2013

The Role of Rumination, Negative Affect, and Fitness on Cardiac Rehabilitation Program Outcomes following a Discrete Cardiac Event

Nathaniel Jay DeYoung
Purdue University

Graduate School ETD Form 9
(Revised 12/07)

PURDUE UNIVERSITY
GRADUATE SCHOOL
Thesis/Dissertation Acceptance

This is to certify that the thesis/dissertation prepared

By Nathaniel Jay DeYoung

Entitled

The Role of Rumination, Negative Affect, and Fitness on Cardiac Rehabilitation Program Outcomes Following a Discrete Cardiac Event

For the degree of Doctor of Philosophy

Is approved by the final examining committee:

Anthony Conger
Chair

David Rollock

Susan South

Elaine Willerton

To the best of my knowledge and as understood by the student in the *Research Integrity and Copyright Disclaimer (Graduate School Form 20)*, this thesis/dissertation adheres to the provisions of Purdue University's "Policy on Integrity in Research" and the use of copyrighted material.

Approved by Major Professor(s): Anthony Conger

Approved by: Christopher R. Agnew 3/22/13
Head of the Graduate Program Date

THE ROLE OF RUMINATION, NEGATIVE AFFECT, AND FITNESS ON CARDIAC REHABILITATION PROGRAM OUTCOMES FOLLOWING A DISCRETE CARDIAC EVENT

A Dissertation

Submitted to the Faculty

of

Purdue University

by

Nathaniel J. DeYoung

In Partial Fulfillment of the

Requirements for the Degree

of

Doctor of Philosophy

May 2013

Purdue University

West Lafayette, Indiana

For my wife Elizabeth

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

Appendix Table Page

Appendix Table Page

LIST OF FIGURES

LIST OF ABBREVIATIONS

6MWT: Six Minute Walk Test

BMI: Body Mass Index

CABG: Coronary Artery Bypass Graft

CR: Cardiac Rehabilitation

CRRQ_pos: Cardiac Rehabilitation Rumination Questionnaire- Positive

CRRQ_neg: Cardiac Rehabilitation Rumination Questionnaire - Negative

CVD: Cardiovascular Disease

HADS_anx: Hospital Anxiety and Depression Scale- Anxiety

HADS_dep: Hospital Anxiety and Depression Scale- Depression

MI: Myocardial Infarction

PSS: Perceived Stress Scale

PSWQ: Penn State Worry Questionnaire

PTCA: Percutaneous Trans Luminal Coronary Angioplasty

RRS_brooding: Rumination Response Scale-Brooding

RRS_reflection: Rumination Response Scale- Reflection

RSS: Rumination on Sadness Scale

ABSTRACT

DeYoung, Nathaniel J. Ph.D., Purdue University, May 2013. The Role of Rumination, Negative Affect, and Fitness on Cardiac Rehabilitation Program Outcomes Following a Discrete Cardiac Event. Major Professor: Anthony Conger

Individuals with cardiovascular disease are at an increased risk for anxiety, depression, stress, and other negative cognitive processes. Following a cardiovascular event such as a myocardial infarction or open heart surgery, cardiac rehabilitation (CR) can have large physical and psychological benefits. This study investigates the role of depression, anxiety, and rumination on CR outcomes including program completion and fitness improvements. Fifty-one patients with cardiovascular disease who were enrolled in CR were tracked over the course of their treatment. Objective fitness testing was completed prior to and after CR program completion. Self-reported psychological, health, and fitness data were gathered at weeks 1, 3 and 8 of CR for each participant. In this study, CR drop-out was predicted by participants who had poorer emotional wellbeing, better self-rated general health, and lower levels of rumination. Initial physical functioning was predicted by depression, while post physical functioning was predicted by both rumination and anxiety. Participants also reported significant health, fitness, and psychological improvements over the course of CR. Overall, this study demonstrates the positive effects of CR on wellness. While depression and anxiety had a negative impact on fitness and program completion,

higher levels of rumination were associated with more positive outcomes in terms of program completion and final physical fitness.

INTRODUCTION

The National Institute of Health estimates that 26.8 million non-institutionalized adults in the United States currently suffer from cardiovascular disease (CVD; Pleis, Ward, & Lucas, 2010). CVD is and has long been the leading cause of death for American men and women. In 2009, the Center for Disease Control and Prevention estimated that 599,413 US deaths were the result of heart disease (Hoyert & Xu, 2012). It currently accounts for 26% to 30% of all deaths in the United States each year (Heron, Murphy, Jiaquan, Kochanek, & Betzaida, 2009). The estimated economic cost of treating and managing CVD in 2009 was roughly 300 billion dollars after accounting for health care services, medications, and lost productivity (Lloyd-Jones et al., 2010). While advances in medicine have improved the long term outcomes for individuals diagnosed with CVD, the American Heart Association (AHA) estimated that 470,000 individuals had a recurrent cardiac event in 2010.

Psychosocial Consequences of Cardiovascular Disease

The relationships between CVD and mood symptoms have been thoroughly investigated. In the general United Stated population, the Center for Disease Control and Prevention (2010) estimated that 8.7%-9.3% of all adults meet criteria for major depression or dysthymia in any 2-week span. Estimates of the lifetime prevalence rate of depression among adults ranges between 13.0% and 16.6% (Bromet et al., 2011;

Kessler et al., 2005; Musselman, Evans, & Nemeroff, 1998). However, the estimated point prevalence of depression within a population diagnosed with CVD rises to somewhere between 15% and 20% (Lavie, Milani, Cassidy, & Gilliland, 1999; Musselman, Evans, & Nemeroff, 1998). The AHA estimates that individuals with CVD are approximately 3 times more likely to experience major depression compared to a community sample (Rozanski, Blumenthal, & Kaplan, 1999). Furthermore, the prevalence of depression symptoms following a cardiovascular event may be particularly high for women (Lavie et al., 1999; Szczepanska-Gieracha, Morka, Kowalska, Kustrzycki, & Rymaszewska. 2012). Anxiety symptoms also appear to be exacerbated for individuals diagnosed with CVD. There is an estimated 1-year prevalence rate of 10.6% in the general population for having at least one diagnosable anxiety disorder; however, the Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.) estimates that the point prevalence of generalized anxiety disorder to be only 3% (American Psychiatric Association, 2000; Somers, Goldner, Waraich, & Hsu, 2006). In a community sample of older adults with CVD, the prevalence rate of diagnosable DSM-IV-TR anxiety disorders was estimated at 14.8% (Grenier et al., 2012).

Beyond the traditional vascular, smoking, unhealthy diet and physical inactivity risk factors for CVD, several psychosocial factors also have a prospective influence on the likelihood of an individual to develop CVD. Emotional factors such as anxiety, depression, and anger/hostility have all been shown to be putative risk factors for CVD (Dimsdale, 2008; Rozanski, Blumenthal, Davidson, Saab, & Kubzansky, 2005; Suls & Bunde, 2005). The stress resulting from low social economic status, work status,

marital problems, and decreased social support also can contribute to adverse cardiac events (Rozanski et al., 2005). Furthermore, these risk factors do not operate in isolation and often overlap or cluster together. When studied independently, anxiety, depression, stress, social support/isolation, and hostility/type A personality traits all negatively impacted health outcomes for individuals diagnosed with CVD (Kuper, Marmot, & Hemingway, 2002; Rozanski, Blumenthal, & Kaplan, 1999; Smith & Ruiz, 2002; Suls & Bunde, 2005). When these psychological factors were studied together, anxiety and depression symptoms were the largest psychological predictors of a recurrent CVD event (Grewal, Gravely-Witte, Stewart, & Grace, 2011). Depression symptoms carry a relative risk comparable to hypertension, smoking, diabetes, and high cholesterol when looking at the occurrence of future CVD (Rozanski et al., 2005). In a study including 15,000 cases across 52 countries, a composite psychological variable including depression, stress, life events, and locus of control was found to be as large of a risk factor for developing CVD as other traditional risk factors (Yusuf et al., 2004).

Not only can psychological factors significantly increase the risk factors for CVD, but there is considerable evidence that the presence of anxiety and depression after a cardiovascular event can adversely affect the recovery process (Lavie, Thomas, Squires, Allison, & Milani 2009; Rozanski et al., 2005). While internalizing symptoms following a cardiovascular event can predict impaired quality of life and mortality at 12-months following a myocardial infarction, cardiac rehabilitation or exercise training programs have been shown to moderate these negative effects (Lane et al, 2001; Yohannes, Doherty, Bundy, & Yalfani, 2010).

Cardiac Rehabilitation Following a Cardiovascular Event

Cardiac rehabilitation (CR) is defined by the AHA as, "the coordinated multifaceted interventions designed to optimize a cardiac patient's physical, psychological, and social functioning, in addition to stabilizing, slowing or even reversing the progression of the underlying atherosclerotic processes, thereby reducing morbidity and mortality" (Leon et al., 2005). The obvious biopsychosocial orientation of this definition lends itself well to holistic and comprehensive care programs (Stephens, 2009). Structured CR programs are specifically well-suited to incorporate the key elements of secondary prevention by incorporating elements of risk factor reduction, nutrition guidelines, physical activity counseling, and psychological monitoring (Stephens, 2009). In order to monitor and accommodate all of these facets, it is recommended that CR programs individualize the care and treatment goals for each patient. This assures that all patients can be assessed for specific risk factors that may inhibit treatment gains and improvements in their quality of life (Yohannes et al., 2010).

Traditionally, CR is recommended for patients following acute myocardial infarctions. As such, comprehensive CR has garnered strong empirical support for reducing mortality and morbidity within this population (Thompson et al., 2003, Jolliffe et al., 2001; Rees et al., 2004). However, patients with other forms of heart disease also benefit from CR. A review of 47 studies which included 10,794 patients with histories of coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI), or a myocardial infarction (MI) were assigned to CR or care as usual. The results found that CR decreased overall cardiovascular specific mortality

rates in the long term compared to care as usual (>12 months follow-up; Heran et al., 2011). CR also significantly decreased the risk of additional hospital admissions within the first 12 months following the cardiac event (Heran et al., 2011). While there is less research investigating the health benefits of CR for patients with histories of stable angina pectoris, atherosclerotic peripheral vascular disease, heart transplant, stable congestive heart failure, valvular surgery, and ventricular assist devices, CR is still considered an empirically supported intervention (Leon et al., 2005; Gibbons et al., 2002; Hambrecht et al., 2000; Hedbäck, Perk, Hornbland, & Ohlsson, 2001; Jairath, Salerno, Chapman, Dornan, & Weisel, 1995; Kobashigawa et al., 1999; Piepoli, Davos, Francis, & Coats, 2004). Regardless of a patient's precipitating reason for attending CR, participation in CR has been shown to significantly improve multiple measures of individual fitness (Bjarnason-Wehrens et al., 2003; Lavie & Milani, 1997). While Egger, Schmid, Schmid, Saner, & von Kanel (2008) found that participants' exercise capacity increased significantly after completing CR, participants' body mass index did not improve. Bjarnason-Wehrens et al. (2003) found that CR significantly improved participants' exercise capacity, cholesterol levels, BMI, and ability to stop smoking.

Psychological Benefits of Cardiac Rehabilitation

An overwhelming number of studies show that CR has a positive impact on psychological variables including: general psychological stress, depression, anxiety, and hostility (Becki, Beckstead, Schocken, Evan, & Fletcher, 2011; Blumenthal et al., 2012; Egger et al., 2008; Lavie, Milani, O'Keefe, & Lavie, 2011; Milani, Lavie, & Cassidy, 1996; Sharif, Shoul, Janati, Kjuri, & Zare, 2012; Yohannes et al., 2010). Studies consistently report 40% to 50% reduction in the depressive symptoms reported

by CR patients who were identified as being depressed at the onset of CR (Lavie et al., 2011; Milani & Lavie, 2007). Milani et al. (1996) compared the pre and post CR scores of 69 depressed participants and found significant reductions in depression, anxiety, and hostility. This study also indicated that even nondepressed participants experienced significantly less anxiety after completing the CR program. Artham, Lavie, and Milani (2008) tracked 500 patients with coronary artery disease as they completed CR and found similar results. The 115 participants who reported the least amount of initial psychological distress still experienced a significant decline in their levels of anxiety and depression over the course of CR. Finally, Yohannes et al. (2010) found that twice-weekly CR over 6 weeks led to significant improvements in depression symptoms, and these gains remained significant even at a 12-month follow-up screening. Lavie et al., (2011) found that 27-28% of their CR samples were identified as having clinical levels of anxiety. However, they reported reductions in the prevalence of anxiety symptoms by more than 50% at the end of CR.

The underlying mechanisms of the psychological improvements observed during CR involve multiple factors that include behavioral, biological, and social changes. Additionally, there is likely a reciprocal relationship between internalizing symptoms and CR outcomes. Not only does CR improve psychological outcomes, but psychological variables impact CR efficacy (Lavie et al., 2011. Szczepanska-Gieracha et al., 2012). While individuals with CVD clearly benefit in many ways from CR exercise training, the mechanisms underlying these processes continue to be explored and refined. (Lavie et al., 2011; Yohannes et al., 2010).

Known Factors That Influence Cardiac Rehabilitation Outcomes

Although CR is an empirically supported treatment for CVD, up to half of all participants who are referred to a CR program do not attend (Clark et al., 2012; Dunlay et al., 2009). A review of 90 studies that investigated participants' reasons for not attending CR programs identified multiple factors that influence this decision. Clark et al. (2012) demonstrated that low insight and knowledge about CR, hopelessness about possible health gains, female gender, work constraints, conflicting priorities, avoidance, and other psychological variables could all decrease the likelihood of participants' participation in CR. Not only do these factors influence the likelihood of not starting a CR program, but many of them are also related to CR outcomes. The likelihood of patients dropping out of CR prior to completing the prescribed treatment is also high. Previous studies recorded drop-out rates ranging from 20 to 60 percent (Simms et al, 2007; Worcester, Murphy, Mee, Roberts, & Goble, 2004; Yohannes, Yalfani, Doherty, & Bundy, 2007). In particular, the impact of gender and depression/anxiety on CR outcomes has been targeted as significant moderators of CR attendance, drop-out, and functional improvement in CR. Other frequently cited factors that affect CR participation include age, illness severity, medical history, and past CR experience (Dunlay et al., 2009).

Gender

The largest issue surrounding gender and CR is that women are less likely to participate in a CR program and more likely to drop-out (Dunlay et al., 2009; Yohannes et al., 2007). This could be due in part to the financial and social costs of CR participation (Clark et al., 2012). Furthermore, women may receive less social

support and may have more family responsibilities that act as barriers to CR participation. Women also tend to be more ill compared to men when starting CR. A study that tracked 228 women enrolled in CR found that almost half (42%) of the sample was considered "high risk" due to their medical conditions and their level of physical fitness (Sanderson & Bittner, 2005). Lavie and Milani (1995) looked at gender differences prior to CR and found that women were more likely to have hypertension and diabetes compared to men, and that women had significantly higher cholesterol levels, percent body fat, and lower exercise capacities. Because of these differences and the fact that women exhibit higher levels of depression, there has been an increasing number of gender tailored CR programs (Beckie, Beckstead, Schocken, Evans, & Fletcher, 2011). As expected, women who complete CR see significant health and psychological improvements (Lavie & Milani, 1995; Sanderson & Bittner, 2005). However, Lavie and Milani, (1995) are the only investigators to test gender as a moderator for psychological and physiological improvement in CR, and they found no significant findings.

Depression and Anxiety

As mentioned earlier, there is a reciprocal relationship between psychological distress and CR outcomes. Moderate to high levels of depression (BDI >14) has been shown to be a significant predictor of participant drop-out from CR (Caulin-Glaser, Maciejewski, Snow, LaLonde, & Mazure, 2007). This appears to be a consistent finding across multiple other studies (Glazer, Emery, Frid, & Banyasz, 2002; Grace et al., 2005; Swardfager et al., 2011). Furthermore, elevated depression can be the strongest predictor of CR drop-out when compared to age, gender, race, marital status,

diagnosis, and smoking status (Swardfager et al., 2011). Caulin-Glaser et al. (2007) found that the exercise capacity of both depressed and nondepressed participants improved over the course of CR. However, the improvement in exercise capacity for non-depressed participants was significantly larger than the improvement observed in depressed participants (Caulin-Glaser et al., 2007; Swardfager et al., 2011). Egger et al., (2008) also found that depression was a significant negative predictor of exercise capacity improvement after completing CR. Yet, contrary to their expectations, higher levels of anxiety led to larger exercise capacity gains in CR. They concluded that increased levels of anxiety helped motivate participants to engage in exercise more intensely (Egger et al., 2008). Contrary to these results, other studies found that both anxiety and depression limit the success of a CR intervention (Kerins, McKee, & Bennett, 2011; French et al., 2005; Rees et al., 2004b; Yohannes et al., 2010).

The Role of Rumination in Cardiac Rehabilitation

The effects of rumination on CR participation and outcomes have not yet been investigated. However, rumination may be a particularly important cognitive process, in addition to depression and anxiety, for clinical providers to identify and monitor as patients begin and progress through CR. As CR programs strive to individualize and tailor treatment to each patient's diagnosis, symptoms, and level of fitness, exploring these relationships can continue to increase the effectiveness of these programs.

Rumination is a cognitive process comprised of self-focused, repetitive, and intrusive thoughts that persist over time (Papageorgiou & Wells, 2004). A large amount of heterogeneity is present among the developed rumination conceptualizations, and these differences can significantly alter the results and

conclusions of a study. Dysphoric rumination occurs in response to distress and involves ruminating on negative thoughts and feelings (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Dysphoric rumination, as measured by the Response Style Questionnaire (RSQ) and the Rumination on Sadness Scale (RSS), looks at an individual's repetitive and passive focus on internal symptoms of depression and the meaning, causes, and consequences of those feelings (Nolen-Hoeksema, 1991). Individuals engage in this type of rumination believing that it will help them generate solutions to their distress. Unfortunately, this type of rumination has been shown to promote a passive state during which individuals perseverate on their thoughts, feelings, and problems without taking any further action. The perseveration on the negative emotions and affect, not specifically the origin of the distress, is a key feature in this conceptualization of rumination (Nolen-Hoeksema et al., 2008).

Other theorists consider rumination to be an event-based cognitive process (Abbott & Rapee, 2004; Clark & Wells, 1995; Kashdan & Roberts, 2007; Martin & Tesser, 1996). For example, Martin and Tesser (1996) posited that rumination is a class of repetitive thoughts that is centered on a specific theme or event and occur following a discrepancy between a person's current state versus their expectations. Post-event rumination theories move the focus of the cognitions from internal feelings to external and concrete events (Abbott & Rapee, 2004). According to Kashdan and Roberts (2007), post-event rumination involves "repetitive thoughts about subjective experiences during a recent social interaction, including self-appraisals and external evaluations of partners and other details involving the event." While the dysphoric rumination construct is linked with depression, the situational evaluation of post-event

rumination conforms more naturally to symptoms of anxiety (Clark & Wells, 1995; Kashdan & Roberts, 2007).

Rumination, regardless of the conceptualization, has generated a large amount of interest as a cognitive process associated with anxiety, depression, and other negative psychosocial variables such as negatively biased thinking, poor problem solving, impaired motivation, and impaired concentration (Baer & Sauer, 2011; Hughes, Alloy, & Cogswell, 2008; Lyubomirsky & Tkach, 2004; Nolen-Hoeksema, Stice, Wade, & Bohon, 2007). Because anxiety and depression are key psychological variables that impact the success of CR (Grewal et al., 2011), both forms of rumination may be well-suited for predicting CR participation and health outcomes following CR and improving CR programs in general.

Negative Consequences of Rumination

Rumination is closely related to intense and negative affect, and individuals who ruminate frequently may experience negative physical effects due to long exposure to these emotional states. A strong body of literature currently links rumination with prolonged bodily responses (Thomsen, 2006). Dysphoric rumination has a negative impact on physiology by impeding cardiovascular recovery and increasing blood pressure (Key, Campbell, & Bacon, 2008; Verkuil, Brosschor, de Beurs, & Thayer, 2009; Vickers & Vogeltanz-Holm, 2003). For example, individuals who demonstrated higher levels of rumination remembered stressful tasks, such as the Stroop task, longer and showed slowed heart rate recovery (Roger & Jamieson, 1988). There is evidence that the effects of rumination can last over longer periods of time. When compared to low ruminators, students who scored higher on measures of

rumination showed slower urinary cortisol recovery three weeks following an examination (Roger & Najarian, 1998). These findings suggest that rumination is associated in some manner to both cardiovascular and hormonal responses. Studies that look at health outcomes outside of the laboratory setting frequently use self-report questionnaires to assess the physiological health of each person. Previous findings using this method indicate that rumination is able to predict somatic symptoms (Lok & Bishop, 1999; Rector & Roger, 1996). Thomsen et al., (2004) found that within an elderly sample, rumination was a significant predictor of self-reported physical health. In addition, this association appeared to be mediated by negative affect.

Rumination and Cardiac Rehabilitation

There is very little research studying the role and effect of rumination on psychological and physical health within a CVD population. There is even less research investigating the role of rumination within a CR context. Within a CVD population, the presence of anxiety, depression, hostility, and other maladaptive psychological processes could indicate poor emotional regulation and increased levels of rumination (Garnefski et al., 2009). Fear of death, a recurrent cardiac event, physical limitations, and inability to work are frequently listed as causes of anxiety following a CVD event (Higgins, Murphy, Nicholas, Worcester, & Linder, 2007). These fears could represent, or be similar to, event-related rumination. Dimsdale (2008) suggests that cardiovascular responses to stressors are typically highly functional; however, the heart can experience adverse effects if a patient continues to propagate the stressor though brooding. If patients engage in continuous and intense rumination, it could possibly lead to poor physical and psychological outcomes in CR.

The rumination conceptualizations described above may not necessarily predict only negative outcomes. The Martin and Tesser (1994) conceptualization of rumination specifically allows for positive emotions to result following rumination. Patients in CR may ruminate in a positive manner regarding their progress in CR. CR staff report that some patients had expected to die from their CVD event, but because a medical intervention saved them and the follow-up CR care helps them improve their health, they may ruminate about how lucky they are to be alive and experiencing improvement. Other patients report frequent thoughts regarding the unpleasantness of their CVD event but use these thoughts as a source of motivation to minimize the risk of a future CVD event. In cases such as these, rumination may indicate that patients understand the severity of their condition and the importance of CR to improve their quality of life.

Overall, there may be an optimal level of rumination that motivates patients to attend CR and allows them to experience the full benefits from the exercise training. This would parallel the findings that CR participants with higher levels of anxiety experienced the largest fitness gains (Egger et al. 2008). Patients who report no or very low levels of rumination may be ambivalent about their CVD and current health problems. These patients may be less likely to follow through with the recommended CR treatment. Patients with very high levels of rumination may be perseverating on their negative emotions and may have more difficulty overcoming the problems that arise as part of the CVD and the barriers that may prevent them from attending CR. This too may be supported by research showing that elevated levels of depression can lead to poor CR outcomes.

Specific Research Questions

As reviewed, there is ample evidence that depression and anxiety are common symptoms after a cardiovascular event and that CR has a significant and positive effect on these symptoms. This is the first study to adequately investigate the role of rumination in CR. Additionally, the majority of past work looking at the effects of psychological variables within CR has looked at each variable in isolation. This study is able to comprehensively look at how illness severity, gender, and rumination impact physical, psychological, and self-perceived fitness outcomes in a CR program. The following hypotheses are proposed:

1) The overall rates of clinical levels of depression and anxiety will be higher than the general population estimates (9.3% for depression and 3% for anxiety). It is expected that females will have higher levels of depression and anxiety symptoms and higher prevalence rates of clinical symptoms compared to men.
2) Participants' levels of depression, anxiety, and rumination will decrease while physical fitness will increase as a result of cardiac rehabilitation. These improvements will be moderated by gender and severity of illness.
3) CR drop-out will be more prevalent for females, participants with clinical levels of mood symptoms, and higher levels of illness severity. Additionally, participants with very high or very low

levels of rumination will be more likely to drop-out of cardiac rehabilitation.

4) High levels of depression and either high or low levels of rumination will predict lower physical fitness.

METHOD

Participants

Individuals were recruited through the Phase II Cardiac Rehabilitation program at Franciscan St. Elizabeth Health, Lafayette Central Hospital. The CR program at Franciscan St. Elizabeth Health, Lafayette Central Hospital is accredited through the American Association of Cardiovascular and Pulmonary Rehabilitation (AACPR). Patients were invited to participate during their first exercise session following their orientation to CR. Over a 6-month period, 80 individuals entered the CR program and completed at least one full exercise session. Seven of these patients were not invited to participate. Three of the excluded patients did not speak English; three showed signs of confusion or cognitive decline, and one patient transferred to Franciscan St. Elizabeth from a different rehabilitation program. Of the remaining 73 eligible patients, 54 agreed to participate in the study. Patients who declined listed reasons such as not being interested, feeling overwhelmed, and being unwilling to fill out more paperwork. Three participants who agreed to participate did not return to the CR program following their first exercise session. The final sample consisted of 51 participants (Table 1).

The mean age of the participants was 61.27 (SD = 10.48) years. The youngest participant was 40 years while the oldest participant was 80 years old. Fifty of the

participants were Euro-American. Thirty-five (68.6%) of the participants were male. Thirty-eight (74.5%) of the participants were married; five were single; four were divorced, and four were widowed. On average, 23.1 (*SD* = 18.2) days elapsed between the patient's cardiac event and the start of phase II CR services. Medical records indicated that 9 participants had a history of previous heart disease (2 myocardial infarctions, 7 stents/PTCA, and 4 CABG).

Procedure

Participants were referred by their medical doctors to the CR program after a discrete cardiac event. Cardiac events included myocardial infarctions, bypass surgeries, stents or angioplasty, valve repair or replacement, and initial diagnosis or exacerbation of cardiomyopathy (See Table 1). The CR program at Franciscan St. Elizabeth Health, Lafayette Central Hospital is a comprehensive rehabilitation program that involves telemetry monitored exercise, education, and risk factor modification.

Cardiac rehabilitation staff collected a large amount of information from the participants as part of the standard protocol of the program. During the CR orientation interview, each participant's medical health history and current medications were recorded. CR staff assessed each participant's risk factors, previous and current exercise levels, orthopedic limitations, and CR goals. The orientation interview included a standardized fitness test (described below). At the start of the CR program, participants filled out questionnaires that measured their global functioning.

Each participant was prescribed an individual exercise plan that accounted for the results of the fitness testing, the medical chart review, and orientation interview. This information was used to determine each participant's risk level. Participants were

identified as low, moderate, or high risk, and this level determined whether they were scheduled for 12, 24, or 36 exercise sessions. Appendix C outlines how the specific variables were used to calculate the risk level. The parameters used to determine participant risk stratification are the risk factors recommended by the AACPR. While other CR programs could calculate risk stratification using a different method, the AACPR accreditation procedure and insurance policies ensure that the majority of CR programs follow the same guidelines. Participants were encouraged to attend CR three times a week for 30 to 60 minutes of exercise each session.

Following the orientation interview, participants were taught how to use the CR exercise equipment and how to report their level of perceived exertion. During regular exercise sessions, participants came at a scheduled time, weighed in at the front desk, connected to the telemetry monitors, sat for a resting blood pressure and heart rate, stretched and warmed up, and then started their aerobic exercise. A variety of exercise machines were available for use by the participants (treadmills, stationary bikes, rowing machines, etc.). Participants consulted with CR staff when choosing their specific exercise modalities.

Additionally, there were 15 voluntary educational classes that covered heart healthy nutrition, the benefits of exercise, stress management, risk factor modification, and coping with heart disease. At the end of the program, participants underwent an exit interview by CR staff. The global functioning questionnaire and the standardized fitness test were repeated at this time. Because some participants left the CR program without completing the exit procedures, only 40 participants completed the final fitness test. The self-report questionnaires and physiological data are described in detail in the

cardiac rehab data section below. Participants signed a release of medical information form that granted the researcher permission to access and record their medical information.

