DEPRESSION PREDICTS FAILURE TO COMPLETE
PHASE-II CARDIAC REHABILITATION

A thesis submitted
to Kent State University in partial
fulfillment of the requirements for the
degree of Master of Arts

by

Elizabeth C. Casey

December, 2007

Thesis written by
Elizabeth C. Casey
B.A., Hamilton College, 2004
M.A., Kent State University, 2007

Approved by

Joel W. Hughes, Advisor

Mary Ann Stephens, Chair, Department of Psychology

Jerry Feezel, Dean, College of Arts and Sciences

TABLE OF CONTENTS

INTRODUCTION.....	1
METHODS.....	25
RESULTS.....	34
DISCUSSION.....	46
REFERENCES.....	65
APPENDIX A - QUESTIONNAIRES.....	81

LIST OF TABLES

Table	Page
1 Clinical and Demographic Characteristics	35
2 Logistic Regression Analysis Predicting CR Completion from Gender, Age, Depression (BDI), Body Mass Index (BMI), and Employment	37
3 Logistic Regression Analysis Predicting CR Completion from Gender, Categorical Age, and Categorical Depression (BDI).....	38
4 Percentage of CR Dropouts and CR Dropouts with Depression by Week.....	40
5 Frequency (and Percentage) of Total, Depressed, and Non-depressed CR Completers and Dropouts According to Reason	42
6 Multinomial Logistic Regression Analysis Predicting CR Completion, Dropout due to Medical Reasons, and Dropout due to Non-medical Reasons from Gender, Categorical Age, and Categorical Depression (BDI).....	43
7 Multinomial Logistic Regression Analysis Predicting CR Completion, Dropout due to Medical Reasons, and Dropout due to Non-medical Reasons from Gender, Categorical Age, and BDI Cognitive and Somatic Subscales	45

INTRODUCTION

More than 79 million Americans currently live with a cardiovascular disease (Centers for Disease Control and Prevention, 2004). The economic impact of cardiovascular diseases on our nation's health care system continues to grow as the population ages. The cost of heart disease and stroke in the United States is projected to be \$431.8 billion in 2007, including health care expenditures and lost productivity from death and disability (American Heart Association, 2006). More than 6 million hospitalizations each year are because of cardiovascular diseases and coronary heart disease is a leading cause of premature, permanent disability in the U.S. workforce (Centers for Disease Control and Prevention, 2005). In addition, more than 910,000 Americans die of cardiovascular diseases each year, accounting for 29% of all deaths in the United States (Centers for Disease Control and Prevention, 2004). Cardiovascular disease claims more lives each year than cancer, chronic lower respiratory diseases, accidents and diabetes mellitus combined (Minino et al., 2006). Although the aging population may contribute to the high number of deaths, the number of sudden deaths from heart disease among people between the ages of 15-34 has increased as well (Centers for Disease Control and Prevention, 2005).

In addition to having a negative economic impact on society, cardiovascular disease is physically and emotionally demanding for the individual patient. Depression is quite prevalent among cardiac patients. The prevalence of major depressive disorder after an acute myocardial is 18-25% (Herridge et al., 2005) and 16-27% among patients

with coronary heart disease (Lett et al., 2004). Depression may contribute to cardiovascular disease and having heart disease may cause depression (Frasure-Smith & Lesperance, 2006; Freedland et al., 1992; Glassman et al., 2002).

The high prevalence of depression among coronary heart disease patients is particularly concerning because depression is also associated with increased risk of mortality among cardiac patients. Depression increases risk of mortality for patients with coronary artery disease (Carney et al., 1988), for patients who have experienced a myocardial infarction (Frasure-Smith et al., 1993; Frasure-Smith et al., 1995; Frasure-Smith et al., 1999; Lesperance et al., 2002; van Melle et al., 2004) and for patients treated with coronary artery bypass graft surgery (Connerney et al., 2001). Major depression makes cardiac mortality four times more likely in the first six months (Frasure-Smith et al., 1993) and over three times more likely in the first year (Frasure-Smith et al., 1999) following a myocardial infarction. A meta-analysis of 20 studies on patient with coronary heart disease showed that the risk of depressed patients dying in the two years after diagnosis was two times higher than the risk for non-depressed patients (Barth et al., 2004). Individuals with higher levels of depressive symptoms are also 1.5 times more likely to die within five years after being hospitalized for acute coronary syndrome compared to patients without high levels of depressive symptoms (Grace et al., 2005).

Depression also increases the risk of a cardiac patient suffering from additional cardiac events. A recent latent class analysis examining the course of depressive symptoms for one year following a myocardial infarction showed that patients who have significant and increasing depressive symptoms are nearly three times more likely to

experience a new cardiovascular event compared with subjects without depressive symptoms (Kaptein et al., 2006). Although the association between depression and an increased risk of mortality is becoming well-established, attempts to decrease the risk of mortality by treating depression have not been successful.

Interventions for reducing mortality among depressed cardiac patients

The “Enhancing Recovery in Coronary Heart Disease” (ENRICHD) randomized clinical trial failed to demonstrate that treating depressed patients with cognitive behavioral therapy after an acute myocardial infarction reduces mortality or recurrent myocardial infarctions (Berkman et al., 2003). Patients with depression or social isolation were randomly assigned to six months of either routine care or cognitive behavioral therapy. Although both the routine care control group and the cognitive behavioral therapy intervention group showed reductions in depressive symptoms, the intervention group showed slightly greater reductions in depressive symptoms when assessed at a 6-month evaluation. However, there were no differences between the intervention and control groups in terms of all-cause mortality, cardiovascular mortality, or nonfatal cardiac events at a 30-month evaluation.

Whereas ENRICHD examined a psychosocial intervention, the SADHART (Sertraline And Depression Heart Attack Randomized Trial) randomized clinical trial assessed the safety and effectiveness of sertraline as a treatment for depression in cardiac patients (Glassman et al., 2002). The SADHART findings showed that sertraline was a safe antidepressant for patients with unstable angina or who had experienced an acute myocardial infarction. Although sertraline was associated with an improved quality of

life, patients in the sertraline group did not have a significantly greater reduction in depression compared to patients in a placebo group unless the patient had severe or recurrent depression. The sample size in the SADHART trial was not large enough to examine mortality rates.

Another recent randomized controlled clinical trial, the Canadian Cardiac Randomized Evaluation of Antidepressant and Psychotherapy Efficacy (CREATE), used a factorial design to examine both the efficacy of citalopram (a selective serotonin reuptake inhibitor) and interpersonal therapy in reducing depressive symptoms in patients with coronary artery disease and major depression (Lesperance et al., 2007). The results of the trial showed that citalopram was superior to placebo in reducing depressive symptoms twelve weeks after administration. However, there was no difference in reduction of depressive symptoms among patients receiving interpersonal therapy compared to its control condition of standard clinical management.

Collectively, the results of these clinical trials failed to provide evidence that treating depressed cardiac patients can reduce risk of mortality. Perhaps the trial interventions were unsuccessful in reducing mortality among depressed patients because little research has been conducted examining the reasons why depression leads to mortality. Currently, the mechanisms responsible for linking depression and increased risk of mortality in cardiac patients remain unclear (Joynt & O'Connor, 2005).

Potential mechanisms linking depression and cardiac mortality

A number of possible mechanisms have been proposed that may account for the relationship between depression and increased risk of cardiac mortality. Carney, Freedland, Miller, and Jaffe (2002) suggested physiological and behavioral mechanisms that potentially link depression and mortality in cardiac patients. Physiological mechanisms that may explain the relationship between depression and mortality include cardiotoxic side effects of antidepressants, more severe coronary disease, exaggerated platelet reactivity, increased inflammatory processes, and dysregulation of the autonomic nervous system. Potential behavioral mechanisms include the possibility that depressed patients are more likely to engage in behaviors deemed to be major cardiac risk factors, such as smoking, eating an unhealthy diet, or living a sedentary lifestyle. Depressed patients may also be more likely to have hypertension, or diabetes, both of which are risk factors for cardiovascular disease. Depressed patients likely have lower levels of physical activity compared to non-depressed patients and depressed patients may also be also less likely to adhere to prescribed medical treatment regimens. It is likely that these potential mechanisms are not mutually exclusive, but overlapping. It is also likely that physiological and behavioral mechanisms interact to increase risk of mortality for depressed cardiac patients. Health behaviors and adherence, for example, may affect mortality through physiological pathways.

Depression and Medical Adherence

Adherence to medical treatment regimens is a particularly important mechanism to examine because non-adherence is highly prevalent among cardiac patients (Burke &

Dunbar-Jacob, 1995). According to the Cardiac Rehabilitation Clinical Practice Guideline, adherence is the extent to which patients follow recommendations by health professionals (Wenger et al., 1995). Prescribed medical regimens for cardiac patients typically include lifestyle modifications, such as taking medication, smoking cessation, controlling diabetes mellitus and hypertension, changes in dietary habits and exercise patterns, and participation in a CR program. Adherence to prescribed lifestyle modifications is particularly important because the prescribed changes target reduction of modifiable risk factors. Patients with cardiovascular disease have a high risk of subsequent cardiovascular events. Risk factor modification by lifestyle changes can decrease morbidity and mortality in these patients (Leon et al., 2005). Depressed patients may fail to reduce their modifiable risk factors as a result of non-adherence to recommended lifestyle changes. Reduced adherence to several different components of the medical treatment regimen, including medication, smoking cessation, dietary changes, physical activity, and participation in cardiac rehabilitation, has been reported among depressed patients with heart disease. For example, three months after being hospitalized for acute coronary syndrome, patients who were persistently depressed were compared to patients with acute coronary syndrome with no depression or with depression in remission with respect to five adherence behaviors including taking medications, attending cardiac rehabilitation, quitting smoking, exercising, and modifying diet. The persistently depressed patients reported significantly lower rates of adherence to quitting smoking, exercising, and attending cardiac rehabilitation compared to both non-depressed patients and those with depression in remission, as well as lower

rates of medication adherence compared to non-depressed patients (Kronish et al., 2006).

Depression appears to have a negative impact on a variety of adherence behaviors.

Depression and smoking cessation. One critical component of the prescribed medical regimen for cardiac patients is smoking cessation. Eliminating smoking greatly reduces the occurrence of coronary heart disease and other cardiovascular diseases. Quitting smoking reduces the risk of repeat heart attacks and death from heart disease by at least 50 percent (U.S. Public Health Service, 1990). In addition to increasing the risk of coronary heart disease by itself, smoking increases blood pressure, decreases exercise tolerance, and increases the tendency for blood to clot (American Heart Association, 2006).

Smoking cessation is particularly difficult for individuals with depression. Smokers with a history of depression are 40% less likely to quit smoking and more likely to relapse compared to non-depressed smokers (Glassman et al., 1990). Depressed cardiac patients are particularly more likely to continue smoking after a cardiac event compared to non-depressed cardiac patients. Resumption of smoking within six months of a myocardial infarction was associated with an increase in anxiety and depression during the first weeks after discharge in a sample of 383 patients (Havik & Maeland, 1988). Although depressed acute coronary syndrome patients were no more likely to be smokers than non-depressed patients at the time of hospital admission, depressed patients were more than two times likely to have continued smoking one year later (McGee et al., 2006). There were no baseline differences in ratings of depression between smokers and nonsmokers in a sample of 1,472 patients who experienced a myocardial infarction.

However, higher levels of depression significantly predicted patients who continued to smoke three years after the event. In addition, smokers had significantly higher levels of depression compared to non-smokers four years later (van Berkel et al., 2000). Higher levels of depressive symptoms were also associated with continued smoking in patients with coronary artery disease. Presence of depressive symptoms increased the likelihood that a patient would be smoking six years later by an odds ratio of 1.6 (Brummett et al., 2002). Smoking cessation is a difficult lifestyle change for any individual with cardiac difficulties, but it appears that depressed patients have even greater difficulties when attempting to quit.

Depression and Medication Adherence. The link between depression and lack of adherence in cardiac patients is also evident in the failure of depressed patients to adhere to prescribed medication routines. Taking a daily low-dose aspirin is typically part of the medication regimen for cardiac patients. The American Heart Association recommends aspirin use for patients who have had a myocardial infarction, unstable angina, ischemic stroke, or transient ischemic attacks. Clinical trials have demonstrated that aspirin helps prevent the recurrence of additional heart attacks, hospitalization for recurrent angina, and additional strokes in non-contraindicated patients (American Heart Association, 2006). Depressed patients are less likely to take aspirin as prescribed. For example, Carney, Freedland, Eisen, Rich, and Jaffe (1995a) examined adherence to a prophylactic aspirin regimen in a sample of patients with coronary artery disease. A significant difference was found between depressed and non-depressed patients in adherence as measured by an electronic monitoring device. Patients diagnosed with major depression

took the aspirin 45% of the days compared to an adherence rate of 69% among a non-depressed comparison group.

