolutely confidential. Records will be stored in a locked cabinet. Data used in publication of the results will not include your name or any identifying characteristics.

As a research subject, I have read the above, and have had any questions answered. I agree to participate in the research project by allowing the investigator to use my survey results and program measurements to evaluate the new coaching technique. I will receive a copy of this form for my information.

Participant's Signature \_\_\_\_\_ Date \_\_\_\_\_

Witness Signature \_\_\_\_\_ Date \_\_\_\_\_

Project Director's Signature \_\_\_\_\_ Date \_\_\_\_\_

If you have any questions regarding this study, you may contact the Project Director at 605-274-4312, [sherry.barkley@augie.edu](mailto:sherry.barkley@augie.edu); or Dr. Debra Spear, Chairperson of the Human Subjects Committee at 605-688-6578, [Debra\\_Spear@sdstate.edu](mailto:Debra_Spear@sdstate.edu).

## Appendix G

### Intervention Tracking Form

[illegible]

Appendix H  
Intervention Log to be placed on Patient Chart—C group  
Intervention Log for Healthy Eating

Session	6	12	18	24	30
minutes per session					
MET level					
THR					
RPE					
BP Response					
weight gain/loss					
resistance training (start date)	/ /	/ /	/ /	/ /	/ /
rhythm					
education	RF-Y,N,NA ST-Y,N,NA Ex-Y,N,NA Diet-Y,N,NA	RF-Y,N,NA ST-Y,N,NA Ex-Y,N,NA Diet-Y,N,NA	RF-Y,N,NA ST-Y,N,NA Ex-Y,N,NA Diet-Y,N,NA	RF-Y,N,NA ST-Y,N,NA Ex-Y,N,NA Diet-Y,N,NA	RF-Y,N,NA ST-Y,N,NA Ex-Y,N,NA Diet-Y,N,NA
meds correct?	reviewed Y N	reviewed Y N	reviewed Y N	reviewed Y N	reviewed Y N
home activity participation	Y N	Y N	Y N	Y N	Y N
document patient goals for healthy eating					
other?					
confidence to reach goals					
document barrier to healthy eating					
next dr visit/ stress test					
anticipated discharge date					
anticipated HEP after discharge					
employee initials					

(back of page)  
**Goal Setting for Healthy Eating**

Date \_\_\_\_\_

Healthy eating goal for next 2 weeks: \_\_\_\_\_

Confidence to reach goal (1=none, 10=total) \_\_\_\_\_

Obstacles \_\_\_\_\_

Plans to address obstacles \_\_\_\_\_

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Date \_\_\_\_\_

Healthy eating goal for next 2 weeks: \_\_\_\_\_

Confidence to reach goal (1=none, 10=total) \_\_\_\_\_

Obstacles \_\_\_\_\_

Plans to address obstacles \_\_\_\_\_

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Date \_\_\_\_\_

Healthy eating goal for next 2 weeks: \_\_\_\_\_

Confidence to reach goal (1=none, 10=total) \_\_\_\_\_

Obstacles \_\_\_\_\_

Plans to address obstacles \_\_\_\_\_

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Date \_\_\_\_\_

Healthy eating goal for next 2 weeks: \_\_\_\_\_

Confidence to reach goal (1=none, 10=total) \_\_\_\_\_

Obstacles \_\_\_\_\_

Plans to address obstacles \_\_\_\_\_

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