Participants were scheduled to complete a psychological questionnaire packet during the first, third, and eighth weeks of their rehabilitation. The packet consisted of seven self-report scales that assessed mood, cognitions, and global functioning (described below). Participants who were only scheduled for 12 rehabilitation sessions were only able to fill out the survey twice due to the time constraint. Due to participant drop-out and early CR program completion, the number of participants filling out the psychological survey packet decreased at each time point. Week 1 included all 51 participants, week 3 included 47 participants, and week 8 included 31 participants. See Appendix D for a flow chart of study events.

Participants received 10 dollars for each packet they completed. Completing the packet took participants between 15 and 30 minutes. If participants were unable to fill out their packet at their originally scheduled time, they were rescheduled to do so as soon as possible. Most participants were able to fill out the survey within a one week window; however, longer delays did occur when participants did not frequently attend CR. When participants neared the end of their CR, they were given an open ended questionnaire to take home and return by mail. The questions focused on the participants' experiences over the course of their rehabilitation.

Demographic Variables

Medical Records

Basic demographic and medical information was collected through each participant's medical record. This provided age, ethnicity, marital status, smoking history, risk factors (dyslipidemia, hypertension, physical inactivity, family history of heart disease, diabetes, stress, and obesity), date of the cardiac event, nature of the cardiac event, angina symptoms, previous health conditions, and a list of current medications. The medical record also indicated if participants completed, finished early, or dropped out of the CR program unexpectedly.

Psychological Questionnaires

All of the psychological questionnaires were filled out by the participants at weeks 1, 3, and 8. The following questionnaires were not part of the formal CR treatment program. They were included for the sole purpose of this study. Reliability estimates for each measure are included in Table 2.

Cardiac Rehabilitation Rumination Questionnaire (CRRQ)

The CRRQ was used to measure event-related rumination in the context of CR following an event due to cardiovascular disease. No event-related rumination scales were appropriate for this specific project, so 10 items were developed based on CR staff reports of topics that patients frequently mentioned during the course of CR. Five items asked about frequency of positive thoughts that could be specific to CR and 5 items addressed the frequency of negative thoughts specific to CR. Participants were asked to indicate how frequently, over the past two weeks, they thought about the positive and negative aspects of the event that led them to CR. Responses were made

on a 5-point scale ranging from 1 (“Never”) to 5 (“Very Often”). Because this measure was created specifically for this study, there is no historical validity and reliability data. However, the current reliability data from this study is presented in Table 2.

Hospital Anxiety and Depression Scale (HADS)

The HADS is a self-assessment scale that was developed specifically to detect depression and anxiety symptoms in a medical outpatient clinic (Zigmond & Snaith, 1983). Since its inception, the HADS has been validated in a variety of clinical and community adult populations (Arving, Glimelius, & Brandberg, 2008; Caci, Bayle, Mattei, Dossios, Robert, & Boyer, 2003; Herrmann, 1997; Mykletun, Strodal, & Dahl, 2001). Of particular importance, this scale has also been validated for patients with heart disease (Martin, Thomson, & Chan, 2004). The scale consists of 14 items that are equally split between anxiety and depression statements. Participants were asked to complete the scale by rating how they have felt over the previous 2 weeks using a 4-point scale ranging from 0 (absence of symptoms) to 4 (severe symptoms). The HADS –anxiety and HADS-depression also has reportedly high internal consistency (anxiety Cronbach's alphas between 0.40 and 0.74; depression Cronbach's alphas between 0.67 and 0.82; Bjelland, Dahl, Haug, & Neckelmann, 2002). A review of 747 papers using the HADS found that using a clinical cutoff score of 8 or higher for both subscales resulted in the best balance between sensitivity and specificity when attempting to identify depression and anxiety disorders (Bjelland et al, 2002).

Penn State Worry Questionnaire (PSWQ)

The PSWQ is a self-report scale developed to measure trait worry that is clinically significant (Meyer et al., 1990). Parallel to the diagnostic criteria listed for

generalized anxiety disorder in the DSM-IV, the PSWQ assesses for worry over time and situations, the intensity and excessive nature of the thoughts, and the uncontrollability of the cognitive process (Molina & Borkovec, 1994). The PSWQ also has reportedly high internal consistency within clinical populations (Cronbach's alphas between 0.86 and 0.93; see Brown, et al., 1992). Studies investigating the structure of the PSWQ typically result in strong support for a single worry dimension (van Rijsoort, Emmelkamp, & Geert Vervaeke, 1999). Participants were asked to rate 16 statements on a scale of 1 ("Not at all typical of me") to 5 ("Very typical of me").

Perceived Stress Scale (PPS)

The PPS is a 10-item self-report scale developed to measure the degree to which each participant perceives and appraises recent life events as stressful (Cohen & Williamson, 1988). The PPS has been shown to have adequate internal consistency (Cronbach's alpha = 0.78; Roberti, Harrington, & Storch, 2006). Participants were asked to reflect over the previous two weeks and answer questions regarding their feelings and thoughts on a 5-point scale that ranges from 1 ("Never") to 5 ("Very Often").

Ruminative Response Scale-Short Form (RRS)

The RRS was developed as a measure of dysphoric rumination (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). The short form version of this scale is an adaptation from the original 22-item RRS developed by Nolen-Hoeksema (1991). The RRS looks at two specific rumination factors: brooding and reflection. The brooding factor is considered the more maladaptive factor which represents the worried preoccupation aspect of rumination and is assessed using 5 of the 10 items of the RRS.

The reflection factor is thought to represent the introspective aspect of rumination and is constructed using the remaining 5 items. Using a 5-point Likert scale (1 = "Never"; 5 = "Very Often"), participants will answer questions regarding how they typically respond to a sad mood. Treynor et al. (2003) reported good internal consistency for both the brooding (Cronbach's alpha = .77) and the reflection (Cronbach's alpha = .74) subscales. For this study, two items were slightly reworded to specifically reference the participant's cardiac event.

Rumination on Sadness Scale-Cardiac Version (RSS)

The RSS is an alternative measure of dysphoric rumination developed to address many of the criticisms faced by the RRS measure (Conway, Csank, Holm, & Blake, 2000). The original version of the RSS asks participants to report their level of rumination when in a negative or sad mood. The scale has been used with both clinical and non-clinical samples and elicits responses to 13 items on a 5-point Likert scale (1 = not at all; 5 = very much). Conway et al. (2000) reported good internal consistency (Cronbach's alpha = 0.88) for the measure in a non-clinical sample. In order to increase the relevance of the questions for the CR participants, seven of the 13 items were minimally reworded. Within these items, the word "sadness" was replaced with the phrase "cardiac event."

Self-Reported Physical Functioning

Short Form-36 Health Survey (SF-36)

The SF-36 is a health questionnaire developed and distributed by RAND. Originally, it was used as part of a RAND study designed to explain variation in medical patient outcomes. The SF-36 consists of generic, coherent, and easily

understood questions that assess an individual's quality of life. This measure is now utilized by a large number of managed care organizations and Medicare as part of routine monitoring and assessment of health outcomes for adult patients (Hays, Sherbourne, & Mazel, 1993). The SF-36 contains 36 items that examine 8 health domains: physical functioning, pain, role limitations due to physical health, role limitations due to psychological health, emotional well-being, social functioning, energy level, and general health. The 36 items are a mix of true or false responses and Likert ratings which are used to create 8 scales that correspond directly to the 8 health domains. Appendix E shows which items fall under each of the 8 domains. The number of items and the reliability estimate for each of the 8 scales is included in Table 2. A number of studies have favorably reported evidence for the validity of the measure (Jenkinson, Wright, & Coulter, 1994; Keller et al., 1998; McHorney, Ware, & Raczek, 1993). The SF-36 was administered as part of the psychology survey packet that was administered to participants at weeks 1, 3, and 8. Estimates of internal consistency were higher than 0.78 or higher for every scale (Hays et al., 1993)

The Dartmouth COOP (COOP)

The COOP uses nine single item illustrated scales that measure core aspects of functioning. Domains include physical fitness, feelings, daily activities, social activities, pain, social support, change in health and overall health. The nine scales can be broken into areas of current functioning, overall well-being, and quality of life. Each scale consists of a title, simple question, and five response statements. Each possible response is described both in words and with an illustration along a 5-point ordinal scale. High numbered responses represent impaired functioning or negative

states. The COOP manual indicates that it is both a reliable and valid instrument for assessing the nine domains across a variety of healthy and clinical populations (see van Weel, Konig-Zahn, Touw-Otten, van Duijn, & Meyboom – de Jong, 1995). This COOP was part of the formal CR program and was conducted prior to and after completing CR.

Objective Physical Fitness Variables

The Six Minute Walk Test (6MWT)

The guidelines for the 6MWT were developed by the American Thoracic Society Functional Standards Committee. The 6MWT is preferred to other exercise tests because it is easy to conduct, can fairly accurately predict morbidity and mortality from heart disease, and is better tolerated by elderly and medically ill patients compared to more stringent fitness tests. The 6MWT is frequently used to test the effectiveness of pulmonary and cardiac rehabilitation treatments (American Thoracic Society, 2002; Enright, 2003). For the 6MWT, participants were instructed to wear comfortable clothing and shoes appropriate for walking. Participants were instructed to "walk as far as possible for 6 minutes." Participants walked back and forth along a 100ft segment of the hallway. The primary variable for the 6MWT is the distance, in feet, that participants are able to cover in 6 minutes. Ancillary 6MWT variables include each participant's resting, peak, and recovery heart rates measured in beats per minute. Participant's resting, peak, and recovery blood pressures (systolic mmHg/diastolic mmHg) were also collected. Each participant's weight, height, Body Mass Index, and percent body fat were also taken at this time. This fitness test was part of the formal CR program and was conducted prior to and after CR (Appendix D).

Qualitative Data

Prior to exiting the CR program, participants were asked to respond to five open-ended questions regarding their experiences going through CR. The questions asked about anticipated, positive, and negative aspects of their CR experience. The questions included 1) What changes in your health were you hoping to see by coming to Cardiac Rehab? 2) What results do you think you have achieved? 3) What do you believe has helped you achieve these results? 4) What did you not achieve that you had hoped to? 5) What do you believe hindered you from achieving more? Participants were asked to fill out the questionnaire at home and were provided with a pre-stamped envelope to return the questionnaire by mail.

RESULTS

Statement Regarding Organization and Structure of the Results Section

Because of the length and complexity of the results section, it is beneficial to describe how the results section is organized. As with the methods section, the results are presented by variable category in the following order: demographic, psychological, self-reported health and fitness, and objective physical fitness. For each variable category, the interrelationships among the variables are described; the effects of gender and illness severity are defined; and the changes seen over time are reported. The first demographic variable section is shortened since demographic variables did not change over time and because the interrelationships among the variables included gender. Additionally, the final portion of the quantitative results is also structured slightly differently since it is designed to pull all of the categories together in order to predict program completion and fitness outcomes. A summary of the qualitative survey responses is included at the end of the results section.

Demographic Variables

Interrelationships Among Demographic Variables

Participant characteristics were compared by gender (Table 1). The 16 female participants had higher percent body fat compared to the 35 male participants. Participants' BMI, which takes into account height (females were significantly shorter

and tended to weigh less) did not differ between genders. Males and female participants did not differ significantly by age ($t(49) = -0.331$, $p = 0.742$). Female participants had significantly fewer cardiac events compared to men, and a trend indicated that female participants waited longer to start CR following their cardiac event ($F(1, 48) = 1.97$, $p = 0.094$). When looking at the cardiac event(s) that prompted participants to attend CR, no female participants experienced a myocardial infarction while almost half of all male participants received this diagnosis. In this sample, female participants were more likely to have experienced valvular repair/replacement. Comparison of participants' risk factors indicated that females were less likely to report a family history of heart disease; however, male and female participants did not differ on any of the other risk factors.

Risk Stratification

Cardiac Rehabilitation staff placed each participant into a low, moderate or high risk group after evaluating their risk factors and physical functioning (see Appendix C). The demographic characteristics for these groups are presented in Table 3. Four individuals were placed into the low risk group, 33 individuals were placed into the moderate risk group, and 14 individuals were placed into the high risk group. The moderate and high risk groups did not differ on any of the demographic (age, gender, height, weight) variables. The low risk group had a lower BMI and percent body fat compared to the moderate and high risk groups. The 4 individuals in the low risk group also had fewer identified risk factors compared to the other groups (see Table 3). There were no differences among the likelihoods of the different medical events between the three groups. All individuals with cardiomyopathy were placed in the

high risk group due to their low ejection fractions (less than 40 percent). Differences in the prevalence of the risk factors were compared across the low, moderate and high risk groups. A significantly larger proportion of the high risk participants continued to smoke cigarettes after their cardiac event compared to the other two groups. Additionally, a significantly lower proportion of the individuals in the low risk group had dyslipidemia compared to the moderate risk group (See Table 3). However, the finding regarding dyslipidemia should be interpreted with caution since the low risk group only consists of 4 individuals.

Psychological Variables

Interrelationships Among the Psychological Variables

Participants completed the psychological measures at weeks one, three, and eight. The descriptive information for each measure at each time point is presented in Table 2. The psychological measures had acceptable to excellent internal consistency. Cronbach's alphas averaged across the three time points ranged from 0.77 to 0.94. The Cronbach's alpha for each measure by week are presented in the diagonals of Tables 4, 5, and 6. The overall prevalence of clinical depression (estimated by HADS-depression scores ≥ 8) was estimated to be 17.6 percent at week 1. This is significantly higher than the estimated population prevalence of 9.3 percent ($p = 0.04$). The overall prevalence of clinical anxiety (estimated by HADS- anxiety scores ≥ 8) was initially estimated to be 27.5 percent (Table 2). This too is significantly higher than current population estimates ($p < 0.001$).

Correlations among the psychological variables at each time point were large and positive except for the positive cardiac rehabilitation rumination variable (Tables 4, 5, 6). Correlations were compared by gender (Tables 7, 8, 9) and risk stratification (Tables 10, 11, 12) within each time point. The low risk group correlations were not calculated due to the small number of participants assigned to that group. The majority of the correlations did not change significantly depending on risk stratification or gender. Given the large number of comparisons and the lack of consistent differences across the time points, it is possible that the few significant differences observed were the result of type I errors.

The number of strong relationships observed within the correlation tables indicates that many of the psychological variables were measuring overlapping constructs. Participants' scores at weeks one, three, and eight on the 9 psychological measures were subjected to a principal component analyses (PCA) followed by varimax rotations. Components were retained using the eigenvalue-one criterion (Kaiser, 1960) and the scree plot results. At each of the three time points, the scree plot and eigenvalues suggested that two components be retained for rotation. The two component solutions accounted for a total of 75.4, 71.4, and 70.2 percent of the total variances at weeks one, three, and eight respectively. The factor loadings and the proportion of each variable's variance that can be explained by the PCA for the psychological questionnaires are presented in Table 13. The first component for weeks one and three can be labeled as general negative affect. The second component can be considered positive repetitive thoughts. The structure changed slightly at week eight so that the first component captured repetitive negative thoughts, and the second

component captures depression symptoms. Figure 1 displays the rotated component plots for the three time points.

A composite rumination/worry measure was created from the variables that loaded onto the first component of the three PCAs. This composite variable included the scores from the RSS, RRS-brooding, RRS-reflection, CRRQ-negative, and PSWQ. Each measure used a 5-point Likert scale for their response options, but they differed on the number of items to which participants responded (see Table 2). The raw scores of the measures were summed and then divided by the total number of items since three of the measures represented subscales of larger measures. Thus, every item was weighted equally in the composite rumination/worry score.

Gender and Demographic Variables Differences

The relationships of gender and the other demographic variables to the psychological variables were evaluated within each time point. Additionally, the differences between the prevalence rates of anxiety and depression disorders were also compared by gender at each time point. At week 1, the differences between male and female participants were not significant (all ps > 0.2) except for positive rumination about cardiac rehabilitation (Table 14). The gender differences between the prevalence rates for anxiety and depression disorders at week 1 were not significant. None of the psychological variables were significantly related to age, BMI, or percent body fat (correlations not presented). The majority of the correlations between psychological variables and specific cardiac events did not significantly differ from zero at week 1. Participants who had stent/PTCA had increased levels of stress ($r = 0.28$, $p < 0.05$); participants who had a myocardial infarction had decreased levels of depression ($r =$

-0.29, $p < 0.05$); and participants who had valvular insufficiency had increased levels of worry ($r = 0.30$, $p < 0.05$). Among the risk factors identified by the CR staff, the stress risk factor was significantly correlated to participant's ratings of perceived stress ($r = 0.35$), reflection ($r = 0.30$), and anxiety ($r = 0.28$). The sum total number of risk factors identified for each participant also showed significant relationships with anxiety and perceived stress variables at week 1 (Table 15). These relationships should be interpreted with caution due to an increased risk of Type I error.

Significant gender differences emerged for two of the psychological variables at week 3 (Table 14). The difference between the prevalence rates for clinical anxiety was not significant, but females had a significantly higher proportion of clinical depression ($p = 0.02$) and higher levels of perceived stress and brooding ($ps < 0.05$). Females also had higher levels of anxiety ratings, depression ratings, worry ratings, and reflection ratings compared to the males, but these differences only trended towards significance (Table 14). There was no gender effect at week 3 for the composite worry/rumination measure. When looking at the week 3 relationships between the other demographic variables, positive rumination about CR was significantly related to BMI ($r = 0.39$, $p = 0.008$), hypertension ($r = 0.30$, $p = 0.046$), family history ($r = 0.35$, $p = 0.018$), stress ($r = 0.32$, $p = 0.032$), obesity ($r = 0.33$, $p = 0.029$), and the sum total of identified risk factors ($r = 0.49$, $p = 0.001$). There were no other significant relationships between week 3 psychological variables and age, number of medical events, time between event and start of rehabilitation, or any of the identified risk factors.

After eight weeks of CR, females continued to have a significantly higher proportion of clinical depression ($p = 0.02$). Furthermore, when looking at overall depression ratings across all three survey time points for the 31 individuals who did not drop-out, women reported significantly higher levels of depression ($F(1, 29) = 4.21$, $p = 0.049$).

The difference between the prevalence rates for clinical anxiety remained insignificant at week 8. On the other psychological variables, females continued to have higher levels of depression, perceived stress, and worry compared to males (Table 14). However, the rumination and reflection variables no longer differed significantly, and there continued to be no significant difference seen for the composite worry/rumination measure. There were no significant relationships between week 8 psychological variables and age, number of medical events, or time between event and start of rehabilitation. Positive CR rumination was again significantly correlated to BMI ($r = 0.54$, $p = .002$) and the stress risk factor ($r = 0.56$, $p = .002$). Additionally, negative CR rumination was related to hypertension ($r = 0.45$, $p = .014$) and stress ($r = -0.37$, $p = .044$).

Risk Stratification Differences

Week 1 ratings of anxiety, composite rumination/worry, stress, and the prevalence of clinical anxiety did not differ among the low, moderate and high risk groups (all ps > 0.1). The differences in initial depression among the three groups trended towards significance ($F(2, 48) = 2.88$, $p = .066$). The high risk group showed the highest levels of initial depression compared to the other two groups (High = 5.86(4.0), Moderate = 3.58(2.6), Low = 4.00 (1.6)). Because the low risk group

included only four individuals, it was not large enough to detect differences. When the low risk group was removed from the analyses, a significant difference in initial depression level between the moderate and high risk groups was seen ($t(45) = 2.34$, $p = .024$). Significant differences were also seen on the two depression focused rumination measures, RRS-brooding and RSS, after the removal of the low risk group (Table 16). In both cases, the high risk group showed higher levels of rumination compared to the moderate risk group. The difference between the prevalence rates for clinical depression was also significant, with the high risk group having a higher prevalence rate.

Comparison of the week 3 psychological variables between the moderate and high risk groups paralleled the results seen at week 1. The high risk group again had significantly higher ratings of depression, rumination, and a higher prevalence of clinical depression (Table 16). Depression and the prevalence of clinical depression were the only variables that resulted in significant differences between moderate and high risk groups at week 8. It is important to note that the participant sample used for week 8 may not be directly comparable to the larger sample used for the week 1 and week 3 comparisons. The effects of CR drop-out and early CR graduation are confounding elements when trying to make comparisons across the three screening periods. The next section of analyses is tailored to account for this phenomenon.

Change in Psychological Variables Across Time

On the nine specific psychological measures and the composite rumination/worry variable, there were no significant differences between the ratings of participants who took only one, two, or all three of the surveys (all ps > 0.05).

However, there was a trend for participants who only took the week 1 survey to have a higher composite rumination/worry score compared to other participants ($F(2, 48) = 2.99$, $p = 0.06$). When looking at all of the participants' ratings at each time point, stress, negative rumination, worry, anxiety and depression each decreased. However, the between group one way ANOVAs indicated that only negative cardiac rehabilitation rumination decreased significantly across time (CRRQ-neg, Table 2). The proportion of individuals with scores that indicated clinical levels of depression decreased from 17.6 percent at week 1 to 9.7 percent at week 8. The proportion of individuals with scores that indicated clinical levels of anxiety decreased from 27.5 percent at week 1 to 19.4 percent at week 8. Unfortunately, these changes are unable to take into account participant drop-out.

In order to remove the participant drop-out confound, the 31 participants who took all three surveys were used to investigate the change in psychological functioning over the eight weeks of CR. To do so, while accounting for the impact of gender and risk stratification (moderate and high), mixed ANOVAs were conducted for the 31 individuals who completed all three of the surveys. From this subsample, 19 were male (61.3%) and 12 female (38.7%); 23 were assigned to the moderate risk group (74.2%) and 8 to the high risk stratification (25.8%). These proportions were similar to those observed in the overall sample. The results of the mixed ANOVA results for the specific psychological variables are presented in Table 17.

The mixed ANOVA for the composite rumination/worry analysis violated the assumption of sphericity, so the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. There was a significant main effect for week ($F(1.46,$

27.77) = 11.10, p = .001, partial eta squared = .396); however, this main effect was moderated by a significant interaction with Gender (F(1.46, 27.77) = 5.27, p = .019, partial eta squared = .217, see Figure 2). There was no interaction between week and risk stratification (F(1.46, 27.77) = 0.85, p = .404, partial eta squared = .043), and there were no main effects for gender or risk stratification (women: *M(SE)* = 86.60(6.35), men: *M(SE)* = 104.04(9.62), p = 0.142).

Across the specific psychological variables, week was a significant main effect for cardiac rehabilitation negative rumination, depression, worry, brooding, and rumination on sadness (Table 17). The sizes of the main effects for the significant models ranged from small (eta-squared = .119 for depression) to moderate (eta-squared = .325 for negative cardiac rumination). This significant drop in depression symptoms can also be observed when looking at the prevalence rate of clinical depression within the subsample of 31 individuals which decreased from 19.4 percent at week 1 to 9.7 percent at week 8. Bonferroni corrected pairwise comparisons indicated that the significant decreases were typically observed when comparing scores between weeks one and eight (Table 18). Negative cardiac rehabilitation rumination was the only measure that showed significant decline between weeks three and eight. The observed changes in stress, anxiety, reflection, and positive cardiac rehabilitation rumination were not significant. Even though the prevalence rate of clinical anxiety decreased from 25.8 percent at week 1 to 19.4 percent at week eight, this drop was not significant.

When evaluating higher order interactions, there was no significant 2-way interaction between week and risk stratification for any of the variables (all ps > 0.05).

Similar to the composite rumination/worry variable, there was a significant interaction between week and gender for positive CR rumination, perceived stress, and brooding (Table 17). The effect of gender on week obscured the overall main effect for both perceived stress and positive rumination. Figures 4, 5, and 6 display the variable means separated by week and gender. The week by gender interaction is unique for each variable. Bonferroni corrected post-hoc comparisons showed that brooding scores did not vary across the screening session for males, but the level of brooding for females was lower at week 8 compared to both weeks 1 and 3 ($ps < 0.05$; Figure 3). Looking at the positive CR rumination means by week and gender revealed a complex interaction. While the scores for males decreased (Week 1-Week 3 = 1.67, $p = 0.283$), the scores for females increased (Week 1 – Week 3 = -2.52, $p = 0.066$; Figure 4). Perceived stress scores decreased slightly for both males and females but at different rates. Scores for males decreased the most between weeks 1 and 3 while scores for females decreased the most between weeks 3 and 8. Because of the differences in the rate of decrease, females had significantly higher levels of perceived stress compared to males at week 3 (Males-Females = -6.93, $p = 0.003$). There were no significant gender difference observed at weeks 1 or 8 (Figure 5).

Self-Reported Health and Fitness

Interrelationships Between the Self-Reported Health and Fitness Measures

This study incorporated two self-reported measures of health and fitness. The CR staff had participants fill out the COOP during their initial orientation session and final exit session. The RAND was then completed as part of the survey packet at week 1, 3, and 8. Because the two measures were initially completed at relatively the same

time and assessed similar constructs, convergent validity was expected. Table 19 presents the agreement of the two measures by functional domain (physical functioning, role limitations, emotional well-being, social functioning, pain, and general health) along the diagonal axis of the lower left quadrant (correlations indicating agreement bolded). The average convergent validity correlation was 0.51 which indicates good agreement among functional domains of the two measures. The average of the off-diagonal correlation between the COOP and RAND was considerably smaller ($r = 0.30$) and lends support to the discriminate validity of the two measures.

Twenty-six participants filled out a final COOP during their CR exit procedure. Nineteen of these participants took their final COOP following completion of the week 8 survey packet, while 7 participants took their final COOP following completion of the week 3 survey packet. The average time between the initial and final Coop was 70 days ($SD = 22$ days). Because the final survey packet did not always occur immediately prior to CR completion, there was a larger time interval between participants' final RAND scores and final COOP scores ($M = 18$ days, $SD = 13$ days). Table 20 presents the agreement of these two measures, controlling for the time delay, at the end of CR. The average convergent validity between the two measures was $r = 0.53$ overall and $r = 0.60$ with social functioning excluded. The average off diagonal correlation was $r = 0.33$. The RAND and COOP measures appeared to show particularly large agreement when assessing pain, and general health, and role limitations (see Tables 19 and 20).

There were several significant relationships between the RAND health domains and the psychological variables (Table 21). Overall, better health and fitness ratings were associated with lower levels of stress, negative affect, and rumination. For example, at week 1, lower levels of depression were strongly related to higher functioning across all 8 of the domains with *r*-values ranging from $r = -0.42$ (role limitations due to physical health) to $r = -0.743$ (emotional well-being). Similar patterns of significant relationships were observed between the 8 RAND domains and the psychological variables at weeks 3 and 8 (values not presented).

Gender and Demographic Variables Differences

The RAND self-reported fitness variables were compared by gender and other demographic variables within each time point (Table 22). At week 1, the differences between male and female participants were not significant (all ps > 0.2). At week 3, gender differences began to emerge. Male participants reported significantly higher levels of emotional wellbeing compared to female participants ($p = 0.05$). Additionally, male participants reported significantly fewer role limitations due to emotional functioning ($p = 0.05$). Neither of these gender differences remained significant at week 8. At week 8, there were several significant gender differences across the self-reported fitness variables. Male participates reported higher physical functioning ($p = 0.01$), fewer role limitations due to physical problems ($p = 0.003$), and less pain ($p = 0.05$) compared to female participants. However, the only significant gender difference that remained when looking at the overall ratings of the 31 individuals who took all three surveys was for emotional well-being ($F(1, 23) = 5.52$, $p = 0.028$). In this case, women reported poorer emotional functioning compared to men.

The other seven self-rated health and fitness domains did not differ significantly when looking at the ratings across all three time points (*p*s >0.05).