Depression severity was also associated with non-adherence to an aspirin regimen in a graded fashion for hospitalized patients with acute coronary syndromes (Rieckmann et al., 2006). Non-adherence was defined as a patient taking the aspirin less than 80% of the days, as measured by an electronic monitoring device. Non-depressed patients had a non-adherence rate of 15% compared to non-adherence rates of 29% for mildly depressed patients and 37% for moderately-to-severely depressed patients. Compared with non-depressed patients, those with moderate-to-severe depression were 3.3 times more likely to not take the aspirin as prescribed. Reductions in depressive symptoms from one month after hospitalization to three months after hospitalization were also related to improvements in adherence.

In addition to reduced adherence to aspirin regimens, depressed patients have reduced adherence to other medication routines. Depressed patients constituted 44% of those who reported difficulty adhering to their entire medication regimen compared to a depression rate of 27% among patients who did not have problems taking their medications. Depressive symptoms also partially accounted for the relationship between difficulty taking medications and worse health status (Morgan et al., 2006). Depression was also associated with reduced medication adherence when adherence was assessed through self-report as opposed to an electronic monitoring device. In a sample of 122 patients who took an average of 4.28 prescribed medications for cardiovascular disease, a lower level of self-reported adherence to medication was associated with a higher number

of depressive symptoms endorsed on a self-report depression inventory in a sample of patients with cardiovascular disease (Bane et al., 2006).

Depression was also associated with medication non-adherence when self-reported non-adherence occurred for a variety of different reasons. In a sample of 940 outpatients with coronary heart disease, depressed patients were 2.8 times more likely than non-depressed patients to not take their medication as prescribed (Gehi et al., 2005). In addition, depressed patients were 2.4 times more likely to not adhere to their medication regimen compared to non-depressed patients when the reason for non-adherence was forgetting to take their medications. Depressed patients were also 2.2 times more likely than non-depressed patients to decide to skip taking their medications. Depression clearly contributes to a lack of adherence to taking prescribed medications that are crucial for secondary prevention in cardiac patients.

Medication adherence is particularly important when a cardiac patient is taking medications to control cardiac risk factors, such as hypertension or diabetes. Depression was the only variable independently associated with higher odds of noncompliance with taking antihypertensive medication after controlling for knowledge of hypertension, health beliefs, social support, satisfaction of care, and demographic variables. For every one point increase on a 14-point depression scale, compliance with taking antihypertensive medication was reduced by 3% (Wang et al., 2002).

Depression and dietary and physical activity changes. To control risk factors, such as hypertension, diabetes, high cholesterol, and obesity, it is recommended that cardiac patients make changes to their dietary habits and increase their level of physical

activity. Recommended changes from the American Heart Association Nutrition Committee include balancing caloric intake and physical activity to maintain a healthy weight, consuming a diet rich in fruits and vegetables, increasing consumption of high-fiber, whole-grain foods, increasing consumption of fish, limiting intake of saturated and trans fats, reducing salt intake, and consuming alcohol only in moderation (Lichtenstein et al., 2006).

Depressed patients adhere less well to prescribed dietary and physical activity changes. In addition to lower levels of adherence to regular exercise, patients with symptoms of minor depression, major depression, or dysthymia had lower adherence to a low-fat diet four months following a myocardial infarction compared to patients without depression (Ziegelstein et al., 2000). In addition, depressed diabetic patients were less likely to adhere to a diabetic diet compared to non-depressed patients with diabetes.

The effect of depression on adherence to diet and physical activity changes may also be related to gender and age. Depression may affect adherence in men differently than in women for some adherence behaviors. Depression was significantly associated with reduced physical activity for both men and women. However, depression was related to an unhealthy diet in men, but not women. In addition, depressed patients aged 65 and older who experienced a myocardial infarction were less likely to adhere to a low-fat, low-cholesterol diet, or diabetic diet, and less likely to be exercising regularly compared to non-depressed patients (Romanelli et al., 2002). Although no comparisons were made between patients aged 65 and over to patients younger than 65, it appears that older depressed patients may be a group that is particularly at risk for failure to adhere to

dietary and physical activity recommendations. Making dietary changes and increasing physical activity commonly requires guidance from health care professionals, making cardiac rehabilitation an ideal environment for cardiac patients to learn about healthy eating and begin an exercise regimen.

Cardiac Rehabilitation (CR)

Adhering to an exercise regimen is particularly important for cardiac patients, but patients with cardiac conditions often are not accustomed to regular exercise, or may feel nervous about resuming exercise safely. A CR program allows patients start exercising slowly after their cardiac event in a supervised setting, either at a hospital or an outpatient center (American Heart Association, 2006).

CR, as defined by the American Association of Cardiovascular & Pulmonary Rehabilitation (AACVPR) is a multifaceted comprehensive intervention program for cardiac patients consisting of exercise training, cardiac risk factor modification, education, and sometimes counseling (American Association of Cardiovascular and Pulmonary Rehabilitation, 2004). The goals of CR include optimizing physiological and psychological functioning, controlling cardiac symptoms, reducing the risk of morbidity and mortality, stabilizing or reducing the atherosclerotic process, and enhancing psychosocial and vocational functioning (Wenger et al., 1995) The American Heart Association noted the benefits of CR citing scientific evidence that exercise training in CR reduces mortality. A meta-analysis revealed that all-cause mortality and cardiac death was 26% lower in patients who participated in CR with exercise training compared to those not enrolled in CR (Taylor et al., 2004). CR is beneficial on the societal level as

well. In stable patients with chronic heart failure who participated in exercise training for 14 months, survival was prolonged by an additional 1.82 years at a cost of \$1,773 per life-year saved in the exercise group compared with non-exercising control subjects (Taylor et al., 2004). In addition, increases in quality of life and physical functioning resulting from CR leads to less time missed from work allowing for societal economic benefits (Leon et al., 2005).

Depressed patients may particularly benefit from participating in CR. Depressed patients have lower levels of physical functioning and lower levels of quality of life, both of which are targeted areas for improvement in CR. For example, depressive symptoms have been found to be related to worse exercise capacity among cardiac patients. In a study of patients with coronary artery disease, depression was independently associated with poor exercise capacity (Ruo et al., 2004). Carels (2004) also found that depression was related to lower levels of quality of life and impaired functional impairment in coronary heart failure patients.

Depressed patients with low levels of physical functioning and quality of life might improve these deficiencies by participating in CR. Patients who participated in a CR exercise training program exhibited greater improvements in exercise capacity, were less likely to experience a subsequent cardiac event, and were more likely to return to work, compared to their counterparts who did not participate in an exercise training program (Leon et al., 2005). Participation in CR is related to improvements in exercise capacity (Evon & Burns, 2004; Hamm et al., 2004), as well as other indicators of improved physical functioning, such as increased heart rate recovery (Tiukinhoy et al.,

2003), improved perceived physical functioning (Dolansky & Moore, 2004), and increased levels of physical activity (Sin et al., 2004).

Several studies also demonstrated that CR participation is associated with improvements in quality of life for the individual patient. Patients enrolled in either a four week CR program or a ten week CR program experienced significant improvements in various aspects of quality of life, such as self-reported energy, social well-being, pain, and general health (Hevey et al., 2003). In addition, patients enrolled in CR had significant increases in self-reported physical health two months after completing CR compared to the start of CR as well as significant increases in self-reported mental health two months and eight months after participating in CR (Michie et al., 2005).

Depressed patients might benefit even more than non-depressed patients from participating in CR. Milani, Lavie, and Cassidy (1996) found that depressed patients had lower exercise capacity, energy levels, general health, quality of life, functional status, and worse cholesterol levels compared to non-depressed patients prior to the start of a CR program. However, after participating in CR the depressed patients had marked improvements in depression and exhibited statistically significant greater increases in quality of life compared to non-depressed patients, in addition to making improvements in exercise capacity, body fat, functional status, energy, and general health ratings.

In addition to the association between CR participation and improvements in quality of life and exercise capacity, patients who enroll in CR tend to experience fewer depressive symptoms at the end of CR compared to the beginning. For example, in a study examining the relationship between depression and CR in patients enrolled in CR,

both men and women showed a reduction in depressive symptomology during CR, but women exhibited a significantly greater reduction in depression symptoms (Josephson et al., 2006). Although recent studies have not used control groups to compare patients who attend CR to those patients who do not participate, it is likely that CR contributes to improvements in physical functioning, quality of life, and possibly depression reduction, in addition to serving as secondary prevention by potentially reducing modifiable risk factors for additional cardiac events.

CR enrollment. Despite the benefits of CR, many cardiac patients do not participate in CR. Only 10-20% of eligible patients who experienced a myocardial infarction or who underwent a revascularization procedure participate in CR each year (Taylor et al., 2004). Depression may be a factor associated with failure to participate in CR. However, previous studies have demonstrated that depressed patients appear to be as likely as non-depressed patients to enroll in CR (Farley et al., 2003; Hughes et al., 2006a). For example, levels of depressive symptoms of attenders and non-attenders of a CR program did not differ among a sample of 85 patients with coronary heart disease when nonattendance was defined as not starting CR or dropping out within the first three sessions (Farley et al., 2003). There was also no age or gender difference between attenders and non-attenders. However, women with a partner were 16 times more likely to attend CR compared to women without a partner. Another study demonstrated that depression was only marginally related to CR enrollment in a sample of 194 hospitalized cardiac patients eligible for CR participation. Age also did not significantly predict enrollment, but men were nearly twice as likely to enroll in CR (Hughes et al., 2006).

Depression and CR Completion. Although depressed patients may be as likely to enroll in CR as non-depressed patients, depressed patients may be less likely to complete the CR program. Contrary to the lack of association between depression and CR enrollment, previous studies have suggested that higher levels of depression are associated with a failure to complete CR (Blumenthal et al., 1982; Glazer et al., 2002; Lane et al., 2001; Sanderson & Bittner, 2005; Turner et al., 2002; Caulin-Glaser et al., 2007).

One of the first studies demonstrating the association between depression and CR dropout was first published over 25 years ago (Blumenthal et al., 1982). A sample of 35 patients who experienced a myocardial infarction and who were enrolled in a one year CR program were examined using the Minnesota Multiphasic Personality Inventory (MMPI), a 566-item self-report questionnaire designed to assess personality characteristics. Patients were judged as a program completer if they attended 75% of more of all sessions, whereas individuals who dropped out early were defined as non-completers. Nine out of the 36 patients dropped out during the first six months and an additional five patients dropped out during the final six months of the program, resulting in a cumulative dropout rate of 40%. Patients who ended up dropping out of CR were more depressed, hypochondriacal, anxious, and introverted, and had lower ego strength at the start of CR compared to patients who remained in the program.

Similarly, Lane et al. (2001) found that CR non-attenders had significantly higher depression scores compared to CR non-attenders in patients who suffered a myocardial infarction. Depression was assessed using the Beck Depression Inventory (BDI) and

patients were considered to have completed CR if they attended 50% or more of the available sessions in either a six-week or eight-week CR program. Out of 288 patients in the study, 108 (41%) completed CR. CR completers had a lower average BDI score of 6.4 ($SD = 5.1$) compared to non-completers ($M = 8.4$, $SD = 7.0$).

Depression, as well as optimism and neuroticism, predicted adherence in a sample of forty-six patients with coronary heart disease (Glazer et al., 2002). Depression was assessed using the BDI. Adherence was defined as number of exercise sessions attended by participants. Participants who attended less than two thirds of the sessions (23 sessions) were considered to have dropped out of CR. Participants attended an average of 32 sessions and 36 out of 46 (78%) of the participants completed CR. CR completers had significantly lower BDI scores ($M = 6.3$, $SD = 5.1$) at the start of CR compared to non-completers ($M = 13.2$, $SD = 9.2$). After controlling for age, gender, neuroticism, and optimism, a hierarchical linear regression showed that depression was a significant predictor of number of sessions attended.

Depression, as measured by the BDI, independently predicted completion in a sample of 348 patients enrolled in a large, urban CR program (Caulin-Glaser et al., 2007). CR completion was defined as longer than seven weeks of participation in the 12-week CR program. Of the 348 participants, 295 (85%) completed the program. Depression was more prevalent among non-completers as 55% of the non-completers had BDI scores of 14 or greater compared to a 13% rate of elevated BDI scores among completers. In addition, a logistic regression analysis showed that patients with a BDI score of 14 or

greater were 5.65 times more likely to not complete CR compared to patients with BDI scores less than 14.

Depression was a significant predictor of dropout in a sample of 1902 cardiac patients admitted to a community-based, hospital-linked CR program (Turner et al., 2002). Patients were considered completers if they participated in a final assessment in CR. CR dropouts did not include patients who failed to complete CR due to death, illness, additional surgeries, or moving away. However, the researchers did not provide an explanation of what completion or dropout entailed. In the sample, 76% of patients completed the program, 5% were referred for surgery, 1% moved, 4% became ill, 1% died, and 13% dropped out. Patients with scores indicative of depression on the Hospital Anxiety and Depression Scale were twice as likely to dropout as patients without depressive symptoms. Gender and age had no effect on dropout when depression was taken into account, but patients who experienced angina or percutaneous transluminal coronary angioplasty were twice as likely to dropout as those who experienced myocardial infarction or coronary artery bypass graft surgery.

Depression was related to CR completion using more specific completion criteria in a study of 228 women with coronary heart disease enrolled in a CR program at an academic medical center (Sanderson & Bittner, 2005). Women who completed their prescribed number of sessions or achieved their exercise and education goals early were considered program completers. Patients who did not complete the prescribed number of sessions or who did not reach individualized exercise and education goals were considered to be non-completers and were categorized by non-completion reasons

including medical condition, moved or transferred to another program, no transportation, financial reason, personal reason, or other. The CR completion rate was 53%. CR completers had significantly lower BDI scores ($M = 9, SD = 7$) at the start of CR compared to non-completers ($M = 16, SD = 11$). In addition, a smaller percentage of women who completed CR (16%) had depression levels indicative of clinically significant depression ($BDI \geq 14$) compared to women who did not complete CR (50%). A logistic regression yielded an odds ratio of 1.15 for depression, and the researchers concluded that non-completers were more likely to have elevated BDI scores compared to completers.

In summary, the previously discussed research has demonstrated that depression is related to failure to complete CR. However, much of the previous literature has limitations that were addressed in the present study. Several of the previous studies were limited by imprecise definitions of completion, whereas others were limited by small sample sizes. In addition, several used analytic strategies that were not well suited to demonstrating that depression symptoms are associated with increased risk of non-adherence. CR completion in most of the studies was based on the number of sessions attended by a patient. Blumenthal et al. (1982) defined completion as a patient completing half of the prescribed number of sessions. In addition to including a small sample of 35 patients, Blumenthal's findings were based on a one-year CR program from over 25 years ago, that may not apply to the three month CR programs that are typically used currently. Lane et al. (2001) had a larger sample of 288 patients, but also defined non-attendance as either not enrolling in the CR program or attending less than 50% of

CR sessions. Turner et al. (2002) had a large sample of 1902 patients, but did not include patients who failed to complete CR due to death, illness, or additional surgeries in their analyses. Glazer et al. (2002) also used number of sessions attended and defined dropouts as participants who attended less than two thirds of exercise sessions, in addition to having a small sample size of 46 patients. Due to the variety of factors that can contribute to a patient's progression in the CR program, number of sessions attended may not be the most accurate way to measure adherence to CR. Sanderson and Bittner (2005) included goal achievement in the definition of completion, in addition to number of sessions attended, by defining completion as patients who attended the prescribed number of CR sessions or achieved their prescribed exercise and education goals. However, their sample was comprised of only women.

The statistics used in previous studies to describe the relationship between depression and failure to complete CR have generally not provided the meaningful information regarding the size of the effect that depression might have on CR completion. The analytic strategy employed in previous studies generally looked at depression in a retrospective manner. That is, several studies clearly demonstrated that non-completers had higher baseline depression scores than completers when examining scores of patients who did or did not complete CR (Blumenthal et al., 1982; Lane et al., 2001; Glazer et al. 2002; Sanderson & Bittner, 2005). While this is informative, it would be more useful to prospectively evaluate the relationship between depression and completion using logistic regression in order to determine the likelihood of a patient completing CR given a particular depression score. Among the logistic regressions conducted in the previously

discussed studies, the researchers interpreted the results as the likelihood of a non-completer being depressed. For example, Lane et al. (2001) concluded that completers were more likely to be depressed compared to non-completers, but did not find that depression was a significant predictor of attendance when included in a multiple logistic regression. Sanderson and Bittner (2005) concluded that completers were less likely to have elevated BDI scores compared to non-completers based on an odds ratio of 0.87. Turner et al. (2002) conducted a logistic regression to show that patients with baseline depression scores indicative of clinical depression were twice as likely to dropout as patients without depression. However, CR dropouts were not clearly defined and did not include patients who failed to complete CR due to death, illness, additional surgeries, or moving away. The primary goal of the present study was to extend and build above the previous literature on depression and completion of CR. In the present study, we hope to show that depression predicts failure to complete CR with prospective statistics and a large sample of both men and women using more accurate and realistic completion criteria.

Other factors affecting CR completion. Several studies have examined multiple other factors related to CR completion, such as age and gender. Glazer et al. (2002) found that dropouts were younger than completers. There were no gender differences in baseline depression or completion, but the lack of significant differences may be due to the sample including only 12 women. Other studies have shown that younger patients are less likely to complete CR. In a comparison of young (age < 55) and old (age > 75) patients with coronary artery disease, 66% of young patients completed a 12-week CR

program compared to 79% completion among old patients (Lavie & Milani, 2006).

Before starting CR, young patients had slightly higher levels of depressive symptoms compared to old patients. Both young and old completers had lower baseline depression scores compared to young and old non-completers.

Previous studies have also reported that women in CR have higher levels of depressive symptomology than men (Josephson et al., 2006; Todaro et al., 2005). Sanderson et al. (2003) found that patients who did not complete CR because of non-medical reasons were less likely to be women compared to patients who completed CR, but there were no gender differences among non-completers for medical reasons. Lane et al. (2001) found that non-completers were more likely to be female, live alone, have no paid employment, and live in more deprived areas. Higher family income, greater anxiety symptomatology, and higher self-efficacy significantly predicted CR participation six months following an ischemic coronary event (Grace et al., 2002). Caulin-Glaser et al. (2007) reported that women were 2.5 times more likely to fail to complete CR compared to men.

There is also evidence that certain medical diagnoses may be associated with CR completion (Turner et al., 2002). Although gender and age had no effect on dropout when depression was accounted for, Turner et al. (2002) found that patients who experienced angina or percutaneous transluminal coronary angioplasty were twice as likely to dropout of CR compared to those who experienced myocardial infarction or coronary artery bypass graft surgery.

Present study

In summary, depressed cardiac patients are at a greater risk of mortality than similar non-depressed patients. Psychosocial treatment of depression failed to lower mortality rates. The lack of successful interventions for depressed cardiac patients may be due to inadequate understanding of the mechanisms that explain the association between depression and mortality. Reduced adherence to prescribed medical regimens that are targeted at reducing known modifiable risk factors for additional cardiac events is one potential mechanism that could help to explain this relationship. In addition to taking prescribed medications, smoking cessation, changing dietary habits, and increasing physical activity, an important aspect of the medical regimen for cardiac patients is phase-II cardiac rehabilitation. CR participation is related to improved physical functioning, increased levels of quality of life, decreased depression levels, and reduced mortality rates in depressed and non-depressed patients. There is some evidence that depression is associated with a reduced likelihood of CR program completion, but previous studies had limited samples, less stringently defined completion criteria, or failed to use prospective statistics.

The primary purpose of the present study was to examine the relationship between depression and adherence to a CR program in cardiac patients. Specifically, the study was conducted to determine if depression predicted completion of a 12-week CR program. The following hypotheses were examined:

Hypothesis 1. Patients reporting more symptoms of depression will be less likely to complete cardiac rehabilitation. In addition, higher levels of depressive symptoms will predict a lower rate of completion in CR, after controlling for age and gender.

Hypothesis 2. Age will significantly predict CR completion. Younger patients will be less likely to complete CR.

Hypothesis 3. Gender will significantly predict completion. Women will be less likely to complete CR.

METHOD

Participants

Participants included 600 consecutive patients who completed the Beck Depression Inventory and were enrolled in Summa Health System's phase II CR program at Akron City Hospital. Demographic and medical characteristics can be found in Table 1. Participants were 70% men with a mean age of 66 years old (ranging from 28 to 89 years old).

Program

The CR program at Summa Health System's Akron City Hospital enrolls over 400 patients in CR each year. The phase II outpatient EKG-monitored exercise and education program was designed to help cardiac patients with recuperation and also to allow patients to develop a personal heart disease prevention program. Patients with heart disease, angina, heart failure, heart attack, coronary artery bypass surgery, heart valve repair or replacement, angioplasty, atherectomy, rotablation, stenting, or heart transplants were admitted to the program based on physician referral. The program has attained national certification by the AACVPR through adherence to and documentation of a high level of clinical standards of patient care (American Association of Cardiovascular and Pulmonary Rehabilitation, 2004) and was most recently recertified in August 2006. As of 1997, Medicare provided coverage for CR for patients who have had a documented diagnosis of acute MI within the preceding 12 months, have had coronary bypass surgery, or have stable angina pectoris and are considered to have a medical need

for CR (American Association of Cardiovascular and Pulmonary Rehabilitation, 2004). The CR program took place in groups ranging from 8-16 patients and was managed by a team of nurses and exercise physiologists.

Following an intake assessment, patients typically attended three sessions of CR per week for twelve weeks for a total of 36 sessions. In some cases, patients were placed on a “short program” of 12-20 sessions due to lack of insurance coverage or entering CR with a high exercise capacity of 10 METS or higher during an intake treadmill stress test. Each session was one and a half hours long with one hour devoted to exercise and one half hour spent on education. The goal of the exercise training was to help the patient learn how to exercise safely, improve stamina, strengthen muscles and develop an individual exercise program to help prevent future heart problems. Each patient had an individual, customized exercise plan consisting of warm-up, stretching, six 8-minute sessions of exercise on a variety of machines (treadmill, cycling, rowing, stepper, airbike, arm crank), and cool-down. Patients’ weight was measured at the prior to each class and blood pressure, heart rate, and rhythm were monitored throughout the entire exercise session. The education sessions were designed to help patients understand their heart conditions, make positive lifestyle changes, and find ways to reduce risk of future heart problems. Education class topics included medical interventions, nutrition and diet (dairy, carbohydrates, fish and seafood, meat and poultry; diabetes and glucose intolerance, cholesterol, salt and sodium, label reading, dining out), blood pressure, exercise maintenance, benefits, and precautions, smoking cessation, strength training, weight loss, symptoms of heart attack and stroke, anatomy of the cardiovascular system, and risk

factors for cardiovascular disease. Patients were expected to notify their case manager if they were unable to attend a scheduled session. During the final week of CR or after all CR sessions had been completed, the patient attended a discharge appointment in which her or she completed exit questionnaires on psychosocial characteristics, cognitive knowledge, and daily functioning. Patients also typically participated in a discharge exercise stress test. If a patient failed to continue to attend CR prior to his or her expected ending date or prior to completing the agreed upon number of sessions, the case manager called the patient to determine the patient's status and reason for discontinuation of CR. If the case managers were unable to contact the patient, calls to the patient were typically made once a week for two months before the patient was considered to have dropped out of the CR program. Case managers recorded all contact and communication with patients in a computerized database.

Procedure

A prospective study design using chart review was used to examine the relationship between depression and CR completion. The procedure was reviewed and approved by the Institutional Review Boards of Kent State University and SUMMA Health System. Prior to starting CR all patients completed a battery of questionnaires including depression and quality of life inventories. Patients also met with a case manager who gathered medical and demographic information and developed an individualized list of goals for the patient. An initial assessment appointment was conducted by a case manager (registered nurse or exercise physiologist) that included an exercise stress test and completion of psychosocial, daily functioning, and cognitive

questionnaires by the patient. The assessment resulted in the formation of individualized exercise and education goals, including the number of sessions that the patient was expected to attend. In addition, 87% of patients participated in a treadmill exercise stress test before starting CR. Physicians waived an entry stress test for patients who had orthopedic or other limitations.

Measures

Depression. The Beck Depression Inventory (BDI) (Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961) was used to assess depressive symptomatology during the previous two weeks. Each of the twenty-one items on the BDI consists of four statements representing increasing degrees of severity with scores ranging from 0 to 3. The total score on the BDI can range from zero (no depression) to a maximum score of 63 (severe state of depression). Patients with a BDI score of 10 or greater are considered to show at least mild to moderate symptoms of depression. Using a cutoff score of 10, the BDI has a sensitivity of 82% and specificity for 79% for diagnosing major depression in patients diagnosed with MI (Strik et al., 2001).

The BDI includes cognitive-affective and somatic symptom subscales. The cognitive-affective subscale consists of the first thirteen items on the BDI and includes questions assessing sadness, hopelessness about the future, feelings of failure and punishment, satisfaction and enjoyment in pleasurable activities, irritability, decision making, guilt, disappointment, suicidal thoughts. For example, in question one a patient would receive zero points for endorsing “I do not feel sad,” one point for “I feel sad,” two points for “I am sad all the time and I can’t snap out of it,” or four points for “I am so sad

or unhappy that I can't stand it." The somatic subscale consists of the final eight items of the measure and assesses physical and somatic symptoms, such as attractiveness, sleep, fatigue, appetite, weight, worries about health problems, and interest in sex. For example, in question 17, a patient would receive zero points for endorsing "I don't get more tired than usual," one point for "I get tired more easily than I used to," two points for "I get tired from doing almost anything," or three points for "I am too tired to do anything."

Patients enrolled in CR completed the BDI at entry and prior to discharge. CR staff members conducting the intake appointment interviewed patients with scores of 19-29, indicating moderate to severe depression, to assess current and prior psychological history, including professional interventions for psychological treatment. Staff members also notified the primary care or the referring physician by attaching a note to the patient's entry report. Case managers immediately telephoned the primary care or referring physician for patients with scores of 30-63, indicative of severe depression, or for patients who responded positively to an item indicating suicidal ideation or intent.