Very few of the self-reported fitness variables were significantly related to age, BMI, or percent body fat. At week 1, age was positively related to emotional wellbeing ($r = 0.32$, $p = 0.03$) and higher BMI was related to fewer role limitations due to physical health ($r = 0.35$, $p = 0.01$). None of the correlations differed significantly from zero at week 3, and the relationship between emotional wellbeing and percent body fat ($r = -0.39$, $p = 0.04$) was the only significant correlation at week 8.

Medical events were significantly related to many of the week 1 self-reported fitness variables. Participants who experienced a MI or a Stent/PTCA tended to rate themselves as having higher Physical Functioning ($p = 0.012$ and $p = 0.009$ respectively) compared to those who did not experience those events. Whereas only individuals who experienced a stent/PTCA reported having fewer role limitations due to physical health ($p = 0.002$). Individuals who experienced either valve repair/replacements or CABG both reported more role limitations due to physical problems ($p = 0.000$ and $p = 0.005$ respectively) compared to those who did not experience either of these medical events. Individuals who experienced a CABG also reported significantly more role limitations due to emotional problems ($p = 0.007$) when compared to the other participants. There were fewer significant differences by medical event at week 3. The only findings were that participants who experienced a MI rated themselves as having significantly higher physical functioning ($p = 0.034$), higher emotional wellbeing ($p = 0.038$), and lower levels of pain ($p = 0.016$). The significant differences at week 8 paralleled the differences seen at week 3. Individuals

who experienced an MI reported higher physical functioning ($p = 0.048$) and lower levels of pain ($p = 0.021$). No significant differences emerged when looking at the other medical events experienced by participants.

Risk Stratification Differences

When comparing the week 1 ratings of health and fitness by risk group, the moderate risk group had higher ratings on all of the variables (Table 23). However, the only significant difference was that the moderate risk group rated their social functioning as higher compared to the high risk group ($p = 0.05$). At week 3, the moderate risk group continued to have higher health and fitness ratings, but most of the differences were not significant. The only significant difference was on Physical Functioning ($p = 0.008$). While there were fewer participants at week 8 due to attrition, there were more significant differences observed between the moderate and high risk groups (Table 23). By week 8, participants in the moderate group had significantly higher ratings on Physical Functioning, Energy, and Social Functioning. When looking at overall differences across all three time points of the 31 individuals who completed all of the survey packets, the high risk group had significantly more pain ($p = 0.037$), less energy ($p = 0.043$), poorer social functioning ($p = 0.010$), and lower physical functioning ($p = 0.009$).

Change in Self-Reported Health and Fitness Over Time

The overall changes in health and fitness ratings from the beginning of CR to the end of CR were assessed using the COOP. Twenty-six individuals completed both the pre and post portions of the COOP. The remaining 25 individuals either dropped out of CR or declined to retake the COOP during their CR exit interview. Table 24

presents the change in health ratings for both the higher COOP domains and the nine specific areas. All three higher order domains (Quality of Life, Physical Fitness, and Well Being) improved significantly from start to finish of CR (all *p*s < 0.01). When looking at the specific 9 direct subscales, participants reported the largest improvements in the areas of physical fitness and ability to complete daily activities (Table 24).

Contrary to the higher order quality of life domain, participants' quality of life subscale ratings did not improve over the course of CR. Therefore, the significant change in the higher order quality of life domain was due to improvements within the overall health subscale and decreased pain subscale. Within the higher order Well Being domain, the increase on the social support subscale showed improvement but only trended towards significance ($p = .057$). When the amount of time each participant spent in CR was included as covariate variable, the results did not change.

To evaluate when the changes in health and fitness occurred during CR, while still accounting for the impact of gender and risk stratification (moderate and high), mixed ANOVAs were conducted for the 31 individuals who completed all three of the surveys. When evaluating the 2-way interactions, there were no significant interactions between week and risk stratification (all *p*s > 0.05). The only significant week by gender interaction was observed on the role limitations due to physical health measure ($p = 0.01$, Figure 6). While the male participants reported significant improvement in this area between weeks 3 and 8 ($p = 0.002$), the females' ratings did not change significantly over the first 8 weeks of CR. While females did not show improvement

on this specific scale, there were several RAND measures that improved significantly over time regardless of gender (Table 25).

Similar to the results of the COOP, participants reported significant improvements in their health and fitness across the majority of the domains on the RAND (Table 25 and 26). Only emotional wellbeing and general health did not improve significantly across 8 weeks of CR ($p = 0.61$ and $p = 0.07$ respectively). The Bonferroni adjusted post-hoc comparisons indicated that the significant gains in health and fitness were typically observed across week 1 and week 8 (Table 26). The only measures that saw significant gains between week 1 and 3 of CR were the pain and social functioning measures. Between week 3 and week 8, only role limitations due to physical health improved significantly. Overall, participants made small gains between weeks 1 to 3 and weeks 3 to 8. Together, these incremental improvements results in large and significant gains over the full course of CR.

Objective Physical Fitness Tests

Interrelationships Between the Self-Reported Health and Fitness Measures

While distance walked is the primary variable of the 6MWT, several blood pressure and heart rate readings were also collected. The relationships among these variables were evaluated for both the pre CR fitness test and the post CR fitness test (Table 27). Prior to starting CR, the amount of distance walked was negatively related to participants' resting and recovery heart rates (ps < 0.05). This suggests that individuals with higher resting heart rates did not walk as far, and individuals who walked farther had lower recovery heart rates. The only variable that distance was significantly associated with at the post CR testing was resting systolic blood pressure.

Participants with higher resting systolic blood pressures walked shorter distances. Prior to CR, participant's resting, peak and recovery blood pressure readings had significant positive relationships with each other (Table 27). After CR completion, the systolic blood pressures across rest, peak, and recovery remained significantly correlated (*p*s < 0.01). However, the diastolic blood pressures across rest, peak, and recovery were no longer significantly related. There were strong relationships among the resting, peak, and recovery heart rate before starting CR (all *p*s < 0.01). After CR, the strength of the relationships between peak heart rate and resting or recovery heart rate declined. The correlation between recovery and resting heart rate remained high (*r* = 0.84).

Analyses looking at the relationships between the week 1 psychological variables and the initial fitness testing showed very few significant correlations. Distance walked on the 6MWT was not significantly related to any of the psychological variables. Post 6MWT Recovery heart rate was negatively related to three of the separate rumination measures (CRRQ_neg *r* = -0.29; Brooding *r* = -0.32; RRS *r* = -0.30), but not the overall composite rumination/worry. There were no significant relationships when looking at peak and resting heart rates (*p*s > 0.05).

Gender and Demographic Variables Differences

Before and after CR 6MWT fitness variables were compared by gender and other demographic variables (Table 28). Fitness variables included resting, peak, and recovery data for heart rate, systolic, and diastolic blood pressures. The distance walked during the 6MWT was also reported. When comparing the post CR fitness testing variables, amount of time in CR was used as a covariate. The only significant

gender difference was that males walked significantly farther compared to females both before and after CR (p = 0.002 and p = 0.022 respectively). There were no other significant gender differences prior to or following CR (all ps >0.05).

Age, BMI, and percent body fat were significantly correlated to several of the pre CR 6MWT fitness variables. Age was related to distance (r = -0.30, p = .036), resting systolic blood pressure (r = 0.31, p = 0.031), peak systolic blood pressure (r = 0.32, p = 0.03), and recovery diastolic blood pressure (r = -0.29, p = 0.04). BMI was associated with peak heart rate and peak systolic blood pressures (r = 0.28, p = 0.05 and r = 0.31, p = .031 respectively). Finally, higher percent body fat was significantly correlated to less distance (r = -0.38, p = 0.008). Age, BMI, and percent body fat were not significantly correlated to post CR fitness testing variables after taking into account the amount of time each participant was in CR.

There were no significant pre or post CR differences on the 6MWT fitness variables between participants who experienced a stent/PTCA or CABG compared to participants who did not. However, individuals who experienced an MI walked significantly farther than the CR participants who did not have an MI (*M(SD)* = 1533.6 (289.0) versus *M(SD)* = 12717.7(326.5), p = 0.009). This difference was also seen at the post CR fitness testing. Additionally, individuals who experienced an MI also had higher recovery diastolic blood pressure (Mean= 76.5mmHg, *SD* = 8.7mmHg) compared to the other participants (*M(SD)* = 71.0(8.2) mmHg). Participants who underwent Valve Repair/replacement had significantly higher resting and recovery heart rates both before and after CR. Participants who had valve repair/replacement

also had lower peak systolic blood pressure compared to other participants (*p*s < 0.05) prior to CR, but this difference was no longer significant following CR participation.

Risk Stratification Differences

When comparing the CR 6MWT fitness variables by risk group, there were no significant differences observed during the initial testing or after CR completion (Table 29).

Change in Fitness Over Time

In order to assess change in physical fitness over time while taking into account gender and risk stratification, mixed ANOVAs were conducted for the 40 individuals who completed both pre and post CR fitness testing. After completing CR, participants were able to walk significantly farther (Table 30). This finding was not moderated by gender or risk stratification. Additionally, participants had significantly higher peak heart rates during the post CR 6MWT ($p = 0.02$). A significant interaction was observed between time and risk stratification when looking at the peak diastolic blood pressure. While the low and high risk groups' peak diastolic blood pressure decreased from pre to post testing, the moderate risk group experienced an increase in peak diastolic blood pressure (Figure 7). However, post hoc comparisons across the time points and between the risk groups did not reveal any significant differences (all *p*s > 0.05).

A significant decrease in participants' percent body fat was observed ($F(1, 29) = 7.39$, $p = 0.011$). Additionally, age was a significant covariate in this model ($F(1, 29) = 5.45$, $p = 0.024$). Older participants experienced smaller decreases in percent body fat after participating in CR. The mixed ANOVA for BMI showed a significant

main effect from the start to end of CR ($F(1, 32) = 4.39$, $p = 0.044$) and a significant interaction between time and undergoing a major surgery (i.e. CABG and valve repair/replacement) immediately prior to starting CR ($F(1, 32) = 4.13$, $p = 0.050$). There was not an overall change in weight for participants after engaging in CR ($p > 0.05$). However, there was again a significant interaction between weight change and undergoing a major surgery immediately prior to starting CR ($F(1, 36) = 4.20$, $p = 0.048$). Participants who underwent major surgery prior to CR weighed significantly less than other participants ($p = 0.010$). While the weight of participants who underwent a major surgery prior to CR did not decrease, the other participants did experience weight loss (See figure 8). Posthoc testing of weight change across CR for the group of participants who did not undergo major surgery was not significant ($p > 0.05$).

Predicting Program Completion and Fitness Outcomes

Of the 51 participants who started the CR program, 32 participants completed the full recommended course of treatment (Table 31). The CR drop-out rate in this sample was 37 percent. However, if the 8 individuals who did not complete the full program but still coordinated with staff to go through the formal CR exit procedures are added, the drop-out rate decreases to 22 percent.

Gender and Demographic Variables Differences

Because of the overarching similarities of the three risk stratification groups, they were pooled together to investigate the relationship of the demographic and medical history variables to CR completion. There was not a significant difference between the proportions of male and female participants who completed CR

(completion rate for both 63%). There were no significant associations between drop-out rate and age, BMI, or percent body fat (all *p*s > 0.05). Drop-out or successful completion of CR was not significantly related to the majority of the screened risk factors including: dyslipidemia, hypertension, physical inactivity, family history of heart disease, type two diabetes, and number of medical events (all *p*s > 0.05). Additionally, the specific medical event that occurred prior to CR did not relate significantly to participants' final status.

Two of the screened risk factors did predict participants' final status. Active smokers were more likely to drop-out of CR compared to individuals who did not smoke (50.0% versus 17.9%). Participants who were identified as struggling with stress were more likely to drop-out of CR compared to those who did not present with this risk factor (57.1% versus 15.9%, $p < 0.05$). The amount of time it took participants to start CR after their cardiac event trended towards significance ($F(2, 46) = 3.02$, $p = .059$) among the different program completion groups . There was a longer delay between the cardiac event and the start of CR for participants who eventually dropped out of the CR program compared to participants who did not drop-out of the program. (days between cardiac event and the start of CR for participants who: completed = 21.0 (15.5), finished early = 16.4 (8.7), and dropped out = 34.7 (26.3)).

The drop-out rate for individuals with clinical anxiety (57.1%) was higher than the drop-out rate for participants without (29.7%); however this difference was not significant ($p = .07$). The drop-out rate for individuals with clinical depression (66.7%) was significantly higher than the drop-out rate for participants without (31.0%, $p = 0.04$).

Risk Stratification Differences

A total of thirty-two[1] participants completed their prescribed number of sessions. The proportions of participants who completed the full CR program did not differ across the three risk groups (Table 3). Eight additional individuals stopped the CR program early but worked with the staff to complete the formal exit procedure. Similar to the participants who completed the prescribed number of sessions, the proportions of the participants who exited CR early did not significantly vary across the three groups. The remaining 11 participants dropped out of the CR program unexpectedly. Six of these 11 participants were assigned to the high risk group. Thus, the proportion of participants in the high risk group who dropped out (6 out of 14, 42.9%) is significantly larger compared to the drop-out rate within the moderate risk group (5 of 33, 15.1%).

Predicting Program Completion

Multivariate logistic regression was used to assess what effect the self-reported variables had on participants' ability to complete their prescribed CR. A backward stepwise approach evaluated the week 1 psychological and self-reported health and fitness ratings to create a prediction equation. The removal criterion was set at $p > 0.10$ and the reentry criterion was set at $p < 0.05$. Because risk stratification was shown earlier to relate to program completion, it was included as a covariate for this analysis. The individual rumination/worry measures were not included as separate variables due to their conceptual overlap. Instead, the composite rumination/worry

[1]Thirty-two participants completed or exceeded their prescribed number of sessions (see Table 3). This is a separate classification that does not correspond to the 31 participants who took all three of the psychology survey packets.

measure was used along with the other psychological variables. Additionally, the initial self-reported health and fitness variables were entered into the equation. A four-variable equation (Table 32) was produced to predict successful CR completion. The final model was significant ($\chi^2 = 29.14$, df = 5, $p = 0.000$) with appropriate goodness-of-fit (Hosmer- Lemeshow Test; $\chi^2 = 4.066$, df = 8, $p = 0.851$; Hosmer, Hosmer, Le Cessie, & Lemeshow; 1997). Nagelkerke's R^2 of 0.620 suggests a moderately strong relationship between prediction and actual outcome (Nagelkerke, 1991). The model correctly predicted the correct outcome for 83.3 percent of the sample. As seen in Table 32, participants' general health, emotional well-being, and rumination/worry levels all were significant predictors of program completion ($p < 0.05$). Participants' risk stratification was not a significant predictor and there were no significant 2-way interactions. Participants who reported higher levels of rumination/worry and emotional well-being were more likely to complete CR. Individuals that rated themselves as having higher levels of general health were less likely to complete CR. ($p < 0.05$). Zero-order equations between the independent and dependent variables for this regression equation are included in Appendix F.

Predicting Fitness and Fitness Gains

Multiple linear regression was used to investigate how psychological and self-reported fitness variables related to participants' fitness and fitness improvements over the course of CR. The multicollinearity, normality, homoscedasticity, linearity, and independent prediction errors assumptions were evaluated for each regression model; however, no serious violations were noted. A stepwise method was used with the

removal criterion set at $p > 0.10$ and the reentry criterion set at $p < 0.05$ for all of the regression models.

When all age, gender, risk stratification, psychological variables, and self-reported fitness variables were used to predict initial 6MWT distance, a significant model was produced ($F(3, 47) = 10.8$, $p = 0.000$, adjusted $R^2 = 0.371$). As expected, age, gender, and self-reported physical functioning were significant variables in the final equation (Table 33). Being female or older in age decreased the distance covered during the 6MWT test. Additionally, self-reported physical functioning was a significant predictor of better 6MWT distance outcomes. When the regression was re-run excluding self-reported fitness variables, the overall model remained significant ($F(3, 47) = 7.91$, $p = 0.000$, adjusted $R^2 = 0.308$). Gender and age remained significant negative predictors of 6MWT distance at the start of CR. Depression was the only significant psychological variable that predicted initial 6MWT distance (Table 33). These results suggest that rumination does not play a significant role in predicting how far participants will walk during their initial 6MWT.

When predicting post CR 6MWT distance, the distance a participant walked during the pre CR6MWT is the strongest predictor variable ($F(1, 38) = 114.63$, $p = 0.000$, adjusted $R^2 = 0.749$). No other variables contributed significantly to the post CR 6MWT distance prediction equation when the patients' pre 6MWT distance was taken into account. However, the impact of mood symptoms on fitness abilities is a primary interest of this study. Because of this, the post CR 6MWT distance prediction equation was rerun taking into account participants' weeks 1, 3, and 8 scores for anxiety, depression, and rumination. Multicollinearity between the week 1 and week 8

rumination variable was a potential problem (VIF = 9.316). Because of the potential for multicollinearity between these variables, only week 1 rumination was used in the equation since it appeared to be the stronger predictor variable of the two. Age, gender and the number of CR sessions attended were also included as covariates. The final model was significant ($F(5, 33) = 7.62$, $p = 0.000$, adjusted $R^2 = 0.501$). Gender, age and week 3 anxiety were all significant negative predictors of Post CR 6MWT distance (all ps < 0.05). While week 1 rumination was a significant positive predictor ($p = 0.009$). See table 34.33 for the full regression model.

Multiple linear regression was used to investigate if week 1 psychological and self-reported fitness variables could predict participants' fitness *gains* by predicting their improvement on the 6MWT. Age was entered into the equation as a covariate. The results of the regression produced a significant model ($F(2, 32) = 4.34$, $p = 0.022$, adjusted $R^2 = 0.168$). The only significant variable in the final equation was participants' initial rating of their physical functioning ($B = -2.46$, $p = 0.028$). This indicates that participants who perceived themselves as having higher physical functioning at the beginning of CR tended to show less improvement on 6MWT distance. When the regression was rerun using only the psychological variables, no variables were retained the final equation. Improvement in participants' ability to recover, as calculated by subtracting their resting heart rate and blood pressure levels from their recovery heart rate and blood pressure after the 6MW, could not be predicted by psychological or self-reported fitness variables. Zero-order equations between the independent and dependent variables for this regression equation are included in Appendix F.

Qualitative Data

Sixteen participants returned the final qualitative questionnaire by mail. Because these surveys were given to participants during their final exercise session in CR, individuals who dropped out of CR did not have the opportunity to respond. Participants who returned the questionnaire overwhelmingly reported that they entered CR hoping that it would help them gain additional stamina and endurance. Multiple participants also stated that they hoped that CR would assist in losing unwanted weight. Lastly, several participants expressed the hope that CR would allow them to get back to normal.

When asked about their achievements in CR, participants had very positive things to report. Most stated that CR helped them recover from their cardiac event and that they were able to accomplish many of their rehabilitation goals. Most respondents wrote that they felt stronger and healthier. Participants also stated that their sense of control and efficacy over their health increased over the course of CR. Additionally, patients consistently recognized that they would need to continue their behavioral lifestyle changes in order to sustain their health gains. As one participant wrote, "[I have] started on the road to sustainable weight loss and better shape." When participants were asked to describe what helped them achieve their results, they offered a wide range of responses. Participants wrote that monitored exercising in a structured environment was key to their CR success. However, some participants placed a large amount of weight on the educational component, their own self-efficacy, and the overall positive atmosphere.

When asked specifically about goals they were unable to achieve, 8 participants did not report anything. The others reported that they would have liked to have achieve greater weight loss, and two individuals also reported that they wished that their stamina had improved more. Participants reported that failure to make CR a priority was a barrier to achieving greater fitness improvements during their treatment. Several participants noted how difficult it was to make lasting behavioral changes. This comment was most often referenced in terms of failure to modify their diet in order to lose weight. Otherwise, participants reported that they would have benefited from additional time in CR.

Summary of Results

Hypothesis 1 predicted that in the study sample the overall rates of clinical depression and anxiety would be higher than the general population estimates (9.3% for depression and 3% for anxiety). Within the current sample, 27.5% of the participants had clinical anxiety. This is significantly higher ($p = 0.001$) than the community estimate. Additionally, 17.6% of the sample had clinical depression. This is also significantly higher ($p = 0.04$) than the community estimate. It was predicted that women would have significantly higher levels of anxiety and depression compared to men. At the week 1 screening, there were no gender differences for anxiety, depression, or any of the other psychological variables. However, women had higher levels of depression, stress, and brooding at weeks 3 and 8. When looking at the overall ratings of the 31 individuals across all three survey time points, women had significantly higher levels of depression, stress, and worry compared to men.

Additionally, the high risk group had an overall higher level of depression compared to the moderate risk group.

Hypothesis 2 predicted that the participants' levels of depression, anxiety, and rumination would decrease while physical fitness would increase over the course of cardiac rehabilitation. Within this study, a significant decline in depression, worry, rumination (RSS), and composite rumination/worry was observed between weeks 1 and 8. However, the decrease in anxiety level was not significant. The significant positive psychological changes experienced by CR participants appeared to take place during the first 3 weeks of CR. There were no additional significant psychological improvements between weeks 3 and 8 for any of the variables. Participants also reported significant health and fitness improvements for physical functioning, role limitations due to physical health, energy/fatigue, social functioning, and pain over the course of CR. The health and fitness variables began to improve over the first 3 weeks of CR, but the changes were typically not significant until looking at the overall improvements between weeks 1 and 8. There were week by gender interactions for the composite rumination, positive cardiac rumination questionnaire, worry, brooding, rumination (RSS) and role limitations due to physical health variables. Overall, men experienced their gains in CR between weeks 1 and 3 while women experienced their gains between weeks 3 and 8. There were no week by risk stratification interactions for any of the other variables.

Hypothesis 3 predicted that females, high levels of anxiety or depression, and high risk illness would be increase drop-out from CR. In the current sample, 37 % of the participants dropped out of CR. Contrary to the study hypothesis, females were not

significantly more likely to drop out of CR in this study. However, as hypothesized, clinical levels of anxiety or depression, and the high risk participants had significantly higher rates of drop out from CR. While the majority of identified risk variables were not associated with increased likelihood of drop-out from CR, participants identified as having high levels of stress and those who actively smokes were more likely to drop out of CR. Interestingly, a longer delay between a participant's CVD event and the start of CR was associated with a higher likelihood of dropping out from CR. The findings of a backwards logistic regression indicated that better physical health and higher levels of negative affect were associated with higher drop-out from CR. As hypothesized, within the logistic regression equation, higher levels of rumination predicted lower levels of CR dropout.

Hypothesis 4 predicted that high levels of depression and high or low levels of rumination will predict lower physical fitness. As expected age, gender, and self-rated physical functioning were significant predictors of fitness at the beginning of CR (pre CR 6MWT distance). Older participants and females walked shorter distances compared to young participants and men. Individuals who rated themselves as having higher levels of physical functioning also walked longer distances. When self-reported variables of health and fitness were removed from the regression equation, level of depression was a negative predictor of pre CR 6MWT distance. Rumination was not a significant variable with predicting pre CR 6MWT distance. The best predictor of post CR fitness is each participants' pre CR 6MWT distance. When pre CR 6MWT distance was included in the regression equation to predict post CR 6MWT distance, no other variables contributed to the model. When pre CR 6MWT distance

was excluded from the equation, age and gender were again significant predictors of post CR 6MWT distance. Additionally, anxiety at week 3 was included in the model as a negative predictor of post CR 6MWT distance, and as hypothesized higher levels of rumination predicted higher levels of fitness.

DISCUSSON

Interrelationships Among Variables

Diagnoses With Psychological, Health and Fitness, and Objective Fitness Testing

The relationships of the participants' cardiovascular disease diagnoses were compared to the psychological, self-reported health and fitness variables, and objective fitness testing. Overall, participants' diagnoses did not appear to have significant associations with the psychological variables. It is important to note that every participant in the study had at least one cardiovascular disease event, and this likely restricted the range. If these associations were re-evaluated in a general community sample, it is much more likely that the presence of cardiovascular disease would be associated with greater emotional distress and poorer fitness. Participants who experienced a MI or a Stent/PTCA tended to rate themselves as having higher physical functioning, and participants who were diagnosed with valve repair/replacement or CABG tended to rate themselves as having more limitations because of their health. These differences may have to do with the fact that individuals who were diagnosed with valve repair/replacement or CABG underwent serious surgical procedures, while participants who were diagnosed with MI or Stent/PTCA received medical treatment that was less invasive. Participants diagnosed with valve repair/replacement or CABG were frequently unable to drive, work, or use their arms until their incisions had healed

sufficiently. While the results from the current study suggest that there are no specific forms of heart disease that are associated with poorer emotional health, there are differences across the diagnoses when looking at overall health and fitness. The relationships between other demographic information, such as illness severity and gender, are discussed throughout the discussion section.

Psychological Variables to Health and Fitness, and Objective Fitness Testing

There were several significant relationships between psychological variables and self-reported health and fitness variables. Higher levels of depression were significantly related to lower health and fitness ratings across all domains. Similarly, higher levels of anxiety or rumination were also significantly related to lower health and fitness ratings across all of the domains except for general health and role limitations due to physical health. These results suggest that individuals who report physical and health difficulties at any point during CR should be carefully screened by CR staff for the presence of depression, anxiety, and rumination. Within a medical setting, patients may find it easier to disclose their health and fitness limitations to the CR staff, while they may be less willing discuss their mental health concerns because of stigma. Awareness of this can help CR staff develop a heightened sensitivity for detecting the presence of mental health symptoms.

Individually, depression, anxiety, rumination, and stress were not significantly related to objective fitness measures from the 6MWT. The few significant relationships that were observed between rumination and recovery heart rate could be due to type I error. The lack of significant relationships between the psychological variables and objective testing may simply be due to the fact that several other factors,

such as gender, height, and illness severity, need to be taken into account when trying to understand the relationships.

Relationships to Demographics and Risk Stratification

Although older men and older women have similar rates of cardiovascular disease, it has been well established that women are less likely to participate in CR (Dunlay et al., 2009; Yohannes et al., 2007). As reviewed earlier, women may face more barriers to treatment following a cardiovascular event. In the current study, a gender discrepancy for CR participation was also observed. Women represented only 30 percent of the study's 51 participants. This discrepancy is further highlighted by the fact that 0 of the 16 females in this study were attending CR due to a MI. While it is well documented that men are at a higher risk for a MI when younger than 65, this discrepancy decreases with advancing age (Lloyd-Jones et al., 2010). The fact that there were no women in this study with a MI may indicate that these women either are not attending CR or are opting to not participate in this study. Women who experience a MI may have additional barriers that make CR attendance and study participation more difficult.

Previous research suggests that women who attend CR tend to be older and have more medical complications and comorbid disorders compared to men (Bello & Mosca, 2004). However in this sample, women did not appear to be significantly more ill compared to men. One possible explanation for this could be that older women with more medical complications were less likely to agree to participate in the current study. However, without access to the medical records of the individuals who declined to participate, this cannot be confirmed. While women were significantly shorter in

height and had a higher percent body fat composition, these are biologically based gender differences that do not relate to health. BMI levels, which take height into account, did not differ between men and women. Women in this study, when compared to men, were equally likely to have dyslipidemia, hypertension, or type I/II diabetes. This is similar to the results of previous research (Lavie & Milani, 1995). Additionally, there were very few gender differences on objective fitness testing prior to CR participation. Women had slightly higher resting heart rates, but this was expected because of gender differences in heart size. Women also covered significantly less distance compared to men on the 6MWT, but this cannot be used to compare fitness across gender since differences in height and body composition can impact the distance each participant walks independently of their true physical fitness.