Completion. For this study, completion of CR was determined on a person-by-person basis in order to differentiate *favorable completion* from *dropping out*. Thus, our aim was to define adherence to CR more carefully than previous studies (Blumenthal et al., 1982; Lane et al., 2001; Glazer et al., 2002; Turner et al., 2002; Sanderson & Bittner, 2005). Patients were coded as either "completed" or "dropped out" according to case manager's notes in discharge summaries and in the comments section of the electronic medical record. Patients were coded as "completed" if the patient completed discharge

procedures (exit paperwork and stress test). Patients were also considered to have favorably completed CR if they attended 30 or more out of 36 sessions (other than patients who were scheduled to be on a shortened program), even if they did not take part in discharge procedures. Finally, a patient was considered to have completed the program without at least 30 sessions or without taking part in exit procedures if the CR staff determined that the patient had sufficiently met CR program expectations and documented a successful discharge in the comments section of the patient's CR chart.

Patients were coded as "failed to complete" if exit paperwork and stress test were not completed (i.e., failed to complete discharge procedures) and if the CR staff did not consider the patient to have participated enough in the program to warrant completion (i.e., less than 30 sessions or less than their agreed-upon treatment goals). Patients were also considered to have "failed to complete" CR if it was noted in the patient's medical records that the patient would no longer be attending CR due to a medical reason, such as additional cardiac procedures, musculoskeletal difficulties, or other medical procedures or problems. Other examples of reasons that patients were considered to have "failed to complete" were notations in the patient's medical records that patient would no longer be participating in rehab for other non-medical reasons such as: return to work, work schedule, or other time commitments; vacation; would rather exercise on his or her own; no longer interested in CR; transportation difficulties; moving to a nursing home; or insurance would no longer cover rehab. In addition, failure to complete was coded if it was noted in the patient's medical records that the patient had not been attending CR. That is, if a patient did not return to CR after two to three months, with weekly phone

messages from the CR staff, the patient was discharged due to lack of attendance.

Decisions regarding the categorization of unclear reasons for dropout were determined by the director of CR. Reasons for failing to complete CR were further coded into the following subcategories: failed to complete for cardiac reasons; failed to complete for musculoskeletal reasons; failed to complete due to other medical reasons; failed to complete due to lack of insurance coverage; failed to complete due to return to work/work schedule; failed to complete due to vacation; failed to complete due to transportation difficulties; failed to complete due to move to nursing home; failed to complete due to exercising on own; failed to complete due to lack of interest; and failed to complete based on discharge due to poor attendance.

Attendance. The number of total sessions attended was recorded for each patient. It was also noted whether or not the patient initially intended to enroll in the program on a shortened schedule (on a track for less than 36 sessions due to lack of insurance coverage or beginning CR with a particularly high physical fitness level).

Exercise capacity. Exercise capacity was used as an indicator of physical fitness. Exercise capacity was measured at the start of the CR program during treadmill stress test conducted according to a modified ramp protocol using a Quinton Medtrack ST55. Exercise capacity was measured in metabolic equivalents (METS) at the point of maximum heart rate, as in accordance with the American College of Sports Medicine's Guidelines for Exercise Testing (American College of Sports Medicine, 2000). METS is a multiple of oxygen consumption at rest, such that 1 MET equals 3.5ml/kg/min, which is the amount of oxygen that a person needs at rest (Pollock & Schmidt, 1995). For

example, 13 METS as a result of an exercise test meant that the patient could exceed his resting oxygen consumption by a multiplier of 13. A person's maximal MET value equals his/her maximal oxygen consumption in ml (ml/kg/min) (American College of Sports Medicine, 2000).

Sociodemographics. Five demographic characteristics were assessed: age, gender, race, education level, and employment status. Age was recorded at the start of CR and was represented as a continuous variable. Gender consisted of two categories: male and female. Race included the categories of non-Hispanic White, African-American, Asian, Native Hawaiian or Pacific Islander, Native American or Alaska Native, and Hispanic. Education level was based on the number of completed years of formal education and was represented as a continuous variable. Employment status consisted of two categories: employed and retired/not employed.

Medical characteristics. Additional medical characteristics relevant to the patient's condition were gathered from intake appointment data including weight, body mass index, diagnosis, medications, and other risk factor information. Weight was a continuous variable measured by balance scale in pounds. Body mass index (BMI) was a continuous variable calculated from the patient's height and weight ($BMI = (Weight \text{ in Pounds} / (Height \text{ in inches})^2) \times 703$). Diagnosis was categorized into the six following categories: coronary artery bypass grafting (CABG), myocardial infarction (MI) & percutaneous coronary intervention (PCI), PCI, MI, angina, and other. The diagnosis list is hierarchical, as the diagnoses listed first include patients with that diagnosis and possibly one or more of the subsequent diagnoses. Medication was represented by nine

classes: beta-blockers, alpha-blockers, diuretics, statins, selective serotonin reuptake inhibitor (SSRI), anti-anxiety medication, anti-depressives, anti-coagulants, and anti-arrhythmias. Patients were coded as currently taking or not currently taking medications in each of the nine classes.

Analytic strategy

Descriptive analyses (frequencies and percentages, means and standard deviations) were used to assess the characteristics of the total sample, completers, and non-completers. Baseline characteristics of completers and non-completers were compared using independent sample t-tests for continuous variables and chi-square analysis for categorical variables. A binary logistic regression was conducted to investigate whether depression predicted completion of cardiac rehabilitation after controlling for age, gender, as well as BMI and employment. For illustrative purposes, depression was categorized into depressed ($BDI \geq 10$) and non-depressed ($BDI < 10$) groups and age was dichotomized at ≥ 65 and < 65 for use in a second binary logistic regression. An exploratory multinomial logistic regression was conducted using CR completion as a reference group to determine if depression, age, and gender predicted drop out due to a medical reason or dropout due to a non-medical reason. In addition, exploratory analysis utilized multinomial logistic regression to examine if depression subscales, somatic and cognitive-affective, predicted CR completion.

RESULTS

Description of the sample

The sample included 600 patients (418 men and 182 women) who enrolled in CR between April 2004 and October 2005. Out of the 600 total patients, 473 (78%) of patients completed the cardiac rehabilitation program. As can be seen in Table 1, BDI scores ranged from 0 – 42, with an average of 7.1 ± 6.6 . For illustrative purposes, BDI scores were broken down into “depressed” ($BDI < 10$) and “non-depressed” ($BDI \geq 10$) categories based on the cutoff for possible depression (Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961). Patients with elevated depression scores ($N = 151$) constituted 25% of the sample. Additional descriptive statistics for the total sample, completers, and non-completers are presented in Table 1.

Depression and Completion

Logistic regression analyses were conducted to investigate whether depression predicted completion of cardiac rehabilitation after controlling for age and gender. The results of the logistic regression are presented in Table 2. As hypothesized, participants who had higher levels of depressive symptoms were less likely to complete cardiac rehabilitation ($B = -.04, p < .01$).

A second logistic regression was conducted treating depression as a categorical variable for illustrative purposes. The results showed that patients with elevated depression scores ($BDI < 10$) were 2.2 times less likely to complete CR compared to non-

Table 1. *Clinical and Demographic Characteristics*

Values represent the mean $\pm$ 1 S.D.

	All Patients	Completers	Non- Completers	<i>p</i> value
N	600	473	127	
Age	66 $\pm$ 12	67 $\pm$ 10	62 $\pm$ 13	.00
Gender (% male)	70%	71%	65%	.16
Race (% Caucasian)	94%	93%	95%	.67
Weight (pounds)	192 $\pm$ 43	191 $\pm$ 40	200 $\pm$ 54	.04
Body mass index	30 $\pm$ 6	30 $\pm$ 5	31 $\pm$ 8	.03
Employed	43%	39%	56%	.00
Education	13.4 $\pm$ 2.9	13.4 $\pm$ 3.0	13.2 $\pm$ 2.8	.50
Diagnoses				.47
CABG	48%	50%	41%	
MI & PCI	19%	19%	21%	
PCI	20%	19%	22%	
MI	7%	7%	9%	
Angina	2%	2%	1%	
Other	3%	3%	5%	
Medications				
Beta blockers	85%	85%	85%	.89
Alpha blockers	16%	18%	9%	.02

Table 1 continued

	All Patients	Completers	Non- Completers	<i>p</i> value
Diuretics	42%	42%	39%	.58
Statins	87%	88%	82%	.06
SSRI	1%	1%	3%	.01
Anti-anxieties	5%	3%	9%	.01
Anti-depressants	14%	12%	21%	.01
Anti-coagulants	69%	68%	72%	.32
Anti-arrhythmias	13%	13%	14%	.61
BDI total scale	7.1±6.6	6.6±6.2	9.0±7.4	.00
cognitive-affective subscale	2.7±3.9	2.5±3.8	3.7±4.4	.00
somatic subscale	4.4±3.3	4.2±3.1	5.1±3.7	.00
Exercise capacity (METs)	6.2±2.8	6.19±2.74	6.14±3.10	.87
Sessions attended	28.3±10.7	32.7±6.1	12.1±8.4	.00

Note: The diagnosis list is hierarchical, as the diagnoses listed first include patients with that diagnosis and one of the subsequent diagnoses. Independent samples t-tests and chi-square analysis were used for continuous and categorical variables, respectively, to compare completers vs. non-completers.

Abbreviations: CABG: coronary artery bypass graft surgery. MI: myocardial infarction.

PCI: percutaneous coronary intervention. SSRI: selective serotonin reuptake inhibitor.

depressed patients (BDI scores ≥ 10), as shown in Table 3. Patients with BDI scores of 10 or greater had a completion percentage of 67% compared to a completion percentage of 83% for patients with BDI scores less than 10.

Age and Completion

Patients who were older were more likely to complete cardiac rehabilitation ($B = .04, p < .01$), as shown by the results of the logistic regression in Table 2. This was not due to an association of age and depression, as was no significant relationship between depression and age at the start of CR ($r = -.07, p > .05$).

For illustrative purposes, a second logistic regression was conducted dichotomizing age at ≥ 65 and < 65 . Patients 65 years old and older were 2.39 times more likely to complete CR compared to patients younger than age 65, as shown in Table 3. Patients 65 years and older had a completion rate of 85% compared to a completion rate of 70% for patients below 65 years old.

Table 2. *Logistic Regression Analysis Predicting CR Completion from Gender, Age, Depression (BDI), Body Mass Index (BMI), and Employment*

	B	SE B	e ^b	C.I.
Gender (males)	.29	.22	1.34	.86 – 2.06
Age	.04**	.01	1.04	1.03 – 1.06
BDI	-.04**	.01	.96	.93 – .99
BMI	-.01	.02	.99	.95 – 1.02
Employed	.31	.29	1.37	.78 – 2.40
Constant	-1.34			
χ^2	35.75			
Df	3			
% completing cardiac rehabilitation	78			

** $p < .01$, C.I. = 95% confidence interval for exp B

Gender and Completion

An independent samples t-test indicated that women ($M = 8.59$, $SD = 7.35$) were significantly more depressed than men ($M = 6.44$, $SD = 6.1$) at the start of CR. However, the logistic regression analysis indicated that gender was not significantly associated with completion of cardiac rehabilitation ($B = .29$, $p = .20$) as shown in Table 2. Out of 182 women in the study, 137 (75%) completed CR. This percentage did not significantly differ from the 336 out of 418 (80%) of men that completed CR, $\chi^2(1) = 1.98$, $p = .16$.

Table 3. *Logistic Regression Analysis Predicting CR Completion from Gender, Categorical Age, and Categorical Depression (BDI)*

	B	SE B	e ^b	C.I.
Gender (males)	.29	.22	1.34	.86 – 2.07
Age (≥ 65)	.87**	.21	2.39	1.58 – 3.60
BDI (< 10)	.79**	.22	2.20	1.43 – 3.38
Constant	.13			
χ^2	34.65			
Df	3			
% completing cardiac rehabilitation	78			

** $p < .01$, C.I. = 95% confidence interval for exp B

Interactions of depression, gender and age

Interaction terms were added to the logistic regression to determine if interactions among depression, gender, and age significantly predicted completion. The logistic regression analysis indicated that the interactions of depression x age ($B = -.001, p = .30$), depression x gender ($B = -.02, p = .42$), age x gender ($B = .02, p = .34$), and depression x age x gender ($B = -.001, p = .18$) did not predict CR completion.

Additional covariates: BMI, employment, and METS

Although completers and non-completers differed in their BMI and employment status, at the start of CR, neither BMI or employment status significantly predicted completion when included in the logistic regression. Non-completers had a higher BMI ($M = 31, SD = 8$) compared to completers ($M = 30, SD = 5$) who were employed, $t(596) = 2.22, p = .03$. However, the logistic regression analysis indicated that BMI was not significantly associated with completion of cardiac rehabilitation ($B = -.01, p = .47$) as shown in Table 2.