There were no significant gender differences observed on participants' self-ratings of health and fitness at the beginning of CR; however, gender differences emerged at weeks 3 and 8. At week 3, women appeared to have significantly more emotional problems, such as anxiety and depression symptoms, compared to men. Women also reported that their "emotional problems" were interfering with their work and other regular daily activities at a higher level compared to men. By week 8, women rated their physical functioning (limitations when climbing stairs, walking several blocks, bathing, etc.) as significantly lower. Women also reported significantly higher levels of pain and more problems with their ability to work and complete daily tasks compared to men at week 8. While the initial sample at the start of CR suggests that women and men had comparable levels of illness, the sample at week 8 indicated that women were experiencing more physical and health problems compared to men.

This finding is tempered by the fact that the sample changed across time points due to drop-out. When comparing gender differences between the 31 individuals who remained in CR through week 8 and completed all three surveys, the only significant difference was that women reported significantly more emotional problems. Thus, the gender differences seen at weeks 3 and 8 may be due to differences resulting from participants dropping out of CR. A detailed description of participant drop-out is included in the next section of the discussion.

The consistent gender difference for emotional problems suggests that women may also be experiencing higher levels of depression, worry, and rumination. However, this effect was not replicated on the specific measures targeting anxiety or rumination. This finding is not entirely unexpected, as previous research investigating gender differences for anxiety produced mixed results. Lavie & Milani, (1995) did not observe a significant gender difference for anxiety, while Szczepanska-Gieracha et al., (2012) did. However, women did report significantly higher levels of stress and worry compared to men in this study. There were no significant gender differences for depression at any single time point. However, when looking at the main effect of gender across all three surveys for the 31 individuals who remained in CR for at least 8 weeks, women had significantly higher overall levels of depression. This is consistent with previous findings that women in CR experience higher levels of depression (Beckie et al., 2011). Overall, CR programs may be able to improve patient outcomes by making sure all patients, particularly women, are screened for maladaptive levels of depression, stress, and worry.

Because participants were also separated by risk stratification, this study had the unique opportunity to look at how illness severity impacted psychological and fitness variables. Overall, the three risk groups did not differ based on age, weight, BMI, gender, and the majority of risk factors. Active smokers were more likely to be placed in the high risk group. This finding was expected since smoking status is part of the formula used to determine each participant's risk group assignment. Furthermore, at the start of CR, there were no differences between the moderate and high risk group on any of the week 1 self-reported health/fitness variables or objective fitness measures. Risk stratification differences on self-reported health and fitness began to emerge at the week 3 and week 8 time points. At week 8, the high risk group had significantly lower ratings of social functioning, energy, and physical functioning. This indicates that participants who were placed in the high risk group and remained in CR for at least 8 weeks may have more health complications which limit their improvement compared to other participants. When looking at the overall main effect of risk stratification across all time points for the 31 participants who filled out all three surveys, individuals in the high risk group reported significantly more pain, less energy, poorer social functioning, and lower physical functioning. Overall, participants placed in the high risk group reported more health and fitness problems compared to the participants in the other groups during and following the completion of CR.

Individuals in the high risk group did not perform worse on the objective fitness testing following CR after completing 36 sessions compared to the moderate group's 24 sessions. Even though the high risk participants perceived themselves as having

poorer physical functioning, this did not translate into impaired fitness after CR. As such, CR staff should not rely exclusively on objective fitness data when evaluating patient outcomes since patients may still be experiencing significant impairments in their perceived health and fitness. These findings again point to the importance of CR program creating individualized treatment plans that cater to the needs of each patient.

When the ratings of the psychological variables were compared by risk group, there were few significant differences. Individuals in the high risk group did not report significantly greater levels of worry, anxiety, or stress. Thus, the act of being classified as a "high risk" patient by the CR staff does not seem to be associated with any additional worry or anxiety. Even though these participants reported more problems with their health and fitness, these issues did not translate into more anxiety, stress, or worry symptoms. However, the high risk group did consistently report higher levels of depression symptoms at each of the three survey time points. The high risk group also reported greater levels of rumination on two of the specific measures of rumination. Participants in the high risk group reported significantly higher levels of brooding and rumination at weeks 1 and 3. Given the strong relationships between rumination and depression symptoms, it is not surprising that the high risk group showed greater levels of both. These findings suggest that individuals who are in the high risk group are more likely to experience increased levels of depression and rumination. Additionally, these participants are likely to also rate themselves as having poorer health and fitness. Consequently, poor health and fitness may be one of the many contributing factors behind the higher levels of depression that are reported in the high risk group.

Changes Over Time

As hypothesized, participants experienced significant positive health, fitness, and psychological changes over the course of CR. The initial overall prevalence of clinical depression was estimated to be 17.6 percent, but the proportion decreased to 9.7 percent by week 8. However, this discrepancy is confounded by the fact that individuals with clinical levels of depression were more likely to drop-out of CR. When estimating the prevalence of depression based only on the individuals who remained in the CR program through the 8th week, the decline was even more prominent. The initial prevalence of depression in this subsample was 19.4 percent which then decreased to 9.7 percent at week 8. This confirms that over the course of eight weeks of CR, participants' depression ratings decrease significantly.

The prevalence of clinical anxiety also decreased over the course of CR from 27.5 percent overall to 19.4 percent at week 8. When looking exclusively at the subsample of individuals who remained in CR through at least week 8, the prevalence of clinical anxiety declined from 25.8 percent to 19.4 percent. While participants' anxiety ratings decreased over the course of CR, the change was not significant. Thus, it appears that the CR program observed in this study was better at helping patients decrease their levels of depression but not their levels of anxiety.

A control group was not included in this study, so the precise effect of CR on depression symptoms cannot be shown; however, independent studies suggest that depression symptoms following a cardiovascular event tend not to diminish when people do not attend CR. These studies estimated that 95 percent of individuals were depressed after a myocardial event continued to be depressed at 6 months and 70

percent remained depressed after 12 months in the absence of CR (Lavie et al., 1999; Ladwig, Roll, Breithardt, Budde, & Borggrefe, 1994; Schleifer & Macari-Hinson, 1989). It is likely then that CR is one of the many factors that may contribute to the decline in patients' clinical level of depression.

When looking at the other psychological variables from the survey packets, participants' ratings of rumination/worry decreased significantly over the course of CR. Stress ratings also decreased, but similar to anxiety, the change was not significant. Participants' ratings of the psychological variables appeared to decline at each time point over the course of the CR; however, for the majority of the variables, only the overall decline between weeks 1 and 8 was significant. These findings suggest that participants may begin to experience the positive effects of CR relatively quickly, and continued attendance appears to translate into the largest psychological gains. Since it appears completion of 8 weeks or more of CR offers the most benefits, CR programs should encourage patients to attend for as long as they are able.

The results of this study also suggest that decreases in negative cognitions may occur at different time points dependent on the participant's gender. When looking at rumination/worry, perceived stress, and brooding, males experienced decreases in negative cognitions earlier in CR compared to women. The largest decreases in rumination/worry, perceived stress, and brooding for men occurred between weeks 1 and 3 but then plateaued between weeks 3 and 8. For women, the largest reductions in rumination/worry, perceived stress, and brooding were not reported until week 8. This is consistent with previous research that highlights the importance of tailoring CR programs to the specific needs and gender of each patient (Beckie et al., 2011;

Sanderson & Bittner, 2005). Women may be more likely to drop-out of CR simply because it may take longer for them to experience the cognitive benefits. Thus, explaining how symptom reduction can vary depending on gender may help reduce perceptions that CR is not helping with specific symptoms. Furthermore, tailoring the program by gender may help expedite the reduction in rumination/worry, perceived stress, and brooding for women and allow for improved graduation rates and emotional wellbeing.

Participants also reported a large improvement in their self- reported health and fitness over the course of CR. Specifically, participants reported feeling more physically fit and having a higher quality of life. Similar to psychological constructs, the significant gains in reported health and fitness were typically seen between weeks 1 and 8. This presents further evidence to suggest that the best outcomes are achieved by participants who remain in the CR program for at least 8 weeks. However, some aspects of health and fitness improved even in the first 3 weeks. Participants reported that their levels of pain and their social functioning had both improved significantly by week three. Considering that CR is an inherently social activity, and that pain levels are closely monitored, it is not surprising that these variables begin to improve relatively early in the program. CR programs may find it helpful to not only educate patients about what health and fitness gains to expect through their participation, but it may also be important to indicate when these improvements are likely to occur. Such education may help staff and patients set goals that are more appropriate and specific. Unlike many of the psychological variables included in this study, the health and

fitness changes across CR did not appear to be moderated by either gender or severity of illness.

As expected from past research, participants also showed significant improvement on objective measures of health. Participants' walking performance improved significantly over the course of CR and participants' percent body fat decreased significantly. These physical improvements are consistent with studies that suggest CR is an effective exercise intervention for improving physical fitness (Milani & Lavie, 2007). These improvements were not qualified by gender or illness severity. There was not a significant overall drop in participants' weight. While this was unexpected, it is important to note that the CR program helps participants attain a weight level that is achievable and healthy. This means that overweight individuals are encouraged to lose weight while underweight individuals are encouraged to gain weight. This became particularly crucial when looking at which participants lost weight and which participants did not. While all participants experienced a CVD event, not all CVD events are treated in the same manner. Stents/PTCA, MI, and cardiomyopathy are treated with pharmacological interventions, shorter in-hospital stays, and outpatient procedures, while CABG and Valve repair/replacement require open heart surgery and extended hospital stays. One of the predominant side effects following major surgery is diminished appetite and weight loss (Miller & Grindel, 2004). As such, the 22 participants who underwent a major surgical procedure may have already lost a large amount of weight prior to starting the CR program. These participants may have maintained or gained weight in order to return to their normal pre-operative weight while participating in CR. This is supported by the significant

interaction between weight change and the presence of a major surgery prior to CR that was seen in this study. While the weight changes observed within these separate groups were not significant, this could be because the participants were tracked between 4 and 12 weeks. There may not have been sufficient time for many participants to experience significant weight loss. Additionally, the current sample may not have had enough power to detect significant weight changes after all the appropriate covariate variables were taken into account.

Overall these findings indicate that CR leads to significant health benefits for patients even if they are very ill or have a large number of identified risk factors. This information may be extremely useful for CR programs and health care providers to use when encouraging their patients to attend and remain in CR.

Program Outcomes

Program Completion

The observed drop-out rate from CR in this sample was 37 percent. This is higher than expected considering that many studies reported drop-out rates between 20 and 25 percent. If the 8 individuals who terminated early but went through the formal CR exit procedures are removed from the "drop-out" category, the drop-out rate becomes 21.5 percent. The discrepancy between the observed drop-out in this study compared to other studies may be due to methodological differences. A significant portion of previous CR research only requires that patients grant access to their medical records for tracking purposes (for example, Worcester et al, 2004). Because the burden of participation for studies that simply track patient records is lower in comparison to this current project, participants may have been more willing to allow their personal

health information to be used for research. The current study required participants to grant access to their medical record and to fill out multiple survey packets. This may have inadvertently created a sampling bias that made it more likely that the individuals in this study would drop-out of CR. For example, it appeared that younger CR attendees were more likely to agree to participate in the study. However, these participants may have been more likely to drop-out of CR because of their age, family obligations, and work commitments (Yohannes et al., 2007). Additionally, other studies only recorded participant drop-out during the first two weeks of the program (Yohannes et al., 2007; Yohannes et al., 2010). Taking this approach decreases the amount of time that participants have to drop-out and likely increased the appearance of CR participation. Since the current study recorded participants who dropped out at any point in time prior to their scheduled graduation date, it is logical that the drop-out rate would be higher. These differences could also help explain why the adjusted drop-out rate of this study was comparable when participants who terminated early were removed from the drop-out group.

In this CR sample, drop-out rates did not significantly differ between gender or type of precipitating cardiac event. Furthermore, CR completion was not significantly associated with age, BMI, or percent body fat. Participants who were actively smoking were more likely to drop-out of CR compared to non-smokers. This is consistent with the findings in the Worcester et al. (2004) study. Individuals who were identified as struggling with stress by CR staff were also more likely to drop-out compared to those who were not identified with this risk factor. Drop-out rates were also significantly different based on participants' illness severity, as defined by their risk stratification

assignment. Individuals in the high risk group were more likely to drop-out of CR unexpectedly compared to individuals in the moderate risk group. Participants with clinical depression were more likely to drop-out of CR before completing the full course of their recommended treatment. This finding is consistent across multiple studies looking at determinates of CR drop-out (Caulin-Glaser et al., 2007). While the presence of clinical anxiety did lead to a higher drop-out rate, the difference was not significant.

Participants' initial self-ratings of their general health, emotional well-being, and rumination all were significant predictors of CR program completion. The higher a participant perceived their overall level of health, the less likely they were to complete CR. This may suggest that participants who continue to view themselves as generally healthy even after a significant cardiovascular event may struggle to see the need and potential benefits of completing a CR program. Additionally, emotional well-being was a significant positive predictor of CR completion. The five items that compose this subscale ask about symptoms associated with anxiety and depression. For example, two items that participants responded to were, "over the past 2 weeks, have you been a very nervous person," and "have you felt so down in the dumps that nothing could cheer you up?" Even though the anxiety and depression specific measures did not significantly predict CR completion, it appears that these symptoms are still important to monitor and track.

The final significant predictor in the regression model of CR completion was the rumination variable. Within the regression model, higher levels of rumination increased the likelihood of CR completion. While the zero-order correlation between

rumination and CR completion was slightly negative and not significant, it became a positive and significant predictor variable after taking general health and negative affect into account. The cardiovascular event that prompted a referral to CR may be more salient to participants who engage in rumination more frequently. The presence of repetitive and intrusive thoughts about their illness may increase the likelihood of program completion since these participants may be worried about their current and future health following their recent cardiovascular event. Individuals who are not engaging in ruminating may not see the need for CR since they do not appear to be thinking about the potential health effects of their cardiovascular event.

Fitness

This study predicted that depression and rumination would influence participants' physical fitness. As expected, age and gender were significant covariates of pre CR 6MWT distance. Females and older participants walked significantly less distance on the 6MWT. Severity of illness was not a significant covariate for pre CR 6MWT distance. When investigating both self-rated health and fitness variables and psychological variables, participants' perception of their physical functioning was the largest positive predictor of pre CR 6MWT distance. Considering that the physical functioning subscale is specifically designed to estimate each participant's physical capability, it is not surprising that self-rated physical functioning is a significant predictor of objective physical fitness. This provides further support that participants' self-ratings of their physical health and fitness levels are fairly accurate estimates. CR programs can take advantage of this by encouraging patients to frequently report their

perceived fitness level in order to track their progress, or lack thereof, while continuing to individualize their treatment plan.

When the self-reported physical functioning variables were excluded, depression emerged as a significant negative predictor of pre CR 6MWT distance along with gender and age. As predicted, participants with higher levels of depression demonstrated poorer walking performance. This study did not explicitly investigate the mechanisms that explain why individuals who report higher levels of depression have poorer walking performance; however, the symptoms of depression such as fatigue, psychomotor slowness, and decreased concentration all could make it difficult for depressed participants to perform well on the 6MWT. These results partially replicate the findings of a larger study (n = 571) that specifically investigated significant determinants of performance on the 6MWT (Ingle, Rigby, Nabb, Jones, Clark, & Cleland, 2006). Ingle et al. (2006) found age, gender, weight, heart rate, anxiety and depression to be independent predictors of 6MWT walking performance in the absence of any clinical/exercise intervention. The smaller sample size (n = 51) of this current study may explain why weight, heart rate, or anxiety were not significantly associated with initial walking performance. While rumination was also hypothesized to predict initial fitness, it was not a significant predictor even after accounting for age and gender.

The largest predictor of walking performance at the end of CR was participants' initial walking performance. When this variable was taken into account, no other demographic, fitness, or psychological variable added to the prediction equation. However, when participants' initial fitness testing was not taking into account, several

significant psychological predictors emerged. Consistent with the initial CR fitness test, being older and female again led to lower 6MWT distances. Negative affect again was a significant predictor of walking performance. Participants' level of anxiety in the middle of CR was the strongest psychological predictor of post CR walking performance with increases in anxiety leading to decreased walking performance. Participants' initial level of rumination was also a positive predictor of walking performance.

The inclusion of the rumination and anxiety variables in the regression equation indicate the presence of a suppression effect (Conger, 1974). The individual zero-order correlations of the anxiety and rumination variables to post CR walking performance were much smaller compared to the standardized betas produced in the regression equation. Thus, the inclusion of these variables together in the regression equation substantially increased the overall predictive ability of both of the variables. The large correlation between the anxiety and rumination variable ($r = 0.75$) appears to allow the variables to work together in order to explain the post CR walking performance variance by decreasing the amount of error variance for anxiety and rumination in respect to post CR walking performance.

Depression, anxiety, and rumination were not significant predictors of walking performance improvement after completing CR after controlling for pre CR physical fitness, and this result was unexpected. A study by Egger et al. (2008) found that depressive symptoms resulted in less physical improvement following a CR program even after taking into account initial physical fitness. The Egger et al. (2008) study also found that anxiety was related to greater improvement in exercise capacity after

CR completion. They believed that the positive relationship between anxiety and improvement in exercise capacity was due to anxiety acting as a "motivator [for patients] to engage in exercise more intensively." While the specific results were not duplicated, the overall findings from the current study suggest that negative affect is associated with lower levels of fitness at the end of CR. Furthermore, worry and rumination following a cardiovascular event may act as a cognitive process that reinforces a participants' perception of the severity of their cardiovascular disease and the need for treatment and CR. Thus, rumination could contribute to the positive fitness outcomes that were observed at the post CR fitness testing.

Limitations and Future Research

Because this study is the first to comprehensively investigate the interrelationships of demographic, fitness, and psychological variables with outcomes in a CR population, many of the analyses were exploratory. Because of this, the results need to be replicated and further established. Because of the large number of variables that are known to impact CR outcomes, a large sample is required to properly power the analyses when all of these covariates are included. Furthermore, the substantial number of participants who drop-out of CR also decreases the power of the analyses used in this study. Thus, the use of a larger sample across multiple sites would be particularly helpful when attempting to replicate the findings from this study.

The data for this study was collected from a single CR program which included a relatively homogeneous sample. It will be important to study these relationships in other CR programs to see if the findings generalize to other settings and patient groups. A larger multi-site sample would allow for greater power when looking at differences

between specific CVD events or other specific subgroups. For example there were only 4 low risk participants in this study. A larger sample would be able to address the specific role of depression, rumination, and other psychological variables in relationship to CR outcomes for individuals who are considered to be at either a low or very high risk. Additionally, the sample for this current study was overwhelmingly Euro-American. Different races and cultures may have significantly different perceptions and cognitions regarding the severity of their chronic cardiovascular disease and the benefits of engaging in a CR program.

The recruitment procedures for this study required participants to opt into the study. This likely led to a sample that was not truly representative of the overall CR population. It is possible that individuals who were overwhelmed, severely depressed, or in very poor heath chose to not participate in the study. As such, the current sample may reflect a healthier group of individuals with a more positive outlook in regards to their health. Future studies would benefit from examining the roles of depression, rumination, and other psychological variables on CR outcomes in samples that include participants experiencing the full range of medical and psychological pathology.

Because the purpose of this study focused on variables that predicted CR outcomes, no control group was included. However, it would be incredibly valuable to track physical and psychological variables in a group of individuals with CVD who opt out of CR. This would provide a better understanding of how depression, anxiety, and rumination following a cardiovascular event may relate to CR participation and overall recovery. Future inclusion of a control group would also provide additional support to

the claims about the psychological benefits of CR participation versus non-participation.

It would also be beneficial to track the long term outcomes of CR participants. It is possible that certain psychological profiles lead to better long term outcomes at 6 and 12 months post CR completion. While rumination within a CR setting is associated with positive outcomes, the majority of rumination research focuses on the negative consequences. Rumination may help participants complete CR by helping them focus on the seriousness of living with CVD. However, continuous rumination following the end of CR may still adversely affect patients' long term health.

LIST OF REFERENCES

LIST OF REFERENCES

Abbott, M., & Rapee, R. (2004). Post-event rumination and negative self-appraisal in social phobia before and after treatment. *Journal of Abnormal Psychology, 113*(1), 136-144. doi:10.1037/0021-843X.113.1.136.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

American Thoracic Society. (2002). ATS statement: Guidelines for the six-minute walk test. *American Journal of Critical Care Medicine, 166,* 111-117.

Artham, S. M., Lavie, C. J., & Milani, R. V. (2008). Cardiac rehabilitation programs markedly improve high-risk profiles in coronary patients with high psychological distress. *Southern Medical Journal, 101,* 262-267. doi: 10.1097/SMJ.0b013e318164dfa8.

Arving, C., Glimelius, B., & Brandberg, Y. (2008). Four weeks of daily assessments of anxiety, depression and activity compared to a point assessment with the Hospital Anxiety and Depression Scale. *Quality of Life Research*, *17*(1), 95-104. doi:10.1007/s11136-007-9275-4.

Baer, R. A., & Sauer, S. E. (2011). Relationships between depressive rumination, anger rumination, and borderline personality features. *Personality Disorders: Theory, Research, and Treatment, 2*(2), 142-150. doi:10.1037/a0019478.

Beckie, T. M., Beckstead, J. W., Schocken, D. D., Evans, M. E., & Fletcher, G. F. (2011). The effects of a tailored cardiac rehabilitation program on depressive symptoms in women: A randomized clinical trial. *International Journal of Nursing Studies, 48,* 3-12. doi:10.1016/j.ijnurstu.2010.06.005.

Bello, N., & Mosca, L. (2004). Epidemiology of coronary heart disease in women. *Progress in Cardiovascular Diseases*, *46*(4), 287-295.

Blumenthal, J. A., Babyak, M. A., O'Connor, C., Keteyian, S., Landzberg, J., Howlett, J., . . . Whellan, D. J. (2012). Effects of exercise training on depressive symptoms in patients with chronic heart failure the HF-ACTION randomized trial. *JAMA: The Journal of the American Medical Association*, *308*(5), 465-474.

Bjarnason-Wehrens, B., Benesch, L., Bischoff, K. O., Buran-Kilian, B., Gysan, D., Hollenstein, U., . . . Sauer, G. (2003). Effects of a phase II cardiac rehabilitation program performed on an outpatient basis. *Herz, 28*(5), 404-412. doi:10.1007/s00059-003-2433-8.

Bjelland, I., Dahl, A. A., Haug, T. T., & Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale-An updated literature review. *Journal of Psychosomatic Research*, *52*(2), 69-78. doi:10.1016/S0022-3999(01)00296-3.

Bromet, E., Andrade, L., Hwang, I., Sampson, N., Alonso, J., ... Kessler, R. C. (2011). Cross-national epidemiology of DSM-IV major depressive episode. *BMC Medicine, 9,* 1-16. doi:10.1186/1741-7015-9-90.

Brown, T. A., Antony, M. M. & Barlow, D. H. (1992). Psychometric properties of the Penn State Worry Questionnaire in a clinical anxiety disorder sample. *Behaviour Research and Therapy, 30*, 33-37. doi:10.1016/0005-7967(92)90093-V.

Caci, H., Bayle, F. J., Mattei, V., Dossios, C., Robert, P., & Boyer, P. (2003). How does the Hospital Anxiety and Depression Scale measure anxiety and depression in healthy subjects? *Psychiatry Research, 118*(1), 89–99. doi:10.1016/S0165-1781(03)00044-1.

Caulin-Glaser, T., Maciejewski, P. K., Snow, R., LaLonde, M., & Mazure, C. (2007). Depressive symptoms and sex affect completion rates and clinical outcomes in cardiac rehabilitation. *Preventative Cardiology, 10*(1), 15-21. doi:10.1111/j.1520-037.2007.05666.x.

Centers for Disease Control and Prevention. (2010). Current depression among adults – United States, 2006 and 2008. *Center for Disease Control and Prevention Morbidity and Mortality Weekly Report, 59*, 1229-1235.

Clark, A. M., King-Shier, K. M., Thompson, D. R., Spaling, M. A., Duncan, A. S., Stone, J. A., . . . Angus, J. E. (2012). A qualitative systematic review of influences on attendance at cardiac rehabilitation programs after referral. *American Heart Journal, 164*, 835-845. doi:10.1016/j.ahj.2012.08.020.

Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R. G. Heimberg, M. R. Liebowitz, D. A. Hope, F. R. Schneier, R. G. Heimberg, M. R. Liebowitz, . . . F. R. Schneier (Eds.) , *Social phobia: Diagnosis, assessment, and treatment* (pp. 69-93). New York, NY: Guilford Press.

Cohen, S., & Williamson, G. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan, & S. Oskamp (Eds.), *The social psychology of health* (pp. 31-67). Newbury Park, CA: Sage.

Conger, A. J. (1974). A revised definition for suppressor variables: A guide to their identification and interpretation. *Educational and Psychological Measurement*, *34*(1), 35-46.

Conway, M., Csank, P. A. R., Holm, S. L., & Blake, C. K. (2000). On individual differences in rumination on sadness. *Journal of Personality Assessment, 75*, 404-425. doi:10.1207/S15327752JPA7503_04.

Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. (2002). ATS statement: guidelines for the six-minute walk test. *American Journal Respiratory Critical Care Medicine, 166*(1),111–117.

Dimsdale, J. E. (2008). Psychological stress and cardiovascular disease. *Journal of the American College of Cardiology*, *51*(13), 1237-1246. doi:10.1016/j.jacc.2007.12.024.

Dunlay, S. M., Witt, B. J., Allison, T. G., Hayes, S. N., Weston, S. A., Koepsell, E., & Roger, V. L. (2009). Barriers to participation in cardiac rehabilitation. *American Heart Journal, 158,* 852-859. doi: 10.1016/j.ahj.2009.08.010

Egger, E., Schmid, J. P., Schmid, R. W., Saner, H., & von Kanerl, R. (2008). Depression and anxiety symptoms affect change in exercise capacity during cardiac rehabilitation. *European Journal of Cardiovascular Prevention and Rehabilitation, 15*(6), 704-708. doi: 10.1097/HJR.0b013e32830eb6c5.

Enright, P. L. (2003). The six-minute walk test. *Respiratory Care*, *48*(8), 783-785.

French, D. P., Lewin, R. P., Watson, N., & Thompson, D. R. (2005). Do illness perceptions predict attendance at cardiac rehabilitation and quality of life following myocardial infarction? *Journal of Psychosomatic Research, 59*(5), 315-322. doi:10.1016/j.jpsychores.2005.03.010

Garnefski, N. N., Kraaij, V. V., Schroevers, M. J., Aarnink, J. J., van der Heijden, D. J., van Es, S. M., . . . Somsen, G. A. (2009). Cognitive coping and goal adjustment after first-time myocardial infarction: Relationships with symptoms of depression. *Behavioral Medicine*, *35*(3), 79-86. doi:10.3200/BMED.35.3.79-86

Gibbons, R. J., Abram, J., Chatterjee, K. Daley, J., Deedwania, P. C., Douglas, J. S., . . . Williams, S. V. (2002). ACC/AHA 2002 guideline update for the management of patients with chronic stable angina— summary article: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on the Management of Patients With Chronic Stable Angina). *Circulation*, *107*(1), 149-158. doi:10.1161/01.CIR.0000047041.66447.29

Glazer, K. M., Emery, C.F., Frid, D. J., & Banyasz, R. E. (2002). Psychological predictors of adherence and outcomes among patients in cardiac rehabilitation. *Journal of Cardiopulmonary Rehabilitation, 22*(1), 40-46. doi:10.1097/00008483-200201000-00006.

Grace, S. L., Abbey, S. E., Pinto, R., Shnek, Z. M., Irvine, J., & Stewart, D. E. (2005). Longitudinal course of depressive symptomatology after a cardiac event: Effects of gender and cardiac rehabilitation. *Psychosomatic Medicine, 67,* 52-58. doi:10.1097/01.psy.0000151486.28349.70.