A greater percentage of non-completers (56%) were employed compared to the percentage of completers (39%) who were employed, $\chi^2(1) = 10.21, p < .01$. As shown in Table 2, employment was not significantly associated with completion of cardiac rehabilitation when included in the logistic regression analysis ($B = .31, p = .27$).

Completers ($M = 6.19, SD = 2.74$) and non-completers ($M = 6.14, SD = 3.10$) did not differ in exercise capacity, as measured in METS, $t(524) = -0.16, p = .88$. Therefore, exercise capacity was not included as a covariate in the logistic regression.

Exploratory analyses

Additional analyses were conducted to examine how quickly patients dropped out of the CR program. Descriptive statistics showed that 71 of the 127 (56%) patients who dropped out did so during their first month of CR, with the most patients ($N = 44$) dropping out during the first two weeks of CR. Table 4 shows that 50% of the 44 patients who dropped out during the first two weeks were depressed, defined as a BDI score ≥ 10 . In addition, 22 (15%) of the 151 depressed patients dropped out during the first two weeks. The 22 depressed patients who dropped out during the first two weeks comprised almost half of the group of 50 depressed patients who dropped out of CR.

Table 4. *Percentage of CR Dropouts and CR Dropouts with Depression by Week*

Dropped out during...	N (%) dropped out	N (%) of dropouts with depression (BDI $\geq$ 10)
Weeks 1-2	44 (35%)	22 (50%)
Weeks 3-4	27 (21%)	10 (37%)
Weeks 5-8	40 (32%)	13 (32%)
Weeks 9-12	16 (13%)	5 (31%)
Total:	127 (100%)	50 (39%)

Exploratory analyses were also conducted to examine if depression predicted reason for dropout. Patient who dropped out were categorized into dropout for “medical reasons” (cardiac, musculoskeletal, or other) and dropout for “other reasons” (transportation, work, vacation, insurance, exercising on own, poor attendance, reason unknown). Table 5 shows the frequencies and percentages for patients who dropped out for medical and non-medical reasons. Dropout was due to medical-related reasons for 52 out of the 127 (41%) dropouts, compared to 75 (59%) patients dropping out for non-medical reasons. Elevated depressive symptomology ($BDI \geq 10$) was present in 22 out of 52 (42%) patients dropping out for medical reasons and in 28 out of 75 (37%) patients dropping out for non-medical reasons. Patients who dropped out for medical reasons ($M = 66.5$, $SD = 11.5$) were significantly older than patients who dropped out for non-medical reasons ($M = 58.2$, $SD = 13.4$), $t(123) = -3.64$, $p < .01$. Men and women were equally likely to drop out for medical or non-medical reasons, $\chi^2(1) = .02$, $p = .89$.

A multinomial logistic regression was conducted to determine if depression scores, age, and gender predicted dropout due to a medical reason or dropout due to a non-medical reason when compared to a reference group of CR completion. As shown in Table 6, depression scores significantly predicted dropout due to a medical reason ($B = 1.00$, $p < .01$), but only marginally predicted dropout for non-medical reasons ($B = .40$, $p = .06$). Patients with BDI scores below 10 were 2.73 times more likely to complete CR, as opposed to dropping out for a medical reason, compared to patients with BDI scores of 10 and above. Age significantly predicted dropping out due to a non-medical reason ($B = 1.41$, $p < .01$), but was unrelated to dropout due to a medical reason ($B = .14$, $p = .62$).

Table 5. *Frequency (and Percentage) of Total, Depressed, and Non-depressed CR Completers and Dropouts According to Reason*

	Total N (%)	Depressed (BDI $\geq$ 10)	Non- depressed (BDI < 10)
Completed cardiac rehab	473 (78%)	101 (21%)	372 (79%)
Failed to complete CR	127 (22%)	50 (39%)	77 (61%)
Medical-related reasons	52 (41%)	22 (42%)	30 (58%)
Cardiac reasons	21 (3%)	11 (52%)	10 (48%)
Musculoskeletal reasons	13 (2%)	5 (39%)	8 (61%)
Other medical reasons	18 (3%)	6 (33%)	12 (67%)
Non-medical related reasons	75 (59%)	28 (37%)	47 (63%)
Insurance	11 (2%)	2 (18%)	9 (82%)
Work schedule/other commitments	20 (3%)	9 (45%)	11 (55%)
Vacation	3 (0.5%)	0 (0%)	3 (100%)
Exercising on own	9 (2%)	2 (22%)	7 (78%)
Transportation	7 (1%)	5 (71%)	2 (29%)
Nursing home	3 (0.5%)	2 (67%)	1 (33%)
Poor attendance	15 (3%)	6 (40%)	9 (60%)
Not interested	7 (1%)	2 (29%)	5 (71%)
Totals	600	151 (25%)	449 (75%)

Table 6. *Multinomial Logistic Regression Analysis Predicting CR Completion, Dropout due to Medical Reasons, and Dropout due to Non-medical Reasons from Gender, Categorical Age, and Categorical Depression (BDI)*

Dropout category*		B	SE B	e ^b	C.I.
Medical Reasons	Gender (males)	-.21	.31	.81	.44 – 1.49
	Age (≥ 65)	0.14	.30	1.15	.64 – 2.07
	BDI (< 10)	1.00**	.30	2.73	1.51 – 4.92
	Constant	-2.41			
Other reasons	Gender (males)	-.36	.28	.70	.40 – 1.22
	Age (≥ 65)	1.41**	.28	4.08	2.34 – 7.11
	BDI (< 10)	.54	.29	1.71	0.97 – 2.99
	Constant	-2.57			
χ^2	43.54				
df	6				
% completing cardiac rehabilitation	78				

*reference category is completed cardiac rehabilitation

**p < .01, C.I. = 95% confidence interval for exp B

Patients who were age 65 above were 4.1 times more likely to complete CR, as opposed to dropping out for a non-medical reason, compared to patients below the age of 65. Gender did not predict dropout due to a medical reason ($B = -.21, p = .81$) or dropout due to a non-medical reason ($B = -.36, p = .19$).

Additional exploratory analyses were conducted to examine if the somatic or cognitive-affective BDI subscales differentially predicted CR completion. The average score per item was higher for the somatic subscale ($M = .55, SD = .41$) compared to the average score per item for the cognitive-affective subscale ($M = .21, SD = .30$), $t(599) = -25.46, p < .01$. As shown in Table 1, non-completers had higher scores on both the cognitive-affective and somatic subscales compared to completers. A second multinomial logistic regression was conducted to determine if the cognitive and somatic subscales predicted completion, dropout due to a medical reason, or dropout due to a non-medical reason. Table 7 shows that after controlling for age and gender, the somatic subscale significantly predicted dropout due a medical reason ($B = .05, p < .01$). Although patients with higher somatic subscale scores were more likely to dropout due to a medical reason, the cognitive-affective subscale score did not predict dropout due to a medical reason ($B = 1.00, p = .78$). After controlling for age and gender, the somatic subscale ($B = .03, p = .34$) and the cognitive-affective subscale ($B = .02, p = .94$) were unrelated to dropout due to non-medical reasons. Age was the only predictor of dropout due to a non-medical reason ($B = 1.43, p < .01$).

Table 7. *Multinomial Logistic Regression Analysis Predicting CR Completion, Dropout due to Medical Reasons, and Dropout due to Non-medical Reasons from Gender, Categorical Age, and BDI Cognitive and Somatic Subscales*

Dropout category*		B	SE B	e ^b	C.I.
Medical Reasons	Gender (males)	-.23	.31	.79	.43 – 1.47
	Age (≥ 65)	0.25	.30	1.29	.71 – 2.35
	BDI cognitive	-.01	.04	.99	.91 – 1.08
	BDI somatic	.05**	.05	.79	.43 – 1.47
	Constant	-2.81			
Other reasons	Gender (males)	-.38	.28	.68	.39 – 1.19
	Age (≥ 65)	1.43**	.29	4.17	2.36 – 7.34
	BDI cognitive	.02	.04	1.02	.94 – 1.10
	BDI somatic	.03	.05	1.03	.93 – 1.14
	Constant	-2.60			
χ^2	42.95				
df	8				
%	78				
completing cardiac rehabilitation					

*reference category is completed cardiac rehabilitation

**p < .01, C.I. = 95% confidence interval for exp B

DISCUSSION

Summary

Descriptive statistics indicate that elevated depressive symptomology was present in 25% of our sample. Completion rates were particularly high, as 78% of the 600 patients completed the cardiac rehabilitation program. As predicted, depression predicted program dropout. Depressed patients were 2.2 times less likely to complete CR compared to non-depressed patients. Also as expected, younger patients were less likely to complete CR. However, the hypothesis that women would be less likely to complete CR was not supported. Results of exploratory analyses suggested that the somatic component of depression is predictive of CR dropout for medical reasons, whereas age is predictive of CR for non-medical reasons. Given the failure of psychosocial interventions at reducing depression and mortality rates among depressed patients (Berkman et al., 2003; Lesperance et al., 2007), the findings underscore the importance of enhancing adherence to medical treatment regimens for depressed patients.

Rate of Depression

The rates of major depression or elevated depressive symptoms reported for cardiac samples in other samples range from 22% to 41% (Frasure-Smith et al, 1993; Frasure-Smith et al, 1999; Hance et al, 1996; Lespérance et al, 2000; Jiang et al, 2001; Connerney et al, 2001). In our study, the rate fell within the lower end of this range, as 25% of the patients had BDI scores of 10 or greater, indicative of elevated levels of

depressive symptomology. Furthermore, not all patients with elevated BDI scores would qualify for a diagnosis of clinical depression, so our rate of clinically significant depression is lower than reported elsewhere.

The lower percentage of depressed CR patients in our sample compared to higher rates of depression among other samples of hospitalized cardiac patients could potentially be a result of the length of time from the cardiac event to start of CR. Depression tends to remit over time, even for patients who are not treated with psychotherapy or antidepressants (Glassman et al., 2002; Berkman et al., 2003). Lauzon et al. (2003) used the BDI to evaluate 550 patients during an initial myocardial infarction and found a 34.7% prevalence rate of clinically significant depressive symptomology ($BDI \geq 10$). Of 466 patients re-evaluated 30 days later, 70% of those depressed at baseline were still depressed. Reduction of depressive symptomology also tends to occur during CR, with women exhibiting the greatest reduction (Josephson et al., 2006). The present study consisted of a subset of cardiac patients as only patients enrolled in CR were included. The 25% prevalence rate of depression in the present study were similar to rates ranging from 15-31% among other studies of patient enrolled in CR patients (Todaro et al., 2005; Sanderson & Bittner, 2005; Lavie & Milani, 2006).

Another issue involving depression assessment is that that most research studies, including the present study, utilized self-report depression questionnaires instead of clinical interviews. Future research should include structured clinical interviews in order to obtain more accurate rates of depression diagnoses including minor depression and dysthymia. The BDI cutoff scores that indicate the possibility of clinically significant

depression are widely used, particularly with research in cardiac samples (Frasure-Smith et al, 1995; Frasure-Smith et al, 1999; Lespérance et al, 2002; Grace et al., 2004).

However, the BDI does not provide as much information regarding depression diagnosis as a clinical interview.

Therefore, future studies that utilize structured clinical interviews could attain more precise estimate of depression rates. For example, as part of another study by the same researchers, 44 CR patients who completed the BDI also participated in a Structured Clinical Interview for the DSM-IV. None of the 22 patients with BDI scores below 5 were diagnosed with any type of depression. Of the 22 patients with BDI scores above 12, eleven were diagnosed with current major depression, four with major depression in remission, two with minor depression, three with dysthymia, and two had no diagnosis of depression. Utilizing both the BDI and diagnostic interviews would allow for the most complete assessment of depression in future research.

Another issue related to using the BDI to assess depression in a sample of CR patients is the overlap of symptoms between depression and cardiac problems. Endorsement of somatic symptoms may be the result of physical difficulties related to the cardiac problem. Silverstein (1999) distinguished *somatic depression* as characterized by sleep disturbance, fatigue, and appetite disturbance from *pure depression* which does not include these somatic symptoms.

The patients in our sample appeared to endorse more somatic symptoms than cognitive-affective symptoms. The average score per item was higher for the somatic subscale compared to the average score per item for the cognitive-affective subscale.

This result is consistent with Martens et al. (2006) finding that symptom presentation of depression in post-myocardial infarction patients is quantitatively and qualitatively different from symptom presentation in depressed psychiatric patients. Compared to psychiatric patients, the post-myocardial infarction patients had a relative lack of depressive cognitions, but an equal or greater endorsement of somatic symptoms. Cardiac patients may have elevated depression rates due to endorsement of several of the somatic components of depression. Martens et al. (2006) also suggest that cardiac patients may normalize their symptoms, attribute symptoms of depression to heart disease, and may be less likely to consider emotional causes of complaints.

On the other hand, depression in a cardiac patient may go undiagnosed because somatic symptoms may be incorrectly attributed to the cardiac condition and not to depression (Thornton, 2001). Researchers have suggested alternative depression measures, such as the Cardiac Depression Scale, that may be more suitable for the cardiac population compared to the BDI (Di Benedetto et al., 2006).

Rate of completion

Overall the sample in the present study had a relatively high percentage of patients completing CR (78%) in comparison to other studies of CR completion with completion percentages ranging from 40% to 85% (Blumenthal et al., 1982; Caulin-Glaser et al., 2007; Daly et al., 2002; Glaser et al., 2002; Jeng & Braun, 1997; Lane et al., 2001; Oldridge et al., 1983; Oldridge & Stoedefalke, 1984; Sanderson et al., 2003; Sanderson & Bittner, 2005; Turner et al., 2002). The completion rate was high despite the stricter completion criteria used in the present study compared to other studies.

Additional analysis in the present study using 50% sessions attended as criteria for completion, a criterion used in other research, resulted in an even higher completion rate (82%). If depression is related to non-completion in a program with such a high completion rate, it is likely that depression also has an impact in programs with lower overall completion rates. Aggressive steps to recruit patients and keep them in the program are taken by staff at Summa Health System, but it is apparent that further steps need to be taken when helping a depressed patient complete the program, despite the program's high completion rate.

Measuring adherence behaviors, such as CR completion, is a difficult task. Researchers have used a variety of measurement procedures because there is no "gold standard" for "completion" or for other health adherence behaviors, making it difficult to compare findings. Certain variables used to measure CR adherence, such as number of sessions attended, might not meaningfully represent the construct that researchers intend to investigate. For example, a patient might have attended the majority of prescribed sessions, but achieved very few CR goals. In addition, some researchers often fail to provide clear definitions of what constituted completion in their study (Turner et al., 2002). In the present study we provided a clear definition of completion and allowed case managers to determine if patients had made enough progress to be deemed CR completers.

Depression and CR Completion

Using a stringent definition of completion, the main hypothesis of the present study was supported, as depression predicted CR completion, after controlling for age and gender. Results of logistic regression analysis indicated that non-depressed patients were 2.2 times more likely to complete CR compared to depressed patients. The results of the present study were quite similar to the findings of Turner et al. (2002) who showed that patients with scores indicative of depression on the Hospital Anxiety and Depression Scale were twice as likely to dropout as patients without depressive symptoms. The twofold increase is on par with other variables predicting non-completion reported by Sanderson et al. (2003), such as smoking (odds ratio = 2.1), obesity (odds ratio = 2.5), and shorter 6-minute walk distance (odds ratio = 1.7). The finding that depression increases risk of dropout by at least a factor of two highlights the clinical impact of depression in cardiac patients.

Age and CR Completion

As expected, age predicted completion, as older patients were more likely to complete CR compared to younger patients. Patients 65 years old and older were 2.39 times more likely to complete CR compared to patients younger than age 65. It might be expected that younger patients are less likely to complete CR due to an increased likelihood of being employed. Although a greater percentage of non-completers were employed (56%) compared to completers (39%), employment did not add any predictive value beyond age when included in logistic regression analysis. This result appears to contradict the findings reported by Sanderson et al. (2003), who found that employed

patients were 2.2 times more likely to drop out of CR for non-medical reasons compared to patients who were unemployed. The apparent discrepancy may be due to the difference in how employment was operationalized in the two studies. In the present study the two employment categories used were employed and non-employed. The non-employed category included individuals who were either retired or unemployed. Alternatively, Sanderson et al. (2003) used three separate categories of employed, unemployed, and retired to classify employment. Sanderson et al.'s finding that employed patients were more likely to drop out for non-medical reasons compared to unemployed patients if retired patients were included in the unemployed category. Future research should assess the specific reasons why younger patients are more likely to dropout of CR. More specific information related to age and employment, such as child care, work responsibilities, and health care plans, could be used to make CR program changes that might contribute to improved adherence rates.

Gender and CR Completion

Contrary to prediction, women were not less likely to complete CR compared to men. In our sample, the percentage of women completing CR (75%) was quite similar to the completion rate for men (80%). These results were somewhat surprising given that other studies showed that women were less likely to complete CR (Caulin-Glaser et al., 2007; Lane et al., 2001; Worcester et al., 2004). The discrepant results between previous studies and the present study may be due to the fact that the previous studies categorized patients who never showed up at all to CR as non-completers. In the present study, only patients who started the CR program, but failed to complete it, were classified as non-

completers. Supporting this argument, we recently found that women are less likely than men to enroll in CR (Hughes, et al., 2006a). In an examination of patients who were already enrolled in CR, Sanderson et al. (2003) found that men were 1.6 times more likely to drop out of CR for non-medical reasons compared to women.

Therefore, women more likely to dropout of CR may not initially enroll, resulting in an apparent increase in the percentage of women that complete CR. It appears that gender is a barrier to CR enrollment, but that once enrolled, women are equally as likely as men to complete CR. Women may actually benefit more from CR than men in some respects, as women showed greater reductions in depression from the start to end of CR (Turner, et al., 2002; Josephson, et al., 2006). These findings suggest that interventions for depressed women may need to occur prior to enrollment in CR. Additional research should be conducted investigating the factors that serve as barriers to enrollment for women.

Exploratory Analysis

Time of dropout

Analysis of the time of dropout showed that over half of the patients who dropped out did so within the first month of CR, with the most patients dropping out during the first two weeks. Half of the patients who dropped out during the first two weeks of CR were depressed. In comparison, only one-third of dropouts during the remaining 2 ½ months of CR were depressed. In addition, Parashar et al. (2006) found that even transient depression (lasting less than 1 month) was associated with poorer long term

outcomes in myocardial infarction patients. The researchers suggested that although depressive symptoms may decrease with time, the biological or behavioral effects of depression take longer to subside. In addition, patients with transient depression may be in a trajectory of higher risk due to the initial adverse effects of depression (Parashar, et al., 2006). The great impact of even short periods of depression and the high rate of depression among dropouts during the first two weeks of CR in the present study lend support for intervening with depressed patients early in the CR program.

Reasons for dropout

A variety of reasons contributed to failure to complete CR, as patients dropped out of CR for medical reasons (41%) or non-medical (59%) reasons. The rates of the present study are similar to the results of Sanderson et al. (2003) who found that 63% of non-completers did not complete CR because of non-medical reasons. In the present study, depression scores predicted dropout due to a medical reason as non-depressed patients were 2.73 times more likely to complete CR, as opposed to dropping out for a medical reason, compared to depressed patients. However, when the depression scores were separated into somatic and cognitive-affective components, only the somatic component predicted dropout due a medical reason. Therefore, patients endorsing fewer somatic symptoms of depression are less likely to dropout of CR for medical reasons. Future research should examine specifically why the high endorsement of somatic symptoms by depressed patients is related to CR dropout.

One possible explanation is that people who are depressed could be sicker and suffer from greater disease severity. Depression may produce several pathophysiological

effects that contribute to increased disease severity, such as chronic inflammation, endothelial dysfunction, platelet abnormalities, dysregulation of the autonomic nervous system, or dysregulation of the hypothalamic-pituitary-adrenocortical axis (Carney et al., 2002). Research has shown that depression is related to worse physiological functioning as evidenced by lower exercise capacity (Ruo et al., 2004), heart rate variability (Carney et al., 2001; Carney et al., 1995b), and heart rate recovery (Hughes et al., 2006b). Disease severity was not specifically controlled for in the present study. However, a few indicators of health status, such as BMI and exercise capacity, were not significant predictors of CR completion when included in the logistic regression analysis. Future studies examining depression in CR patients control for physiological measures of disease severity as well as objective measures of symptoms.

A second possibility is that the endorsement of somatic symptoms may not be due to disease or illness severity, but rather cognitive biases. Depressed patients may not actually be sicker, but may instead perceive more symptoms. In an examination of patients with coronary heart disease, Sullivan et al. (1999) found that patients with major and minor depression complained more about cardiac symptoms (chest discomfort, breathlessness, rapid or irregular heartbeat) compared to control subjects even after controlling for disease severity and medical comorbidity. This finding suggests that although depressed patients may not actually have more symptoms, they may perceive more symptoms or perceive the symptoms as more severe.

A third possibility is that depressed and non-depressed patients may have similar symptoms and even perceive similar symptoms, yet depressed patients may perceive the

symptoms as more aversive and problematic. Depressed and non-depressed patients may experience and perceive similar symptoms, but the symptoms are more problematic for depressed patients. After controlling for disease severity, medical comorbidity, and symptom severity, Sullivan et al. (1999) found that self-reported functional impairment was marginally greater in patients with major or minor depression compared to patients without depression. This finding suggests that actual or perceived symptom severity does not completely explain the difference in functional impairment between depressed and non-depressed patients. Even if depressed and non-depressed patients experience and perceive similar symptoms, the symptoms may create more problems in living for depressed patients.

Patients viewing their symptoms as problematic may be less resilient and allow the symptoms to be barriers for functioning and adhering to medical treatment recommendations, such as completing a CR program. Whitmarsh, Kourtantji, and Sidell (2003) examined psychological determinants of CR attendance and found that depression was not an independent predictor of attending or completing CR. However, the researchers found that the best predictors of poor or no attendance were lower perceptions of symptoms (as measured by the Illness Perceptions Questionnaire) and controllability/curability of illness as well as less frequent use of problem-focused coping and more frequent use of maladaptive coping strategies. The results suggest that perceptions of illness and coping strategies may largely contribute to CR adherence. Assessing other variables in addition to depression, such as actual symptom severity,

perceived symptom severity, coping strategies, and resilience, may help to create more effective treatment plans for depressed CR patients.

The result that the somatic component of depression, but not the cognitive-affective component, predicts dropout was not entirely consistent with previous findings. Glazer et al. (2002) found that both the cognitive-affective and somatic symptom subscales of the BDI also predicted adherence, as defined by number of sessions attended. When controlling for somatic symptoms in a hierarchical linear regression, the cognitive-affective component predicted adherence, whereas when controlling for the cognitive-affective subscale, somatic symptoms did not predict adherence. Glazer et al.'s findings lend support for the cognitive-affective component of depression as a predictor of CR adherence and appear to conflict with the findings of the present study that the somatic component of depression may be a better predictor of adherence. However, Glazer et al. found that somatic symptoms predicted change in aerobic capacity, whereas the cognitive-affective subscale did not. Given the definition of completion used in the present study, it is likely that patients deemed as completing CR had positive outcomes such as improved aerobic capacity. Therefore, the finding that somatic symptoms, but not cognitive-affective symptoms of depression, predicted better CR outcomes is consistent with the findings of the present study. Future research should examine the predictive value of somatic and cognitive-affective subscales for both completion and CR outcomes, such as aerobic capacity.

Depression was unrelated to dropout for non-medical reasons. Age was the only predictor of dropout due to a non-medical reason, as patients aged 65 and above were 4.1

times more likely to complete CR, as opposed to dropping out for a non-medical reason, compared to patients below the age of 65. This finding suggests that targeting logistic and practical barriers to completing CR for younger patients may contribute to improved adherence rates.

In summary, the exploratory results show that only the somatic component of depression is related to dropout for medical reasons and that only younger age is related to dropout for non-medical reasons. Future research should be conducted to determine if the somatic component of depression predicts dropout because depression patients have more symptoms, perceive more symptoms, or view their symptoms as more problematic compared to non-depressed patients.

Limitations

There are several limitations within the present study. One limitation is that the data were obtained from self-report measures of depression. Although the BDI is a widely used and well-validated measure, it does not provide diagnoses of depression. Therefore, the rates of depression reported for sample in the present study represents percentages of patients experiencing depressive symptomatology and not patients actually diagnosed with depression. Future research should utilize structured clinical interviews in order to better assess the prevalence of depression in CR patients.

Another limitation is generalizability of this sample of patients from the phase-II program at Summa Health System's Akron City Hospital to other CR programs. Summa's CR program is a well run and innovative program. In 2005, Summa's CR program was awarded the honor of "Most Innovative Program" at the AACVPR annual

conference. Summa's CR program is well staffed, offers a flexible schedule of session days and times each week, and is conducted in a spacious facility with top-of-the-line exercise equipment. The high quality of Summa's CR program likely contributed to the 78% completion rate. It is unclear if the results of the present study would generalize to other programs that face more challenges (i.e., less staff, smaller facility, less flexible class times). However, the fact that depression still predicted completion in one of the top CR programs in the country with high CR completion rates suggests that the effect of depression on completion is robust. It is likely that a stronger relationship between depression and completion would exist in CR programs without high completion rates. Future research should be conducted in several different types of CR programs in order to determine generalizability of the current findings.

Another limitation is that the exact reason for dropout was not available for all patients. For 15 patients, the reason for dropout was not reported, as the patient dropped out of the program with no notification. After several unsuccessful attempts at contacting the patients through phone calls and letters, these patients were labeled as "dropouts due to poor attendance." In addition, one primary reason for dropout was determined for each patient that failed to complete CR. The reason was based on the judgments of the CR staff, but it is possible that multiple medical and life factors contributed to dropout. In order to get more specific information about reasons for dropout, it would be beneficial for future studies to include patients' multiple reasons for dropout.