Grenier, S., Potvin, O., Hudon, C., Boyer, R., Préville, M., Desjardins, L., & Bherer, L. (2012). Twelve-month prevalence and correlates of subthreshold and threshold anxiety in community-dwelling older adults with cardiovascular diseases. *Journal of Affective Disorders, 136*(3), 724-732. doi:10.1016/j.jad.2011.09.052

Grewal, K., Gravely-Witte, S., Stewart, D. E., & Grace, S. L. (2011). A simultaneous test of the relationship between identified psychosocial risk factors and recurrent events in coronary artery disease patients. *Anxiety, Stress & Coping: An International Journal, 24*(4), 463-475. doi:10.1080/10615806.2010.546838

Hambrecht, R., Gielen, S., Linke, A., Fiehn, E., Yu, J., Walther, C., . . . Schuler, G. (2000). Effects of exercise training on left ventricular function and peripheral resistance in patients with chronic heart failure: A randomized trial. *The Journal of the American Medical Association, 283*(23), 3095-3101. doi: 10.1001/jama.283.23.3095

Hays, R. D., Sherbourne, C. D., & Mazel, R. M. (1993). The RAND 36-item health survey 1.0. *Health Economy, 2,* 217-227. doi:10.1002/hec.4730020305.

Hedbäck, B., Perk, J., Hörnblad, M., & Ohlsson, U. (2001). Cardiac rehabilitation after coronary artery bypass surgery: 10-year results on mortality, morbidity and readmissions to hospital. *Journal of Cardiovascular Risk*, *8*(3), 153-158. doi:10.1177/174182670100800306.

Heran, B. S., Chen, J. M. H., Ebrahim, S., Moxham, T., Oldridge, N., Rees, K., . . . Taylor, R. S. (2011). Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database of Systematic Reviews, 7*, doi:10.1002/14651858.CD001800.pub2.

Heron, M., D. L., Murphy, S. L, Jiaquan, X., Kochanek, K. D., & Betzaida, T. V. (2009). Deaths: Final data for 2006. *National Vital Statistics Reports, 57(14)*, 1-136.

Herrmann, C. (1997). International experiences with the Hospital Anxiety and Depression Scale-a review of validation data and clinical results. *Journal of Psychosomatic Research*, *42*(1), 17-41. doi:10.1016/S0022-3999(96)00216-4.

Higgins, R. O., Murphy, B. M., Nicholas, A., Worcester, M. U., & Lindner, H. (2007). Emotional and adjustment issues faced by cardiac patients seen in clinical practice: A qualitative survey of experienced clinicians. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *27*(5), 291–297. doi: 10.1097/01.HCR.0000291296.62894.e5.

Hosmer, D. W., Hosmer, T., Le Cessie, S., & Lemeshow, S. (1997). A comparison of goodness-of-fit tests for the logistic regression model. *Statistics in Medicine, 16*(9), 965-980.

Hoyert, D. L., & Xu, J. (2012). Deaths: Preliminary data for 2011. *National Vital Statistics Reports, 61*(6), 1-56.

Hughes, M. E., Alloy, L. B., & Cogswell, A. (2008). Repetitive thought in psychopathology: The relation of rumination and worry to depression and anxiety symptoms. *Journal of Cognitive Psychotherapy, 22*(3), 271-288. doi:10.1891/0889-8391.22.3.271.

Ingle, L., Rigby, A. S., Nabb, S., Jones, P. K., Clark, A. L., & Cleland, J. G. F. (2006). Clinical determinants of poor six-minute walk test performance in patients with left ventricular systolic dysfunction and no major structural heart disease. *European Journal of Heart Failure*, *8*(3), 321-325. doi:10.1016/j.ejheart.2005.08.006.

Jairath, N., Salerno, T., Chapman, J., Dornan, J., & Weisel, R. (1995). The effect of moderate exercise training on oxygen uptake post-aortic/mitral valve surgery. *Journal of Cardiopulmonary Rehabilitation, 15*(6), *424*-430.

Jenkinson, C., Wright, L., & Coulter, A. (1994). Criterion validity and reliability of the SF-36 in a population sample. *Quality of Life Research, 3,* 7-12. doi:10.1007/BF00647843.

Jolliffe, J. A., Rees, K., Taylor, R. S., Thompson, D., Oldridge, N., & Ebrahim, S. (2001). Exercise-based rehabilitation for coronary heart disease. *Cochrane Database of Systematic Reviews*, *1*. doi:10.1002/14651858.CD001800.

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement, 20,* 141-151. doi:10.1177/001316446002000116.

Kashdan, T., & Roberts, J. (2007). Social anxiety, depressive symptoms, and post-event rumination: Affective consequences and social contextual influences. *Journal of Anxiety Disorders, 21*(3), 284-301. doi:10.1016/j.janxdis.2006.05.009.

Keller, S. D., Ware, J. E., Jr., Bentler, P. M., Aaronson, N. K., Alonso, J., Apolone, G., . . . Gandek, B. (1998). Use of structural equation modeling to test the construct validity of the SF-36 Health Survey in ten countries: Results from the IQOLA Project. International Quality of Life Assessment. *Journal of Clinical Epidemiology*, *51*(11), 1179-1188.

Kerins, M., McKee, G., & Bennett, K. (2011). Contributing factors to patient non-attendance at and non-completion of Phase III cardiac rehabilitation. *European Journal of Cardiovascular Nursing*, *10*(1), 31-36. doi:10.1016/j.ejcnurse.2010.03.006.

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the national comorbidity survey replication. *Archive of General Psychiatry, 62*, 593-602. doi:10.1001/archpsyc.62.6.593.

Key, B. L., Campbell, T. S., Bacon, S. L., & Gerin, W. (2008). The influence of trait and state rumination on cardiovascular recovery from a negative emotional stressor. *Journal of Behavioral Medicine, 31*(3), 237-248. doi:10.1007/s10865-008-9152-9

Kobashigawa, J. A., Leaf, D. A., Lee, N., Gleeson, M. P., Liu, H., Hamilton, M. A., . . . Laks, H. (1999). A controlled trial of exercise rehabilitation after heart transplantation. *New England Journal of Medicine*, *340*(4), 272-277. doi:10.1056/NEJM199901283400404.

Kuper, H., Marmot, M., & Hemingway, H. (2002). Systematic review of prospective cohort studies of psychosocial factors in the etiology and prognosis of coronary heart disease. *Seminars in Vascular Medicine, 2*, 267–314. doi: 10.1055/s-2002-35401.

Ladwig, K. H., Roll, G., Breithard, G., Budde, T., & Borggrefe, M. (1994). Post-infarction depression and incomplete recovery 6 months after acute myocardial infarction. *The Lancet*, *343*(8), 20-23. doi:10.1016/S0140-6736(94)90877-X.

Lane. D., Carroll, D., Ring, C., Beevers, D. G., & Lip, G. Y. (2001). Mortality and quality of life 12 months after myocardial infarction: effects of depression and anxiety. *Psychosomatic Medicine, 63*, 221–230.

Lavie, C. J., & Milani, R. V. (1995). Effects of cardiac rehabilitation and exercise training on exercise capacity, coronary risk factors, behavioral characteristics, and quality of life in women. *The American Journal of Cardiology, 75*(5), 340-343. doi:10.1016/S0002-9149(99)80550-5.

Lavie, C. J., & Milani, R. V. (1997). Effects of cardiac rehabilitation, exercise training, and weight reduction on exercise capacity, coronary risk factors, behavioral characteristics, and quality of life in obese coronary patients. *The American Journal of Cardiology*, *79*(4), 397-401. doi:10.1016/S0002-9149(97)89239-9.

Lavie, C. J., Milani, R. V., Cassidy, M. M., & Gilliland, Y. E. (1999). Effects of cardiac rehabilitation and exercise training programs in women with depression. *The American Journal of Cardiology*, *83(*10), 1480. doi:10.1016/S0002-9149(99)00127-7.

Lavie, C. J., Milani, R. V., O'Keefe, J. H., & Lavie, T. J. (2011). Impact of exercise training on psychological risk factors. *Progress in Cardiovascular Diseases*, *53*(6), 464-470. doi:10.1016/j.pcad.2011.03.007.

Lavie, C. J., Thomas, R. J., Squires, R. W., Allison, T. G., & Milani, R. V. (2009, April). Exercise training and cardiac rehabilitation in primary and secondary prevention of coronary heart disease. *Mayo Clinic Proceedings, 84*(4), 373-383. doi:10.4065/84.4.373.

Leon, A. S., Franklin, B. A., Costa F., Balady, G. J., Berra, K. A., Stewart, J. K., . . . Lauer, M. S. (2005). Cardiac rehabilitation and secondary prevention of coronary heart disease: an American Heart Association scientific statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity), in collaboration with the American Association of Cardiovascular and Pulmonary Rehabilitation. *Circulation, 111*, 369-376. doi: 10.1161/01.CIR.0000151788.08740.5C

Lloyd-Jones, D., Adams, R. J., Brown, T. M., Carnethon, M., Dai, S., De Simone, G., . . . Wylie-Rosett, J. (2010). Heart disease and stroke statistics—2010 update. *Circulation*, *121*(7), e46-e215. doi:10.1161/CIRCULATIONAHA.109.192667.

Lok, C., & Bishop, G. D. (1999). Emotion control, stress, and health. *Psychology & Health*, 14(5), 813-827. doi:10.1080/08870449908407349

Lyubomirsky S., & Tkach C. (2004). The consequences of dysphoric rumination. In C. Papageorgiou, & A. Wells (Eds.), *Depressive rumination: Nature, theory, and treatment* (pp. 21–42). Chichester, England: Wiley.

Martin, C. R., Thompson, D. R., & Chan, D. S. (2004). An examination of the psychometric properties of the Hospital Anxiety and Depression Scale in Chinese patients with acute coronary syndrome. *Psychiatry Research, 129(3),* 279–288. doi:10.1016/j.psychres.2004.06.012.

Martin, L. L., & Tesser, A. (1996). Some ruminative thoughts. In R .S. Wyer, Jr. (Ed.), *Ruminative thoughts* (pp.1-47). Mahwah, NJ: Erlbaum.

McHorney, C. A., Ware, J. E., & Racek, A. E. (1993). The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Medical Care, 31,* 247-263. doi: 10.1097/00005650-199303000-00006.

Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy, 28,* 487-495. doi:10.1016/0005-7967(90)90135-6.

Milani, R. V., & Lavie, C. J. (2007). Impact of cardiac rehabilitation on depression and its associated mortality. *The American Journal of Medicine*, *120*(9), 799-806. doi:10.1016/j.amjmed.2007.03.026.

Milani, R. V., Lavie, C. J., & Cassidy, M. M. (1996). Effects of cardiac rehabilitation and exercise training programs on depression in patients after major coronary events. *American Heart Journal*, *132*(4), 726-732. doi:10.1016/S0002-8703(96)90304-X.

Miller, K. H., & Grindel, C. G. (2004). Comparison of symptoms of younger and older patients undergoing coronary artery bypass surgery. *Clinical Nursing Research*, *13*(3), 179-193. doi: 10.1177/1054773804265693.

Molina, S., & Borkovec, T. D. (1994). The Penn State Worry Questionnaire: Psychometric properties and associated characteristics. In G. C. L. Davey & F. Tallis (Eds.), *Worrying. perspectives on theory, assessment and* treatment (pp. 265-282). Chichester, England: John Wiley & Sons.

Musselman, D. L., Evans, D. L., & Nemeroff, C. B. (1998). The relationship of depression to cardiovascular disease: Epidemiology, biology, and treatment. *Archives of General Psychiatry, 55*(7), 580-592. doi:10.1001/archpsyc.55.7.580

Mykletun, A., Stordal, E., & Dahl, A. A. (2001). Hospital Anxiety and Depression Scale: Factor structure, item analyses and internal consistency in a large population. *British Journal of Psychiatry, 179*, 540–544. doi:10.1192/bjp.179.6.540.

Nagelkerke, N. J. (1991). A note on a general definition of the coefficient of determination. *Biometrika, 78*(3), 691-692.

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*, 569–582. doi:10.1037/0021-843X.100.4.569.

Nolen-Hoeksema, S., Stice, E., Wade, E., & Bohon, C. (2007). Reciprocal relations between rumination and bulimic, substance abuse, and depressive symptoms in female adolescents. *Journal of Abnormal Psychology, 116*(1), 198-207. doi:10.1037/0021-843X.116.1.198.

Nolen-Hoeksema, S., Wisco, B., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science, 3*(5), 400-424. doi:10.1111/j.1745-6924.2008.0008.

Papageorgiou, C., & Wells, A. (2004). *Depressive rumination: Nature, theory and treatment.* Chichester, England: John Wiley & Sons.

Piepoli, M. F., Davos, C., Francis, D. P., & Coats, A. J., (2004). Exercise training meta-analysis of trials in patients with chronic heart failure (ExTraMATCH). *British Medical Journal, 328*(7433), 189-198. doi: 10.1136/bmj.37938.645220.EE

Pleis, J. R., Ward, B. W., & Lucas, J. W. (2010). Summary health statistics for U.S. adults: National Health Interview Survey, 2009. *Vital and Health Statistics, 10*(249), 1-217.

Rector, N. A., & Roger, D. (1996). Cognitive style and well-being: A prospective examination. *Personality and Individual Differences*, *21*(5), 663-674. doi:10.1016/0191-8869(96)00124-9

Rees, K., Taylor, R. S., Singh, S., Coats, A. J., & Ebrahim, S. (2004). Exercise based rehabilitation for heart failure. *Cochrane Database of Systematic Reviews*, *3*. doi:10.1002/14651858.CD003331.pub2.

Roberti, J, Harrington, L, & Storch, E. (2006). Further psychometric support for the 10-Item version of the Perceived Stress Scale. *Journal of University Counseling, 9,* 135-147. doi:10.1002/j.2161-1882.2006.tb00100.x.

Roger, D., & Jamieson, J. (1988). Individual differences in delayed heart-rate recovery following stress: The role of extraversion, neuroticism and emotional control. *Personality and Individual Differences*, *9*(4), 721-726. doi:10.1016/0191-8869(88)90061-X

Roger, D., & Najarian B. The relationship between emotional rumination and cortisol secretion under stress. *Personality and Individual Differences* [serial online]. April 1998;24(4):531-538. Available from: PsycINFO, Ipswich, MA. Accessed September 11, 2011. doi:10.1016/S0191-8869(97)00204-3.

Rozanski, A., Blumenthal, J. A., Davidson, K. W., Saab, P. G., & Kubzansky, L. (2005). The epidemiology, pathophysiology, and management of psychosocial risk factors in cardiac practice: The emerging field of behavioral cardiology. *Journal of the American College of Cardiology*, *45*(5), 637-651. doi:10.1016/j.jacc.2004.12.005.

Rozanski, A., Blumenthal, J., & Kaplan, J. (1999). Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. *Circulation, 99*, 2192-2217, doi:10.1161/01.CIR.99.16.2192

Sanderson, B. K., & Bittner, V. (2005). Women in cardiac rehabilitation: Outcomes and identifying risk for dropout. *American Heart Journal, 150,* 1052-1058, doi: 10.1016/j.ahj.2004.12.027.

Schleifer, S. J., & Macari-Hinson, M. M. (1989). The nature and course of depression following myocardial infarction. *Archives of Internal Medicine*, *149*(8), 1785. doi:10.1001/archinte.149.8.1785.

Sharif, F., Shoul, A., Janati, M., Kojuri, J., & Zare, N. (2012). The effect of cardiac rehabilitation on anxiety and depression in patients undergoing cardiac bypass graft surgery in Iran. *BMC Cardiovascular Disorders, 8,* 1-7. doi: 10.1186/1471-2261-12-40.

Simms, K., Myers, C., Adams, J., Hartman, J., Lindsey, C., Doler, M., & Suhr, J. (2007). Exercise tolerance testing in a cardiac rehabilitation setting: an exploratory study of its safety and practicality for exercise prescription and outcome data collection. *Baylor University Medical Center Proceedings*, *20*(4), 344-347.

Smith, T. W., & Ruiz, J. M. (2002). Psychosocial influences on the development and course of coronary heart disease: Current status and implications for research and practice. *Journal of Consulting and Clinical Psychology, 70*(3), 548-568. doi:10.1037/0022-006X.70.3.548

Somers, J. M., Goldner, E. M., Waraich, P., & Hsu, L. (2006). Prevalence and incidence studies of anxiety disorders: A systematic review of the literature. *The Canadian Journal of Psychiatry, 51*(2), 100-113.

Stephens, M. B., (2009). Cardiac rehabilitation. *American Family Physician, 80,* 955-959. Retrieved from www.aafp.org/afp

Suls, J., & Bunde, J. (2005). Anger, anxiety, and depression as risk factors for cardiovascular disease: The problems and implications of overlapping affective dispositions. *Psychological Bulletin, 131*(2), 260-300. doi:10.1037/0033-2909.131.2.260

Swardfager, W., Herrmann, N., Marzolini, S., Saleem, M., Farber, S. B., Kiss, A., . . . Lanctôt, K. L. (2011). Major depressive disorder predicts completion, adherence, and outcomes in cardiac rehabilitation: A prospective cohort study of 195 patients with coronary artery disease. *Journal of Clinical Psychiatry, 72*(9), 1181-1188. doi:10.4088/JCP.09m05810blu

Szczepanska-Gieracha, J., Morka, J., Kowalska, J., Kustrzycki, W., & Rymaszewska, J. (2012). The role of depressive and anxiety symptoms in the evaluation of cardiac rehabilitation efficacy after coronary artery bypass grafting surgery. *European Journal of Cardiothoracic Surgery, 42,* 108-114. doi: 10.1093/ejcts/ezs463.

Thompson, P. D., Buchner, D., Piña, I. L., Balady, G. J., Williams, M. A., Marcus, B. H., . . . Wenger, N. K. (2003). AHA Scientific Statement. *Circulation*, *107*, 3109-3116.

Thomsen, D. (2006). The association between rumination and negative affect: A review. *Cognition and Emotion, 20*(8), 1216-1235. doi:10.1080/02699930500473533.

Thomsen, D. K., Mehlsen, M. Y., Olesen, F., Hokland, M., Viidik, A., Avlund, K., & Zachariae, R. (2004). Is there an association between rumination and self-reported physical health? A one-year follow-up in a young and an elderly sample. *Journal of Behavioral Medicine*, *27*(3), 215-231.

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research, 27*, 247-259. doi:10.1023/A:1023910315561.

van Rijsoort, S., Emmelkamp, P., & Vervaeke, G. (1999). The Penn State Worry Questionnaire and the Worry Domains Questionnaire: Structure, reliability and validity. *Clinical Psychology & Psychotherapy, 6*(4), 297-307. doi:10.1002/(SICI)1099-0879(199910)6:4<297::AID-CPP206>3.0.CO;2-E

van Weel, C., König-Zahn, C., Touw-Otten, F. W. M. M., Van Duijn, N. P., & Meyboom-de Jong, B. (1995). *COOP/WONCA charts: A manual.* Groningen, The Netherlands: WONCA/ERGHO/NCH.

Verkuil, B., Brosschot, J. F., de Beurs, D. P., & Thayer, J. F. (2009). Effects of explicit and implicit perseverative cognition on cardiac recovery after cognitive stress. *International Journal of Psychophysiology*, *74*(3), 220-228. doi:10.1016/j.ijpsycho.2009.09.003

Vickers, K. S., & Vogeltanz-Holm, N. D. (2003). The effects of rumination and distraction tasks on psychophysiological responses and mood in dysphoric and nondysphoric individuals. *Cognitive Therapy and Research*, *27*(3), 331-348. doi:10.1023/A:1023970501448

Worcester, M. U., Murphy, B. M., Mee, V. K., Roberts, S. B., & Goble, A. J. (2004). Cardiac rehabilitation programmes: Predictors of non-attendance and drop-out. *European Journal of Cardiovascular Prevention & Rehabilitation*, *11*(4), 328-335. doi:10.1097/01.hjr.0000137083.20844.54.

Yohannes, A., Doherty, P., Bundy, C., & Yalfani, A. (2010). The long-term benefits of cardiac rehabilitation on depression, anxiety, physical activity and quality of life. *Journal of Clinical Nursing,* 19*(19-20),* 2806-2813. doi:10.1111/j.1365-2702.2010.03313.x

Yohannes, A. M., Yalfani, A., Doherty, P., & Bundy, C. (2007). Predictors of drop-out from an outpatient cardiac rehabilitation programme. *Clinical Rehabilitation*, *21*(3), 222-229. doi:10.1177/0269215506070771.

Yusuf, S., Hawken, S., Ôunpuu, S., Dans, T., Avezum, A., Lanas, F., . . . Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *The Lancet*, *364*(9438), 937-952. doi:10.1016/S0140-6736(04)17018-9.

Zigmond, A. S., & Snaith, R. P. (1983), The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica, 67*, 361-370. doi: 10.1111/j.1600-0447.1983.tb09716.x

APPENDICES

Appendix A: Tables

Table 1

Demographics by Gender

	Overall (n = 51)	Male (n = 35)	Female (n = 16)
Demographics	*M* ± *SD*	*M* ± *SD*	*M* ± *SD*
Age	61.3 ± 10.5	60.9 ± 10.2	62.0 ± 11.3
Weight (lbs.)	195.7 ± 37.9	202.7 ± 33.9	180.6 ± 42.9†
Height (in.)	67.1 ± 5.0	69.2 ± 4.5	62.8 ± 3.1***
Body fat (%)	34.0 ± 10.4	29.9 ± 7.5	41.9 ± 10.9***
Body mass index (kg/m^2)	30.1 ± 5.6	29.3 ±5.2	31.9 ± 6.3
Gender (M/F)	35/16		
Time since event (days)	23.1 ± 18.2	20.2 ± 16.6	29.1 ± 20.22
Number of medical events	1.4 ± 0.5	1.5 ± 0.5	1.1 ± 0.3**
Medical Event	*n* (%)	*n* (%)	*n* (%)
Stent/Coronary angioplasty (PTCA)	25 (49.0)	19 (54.3)	6 (37.5)
Myocardial Infarction	16 (31.4)	16 (45.7)	0 (0)**
Coronary artery bypass graft (CABG)	14 (27.5)	11 (31.4)	3 (18.8)
Valvular insufficiency	12 (23.5)	5 (14.3)	7 (43.8)*
Cardiomyopathy	2 (3.9)	1 (2.9)	1 (6.3)
Risk Factor			
Smoking (Yes/Previous)	10 (19.6)/8 (15.7)	8 (22.9)/5 (14.3)	2 (12.5)/3 (18.8)
Dyslipidemia	39 (76.5)	27 (77.1)	12 (75.0)
Hypertension	33 (64.7)	23 (65.7)	10 (62.5)
Family history	26 (51.0)	22 (62.9)	4 (25.0)**
Obesity	14 (27.5)	8 (22.9)	6 (37.5)
Physical inactivity	13 (25.5)	7 (20.0)	6 (37.5)
Type II diabetes	8 (15.7)	5 (14.3)	3 (18.8)
Stress	7 (13.7)	5 (14.3)	2 (12.5)
Type I diabetes	0	0	0

Note. † ≤ .1, * ≤ .05, ** ≤ .01, *** ≤ .001

Table 2

Basic Self Report Statistics

	Item *n*	Week 1 (*n* = 51)	Week 3 (n = 47)	Week 8 (*n* = 31)	Mean Alpha
CRRQ		M ± SD	M ± SD	M ± SD	
Positive	5	17.02(3.75)	17.36(3.4)	17.35(3.85)	0.81
Negative	5	12.48(4.58) [a]	11.48(3.80) [ab]	9.67(3.36) [b]	0.84
HADS					
Anxiety	7	5.65(2.97)	5.18(3.32)	4.90(3.00)	0.77
% above cutoff (n)		27.5	25.5	19.4	
Depression	7	4.24(3.10)	3.33(2.95)	3.26(2.89)	0.81
% above cutoff (n)		17.6	10.6	9.7	
PSS	10	20.52(5.18)	19.08(5.68)	18.73(5.91)	0.83
PSWQ	16	43.12(13.46)	40.86(12.96)	39.47(13.00)	0.94
RRS					
Brooding	5	9.96(3.61)	9.74(3.23)	8.60(2.69)	0.82
Reflection	5	9.27(3.21)	8.57(2.69)	8.29(2.83)	0.78
RSS	13	22.86(8.14)	20.77(6.95)	19.77(6.21)	0.85
RAND					
Physical functioning	10	60.49(22.23) [a]	69.78(22.31) [ab]	75.00(21.05) [b]	0.89
Role limits – physical health	4	23.53(35.51) [a]	45.12(42.37) [b]	63.33(37.56) [b]	0.84
Role limits – emotional	3	60.78(41.48)	69.57(38.38)	78.49(31.68)	0.76
Energy and fatigue	4	49.00(23.56)	56.48(25.44)	57.93(25.76)	0.94
Emotional wellbeing	5	77.60(14.97)	78.70(13.71)	80.27(16.51)	0.85
Social functioning	2	69.39(25.27) [a]	82.56(21.67) [b]	85.48(21.91) [b]	0.81
Pain	2	60.49(25.12) [a]	72.55(21.94) [b]	75.16(22.43) [b]	0.87
General health	5	63.04(19.24)	66.00(17.82)	66.67(19.58)	0.78

Note. Different superscript letters denote mean differences across time points at the 0.05 level.

Table 3

Demographic Data by Risk Stratification

	Low (*n* = 4)	Moderate (*n* = 33)	High (*n* = 14)
Program Trajectory	*n* (%)	*n* (%)	*n* (%)
Number of sessions	12	24	36
Completed program	4 (100.0) [a]	22 (66.7) [a b]	6 (42.9) [b]
Finished early	0 (0)	6 (18.2)	2 (1.4)
Dropped out	0 (0) [ab]	5 (15.1) [a]	6 (42.9) [b]
Complications due to illness*	0 (0)	3 (9.1)	2 (15.4)
Adherence (high/low)	3/1	16/17	7/7
Demographics	*M* ± *SD*	*M* ± *SD*	*M* ± *SD*
Age	61.0 ± 12.7	62.9 ± 10.7	57.4 ± 9.0
Weight (lbs.)	173.7 ± 15.7	199.23 ± 39.6	193.8 ± 37.9
Height (in)	71 ± 4.3	67.0 ± 4.0	66.7 ± 6.9
Body fat (%)	20.8 ± 4.6 [a]	35.4 ± 10.2 [b]	35.0 ± 9.7 [b]
Body mass index (kg/m^2)	24.3 ± 2.3 [a]	31.1 ± 5.4 [b]	29.5 ± 5.8 [b]
Gender (M/F)	4/0	22/11	9/5
Time since event (days)	23.6 ± 9.1	20.7 ± 13.8	29.7 ± 28.3
Number of medical events	1.3 ± 0.5	1.3 ± 0.5	1.4 ± 0.5
Number of risk factors	1.75 ± 1.5 [a]	3.4 ± 1.3 [b]	3.4 ± 1.7 [b]
Medical event	*n* (%)	*n* (%)	*n* (%)
Stent/Coronary angioplasty(PTCA)	1 (25)	16 (48.5)	8 (57.1)
Myocardial Infarction	1 (25)	9 (27.3)	6 (42.9)
Coronary artery bypass graft (CABG)	2 (50)	9 (27.3)	3 (21.4)
Valvular insufficiency	1 (25)	10 (30.3)	1 (7.1)
Cardiomyopathy	0 (0) [ab]	0 (0) [a]	2 (14.3) [b]

(*table continues*)

	Low (n = 4)	Moderate (n = 33)	High (n = 14)
Risk Factors	n (%)	n (%)	n (%)
Smoking (Yes/Previous)	0 (0) [a] /2 (50.0) [a]	2 (6.1) [a] /5 (15.2) [ab]	8 (57.1) [b] / 1 (7.1) [b]
Dyslipidemia	1 (25) [a]	29 (87.9) [b]	9 (64.3) [a,b]
Hypertension	1 (25)	23 (69.7)	9 (64.3)
Family history	1(25)	18 (54.5)	7 (50.0)
Obesity	0 (0)	12 (36.4)	2 (14.3)
Physical inactivity	0 (0)	9 (27.3)	4 (28.6)
Type II diabetes	0 (0)	5 (15.2)	3 (21.4)
Stress	0 (0)	3 (9.1)	3 (21.4)
Type I diabetes	0 (0)	0 (0)	0 (0)
Ejection fracture <40%	0 (0) [a]	0 (0) [a]	5 (35.7) [b]

Note. Superscript denote groupings at a $p \leq .05$ level. Groupings not included if no differences. *This category is not independent of the others.

Table 4

Week 1 Correlations Among Psychological Variables

	CRRQ_pos	CCRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos	0.78	0.09	0.19	-0.12	0.23	-0.10	0.17	0.17	0.25
CRRQ_neg		0.88	0.60	0.65	0.68	0.62	0.62	0.69	0.66
HADS_anx			0.74	0.58	0.73	0.65	0.79	0.63	0.70
HADS_dep				0.78	0.48	0.54	0.56	0.49	0.52
PSS					0.80	0.55	0.67	0.75	0.75
PSWQ						0.94	0.49	0.56	0.48
RRS_brood							0.82	0.75	0.84
RRS_reflect								0.84	0.85
RSS									0.92

Note. Time 1 Cronbach's alphas are presented in the diagonal cells.

Table 5

Week 3 Correlations Among Psychological Variables

	CRRQ_pos	CCRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos	0.77	0.02	0.13	-0.24	0.17	-0.14	0.26	0.05	0.16
CRRQ_neg		0.82	0.51	0.59	0.65	0.38	0.62	0.67	0.66
HADS_anx			0.78	0.55	0.66	0.65	0.74	0.69	0.64
HADS_dep				0.81	0.58	0.33	0.51	0.57	0.54
PSS					0.83	0.43	0.65	0.71	0.57
PSWQ						0.93	0.42	0.53	0.38
RRS_brood							0.81	0.84	0.78
RRS_reflect								0.78	0.82
RSS									0.93

Note. Time 2 Cronbach's alphas are presented in the diagonal cells.

Table 6

Week 8 Correlations Among Psychological Variables

	CRRQ_pos	CRRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos	0.87	-0.17	-0.07	-0.28	-0.15	-0.01	-0.03	0.05	0.19
CRRQ_neg		0.82	0.46	0.53	0.65	0.57	0.38	0.49	0.37
HADS_anx			0.79	0.65	0.76	0.63	0.56	0.81	0.71
HADS_dep				0.83	0.65	0.46	0.15	0.66	0.43
PSS					0.86	0.74	0.60	0.70	0.61
PSWQ						0.94	0.61	0.55	0.45
RRS_brood							0.82	0.47	0.76
RRS_reflect								0.70	0.73
RSS									0.90

Note. Time 3 Cronbach's alphas are presented in the diagonal cells.

Table 7

Week 1 Correlations Among Psychological Variables Separated by Gender

	CCRQ_pos	CCRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos		0.38	0.60*	-0.04	0.67**	0.25	0.58**	0.48	0.62**
CRRQ_neg	-0.18		0.45	0.62	0.80	0.71	0.41	0.67	0.54
HADS_anx	-0.01*	0.71		0.39	0.67	0.48	0.77	0.59	0.66
HADS_dep	-0.15	0.69	0.70		0.43	0.62	0.38	0.52	0.34
PSS	-0.12**	0.63	0.76	0.51		0.58	0.65	0.77	0.82
PSWQ	-0.27	0.60	0.72	0.51	0.53		0.40	0.53	0.41
RRS_brood	-0.11**	0.78	0.81	0.70	0.68	0.55		0.74	0.84
RRS_reflect	-0.12	0.73	0.68	0.47	0.75	0.60	0.77		0.89
RSS	-0.19**	0.78	0.76	0.69	0.72	0.57	0.87	0.81	

Note. Female correlations (n = 16) are reported above the diagonal, and male correlations (n = 35) reported below.

* < .05, ** < .01 indicate significant differences between gender

Table 8

Week 3 Correlations Among Psychological Variables Separated by Gender

	CRRQ_pos	CRRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos		0.11	0.47	-0.25	0.34	0.24	0.65*	0.33	0.47
CRRQ_neg	0.01		0.52	0.66	0.80	0.66	0.59	0.67	0.64
HADS_anx	0.01	0.49		0.36	0.69	0.60	0.85	0.60	0.71
HADS_dep	-0.06	0.57	0.70		0.57	0.27	0.35	0.42	0.47
PSS	0.24	0.56	0.61	0.50		0.56	0.62	0.64	0.67
PSWQ	-0.33	0.23	0.64	0.30	0.27		0.58	0.65	0.67
RRS_brood	0.00*	0.64	0.65	0.62	0.61	0.25		0.74	0.82
RRS_reflect	-0.08	0.67	0.72	0.65	0.70	0.40	0.91		0.84
RSS	-0.09	0.67	0.60	0.64	0.52	0.23	0.77	0.83	

Note. Female (n = 16) correlations are reported above the diagonal, and male (n = 31) correlations reported below.

* < .05, ** < .01 indicate significant differences between gender

Table 9

Week 8 Correlations Among Psychological Variables Separated by Gender

	CRRQ_pos	CRRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos		-0.03	0.07	-0.27	-0.19	0.06	0.33	0.30	0.42
CRRQ_neg	-0.28		0.31	0.42	0.64	0.56	0.32	0.24	0.10
HADS_anx	-0.15	0.54		0.76	0.65	0.33	0.13*	0.88	0.71
HADS_dep	-0.28	0.67	0.49		0.74	0.36	-0.14	0.72	0.49
PSS	-0.09	0.66	0.81	0.45		0.53	0.23	0.52	0.54
PSWQ	-0.06	0.52	0.73	0.40	0.79		0.59	0.24	0.35
RRS_brood	-0.21	0.45	0.76*	0.41	0.84	0.69		0.06*	0.59
RRS_reflect	-0.15	0.69	0.73	0.45	0.79	0.63	0.75*		0.75
RSS	-0.02	0.65	0.80	0.82	0.82	0.62	0.85	0.89	

Note. Female correlations (n = 11) are reported above the diagonal, and male correlations (n = 20) reported below.

* < .05, ** < .01 indicate significant differences between gender

Table 10

Week 1 Correlations Among Psychological Variables Separated by Risk Stratification

	CCRQ_pos	CCRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos		-0.13	0.08	-0.23	0.23	-0.40	0.24	0.11	0.29
CRRQ_neg	0.20		0.80	0.67	0.75	0.74	0.72	0.74	0.66
HADS_anx	0.29	0.52		0.75	0.85	0.70	0.88	0.79	0.77
HADS_dep	-0.04	0.71	0.40		0.52	0.71	0.60	0.54	0.43
PSS	0.28	0.72	0.64	0.42		0.59	0.88*	0.85	0.86*
PSWQ	0.09	0.60	0.62	0.46	0.54		0.57	0.48	0.46
RRS_brood	0.26	0.59	0.76	0.49	0.49*	0.49		0.88	0.95
RRS_reflect	0.36	0.74	0.52	0.40	0.57	0.57	0.67		0.85
RSS	0.32	0.70	0.62	0.50	0.50*	0.50	0.76	0.85	

Note. Moderate risk (n = 33) correlations are reported above the diagonal, and high risk (n = 14) correlations reported below.

* ≤ .05, ** ≤ .01 indicate significant differences between risk group

Table 11

Week 3 Correlations Among Psychological Variables Separated by Risk Stratification

	CRRQ_pos	CRRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos		-0.46	0.00	-0.34	0.30	-0.05	0.21	0.00	0.03
CRRQ_neg	0.20		0.58	0.89*	0.59	0.61	0.50	0.70	0.57
HADS_anx	0.22	0.47		0.79	0.66	0.85	0.89	0.91*	0.89*
HADS_dep	-0.27	0.47*	0.34		0.69	0.88**	0.68	0.87**	0.75
PSS	0.09	0.64	0.65	0.44		0.75	0.72	0.82	0.63
PSWQ	-0.05	0.32	0.59	0.11**	0.38		0.83*	0.93**	0.77*
RRS_brood	0.34	0.63	0.66	0.32	0.60	0.25*		0.92	0.94
RRS_reflect	0.08	0.60	0.54*	0.24**	0.62	0.38**	0.77		0.94
RSS	0.28	0.72	0.42*	0.30	0.46	0.22*	0.68	0.71	

Note. Moderate risk (n = 32) correlations are reported above the diagonal, and high risk (n = 11) correlations reported below.

* < .05, ** < .01 indicate significant differences between risk group

Table 12

Week 8 Correlations Among Psychological Variables Separated by Risk Stratification

	CRRQ_pos	CRRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS
CRRQ_pos		-0.31	0.27	-0.16	0.42	0.49	0.26	0.39	0.47
CRRQ_neg	-0.14		0.01	0.26	0.42	0.21	0.37	0.30	0.12
HADS_anx	-0.20	0.57		0.71	0.77	0.85	0.68	0.83	0.74
HADS_dep	-0.37	0.63	0.63		0.63	0.59	-0.08	0.62	0.32
PSS	-0.40	0.75	0.76	0.71		0.84	0.74	0.97**	0.82
PSWQ	-0.18	0.64	0.64	0.38	0.71		0.68	0.83	0.62
RRS_brood	-0.12	0.37	0.37	0.20	0.56	0.62		0.81	0.85
RRS_reflect	-0.13	0.55	0.55	0.65	0.53**	0.41	0.34		0.88
RSS	0.06	0.44	0.44	0.41	0.49	0.36	0.73	0.58	

Note. Moderate risk ($n = 23$) correlations are reported above the diagonal, and high risk ($n = 8$) correlations reported below.

* < .05, ** < .01 indicate significant differences between risk group

Table 13

Rotated PCAs and Factor Loadings for Psychological Variables at Three Time Points

	Component			
	1	2	h^2	Measure
Week 1	**0.88**	0.24	0.84	RSS
	0.87	0.11	0.77	RRS-brooding
	0.87	0.15	0.78	RRS-reflection
	0.87	0.08	0.76	HADS-anxiety
	0.85	0.19	0.76	PSS
	0.83	-0.14	0.71	CRRQ-negative
	0.74	-0.34	0.66	PSWQ
	0.74	-0.36	0.67	HADS-depression
	0.11	**0.91**	0.84	CRRQ-positive
var	61.78	13.59		
totvar		75.37		
Week 3				
	0.84	0.21	0.66	RSS
	0.92	0.06	0.71	RRS-brooding
	0.88	0.24	0.64	RRS-reflection
	0.84	0.01	0.49	HADS-anxiety
	0.81	0.08	0.90	PSS
	0.75	-0.14	0.59	CRRQ-negative

(*table continues*)

	Component 1	2	h^2	Measure
	0.64	-0.30	0.84	PSWQ
	0.72	-0.34	0.85	HADS-depression
	0.07	**0.95**	0.76	CRRQ-positive
var	57.80	13.59		
totvar		71.39		
Week 8				
	0.88	-0.05	0.77	RSS
	0.86	-0.04	0.73	RRS-brooding
	0.74	0.35	0.67	RRS-reflection
	0.76	0.39	0.74	HADS-anxiety
	0.74	0.50	0.80	PSS
	0.47	**0.65**	0.64	CRRQ-negative
	0.71	0.25	0.56	PSWQ
	0.29	**0.82**	0.76	HADS-depression
	0.12	**-0.79**	0.64	CRRQ-positive
var	44.40	25.77		
totvar		70.17		

Note. Time 1 $N = 51$, Time 2 $N = 47$, Time 3 $N = 31$. The proportion of each variable's variance that can be explained by the PCA are presented in column headed h^2.

Table 14

Weeks 1, 3, and 8 Psychological Variables Separated by Gender

	Week 1				Week 3				Week 8			
	Male (*N* = 35)	Female (*N* = 16)			Male (*N* = 31)	Female (*N* = 16)			Male (*N* = 19)	Female (*N* = 12)		
	M (SD)	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*
Rum/Worry Composite	98.0 (27.1)	101.7 (31.1)	-0.4	0.68	87.3 (21.3)	101.3 (29.3)	-1.7	0.10	81.1 (23.8)	90.4 (15.5)	-1.1	0.28
CRRQ												
Positive	18.1 (2.7)	14.7 (4.8)	2.6*	0.02	17.9 (2.8)	16.3 (4.3)	1.3*	0.22	17.6 (3.7)	17.0 (4.3)	0.4	0.69
Negative	12.7 (4.6)	12.0 (4.6)	0.5	0.61	11.1 (3.7)	12.3 (4.0)	-1.0	0.34	9.2 (3.2)	10.3 (3.6)	-0.9	0.38
HADS												
Anxiety	5.3 (2.8)	6.3 (3.3)	-1.1	0.28	4.6 (3.3)	6.3 (3.2)	-1.7*	0.10	4.3 (2.8)	5.8 (3.1)	-1.4	0.18
% above cutoff	25.7	31.2		0.68	19.3	37.5		0.18	15.8	25.0		0.53
Depression	4.1 (2.9)	4.6 (3.6)	-0.6	0.55	2.7 (2.1)	4.7 (3.9)	-1.9	0.08	2.4 (2.0)	4.7 (3.6)	-2.0*	0.06
% above cutoff	17.1	18.8		0.89	3.2	25.0		0.02	0	25.0		0.02
PSS	20.3 (4.9)	20.9 (5.9)	-0.4	0.70	17.5 (5.0)	22.2 (5.7)	-2.9	0.01	17.6 (3.7)	17.0 (4.3)	-2.1	0.05
PSWQ	43.1 (13.8)	46.6 (12.9)	-0.8	0.40	38.7 (12.5)	45.7 (4.3)	-1.8	0.09	35.8 (12.7)	45.7 (11.5)	-2.1	0.04

(*table continues*)

	Week 1				Week 3				Week 8			
	Male (N = 35)	Female (N = 16)			Male (N = 31)	Female (N = 16)			Male (N = 19)	Female (N = 12)		
	M (SD)	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*
RRS												
Brooding	9.9 (3.1)	10.1 (4.7)	-0.2	0.83	9.0 (2.8)	11.1 (3.6)	-2.2	0.03	8.8 (3.0)	8.3 (2.1)	0.5	0.62
Reflection	9.1 (2.8)	9.7 (4.0)	-0.6	0.54	8.0 (2.4)	9.6 (3.3)	-1.9	0.07	7.5 (2.3)	9.5 (3.26)	-2.0	0.06
RSS	23.0 (6.8)	22.6 (10.8)	0.2	0.86	20.3 (6.3)	21.6 (8.2)	-0.6	0.55	20.2 (19.1)	19.1 (7.1)	0.5	0.63

Note. * denotes equal variances not assumed.

Table 15

Correlations Between Week 1 Psychological Variables and Risk Factors

	CRRQ_pos	CRRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS	Composite
Cardiac Event										
Stent/Coronary Angioplasty(PTCA)	0.13	0.02	0.14	-0.14	0.28*	-0.01	0.16	0.16	0.22	0.09
Myocardial Infarction	0.15	-0.05	-0.19	-0.29*	-0.04	-0.11	0.01	-0.08	-0.01	-0.09
Coronary artery Bypass graft (CABG)	0.05	0.03	-0.17	0.05	-0.10	-0.13	-0.18	-0.15	-0.12	-0.11
Valve insufficiency	-0.23	0.07	0.11	0.18	-0.08	0.30*	0.01	0.01	-0.02	0.15
Cardiomyopathy	-0.11	-0.16	-0.01	0.12	-0.20	-0.13	-0.05	-0.08	-0.12	-0.15
Risk Factors										
Smoking (Yes/Prev)	0.15	0.07	0.21	0.19	0.18	-0.01	0.14	0.24	0.20	0.10
Dyslipidemia	-0.04	0.10	0.09	0.10	0.20	-0.08	-0.06	-0.02	0.12	0.01
Hypertension	0.21	0.29*	0.08	0.16	0.12	0.05	0.00	0.14	0.20	0.16
Family history	0.27	0.14	0.14	0.16	0.08	0.01	0.08	0.04	0.11	0.06
Obesity	0.15	0.11	0.14	-0.08	0.13	-0.07	0.07	0.20	0.06	0.03
Physical inactivity	-0.05	-0.14	-0.01	0.00	0.00	-0.17	-0.08	0.03	-0.02	-0.11
Type II diabetes	-0.12	0.12	0.09	0.07	0.12	0.12	0.11	0.06	0.09	0.12
Stress	-0.02	0.07	0.28*	0.16	0.35*	0.05	0.23	0.31*	0.25	0.17
Total risk factors	0.23	0.17	0.29*	0.23	0.29*	-0.07	0.09	0.26	0.26	0.11

Note. * < 0.05, ** < .001

Table 16

Weeks 1, 3, and 8 Psychological Variables Comparison by Risk Group

	Week 1				Week 3				Week 8			
	Moderate ($N = 33$)	High ($N = 14$)			Moderate ($N = 32$)	High ($N = 11$)			Moderate ($N = 23$)	High ($N = 8$)		
	M (SD)	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*
Rum/Worry Composite	92.9 (25.7)	109.1 (32.9)	1.8	0.08	86.1(19.6)	95.8(33.8)	1.1	0.30	82.8(22.2)	89.2(19.6)	0.68	0.50
CRRQ												
Positive	17.1 (3.7)	16.4(4.0)	-0.6	0.57	17.4(3.3)	17.5(4.1)	0.09	0.93	17.4(3.8)	17.3(4.2)	-0.09	0.931
Negative	12.2 (4.8)	12.8 (4.7)	0.4	0.68	10.5(3.8)	12.9(3.0)	1.9	0.07	9.2(3.5)	10.9(2.7)	1.2	0.241
HADS												
Anxiety	5.2 (2.6)	2.6 (4.0)	1.1	0.28	4.7(3.0)	5.9(4.2)	1.0	0.32	4.7(2.9)	5.6(3.3)	0.78	0.35
% above cutoff	24.2	42.9		0.21	18.8	36.4		0.24	17.4	25.0		0.64
Depression	3.6 (2.6)	5.9 (4.0)	2.3	0.02	2.7(2.5)	5.0(3.9)	2.2	0.03	2.7(2.3)	5.0(3.7)	2.1	0.05
% above cutoff	9.1	42.9		0.01	3.1	36.4		0.00	4.3	25.0		0.16
PSS	19.5 (4.8)	22.4 (6.1)	1.7	0.09	18.0(5.5)	21.8(6.0)	2.0	0.06	18.4(5.6)	19.6(7.0)	0.49	0.63
PSWQ	41.7 (12.5)	47.5 (15.1)	1.4	0.18	39.1(10.8)	39.0(17.0)	-0.01	0.99	38.2(13.3)	43.0(12.2)	0.89	0.38

(*table continues*)

	Week 1				Week 3				Week 8			
	Moderate (N = 33)	High (N = 14)			Moderate (N = 32)	High (N = 11)			Moderate (N = 23)	High (N = 8)		
	M (SD)	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*
RRS												
Brooding	8.9 (3.0)	11.8 (4.3)	2.7	0.01	8.9(2.7)	11.3(4.1)	2.2	0.04	8.4(2.7)	9.1(2.9)	0.60	0.51
Reflection	8.8 (2.9)	10.5 (3.9)	1.7	0.10	8.1(2.5)	9.7(3.7)	1.7	0.10	7.9(2.4)	9.5(3.8)	1.40	0.16
RSS	21.0 (6.9)	26.6 (10.5)	2.2	0.04	19.3(5.4)	24.2(9.1)	2.1	0.04	18.8(5.2)	22.6(8.2)	1.20*	0.25

Note. * denotes equal variances not assumed.

Table 17

Mixed ANOVA Models for Psychological Variables

	W			WxG			WxR		
Measure	*F*	sig	eta squared	*F*	sig	eta squared	*F*	sig	eta squared
COMP	11.10	0.001	0.369	5.27	0.019	0.217	0.85	0.404	0.043
CRRQ_pos	0.84	0.415	0.034	6.54	0.006	0.214	0.75	0.447	0.030
CRRQ_neg	11.28	0.000	0.329	0.62	0.543	0.026	0.02	0.986	0.001
HADS_anx	0.95	0.345	0.034	0.22	0.805	0.008	0.77	0.469	0.028
HADS_dep	3.64	0.033	0.119	0.81	0.452	0.029	0.44	0.648	0.016
PSS	1.76	0.181	0.064	1.05	0.357	0.039	0.54	0.588	0.020
PSWQ	4.26	0.020	0.151	3.71	0.032	0.134	0.85	0.433	0.034
RRS_brood	4.42	0.017	0.145	4.49	0.016	0.147	2.43	0.098	0.086
RRS_reflect	3.00	0.058	0.100	0.20	0.822	0.007	0.50	0.608	0.018
RSS	5.34	0.008	0.165	2.52	0.088	0.086	1.65	0.201	0.058

Note. Week(W), Gender(G), Risk Stratification(R)

Table 18

Post hoc Comparisons for Change in Ratings by Week

	Week 1-Week 3 Mean Change (*SD*)	Week 3-Week 8 Mean Change (*SD*)	Week 1-Week 8 Mean Change (*SD*)
CRRQ_pos	0.5 (0.5)	-0.5 (0.5)	0.0 (0.7)
CRRQ_neg	-1.2 (0.6)	-1.7 (0.4)**	-2.9 (0.6)**
HADS_anx	-0.6 (0.4)	-0.1 (0.4)	-0.7 (0.4)
HADS_dep	-1.0 (0.4)*	0.0 (0.3)	-1.0 (0.3)*
PSS	-0.9 (0.7)	-0.6 (0.8)	-1.5 (0.8)
PSWQ	-4.0 (1.3)*	0.3 (1.2)	-3.8 (1.4)*
RRS_brood	0.1 (0.6)	-1.0 (0.5)	-0.9 (0.5)
RRS_reflect	-0.6 (0.5)	-0.5 (0.3)	-1.2 (0.5)†
RSS	-1.9 (1.2)	-1.3 (1.0)	-3.2 (0.4)*
Composite	-8.9 (3.4)*	-4.0 (3.0)	-12.9 (2.3)**

Note. $n = 31$. Numerals represent change between weeks. Bonferroni adjusted pairwise comparisons † < .1, * < 0.05, ** < .001

Table 19

Initial Self-Reported Fitness and Quality of Life Measures.

	RAND Scales							COOP Scales						
Functional Measures	Physical Functioning	Role Limitations	Emotional Well Being	Social Functioning	Pain	General Health	Energy	Physical Functioning	Role Limitations	Emotional Well Being	Social Functioning	Pain	General Health	Quality of Life
RAND														
Physical Functioning	1.00													
Role Limitations	0.43	1.00												
Emotional Well Being	0.39	0.30	1.00											
Social Functioning	0.67	0.43	0.57	1.00										
Pain	0.52	0.53	0.35	0.65	1.00									
General Health	0.49	0.31	0.53	0.55	0.50	1.00								
Energy	0.70	0.57	0.51	0.71	0.67	0.56	1.00							
COOP														
Physical Functioning	0.34	0.08	-0.18	0.10	0.16	0.02	-0.10	1.00						
Role Limitations	0.59	0.51	0.38	0.62	0.58	0.38	0.58	0.21	1.00					
Emotional Well Being	0.22	0.08	0.39	0.29	0.17	0.17	0.22	0.07	0.35	1.00				
Social Functioning	-0.03	-0.06	0.17	0.52	0.18	0.24	0.04	0.00	0.05	0.14	1.00			
Pain	0.37	0.32	0.39	0.59	0.68	0.42	0.49	0.17	0.59	0.57	0.17	1.00		
General Health	0.53	0.46	0.46	0.42	0.38	0.57	0.55	0.02	0.52	0.35	0.36	0.52	1.00	
Quality of Life	-0.01	0.39	0.39	0.19	0.14	0.11	0.13	-0.03	0.23	0.34	0.35	0.34	0.45	1.00
Change in Health	0.08	0.19	0.19	0.01	0.16	0.03	0.18	-0.05	0.00	0.09	-0.03	-0.04	0.11	0.20

Note. RAND (n = 51). COOP (n = 43). Bolded values indicate the agreement between measures across functional domains.

Table 20

Final Self-Reported Fitness and Quality of Life Measures

	COOP			RAND		
	Physical Functioning	Role Limitations	Emotional Well Being	Social Functioning	Pain	General Health
Physical Functioning	**0.59**	0.31	0.34	0.61	0.52	0.49
Role Limitations	0.62	**0.60**	0.58	0.72	0.54	0.40
Emotional Well Being	0.54	0.47	**0.49**	0.34	0.45	0.34
Social Functioning	0.03	-0.19	-0.19	**0.44**	-0.11	0.08
Pain	0.38	0.16	0.18	0.45	**0.68**	0.07
General Health	0.49	0.04	0.19	0.46	0.36	**0.62**
Quality of Life	0.23	0.24	0.26	0.30	0.36	0.23

Note. $n = 26$. Bolded values indicate the agreement between measures across functional domains.

Table 21

Correlations Between Week 1 Psychological Variables and Self-Reported Health and Fitness

	CRRQ_pos	CRRQ_neg	HADS_anx	HADS_dep	PSS	PSWQ	RRS_brood	RRS_reflect	RSS	Composite
RAND										
Physical Functioning	0.07	-0.35*	-0.26	-0.55**	-0.11	-0.37	0.01	-0.13	0.02	-0.27
Role Limitations- Due to Physical	0.11	-0.42**	-0.14	-0.42**	-0.14	-0.44	-0.15	-0.07	-0.11	-0.36*
Role Limitations-Due to Emotional	0.14	-0.36*	-0.30*	-0.53**	-0.41*	-0.23	-0.25	-0.25	-0.30*	-0.34*
Emotional Well Being	0.01	-0.69**	-0.78**	-0.74**	-0.61**	-0.63**	-0.58**	-0.73**	-0.59**	-0.76**
Social Functioning	0.02	-0.56**	-0.50**	-0.72**	-0.33*	-0.58**	-0.29*	-0.46**	-0.35*	-0.58**
Pain	-0.11	-0.44**	-0.31*	-0.49**	-0.27	-0.32*	-0.36**	-0.40**	-0.30*	-0.42**
General Health	-0.07	-0.56**	-0.48**	-0.56**	-0.37**	-0.42**	-0.37**	-0.45**	-0.35*	-0.50**
Energy	0.11	-0.56**	-0.38**	-0.64**	-0.32*	-0.43**	-0.24	-0.30*	-0.19	-0.42**

Note. * < 0.05, ** < .001

Table 22

Weeks 1, 3, and 8 Psychological Variables Separated by Gender

	Week 1				Week 3				Week 8			
	Male (N = 35)	Female (N = 16)			Male (N = 31)	Female (N = 16)			Male (N = 19)	Female (N = 12)		
	M (SD)	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*
Physical Functioning	63.0 (21.4)	55.0 (23.7)	1.2	0.24	72.7 (21.3)	63.2 (23.9)	1.3	0.19	82.8 (18.9)	63.3 (19.2)	2.7	0.01
Role Limits – Physical	22.1 (34.2)	26.6 (39.3)	-0.4	0.68	44.4 (42.2)	46.7 (44.2)	-0.17	0.87	79.2 (26.1)	39.6 (40.5)	3.3	0.003
Role Limits – Emotional	59.0 (42.1)	64.6 (41.2)	-0.4	0.66	77.4 (34.8)	53.3 (41.4)	2.1	0.05	86.0 (25.6)	66.7 (37.6)	1.5*	0.14
Energy and Fatigue	49.9 (22.0)	47.0 (27.6)	0.4	0.70	59.0 (25.6)	51.7 (25.2)	0.91	0.37	64.5 (22.3)	45.5 (28.4)	2.0	0.06
Emotional Wellbeing	78.3 (14.9)	76.0 (15.4)	0.5	0.63	82.3 (9.9)	72.0 (17.4)	2.1*	0.05	85.1 (11.5)	72.0 (20.8)	1.9*	0.08
Social Functioning	70.6 (24.2)	66.7 (28.2)	0.5	0.06	84.4 (18.8)	69.2 (26.6)	0.67*	0.51	88.2 (20.2)	81.2 (24.7)	0.9	0.40
Pain	60.6 (23.0)	60.3 (30.1)	0.03	0.97	75.1 (23.3)	67.2 (18.4)	1.2	0.25	81.3 (20.1)	65.4 (23.2)	2.0	0.05
General Health	64.9 (19.0)	59.0 (19.8)	1.0	0.32	68.9 (16.4)	59.6 (19.9)	1.6	0.11	69.2 (21.1)	62.3 (16.6)	0.9	0.36

Note. * denotes equal variances not assumed. Higher scores represent healthier functioning and less dysfunction.