A final limitation of the present study is the lack of follow up information on depressed patients that completed or dropped out from the program. Regardless of their

reason for dropout, non-depressed dropouts may have been more proactive than dropouts in pursuing exercise opportunities outside of CR. Future studies should include the collection of follow up data regarding health adherence behaviors of depressed and non-depressed completers and non-completers. Previous research has provided evidence of increased risk of mortality for depressed patients up to five years after a cardiac event (Frasure-Smith et al., 1999; Grace et al., 2005). Research has also shown that the negative effects of depression persist well after the depression itself has subsided (Parashar et al., 2006). Perhaps depressed patients, whether they completed or dropped out of CR, need additional assistance from health care professionals after they have left the CR program. Follow-up information may help to determine the point at which depressed patients are most susceptible to failing to adhere to exercise regimens and other healthy lifestyle recommendations.

Interventions for Depressed CR Patients

Until more research is available that identifies the best interventions for reducing depression among cardiac patients, physicians, nurses, and exercise physiologists working with patients in the CR setting will have to assume the primary responsibility of addressing their patients' psychological problems. A stepped collaborative care intervention is one approach that may be used to guide the management of depressive symptoms in CR patients (Rozanski et al., 2005). In this approach, the patient's degree of depressive symptomology would determine the need for collaborative care. At the lowest step, patients with mild depressive symptoms would be treated by CR staff without the involvement of mental health professionals. The second step might involve referral of

patients to a designated team for monitoring and counseling. The third step would include patients with higher levels of depression receiving collaborative care, possibly with the help of mental health professionals.

Regardless of the step of intervention, certain interventions may not effectively reduce depression or mortality rates. Although research indicates that cardiac patients experience significant levels of depression, interventions addressing depression have been unsuccessful. Previous attempts at treating depression through psychotherapy (ENRICHED), antidepressants (SADHART), or both (CREATE) had little impact on reducing depression and mortality among cardiac patients (Glassman et al., 2002; Berkman et al., 2003; Lesperance et al., 2007). Particularly given the finding that somatic symptoms predict adherence, as opposed to cognitive/affective symptoms, perhaps treating depression through psychotherapy or medication is not the most effective intervention. It may be more beneficial to develop plans to ensure that depressed cardiac patients adhere to medical recommendations, such as completing the entire CR program, rather than focus on reducing depressive cognitions. Evidence has shown that CR is beneficial in reducing cardiac mortality (Wenger et al., 1995; Taylor et al., 2004; Leon et al., 2005) and some evidence has also shown that depressed cardiac patients may even benefit more from CR than non-depressed patients (Milani et al., 1996; Taylor et al., 2004; Ruo et al., 2004; Carels, 2004). Depressed patients are more likely get the mortality reducing benefits by improving adherence to medical regimens, such as completing CR.

Focusing on behavior change may be an effective alternative for depressed patients as opposed to concentrating on reducing depressive cognitions. Rozanski (2005) asserts that three categories of assistance have been developed for promoting patient adherence to health habit change. The first category is overcoming barriers to maintaining new health behaviors. In addition to logistic barriers, such as transportation and insurance, depression may be a barrier to adhering to health behavior change, such as completing CR, for a variety of potential reasons. Depression may contribute to feelings of lack of energy and fatigue, making it difficult for patients to have the energy to make change. In addition, depressed patients may be accustomed to using unhealthy behaviors, such as being sedentary, eating an unhealthy diet, or smoking, as a way to temporarily relieve or ignore their negative symptoms.

Rozanski's second category is providing external support for maintaining new health behaviors. While CR inherently provides external support, perhaps additional external support such as extra telephone check-ins, behavioral contracts, and increased interaction between patients and staff, would increase the likelihood of depressed patients completing CR.

The third category is motivating patients to initiate and sustain their own behavioral self-management. Using interventions that increase motivation may help to improve completion rates. For example, motivational interviewing is a client-centered, directive method used to enhance intrinsic motivation to change by exploring and resolving ambivalence (Rollnick & Miller, 1995). A study of patients with chronic heart failure conducted by Brodie and Inoue (2005) found that motivational interviewing

increased the level and type of physical activity in the heart failure patients. In another study with patients with coronary artery disease, Scales (1998) compared an intervention group (traditional CR exercise program plus one of hour motivational interviewing and three sessions of skills-based counseling) to a control group (traditional CR exercise program plus information lectures). After 12 weeks, the intervention group had significantly greater improvements in perceived stress, physical activity, and dietary fat intake, compared to a standard care CR control group. However, it is also important to note that the findings of the present study suggest that non-completion is not simply due to lack of motivation or effort by the CR patient, but may be more likely to due to medical problems or logistical barriers. Therefore, system changes need to be addressed to increase completion rates, as opposed to only concentrating on changes in the individual patient.

Conclusions

The present study extended previous findings by prospectively examining the effect of depression on CR completion in a large sample of men and women using clearly defined completion criteria. Higher levels of depressive symptomology predicted a failure to complete CR after controlling for age and gender. Younger patients were also less likely to complete CR, but there were no differences in completion between men and women. Additional analysis showed that the somatic component of depression predicted dropout due to medical reasons and that younger age predicted dropout due to non-medical reasons. Depression was prevalent in this sample as 25% reported mild to severe depressive symptoms. The completion rate of 78% was quite high in this sample. These

results suggest that depressed patients are at a higher risk of failing to complete CR compared to non-depressed patients. Consequently, interventions should be implemented that target the completion of CR, particularly for depressed patients. Interventions targeting behavior change in order to improve medical adherence, particularly for younger patients and patients with higher levels of depressive somatic symptoms, might prove to be more effective at reducing cardiac mortality among depressed patients compared to interventions targeting reduction of depression symptoms.

REFERENCES

- American Association of Cardiovascular and Pulmonary Rehabilitation (2004).
Guidelines for cardiac rehabilitation and secondary prevention programs. (4th ed ed.) Champaign, IL: Human Kinetics.
- American College of Sports Medicine (2000). *ACSM's guidelines for exercise testing and prescription*. (6th ed.) Lippincott Williams & Wilkins.
- American Heart Association (2006). *Heart disease and stroke facts: 2006 update*. Dallas, Texas: American Heart Association.
- Bane, C., Hughes, C. M., & McElnay, J. C. (2006). The impact of depressive symptoms and psychosocial factors on medication adherence in cardiovascular disease.
Patient education and counseling, 60, 187-193.
- Barth, J., Schumacher, M., & Herrmann-Lingen, C. (2004). Depression as a risk factor for mortality in patients with coronary heart disease: a meta-analysis.
Psychosomatic medicine, 66, 802-813.
- Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of general psychiatry*, 4, 561-571.
- Berkman, L. F., Blumenthal, J., Burg, M., Carney, R. M., Catellier, D., Cowan, M. J. et al. (2003). Effects of treating depression and low perceived social support on

clinical events after myocardial infarction: the Enhancing Recovery in Coronary Heart Disease Patients (ENRICHD) Randomized Trial. *JAMA : the journal of the American Medical Association*, 289, 3106-3116.

Blumenthal, J. A., Williams, R. S., Wallace, A. G., Williams, R. B. J., & Needles, T. L.

(1982). Physiological and psychological variables predict compliance to prescribed exercise therapy in patients recovering from myocardial infarction. *Psychosomatic medicine*, 44, 519-527.

Brodie, D. A. & Inoue, A. (2005). Motivational interviewing to promote physical activity for people with chronic heart failure. *Journal of advanced nursing*, 50, 518-527.

Brummett, B. H., Babyak, M. A., Mark, D. C., Williams, R. B., Siegler, I. C., Clapp-

Channing, N. et al. (2002). Predictors of smoking cessation in patients with a diagnosis of coronary artery disease. *Journal of cardiopulmonary rehabilitation*, 22, 143-147.

Burke, L. E. & Dunbar-Jacob, J. (1995). Adherence to medication, diet, and activity recommendations: from assessment to maintenance. *The Journal of cardiovascular nursing*, 9, 62-79.

Carels, R. A. (2004). The association between disease severity, functional status, depression and daily quality of life in congestive heart failure patients. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation*, 13, 63-72.

- Carney, R. M., Blumenthal, J. A., Stein, P. K., Watkins, L., Catellier, D., Berkman, L. F. et al. (2001). Depression, heart rate variability, and acute myocardial infarction. *Circulation*, 104, 2024-2028.
- Carney, R. M., Freedland, K. E., Eisen, S. A., Rich, M. W., & Jaffe, A. S. (1995a). Major depression and medication adherence in elderly patients with coronary artery disease. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association*, 14, 88-90.
- Carney, R. M., Rich, M. W., teVelde, A., Saini, J., Clark, K., & Freedland, K. E. (1988). The relationship between heart rate, heart rate variability and depression in patients with coronary artery disease. *Journal of psychosomatic research*, 32, 159-164.
- Carney, R. M., Saunders, R. D., Freedland, K. E., Stein, P., Rich, M. W., & Jaffe, A. S. (1995b). Association of depression with reduced heart rate variability in coronary artery disease. *Am.J.Cardiol.*, 76, 562-564.
- Carney, R. M., Freedland, K. E., Miller, G. E., & Jaffe, A. S. (2002). Depression as a risk factor for cardiac mortality and morbidity: a review of potential mechanisms. *Journal of psychosomatic research*, 53, 897-902.
- 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. *Preventive cardiology*, 10, 15-21.

Centers for Disease Control and Prevention (2004). *The Burden of Heart Disease and Stroke in the United States: State and National Data*. Atlanta: Centers for Disease Control and Prevention.

Centers for Disease Control and Prevention (2005). *Health, United States, 2005 with Chartbook on Trends in the Health of Americans*. Hyattsville, MD: National Center for Health Statistics.

Connerney, I., Shapiro, P. A., McLaughlin, J. S., Bagiella, E., & Sloan, R. P. (2001). Relation between depression after coronary artery bypass surgery and 12-month outcome: a prospective study. *Lancet*, 358, 1766-1771.

Daly, J., Sindone, A. P., Thompson, D. R., Hancock, K., Chang, E., & Davidson, P. (2002). Barriers to participation in and adherence to cardiac rehabilitation programs: a critical literature review. *Progress in cardiovascular nursing*, 17, 8-17.

Di Benedetto, M., Lindner, H., Hare, D. L., & Kent, S. (2006). Depression following acute coronary syndromes: a comparison between the Cardiac Depression Scale and the Beck Depression Inventory II. *Journal of psychosomatic research*, 60, 13-20.

Dolansky, M. A. & Moore, S. M. (2004). Effects of cardiac rehabilitation on the recovery outcomes of older adults after coronary artery bypass surgery. *Journal of cardiopulmonary rehabilitation*, 24, 236-244.

- Evon, D. M. & Burns, J. W. (2004). Process and outcome in cardiac rehabilitation: an examination of cross-lagged effects. *Journal of consulting and clinical psychology, 72*, 605-616.
- Farley, R. L., Wade, T. D., & Birchmore, L. (2003). Factors influencing attendance at cardiac rehabilitation among coronary heart disease patients. *European journal of cardiovascular nursing : journal of the Working Group on Cardiovascular Nursing of the European Society of Cardiology, 2*, 205-212.
- Frasure-Smith, N., Lesperance, F., Juneau, M., Talajic, M., & Bourassa, M. G. (1999). Gender, depression, and one-year prognosis after myocardial infarction. *Psychosomatic medicine, 61*, 26-37.
- Frasure-Smith, N., Lesperance, F., & Talajic, M. (1993). Depression following myocardial infarction. Impact on 6-month survival. *JAMA : the journal of the American Medical Association, 270*, 1819-1825.
- Frasure-Smith, N., Lesperance, F., & Talajic, M. (1995). Depression and 18-month prognosis after myocardial infarction. *Circulation, 91*, 999-1005.
- Frasure-Smith, N. & Lesperance, F. (2006). Recent evidence linking coronary heart disease and depression. *Canadian journal of psychiatry. Revue canadienne de psychiatrie, 51*, 730-737.

Freedland, K. E., Carney, R. M., Lustman, P. J., Rich, M. W., & Jaffe, A. S. (1992).

Major depression in coronary artery disease patients with vs. without a prior history of depression. *Psychosomatic medicine*, 54, 416-421.

Gehi, A., Haas, D., Pipkin, S., & Whooley, M. A. (2005). Depression and medication

adherence in outpatients with coronary heart disease: findings from the Heart and Soul Study. *Archives of Internal Medicine*, 165, 2508-2513.

Glassman, A. H., Helzer, J. E., Covey, L. S., Cottler, L. B., Stetner, F., Tipp, J. E. et al.

(1990). Smoking, smoking cessation, and major depression. *JAMA : the journal of the American Medical Association*, 264, 1546-1549.

Glassman, A., O'Connor, C., Califf, R., Swedberg, K., Schwartz, P., Bigger, J. T. J. et al.

(2002). Sertraline treatment of major depression in patients with acute MI or unstable angina. *JAMA : the journal of the American Medical Association*, 288, 701-709.