Table 23

Weeks 1, 3, and 8 Self-Reported Health and Fitness Variables Separated by Risk Group

	Week 1				Week 3				Week 8			
	Moderate ($N = 33$)	High ($N = 14$)			Moderate ($N = 31$)	High ($N = 11$)			Moderate ($N = 23$)	High ($N = 8$)		
	M (SD)	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*
Physical Functioning	61.1 (22.2)	56.8 (23.7)	0.6	0.56	75.7 (20.9)	55.0 (21.6)	2.8	0.008	79.8 (20.0)	61.9 (19.3)	2.2	0.04
Role Limits – Physical	28.0 (38.9)	19.6 (29.7)	0.7	0.48	51.6 (43.3)	36.3 (42.3)	1.0	0.32	70.5 (35.9)	43.8 (37.2)	1.8	0.09
Role Limits – Emotional	68.7 (39.9)	50.0 (44.8)	1.4	0.16	73.1 (36.9)	54.5 (45.4)	1.3	0.19	79.7 (31.4)	75.0 (34.5)	0.4	0.72
Energy and Fatigue	52.5 (23.1)	42.5 (26.1)	1.3	0.20	61.4 (24.0)	51.4 (26.9)	1.1	0.26	63.2 (22.0)	41.4 (31.3)	2.1	0.05
Emotional Wellbeing	79.8 (11.9)	72.6 (20.4)	1.2*	0.23	81.7 (11.2)	72.7 (19.0)	1.5*	0.17	83.0 (12.8)	71.4 (24.4)	1.2*	0.27
Social Functioning	74.2 (22.2)	58.0 (30.5)	2.0	0.05	84.5 (20.8)	75.0 (25.0)	1.2	0.23	91.8 (16.7)	67.2 (25.8)	3.1	0.004
Pain	63.7 (22.0)	55.0 (30.6)	1.1	0.28	77.2 (20.7)	63.4 (21.1)	1.8	0.08	77.8 (22.9)	67.5 (20.3)	1.1	0.27
General Health	63.5 (19.4)	60.0 (21.7)	0.5	0.32	68.4 (17.0)	57.5 (19.3)	1.7	0.10	70.0 (18.3)	55.7 (20.9)	1.7	0.90

Note. * denotes equal variances not assumed. Higher scores represent healthier functioning and less dysfunction.

Table 24

Within Subject Comparison of Pre and Post COOP Scores

Domain	Specific Area	Mean Change	St Error	*F*	*p*
Fitness		2.46	0.41	36.88	0.000
	Change in Health	0.59	0.24	6.08	0.021
	Daily Activities	0.96	0.22	19.75	0.000
	Physical Fitness	0.91	0.22	16.99	0.000
Quality of Life		1.39	0.44	9.95	0.004
	Overall Health	0.43	0.19	5.23	0.031
	Pain	0.61	0.27	5.23	0.031
	Quality of life	0.07	0.21	0.73	0.731
Well Being		1.56	0.35	20.06	0.000
	Feelings	0.78	0.15	25.48	0.000
	Social Activities	0.70	0.22	10.34	0.003
	Social Support	0.35	0.18	3.97	0.057

Note. $n = 26$

Table 25

Mixed ANOVA Models for Self-Reported Fitness Variables

	W			WxG			WxR		
Measure	*F*	sig	eta squared	*F*	sig	eta squared	*F*	sig	eta squared
Physical Functioning	6.61	0.003	0.209	0.57	0.569	0.022	0.93	0.402	0.036
Role Limits – Physical Health	7.25	0.002	0.218	5.05	0.010	0.163	0.39	0.681	0.015
Role Limits – Emotional	4.41	0.017	0.140	1.75	0.184	0.061	1.69	0.194	0.059
Energy and Fatigue	3.70	0.046	0.138	0.32	0.667	0.014	0.14	0.872	0.006
Emotional Well Being	0.50	0.613	0.021	0.33	0.720	0.014	0.31	0.736	0.013
Social Functioning	7.11	0.002	0.221	0.26	0.776	0.010	0.47	0.625	0.019
Pain	10.86	0.000	0.287	0.31	0.736	0.011	1.28	0.287	0.045
General Health	2.81	0.069	0.098	0.69	0.507	0.026	0.58	0.563	0.022

Note. Week (W), Gender (G), Risk Stratification (R).

Table 26

RAND Post hoc Comparisons for Week Main Effect

	Week 1-Week 3 Mean Change (*SD*)	Week 3-Week 8 Mean Change (*SD*)	Week 1-Week 8 Mean Change (*SD*)
Physical Functioning	-3.17 (4.46)	-11.03 (4.39)†	-14.20 (3.36)***
Role Limits – physical health	-6.03 (6.13)	-18.97 (7.35)*	-25.00 (7.03)**
Role Limits – emotional	-16.88 (6.83)†	-19.31 (8.19)†	-2.43 (6.07)
Energy and Fatigue	-9.15 (4.71)	0.37 (3.65)	-8.78 (2.83)*
Emotional Wellbeing	0.43 (2.64)	-2.37 (2.44)	-1.94 (2.52)
Social Functioning	-14.51 (4.63)*	-2.34 (4.85)	-16.86 (5.04)**
Pain	-14.77 (5.17)*	-5.29 (4.20)	-20.06 (3.91)***
General Health	-4.05 (3.09)	-3.14 (2.59)†	-7.19 (3.39)

Note. Bonferroni adjusted pairwise comparisons † < .1, * < 0.05, ** < .01, ***<.001. Negative values represent improved

Table 27

Relationships Between Pre and Post Cardiac Rehabilitation Fitness Variables

Six Minute Walk Variable	Distance	Resting SBP	Resting DBP	Peak SBP	Peak DBP	Recovery SBP	Recovery DBP	Resting HR	Peak HR	Recovery HR
Distance	–	-0.40*	-0.03	0.24	0.30	-0.11	0.24	-0.24	0.27	-0.18
Resting SBP	-0.13	–	0.45**	0.47**	0.30	0.44**	0.12	0.13	0.05	0.18
Resting DBP	0.08	0.56**	–	0.07	0.03	0.31	0.30	-0.04	-0.21	-0.10
Peak SBP	0.16	0.54**	0.28*	–	0.52**	0.46**	0.12	-0.04	0.53**	0.25
Peak DBP	0.07	0.27	0.51**	0.35*	–	0.00	0.25	-0.08	0.21	0.10
Recovery SBP	0.04	0.72**	0.35*	0.56**	0.21	–	0.05	0.05	0.21	0.16
Recovery DBP	0.20	0.27	0.45**	0.23	0.51**	0.44**	–	0.09	0.06	0.08
Resting HR	-0.31*	-0.14	0.17	-0.23	0.01	-0.29*	-0.03	–	0.24	0.84**
Peak HR	-0.02	0.12	0.14	0.24	0.22	0.03	0.10	0.57**	–	0.43**
Recovery HR	-0.31*	-0.07	0.22	-0.16	0.06	-0.21	-0.04	0.89**	0.64**	–

Note. SBP = systolic blood pressure, DBP = diastolic blood pressure, HR = HR Values below the diagonal represent the relationships from the Pre CR fitness test and values above the diagonal represent the relationships from the Post CR fitness test. * < 0.05, ** < .001

Table 28

Pre and Post CR Six Minute Walk Fitness Variables Separated by Gender

		Pre CR				Post CR			
		Male (*N* = 35)	Female (*N* = 16)			Male (*N* = 27)	Female (*N* = 12)		
Six Minute Walk Variable	Unit	*M (SD)*	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*
Distance	ft	1451.4 (320.0)	1140.6 (299.9)	3.3	0.002	1699.9 (62.2)	1432.8 (91.9)	7.7	0.022
Resting Systolic	mmHg	111.6 (16.7)	120.0 (22.4)	-1.5	0.146	114.3 (2.4)	119.3 (3.6)	0.5	0.497
Resting Diastolic	mmHg	68.2 (15.3)	69.0 (10.8)	-0.2	0.846	72.4 (1.6)	70.8 (2.4)	0.3	0.594
Resting Heart Rate	BPM	65.1 (15.0)	73.7 (17.6)	-1.8	0.079	67.4 (1.8)	73.6 (2.7)	3.7	0.062
Peak Systolic	mmHg	132.5 (33.3)	132.5 (40.8)	0.0	0.999	141.2 (5.7)	151.5 (8.6)	1.0	0.328
Peak Diastolic	mmHg	69.7 (15.5)	77.5 (15.1)	-1.7	0.100	72.5 (1.8)	75.8 (2.8)	1.0	0.337
Peak Heart Rate	BPM	91.5 (27.7)	96.1 (29.6)	-0.5	0.597	103.5 (3.3)	110.9 (4.7)	1.7	0.207
Recovery Systolic	mmHg	111.4 (26.4)	118.9 (22.4)	-1.0	0.334	117.6 (5.1)	110.6 (7.7)	0.6	0.458
Recovery Diastolic	mmHg	69.9 (15.2)	74.4 (7.4)	-1.1	0.275	70.0 (1.7)	72.1 (2.5)	0.5	0.484
Recovery Heart Rate	BPM	69.6 (18.1)	70.6 (25.5)	-0.2	0.882	72.1 (2.2)	79.3 (3.3)	3.4	0.076

Note. * denotes equal variances not assumed. Post CR statistics include amount of time in CR as a covariate.

Table 29

Pre and Post CR Six Minute Walk Fitness Variables Separated by Risk Stratification

		Pre CR				Post CR			
		Moderate ($N = 33$)	High ($N = 14$)			Moderate ($N = 26$)	High ($N = 8$)		
Six Minute Walk Variable	Unit	*M (SD)*	*M (SD)*	*t*	*p*	*M (SD)*	*M (SD)*	*t*	*p*
Distance	ft	1340.4 (305.8)	1295.4 (373.0)	0.4	0.667	1590.1(315.1)	1534.6 (407.0)	0.1	0.760
Resting Systolic	mmHg	115.0 (14.6)	116.8(28.2)	-0.2*	0.833	118.7 (11.9)	112.8 (13.4)	2.1	0.162
Resting Diastolic	mmHg	69.0 (9.0)	72.6 (13.0)	-0.9*	0.633	72.8 (8.4)	71.5(6.4)	0.0	0.911
Resting Heart Rate	BPM	69.9 (14.0)	69.6 (12.8)	0.1	0.948	68.5 (9.4)	75.1 (8.4)	3.3	0.081
Peak Systolic	mmHg	137.8 (22.2)	131.4 (48.1)	0.6	0.539	150.0 (27.7)	131.7 (31.2)	2.2	0.149
Peak Diastolic	mmHg	71.8 (12.1)	78.9 (48.1)	-1.8	0.075	74.9 (8.7)	72.3 (7.5)	0.5	0.470
Peak Heart Rate	BPM	99.9 (16.7)	100.8 (13.4)	-0.2	0.859	107.4 (16.5)	100.8(16.6)	0.5	0.490
Recovery Systolic	mmHg	117.4 (17.5)	117.5 (25.4)	-0.0	0.982	118.7 (28.2)	109.7 (14.3)	0.5	0.480
Recovery Diastolic	mmHg	73.5 (8.5)	73.5 (7.4)	-0.0	0.993	71.9 (7.3)	67.0 (8.4)	1.8	0.185
Recovery Heart Rate	BPM	73.4 (15.4)	74.5 (15.3)	-0.2	0.819	73.6 (11.7)	81.5 (10.7)	1.8	0.191

Note. * denotes equal variances not assumed. Post CR statistics include amount of time in CR as a covariate.

Table 30

Mixed ANOVA Models for Fitness Variables

	T			TxG			TxR		
Measure	*F*	sig	eta squared	*F*	sig	eta squared	*F*	sig	eta squared
Distance	12.90	0.001	0.287	0.32	0.575	0.010	1.25	0.300	0.072
Resting Systolic	0.26	0.611	0.008	0.14	0.709	0.004	1.17	0.322	0.066
Resting Diastolic	0.01	0.908	0.000	0.31	0.583	0.009	1.22	0.308	0.069
Resting Heart Rate	1.36	0.252	0.040	0.27	0.604	0.008	1.65	0.208	0.091
Peak Systolic	1.68	0.205	0.053	0.26	0.611	0.009	1.07	0.356	0.066
Peak Diastolic	0.36	0.551	0.012	2.21	0.148	0.068	4.19	0.025	0.218
Peak Heart Rate	6.06	0.020	0.168	0.25	0.620	0.008	0.16	0.854	0.010
Recovery Systolic	0.15	0.700	0.005	1.23	0.276	0.039	0.14	0.868	0.009
Recovery Disastolic	0.02	0.890	0.001	0.83	0.370	0.027	0.77	0.471	0.049
Recovery Heart Rate	0.04	0.850	0.001	0.10	0.749	0.003	0.69	0.509	0.043

Note. Time (T), Gender (G), Risk Stratification (R)

Table 31

Cardiac Rehabilitation Participation

Testing	CR attendees	Invited	Began study	Completed CR	Completed Post CR Fitness
Overall	80	73	51	32	40
Male/female	55/25	51/22	35/16	22/10	28/12
Moderate/high	Unknown	Unknown	33/14	22/6	28/8

Table 32

Logistic Regression Analysis of Cardiac Rehabilitation Program Completion

Predictor	*B*	*SE B*	Wald's χ^2	*df*	*p*	odds ratio
Constant	-20.285	8.38	5.859	1	0.015	—
Risk Stratification	—	—	1.779	2	0.411	—
General Health	-0.126	0.05	6.444	1	0.011	0.88
Emotional Well-Being	0.284	0.098	8.399	1	0.004	1.33
Rumination Composite	0.066	0.033	5.859	1	0.047	1.07

Note. Nagelkerke-R^2 = 0.620

Table 33

Multivariate Regression Analyses of Initial 6-Minute Walk Distance

Model	Predictor	*B*	*SE B*	Beta	*t*	*p*
1	Constant	1844.50	277.04	—	6.6	0.000
	Age	-8.38	3.61	-0.26	-2.3	0.025
	Gender	-254.61	82.03	-0.35	-3.1	0.003
	Physical Functioning	5.91	1.73	0.39	3.4	0.001
2	Constant	2505.19	277.68	—	8.2	0.000
	Age	-9.98	4.05	-0.31	-2.5	0.018
	Gender	-291.65	88.71	-0.40	-3.3	0.018
	Depression	-33.87	13.49	-0.31	-2.5	0.016

Note. Model 1 adj-R^2 = 0.371, Model 2 adj-R^2 = 0.308

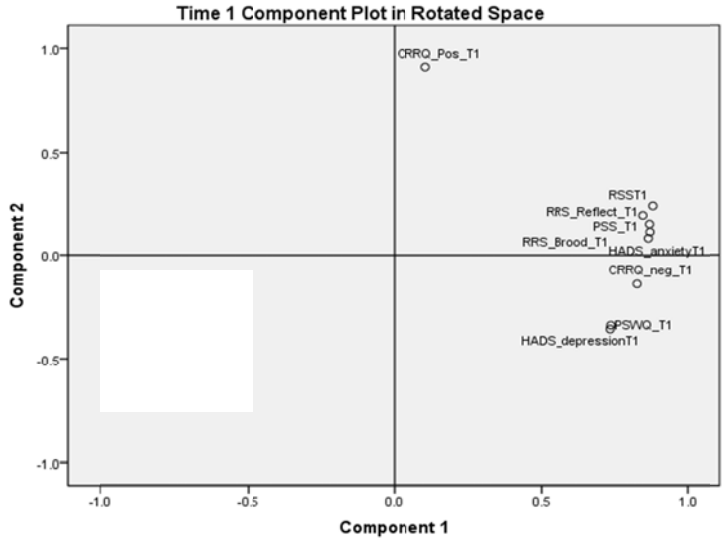
Table 34

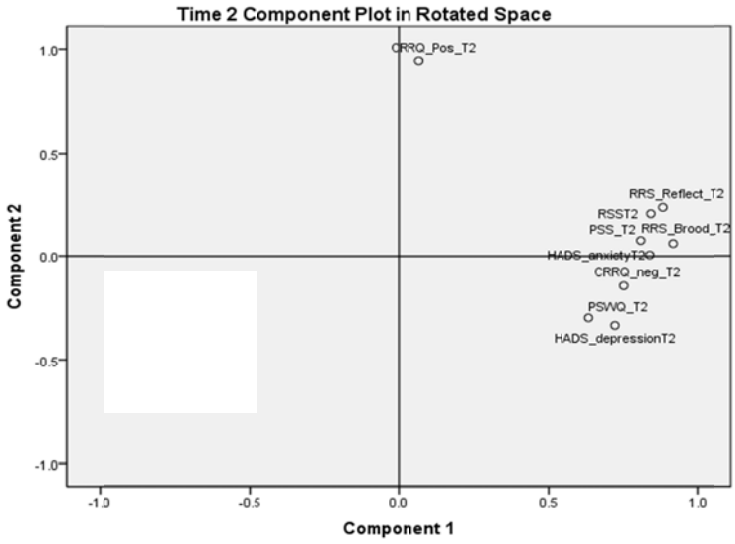
Multivariate Regression Analyses of Final 6-Minute Walk Distance

Model	Predictor	*B*	*SE B*	Beta	*t*	*p*
1	Constant	242.00	132.69	—	1.82	0.076
	Pre CR distance	1.01	0.10	0.86	10.71	0.000
2	Constant	2546.99	356.71	—	7.14	0.000
	Age	-12.21	3.98	-0.38	-3.06	0.005
	Gender	-192.58	90.30	-0.27	-2.13	0.042
	Number of sessions	-6.88	5.21	-0.17	-1.32	0.197
	Week 1 rumination	6.49	2.32	0.53	2.80	0.009
	Week 3 anxiety	-73.51	19.11	-0.72	-3.85	0.001

Note. Model 1 adj-R^2 = 0.749, Model 2 adj-R^2 = 0.501

Appendix B: Figures





(*figure continues*)

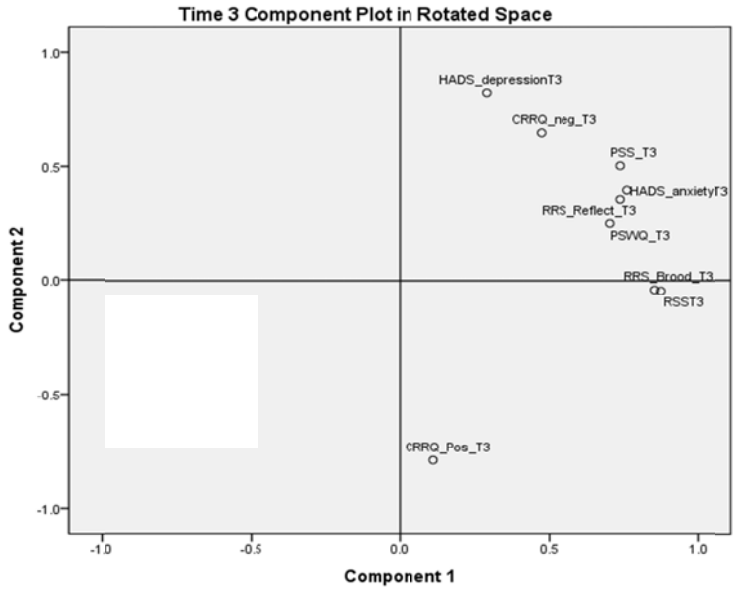


Figure 1. Principle component plots of survey pack measures at week 1, 3, and 8.

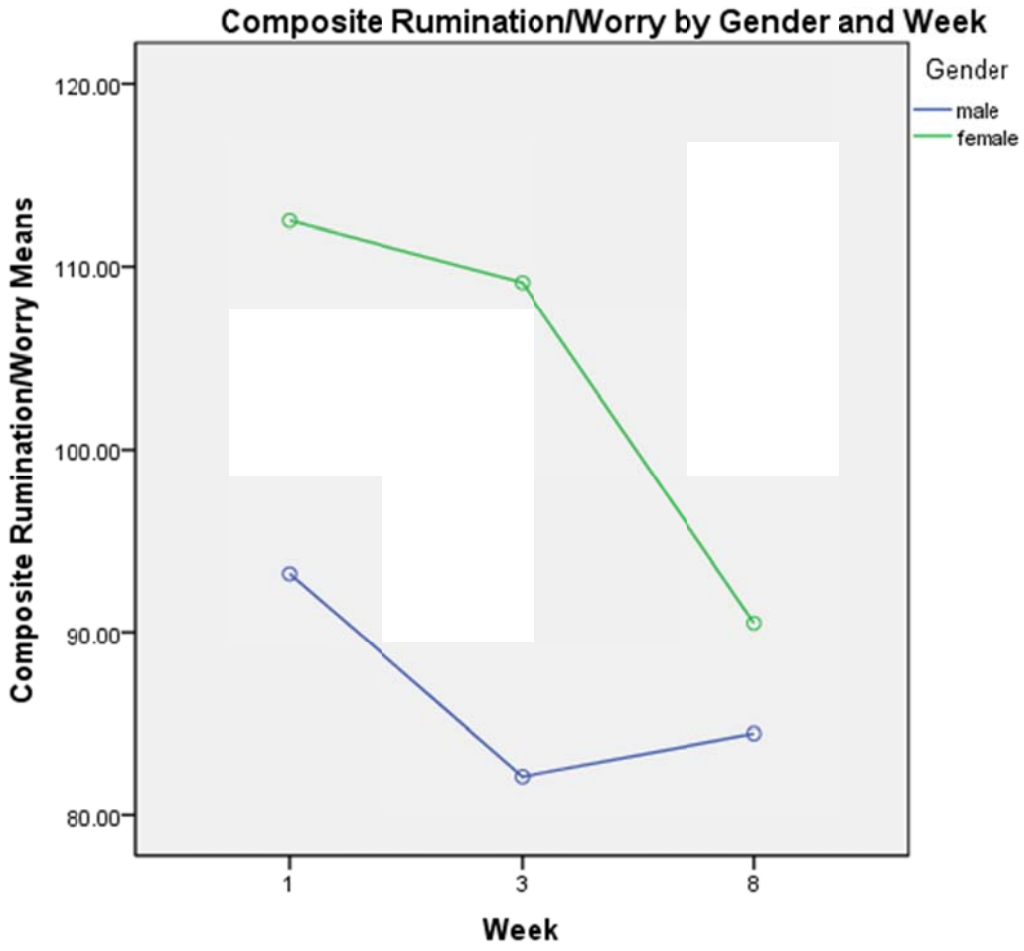


Figure 2. Results of the multivariate analysis of variance for the composite rumination and worry ratings by week and gender.

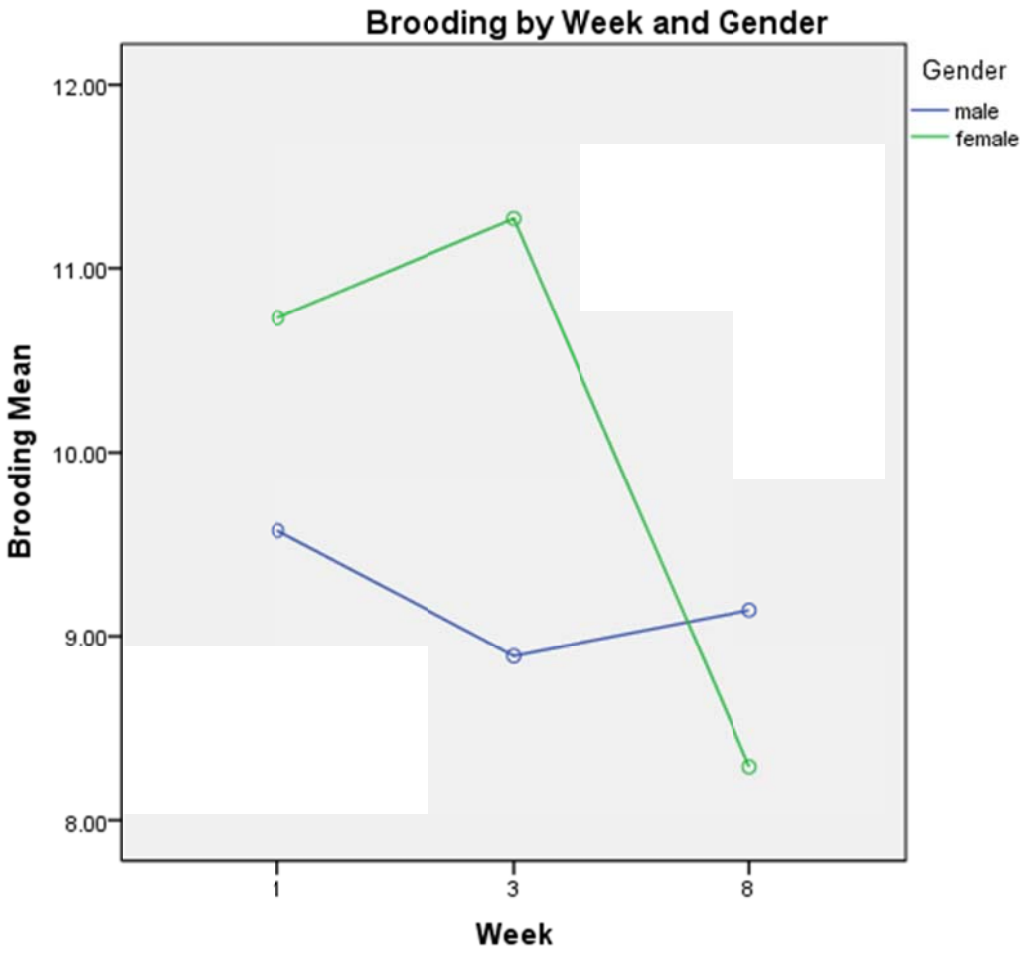


Figure 3. Results of the multivariate analysis of variance for the brooding ratings by week and gender.

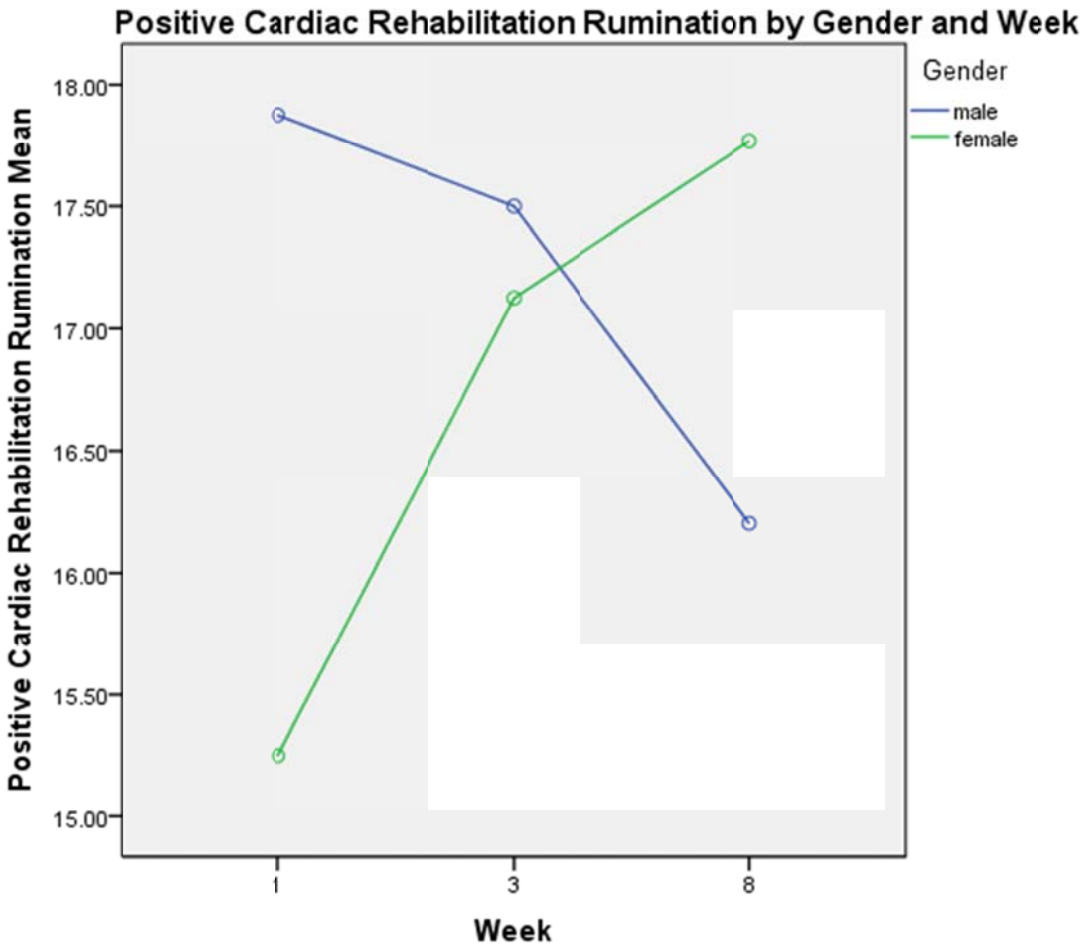


Figure 4. Results of the multivariate analysis of variance for the positive cardiac rehabilitation rumination questionnaire ratings by week and gender.

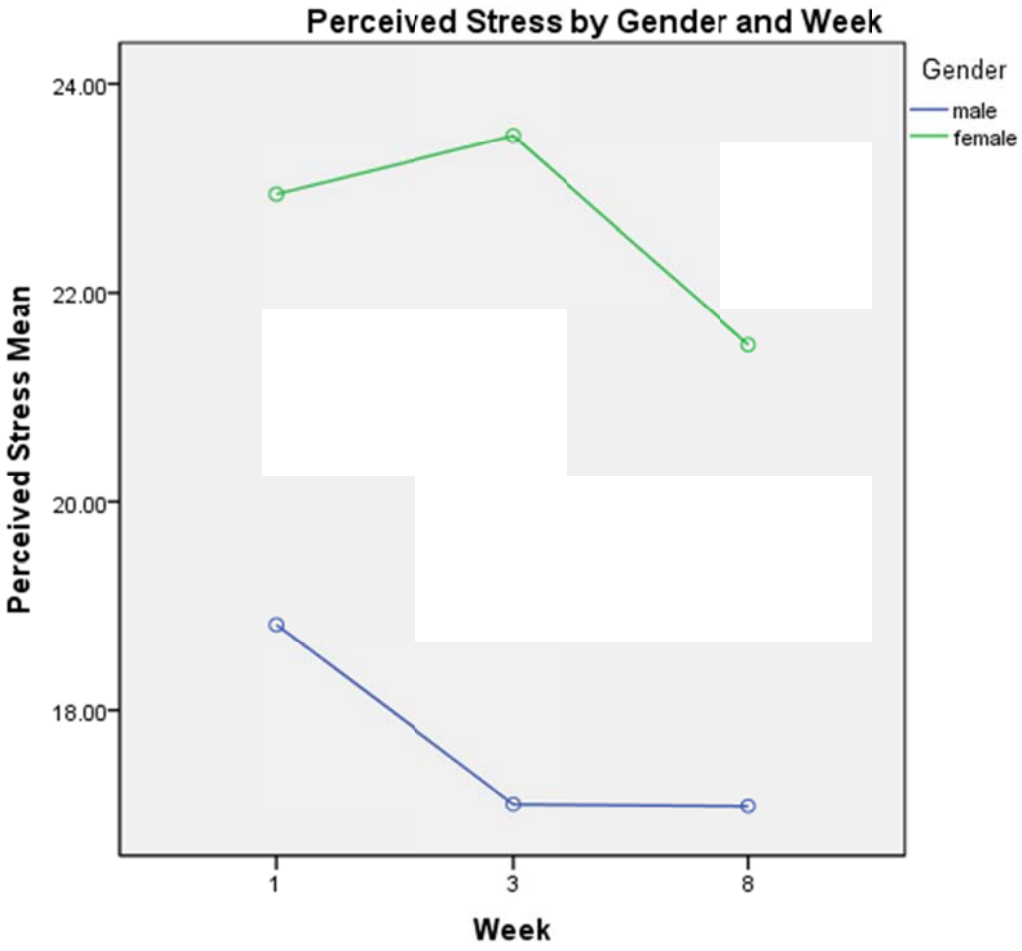


Figure 5. Results of the multivariate analysis of variance for the stress ratings by week and gender.

Figure 6. Results of the multivariate analysis of variance for the role limitations due to physical health ratings by week and gender.

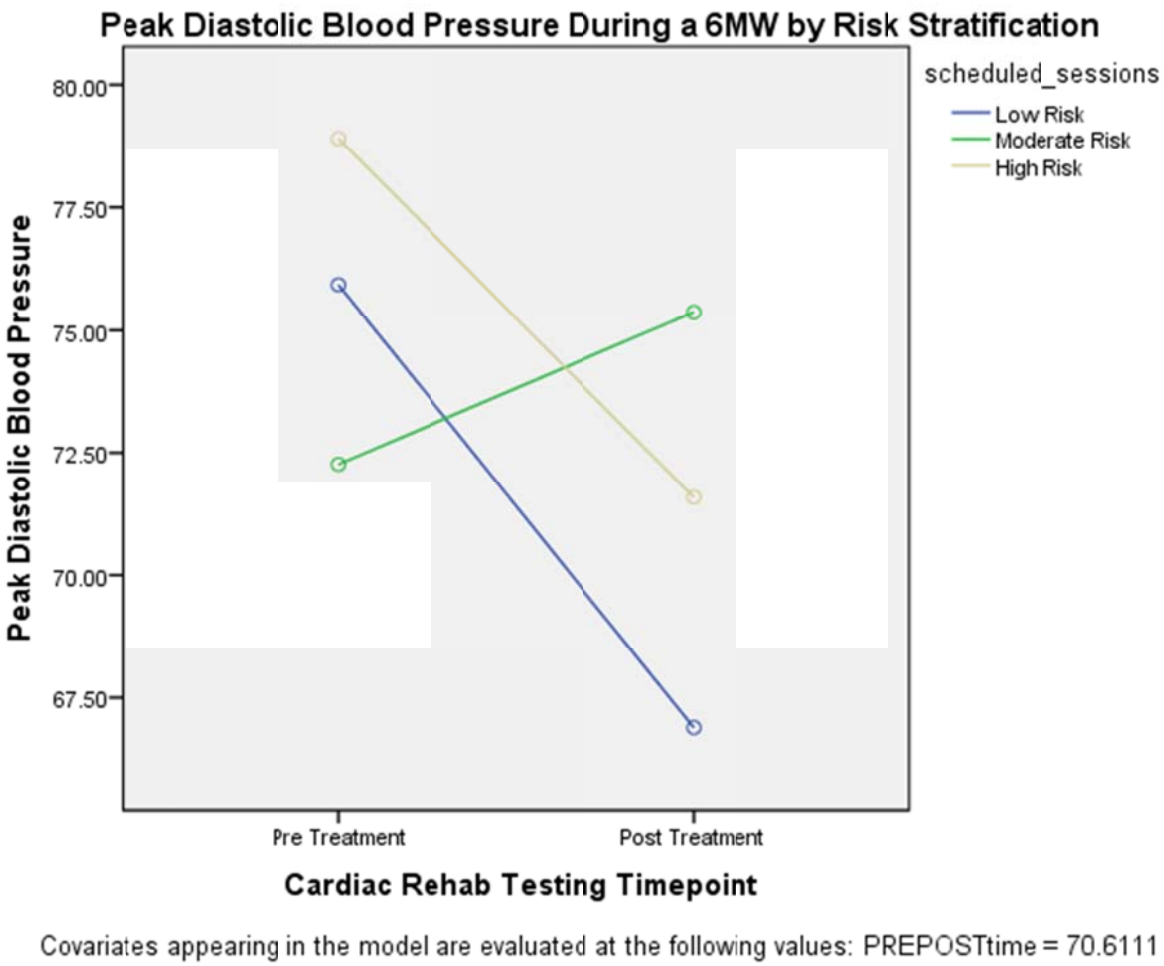


Figure 7. Results of the multivariate analysis of variance for the peak diastolic blood pressure readings by time and risk stratification.

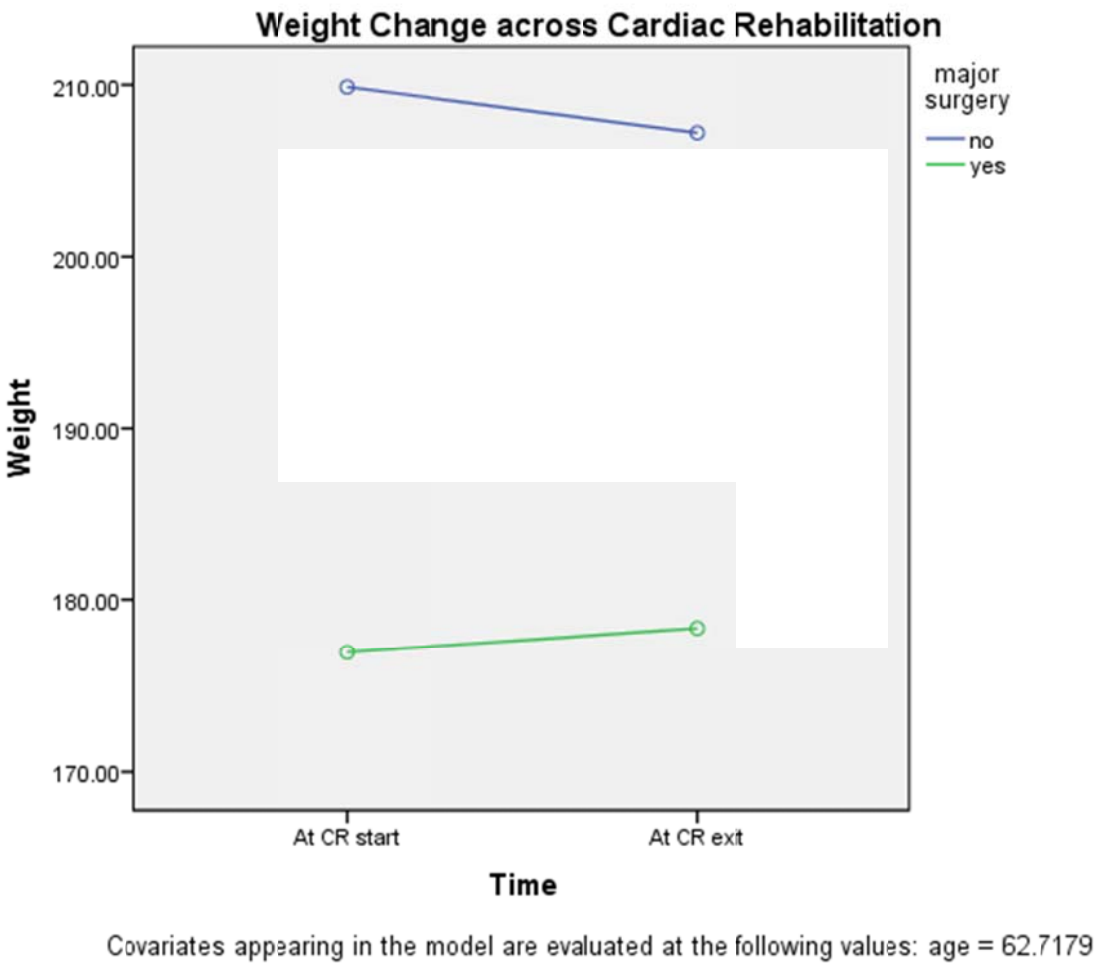


Figure 8. Results of the multivariate analysis of variance for weight change across cardiac rehabilitation separated by major surgery.

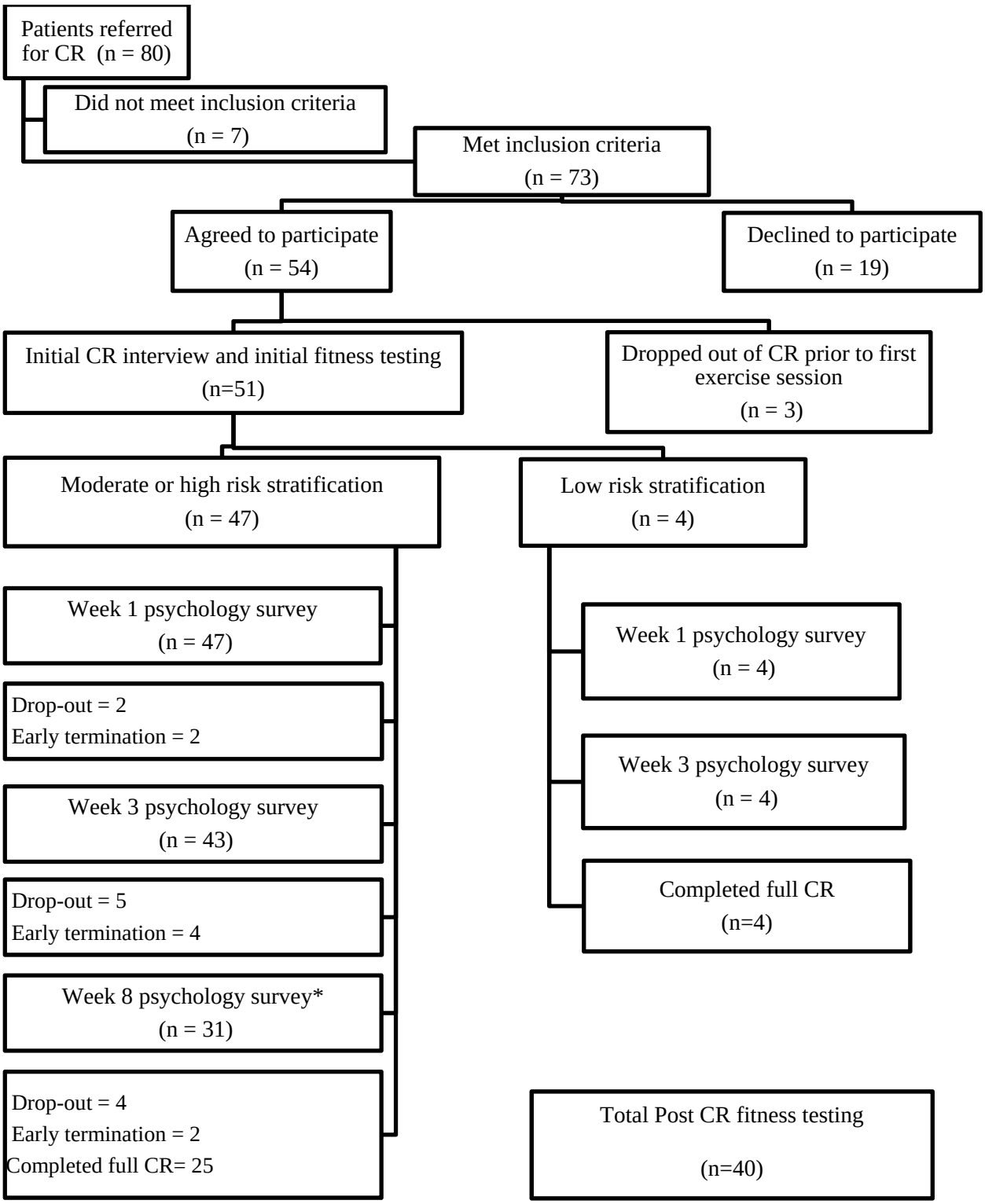
Appendix C: Risk Stratification Guide

The following variables were used to calculate each participant's risk level. Participants who scored less than 6 points were considered "low risk". Scores of 7-12 points were considered moderate risk. Scores of 12 or higher were "high risk."

	Points	
Resting systolic blood pressure (mmhg)		
<130	1	
130-150	3	
>150	5	_____
Low Density Lipoprotein (mg/dl)		
<100	1	
100-130	3	
>130	5	_____
Type I or II Diabetes		
No	0	
Yes	1	_____
Smoking Status		
Never smoked/quit more than 6 months ago	1	
Quit less than 6 months ago	3	
Actively smoking	5	_____
Six Minute Walk Distance (ft)		
>1400	1	
1000-1399	2	
<1000	3	_____
Body Mass Index (kg/m^2)		
<27	1	
27-29	2	
>30	3	_____
Ejection fraction (%)		
<40	13	_____

Sum = _____

Appendix D: Flowchart of Participant Outcomes



Note. * 3 participants refused to take the survey at week 8 but remained in the study.

Appendix E: Rand SF-36 Domain Questions

Physical functioning items: For each question, read all the possible answers and check the most accurate one for the past two weeks.

Vigorous activities, such as running, lifting heavy objects, strenuous sports

Moderate activities, such as moving a table, pushing a vacuum, bowling, or playing golf

Lifting or carrying groceries

Climbing several flights of stairs

Climbing one flights of stairs

Bending, kneeling, or stooping

Walking more than a mile

Walking several blocks

Walking one block

Bathing or dressing yourself

Role limitations due to physical health: During the past 2 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

Cut down the amount of time you spent on work or other activities

Accomplished less than you would like

Were limited in the kind of work or other activities

Had difficulty performing the work or other activities (for example, it took extra effort)

Role limitations due to emotional problems: During the past 2 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

Cut down the amount of time you spent on work or other activities

Accomplished less than you would like

Didn't do work or other activities as carefully as usual

Energy/fatigue: These questions are about how you feel and how things have been with you during the past 2 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

Did you feel full of pep?

Did you have a lot of energy?

Did you feel worn out?

Did you feel tired?

Emotional well-being: These questions are about how you feel and how things have been with you during the past 2 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

Have you been a very nervous person?

Have you felt so down in the dumps that nothing could cheer you up?

Have you felt calm and peaceful?

Have you felt downhearted and blue?

Did you feel worn out?

Social Functioning: No prompt

During the past 2 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

During the past 2 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

Pain: No prompt

How much bodily pain have you had during the past 2 weeks?

In the past 2 weeks, how much did pain interfere with your normal work?

General Health: How TRUE or FALSE is each of the following statements for you?

I seem to get sick a little easier than other people.

I am as healthy as anybody I know.

I expect my health to get worse.

My health is excellent.

Over the past two weeks, would you say your health is…

Appendix F: Zero Order Correlations Between the Dependent and Independent Variables for the Three Regression Equations

	Variable	CR Dropout	Initial Fitness	Final Fitness
Demographic	Gender	0.00	**-0.43****	**-0.41****
	Risk Stratification	**0.31***	-0.22	**-0.27**
	Age	-0.14	**-0.30***	**-0.50****
Self-Related Fitness	General Health	**0.16**	0.24	0.18
	Emotional Well-Being	**-0.35***	0.10	-0.12
	Physical Functioning	-0.05	**0.46****	0.23
Psychological	Rumination/Worry Composite	**0.03**	-0.05	**0.06**
	Depression	0.22	-0.26	-0.15
	Anxiety (week 3)	0.08	-0.34	**-0.38***
Objective Fitness	Pre CR 6MWT Distance	0.36	1.00	0.87**

Note. All independent variables are from week 1 except where noted. Bolded numbers represent variables included in final regression equation for the column variable. *p*-values, * < 0.05, ** < .01.

VITA

VITA

NATHANIEL J. DEYOUNG

EDUCATION HISTORY

2012-2013		*Predoctoral Internship in Clinical Psychology (APA accredited)* Mental Health Service Line Salem VA Medical Center, Salem, VA
2007- 2013		*Doctoral Program in Clinical Psychology* Department of Psychological Sciences Purdue University, West Lafayette, IN
2013	**Doctor of Philosophy (anticipated)**	Title: *The Role of Rumination, Negative Affect, and Fitness on Cardiac Rehabilitation Program Outcomes following a Discrete Cardiac Event* Defended: 2013; Advisor: Anthony Conger, Ph.D.
2011	**Preliminary Exam**	Department of Psychological Sciences Purdue University, West Lafayette, IN Title: *Untangling the Relationships of Rumination to Depression and Anxiety: A Meta-Analysis* Defended: 2011; Advisor: Anthony Conger, Ph.D.
2009	**Master of Science**	Department of Psychological Sciences Purdue University, West Lafayette, IN Title: *A Comparison of College Students with Narcissistic Versus Avoidant Personality Features on Forgiveness and Vengeance* Defended: 2009; Advisor: Rebecca Merritt, Ph.D.
2007	**Bachelor of Arts, Honors**	Department of Psychological Sciences Holland, MI Major: Psychology; Minor: English Advisor: Charlotte vanOyen-Witvliet, Ph.D.

RESEARCH EXPERIENCE

PUBLICATIONS

1. Morris, D. R. & **DeYoung, N. J.** (2012). Psychiatric diagnoses, competency-related legal abilities, and successful restoration of competence to stand trial. *Behavioral Science and the Law.*

2. South, S. & **DeYoung, N. J.** (2012). Behavior genetics of personality disorders: Informing classification and conceptualization in DSM-5. *Personality Disorders: Theory, Research, and Treatment.*

3. vanOyen-Witvliet, C., **DeYoung N. J**., Hofelich, A. J., & DeYoung, P. A. (2011). Compassionate reappraisal and emotion suppression as alternatives to offense-focused rumination: Implications for forgiveness and psychophysiological well-being. *Journal of Positive Psychology, 6(4),* 286-299.

CONFERENCE PRESENTATIONS

1. Morris, D. R., **DeYoung, N. J.** (2011, October). Psycholegal Abilities and Successful Competence Restoration. 42nd Annual Meeting of the American Academy of Psychiatry and the Law, Boston, MA.

2. **DeYoung, N. J.**, Klyce, D., & Conger, A. (2011, May). Reconciling Low Parent and Teacher Rating Agreement Using Rasch Modeling Techniques. Poster Presentation at the Midwestern Psychological Association 83st Annual Meeting, Chicago, IL.

3. Conger, A., Klyce, D., & **DeYoung, N. J.** (2011, May) Unipolar Multivariate Spaces in Assessment of Psychopathology. Poster Presentation at the Midwestern Psychological Association 83st Annual Meeting, Chicago, IL, May 2011.

4. **DeYoung, N. J.**, & Klyce, D. (2011, March). Comparison of the Factor Structures of the Report of Child Behavior by Teachers and Parents Using Rasch Modeling. Symposium at the Society for Research in Child Development Biannual Meeting, Montreal, QC.

5. **DeYoung, N. J.**, Sungeun, Y., Merritt, R. D., & Corry, N. (2009, May). Exploring the Relationship between Narcissism and Alexithymia in a College Population. Presentation at the Midwestern Psychological Association 81st Annual Meeting, Chicago, IL.

6. Corry, N., Sungeun, Y., **DeYoung, N. J.**, & Merritt, R. D. (2009, May). Confirmatory Factor Analysis of the Toronto Alexithymia Scale: A Comparison of Models. Presentation at the Midwestern Psychological Association 81st Annual Meeting, Chicago, IL.

7. Sungeun, Y., Merritt, R. D., & **DeYoung, N. J.** (2009, May) Narcissistic Personality Inventory Endorsement Rates as a Function of Ethnicity. Poster Presentation at the Midwestern Psychological Association 81st Annual Meeting, Chicago, IL, May 2009.

8. Sungeun, Y., Corry., N., **DeYoung., N. J.,** & Merritt, R. D. (2009, May). Exploratory Factor Analysis of the Toronto Alexithymia Scale. Presentation at the Midwestern Psychological Association 81st Annual Meeting, Chicago, IL, May 2009.

9. **DeYoung, N. J.**, Witvliet, C.V.O., Hofelich, A., & Demaree, H. (2007, January). Trying to Forgive: A Psychophysiological Analysis of Rumination, Suppression, and Reappraisal in Response to a Real-Life Offender. Poster Presentation at the Eighth Annual Meeting of the Society for Personality and Social Psychology, Memphis, TN.

10. Witvliet, C.V.O., Hofelich, A., **DeYoung, N. J.**, & Dueck, A. (2007, January). The Language of Forgiveness: Linguistic Analyses of Suppression and Reappraisal Responses to a Real-Life Offender. Poster Presentation at the Eighth Annual Meeting of the Society for Personality and Social Psychology, Memphis, TN.

11. **DeYoung, N. J.** & Hofelich, A. (2007, January). Assessing Forgiveness Physiology: An Experimental Comparison of Suppression and Reappraisal Responses to Cope with Memories of a Past Interpersonal Hurt. Sixth Annual Celebration of Undergraduate Research and Creative Performance, Hope College, Holland, MI.

12. Hofelich, A., & **DeYoung, N. J.** (January, 2007). Linguistic Analyses of Attempts to Forgive a Real-Life Offender: An Experimental Comparison of Reappraisal, Suppression, and Rumination. Sixth Annual Celebration of Undergraduate Research and Creative Performance, Hope College, Holland, MI.

13. **DeYoung, N. J.** (2007, January). Heart Rate Variability and Spectral Densities: Using Fast Fourier Transformations to Separate R-R Intervals into Frequency Data. Sixth Annual Celebration of Undergraduate Research and Creative Performance, Hope College, Holland, MI.

14. **DeYoung, N. J.** & Hofelich, A. (2007, May). The Psychophysiology of Forgiveness: Assessing the Effects of Suppression and Reappraisal to Cope with Memories of a Past Interpersonal Hurt. Psi Chi Midwest Regional Research Symposium, Chicago, IL.

15. Hofelich, A. & **DeYoung, N. J.** (2007, May). The Language of Forgiveness: Linguistic Analyses of Suppression and Reappraisal Responses to a Real-Life Offender. Psi Chi Midwest Regional Research Symposium, Chicago, IL.

INVITED PRESENTATIONS

2011 Invited Presentation,
Purdue University, West Lafayette, IN
Department of Psychological Sciences
Untangling the Relationships of Rumination to Depression and Anxiety: A Meta-Analysis

2008 Invited Presentation (with Conger, A. & Klyce, D.),
Purdue University, West Lafayette, IN
Department of Psychological Sciences
Personality Is Conditionally Normal, But Psychopathology is Not

PROFESSIONAL ACTIVITIES

AWARDS AND HONORS

2011 3rd Annual AAPL Research Poster Award
American Academy of Psychiatry and the Law
Boston, MA

2011 Arthur J. Krueger Scholarship
Purdue University, Department of Psychological Sciences
West Lafayette, IN – 1000.00

2010 Arthur J. Krueger Scholarship
Purdue University, Department of Psychological Sciences
West Lafayette, IN – 1000.00

2007 Sigma Xi Award
Hope College
Holland, MI

2007 Psi Chi Regional Research Award
Midwestern Psychological Association
Chicago, IL