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, 40-46.

Grace, S. L., Abbey, S. E., Kapral, M. K., Fang, J., Nolan, R. P., & Stewart, D. E. (2005).

Effect of depression on five-year mortality after an acute coronary syndrome. *The American Journal of Cardiology*, 96, 1179-1185.

Grace, S. L., Abbey, S. E., Shnek, Z. M., Irvine, J., Franche, R. L., & Stewart, D. E.

(2002). Cardiac rehabilitation II: referral and participation. *General hospital psychiatry*, 24, 127-134.

Hamm, L. F., Kavanagh, T., Campbell, R. B., Mertens, D. J., Beyene, J., Kennedy, J. et

al. (2004). Timeline for peak improvements during 52 weeks of outpatient cardiac rehabilitation. *Journal of cardiopulmonary rehabilitation*, 24, 374-380.

Havik, O. E. & Maeland, J. G. (1988). Changes in smoking behavior after a myocardial

infarction. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association*, 7, 403-420.

Herridge, M. L., Stimler, C. E., Southard, D. R., King, M. L., & King, M. L. (2005).

Depression screening in cardiac rehabilitation: AACVPR Task Force Report. *Journal of cardiopulmonary rehabilitation*, 25, 11-13.

Hevey, D., Brown, A., Cahill, A., Newton, H., Kierns, M., & Horgan, J. H. (2003). Four-

week multidisciplinary cardiac rehabilitation produces similar improvements in exercise capacity and quality of life to a 10-week program. *Journal of cardiopulmonary rehabilitation*, 23, 17-21.

Hughes, J. W., Bartley, A. G., Casey, E., Luyster, F., Rosneck, J., Waechter, D. et al.

(2006a). Depression symptoms are not a major impediment to enrollment in phase-II cardiac rehabilitation (Abstract). *Journal of cardiopulmonary rehabilitation*, 26, 255.

Hughes, J., Casey, E., Luyster, F., Doe, V., Waechter, D., Rosneck, J. et al. (2006b).

Depression symptoms predict heart rate recovery after treadmill stress testing.

American Heart Journal, 151, 1122-1126.

Jeng, C. & Braun, L. T. (1997). The influence of self-efficacy on exercise intensity,

compliance rate and cardiac rehabilitation outcomes among coronary artery

disease patients. *Progress in cardiovascular nursing*, 12, 13-24.

Josephson, E., Casey, E., Waechter, D., Rosneck, J., & Hughes, J. W. (2006). Gender and

depression symptoms in cardiac rehabilitation: women initially exhibit higher

depression scores but experience more improvement. *Journal of cardiopulmonary*

rehabilitation, 26, 160-163.

Joynt, K. E. & O'Connor, C. M. (2005). Lessons from SADHART, ENRICHD, and other

trials. *Psychosomatic medicine*, 67 Suppl 1, S63-S66.

Kaptein, K. I., De Jonge, P., Van Den Brink, R. H. S., & Korf, J. (2006). Course of

depressive symptoms after myocardial infarction and cardiac prognosis: a latent

class analysis. *Psychosomatic medicine*, 68, 662-668.

Kronish, I. M., Rieckmann, N., Halm, E. A., Shimbo, D., Vorchheimer, D., Haas, D. C. et

al. (2006). Persistent depression affects adherence to secondary prevention

behaviors after acute coronary syndromes. *Journal of general internal medicine :*

official journal of the Society for Research and Education in Primary Care

Internal Medicine, 21, 1178-1183.

- Lane, D., Carroll, D., Ring, C., Beevers, D. G., & Lip, G. Y. (2001). Predictors of attendance at cardiac rehabilitation after myocardial infarction. *Journal of psychosomatic research*, 51, 497-501.
- Lauzon, C., Beck, C. A., Huynh, T., Dion, D., Racine, N., Carignan, S. et al. (2003). Depression and prognosis following hospital admission because of acute myocardial infarction. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, 168, 547-552.
- Lavie, C. J. & Milani, R. V. (2006). Adverse psychological and coronary risk profiles in young patients with coronary artery disease and benefits of formal cardiac rehabilitation. *Archives of Internal Medicine*, 166, 1878-1883.
- Leon, A. S., Franklin, B. A., Costa, F., Balady, G. J., Berra, K. A., Stewart, K. J. et al. (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.
- Lesperance, F., Frasure-Smith, N., Koszycki, D., Laliberte, M. A., van Zyl, L. T., Baker, B. et al. (2007). Effects of citalopram and interpersonal psychotherapy on depression in patients with coronary artery disease: the Canadian Cardiac

Randomized Evaluation of Antidepressant and Psychotherapy Efficacy (CREATE) trial. *JAMA : the journal of the American Medical Association*, 297, 367-379.

Lesperance, F., Frasure-Smith, N., Talajic, M., & Bourassa, M. G. (2002). Five-year risk of cardiac mortality in relation to initial severity and one-year changes in depression symptoms after myocardial infarction. *Circulation*, 105, 1049-1053.

Lett, H. S., Blumenthal, J. A., Babyak, M. A., Sherwood, A., Strauman, T., Robins, C. et al. (2004). Depression as a risk factor for coronary artery disease: evidence, mechanisms, and treatment. *Psychosomatic medicine*, 66, 305-315.

Lichtenstein, A. H., Appel, L. J., Brands, M., Carnethon, M., Daniels, S., Franch, H. A. et al. (2006). Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation*, 114, 82-96.

McGee, H. M., Doyle, F., Conroy, R. M., De La Harpe, D., & Shelley, E. (2006). Impact of briefly-assessed depression on secondary prevention outcomes after acute coronary syndrome: a one-year longitudinal survey. *BMC health services research [electronic resource]*, 6, 9.

Michie, S., O'Connor, D., Bath, J., Giles, M., & Earll, L. (2005). Cardiac rehabilitation: The psychological changes that predict health outcome and healthy behaviour. *Psychology, Health & Medicine*, 10, 88-95.

- 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, 726-732.
- Minino, A. M., Heron, M. P., & Smith, B. L. (2006). Deaths: preliminary data for 2004. *National vital statistics reports : from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System*, 54, 1-49.
- Morgan, A., Masoudi, F., Havranek, E., Jones, P., Peterson, P., Krumholz, H. et al. (2006). Difficulty taking medications, depression, and health status in heart failure patients. *Journal of cardiac failure*, 12, 54-60.
- Oldridge, N. B., Donner, A. P., Buck, C. W., Jones, N. L., Andrew, G. M., Parker, J. O. et al. (1983). Predictors of dropout from cardiac exercise rehabilitation. Ontario Exercise-Heart Collaborative Study. *The American Journal of Cardiology*, 51, 70-74.
- Oldridge, N. B. & Stoedefalke, K. G. (1984). Compliance and motivation in cardiac exercise programs. *Clinics in sports medicine*, 3, 443-454.
- Parashar, S., Rumsfeld, J. S., Spertus, J. A., Reid, K. J., Wenger, N. K., Krumholz, H. M. et al. (2006). Time course of depression and outcome of myocardial infarction. *Archives of Internal Medicine*, 166, 2035-2043.

Rieckmann, N., Gerin, W., Kronish, I. M., Burg, M. M., Chaplin, W. F., Kong, G. et al.

(2006). Course of depressive symptoms and medication adherence after acute coronary syndromes: an electronic medication monitoring study. *Journal of the American College of Cardiology*, 48, 2218-2222.

Rollnick, S. & Miller, W. R. (1995). What is motivational interviewing? *Behavioural and Cognitive Psychotherapy*, 23, 325-334.

Romanelli, J., Fauerbach, J. A., Bush, D. E., & Ziegelstein, R. C. (2002). The significance of depression in older patients after myocardial infarction. *Journal of the American Geriatrics Society*, 50, 817-822.

Rozanski, A. (2005). Integrating psychologic approaches into the behavioral management of cardiac patients. *Psychosomatic medicine*, 67 Suppl 1, S67-S73.

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, 637-651.

Ruo, B., Rumsfeld, J. S., Pipkin, S., & Whooley, M. A. (2004). Relation between depressive symptoms and treadmill exercise capacity in the Heart and Soul Study. *The American Journal of Cardiology*, 94, 96-99.

Sanderson, B. K. & Bittner, V. (2005). Women in cardiac rehabilitation: outcomes and identifying risk for dropout. *American Heart Journal*, 150, 1052-1058.

- Sanderson, B. K., Phillips, M. M., Gerald, L., DiLillo, V., & Bittner, V. (2003). Factors associated with the failure of patients to complete cardiac rehabilitation for medical and nonmedical reasons. *Journal of cardiopulmonary rehabilitation*, 23, 281-289.
- Scales, R. (1998). *Motivational interviewing and skills-based counseling in cardiac rehabilitation: The Cardiovascular Health Initiative and Lifestyle Intervention (CHILE) Study*. Doctoral Dissertation, The University of New Mexico.
- Sin, M. K., Sanderson, B., Weaver, M., Giger, J., Pemberton, J., & Klapow, J. (2004). Personal characteristics, health status, physical activity, and quality of life in cardiac rehabilitation participants. *International journal of nursing studies*, 41, 173-181.
- Strik, J. J., Honig, A., Lousberg, R., & Denollet, J. (2001). Sensitivity and specificity of observer and self-report questionnaires in major and minor depression following myocardial infarction. *Psychosomatics*, 42, 423-428.
- Sullivan, M., LaCroix, A., Russo, J., Swords, E., Sornson, M., & Katon, W. (1999). Depression in coronary heart disease. What is the appropriate diagnostic threshold? *Psychosomatics*, 40, 286-292.
- Taylor, R. S., Brown, A., Ebrahim, S., Jolliffe, J., Noorani, H., Rees, K. et al. (2004). Exercise-based rehabilitation for patients with coronary heart disease: systematic

review and meta-analysis of randomized controlled trials. *The American journal of medicine*, 116, 682-692.

Thornton, L. A. (2001). Depression in post-acute myocardial infarction patients. *Journal of the American Academy of Nurse Practitioners*, 13, 364-367.

Tiukinhoy, S., Beohar, N., & Hsie, M. (2003). Improvement in heart rate recovery after cardiac rehabilitation. *Journal of cardiopulmonary rehabilitation*, 23, 84-87.

Todaro, J., Shen, B., Niaura, R., & Tilkemeier, P. (2005). Prevalence of Depressive Disorders in Men and Women Enrolled in Cardiac Rehabilitation. *Journal of cardiopulmonary rehabilitation*, 25, 71-75.

Turner, S. C., Bethell, H. J. N., Evans, J. A., Goddard, J. R., & Mullee, M. A. (2002). Patient characteristics and outcomes of cardiac rehabilitation. *Journal of cardiopulmonary rehabilitation*, 22, 253-260.

U.S. Public Health Service (1990). *Report of the Surgeon General on the Health Benefits of Smoking Cessation* United States Department of Health and Human Services.

van Berkel, T. F., van der Vlugt, M. J., & Boersma, H. (2000). Characteristics of smokers and long-term changes in smoking behavior in consecutive patients with myocardial infarction. *Preventive medicine*, 31, 732-741.

van Melle, J. P., De Jonge, P., Spijkerman, T. A., Tijssen, J. G. P., Ormel, J., van Veldhuisen, D. J. et al. (2004). Prognostic association of depression following

myocardial infarction with mortality and cardiovascular events: a meta-analysis.

Psychosomatic medicine, 66, 814-822.

Wang, P., Bohn, R., Knight, E., Glynn, R., Mogun, H., & Avorn, J. (2002).

Noncompliance with antihypertensive medications: the impact of depressive symptoms and psychosocial factors. *Journal of general internal medicine : official journal of the Society for Research and Education in Primary Care Internal Medicine*, 17, 504-511.

Wenger, N. K., Froelicher, E. S., Smith, L. K., Ades, P. A., Berra, K., Blumenthal, J. A.

et al. (1995). Cardiac rehabilitation as secondary prevention. Agency for Health Care Policy and Research and National Heart, Lung, and Blood Institute. *Clinical practice guideline. Quick reference guide for clinicians*, 1-23.

Whitmarsh, A., Koutantji, M., & Sidell, K. (2003). Illness perceptions, mood and coping

in predicting attendance at cardiac rehabilitation. *British journal of health psychology*, 8, 209-221.

Worcester, M. U. C., 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 and rehabilitation : official journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology*, 11, 328-335.

Ziegelstein, R. C., Fauerbach, J. A., Stevens, S. S., Romanelli, J., Richter, D. P., & Bush, D. E. (2000). Patients with depression are less likely to follow recommendations to reduce cardiac risk during recovery from a myocardial infarction. *Archives of Internal Medicine*, 160, 1818-1823.

APPENDIX A

QUESTIONNAIRES

This copy of the Beck Depression Index has
been removed due to potential copyright
issues.

This copy of the Beck Depression Index has
been removed due to potential copyright
issues.

This copy of the Beck Depression Index has
been removed due to potential copyright
issues.

This copy of the Beck Depression Index has
been removed due to potential copyright
issues.