University of Alberta

Determining the Impact of Cardiac Rehabilitation on Activities of Daily Living in Elderly Cardiac Patients

by

Megan Elizabeth Johnston

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Rehabilitation Science

Faculty of Rehabilitation Medicine

Spring 2010
Edmonton, Alberta

Examining Committee

Dr. Robert Haennel, Rehabilitation Medicine

Dr. Patricia Manns, Rehabilitation Medicine

Dr. Wendy Rodgers, Physical Education and Recreation

ABSTRACT

DETERMINING THE IMPACT OF CARDIAC REHABILITATION ON ACTIVITIES OF DAILY LIVING IN ELDERLY CARDIAC PATIENTS

Background and Aims: Little is known about the impact cardiac rehabilitation (CR) exercise programs have on daily functional abilities. The purpose of this study was to determine the impact of CR on elderly patients' ability to perform common household tasks.

Methods and Materials: Twenty-two post myocardial infarction patients (10 female, 12 male; age 75 ± 6.3 years) were studied. Patients were tested prior to entering and again after completion of a CR program (20 combined aerobic + strength training sessions over 8 to 10 weeks; 45 min/day). Physical function was assessed using the Continuous Scale – Physical Function Performance 10 test battery (PFP-10).

Results: Post-CR the global PFP-10 score increased significantly (59 + 14 vs. 52 ± 17; p = 0.003). Prior to CR 7 patients scored above the threshold for independent living, as defined by a global score ≥ 57 units. Post-CR, 12 patients scored above the threshold.

Conclusions: A 20 session exercise-based CR program significantly enhanced the physical function of elderly patients. More importantly, 55% of patients scored above the threshold for independence post-CR, suggesting that CR may enhance elderly patient's ability to live independently.

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Dr. Robert Haennel, who was and will continue to be an excellent mentor. Particularly, I would like to thank him for the opportunity to study chronic disease under his guidance and support. I am thankful for my MSc. committee members, Dr. Patricia Manns and Dr. Wendy Rodgers for their knowledge and advice. Thank you to Cheryl Low, our administrative assistant, for her time and patience with me. Thanks to the Cardiac Rehabilitation staff at the Grey Nuns Hospital. I would also like to thank a special friend of mine, Ms. Lea Carlyle, who I met during the course of my research. Thank you to my grandparents, the Bissells; parents, Grant and Sheila; and to my brother Mark, for their unconditional love and support. Finally, I would like to thank my fiancée, Dr. Dennis Lefebvre. Dennis is someone I am amazed by and continue to look up to on a daily basis. I would not be where I am today without his love, humor and shoulder to lean on.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CR	Cardiac Rehabilitation
ADL	Activities of Daily Living
CAD	Coronary Artery Disease
MI	Myocardial Infarction
VO_{2max}	Maximal Oxygen Uptake
CS-PFP	Continuous Scale – Physical Function Performance test battery
SE	Self-efficacy
EE	Energy Expenditure
PFP-10	Continuous Scale - Physical Functional Performance 10 test battery
PA	Physical Activity
SWA	SenseWear™ Pro Armband
STEPS	Number of steps taken per day
GNH	Grey Nuns Hospital
MOS SF-36	Medical Outcomes Survey Short Form 36-Item

MSES	Multidimensional Self-Efficacy Scale
6MWT	6-Minute Walk Test
CABG	Coronary Artery Bypass Graft surgery
CVD	Cardiovascular Disease
IHD	Ischemic Heart Disease
ECG	Electrocardiograph
AHA	American Heart Association
PTCA	Percutaneous Transluminal Coronary Angioplasty
CHF	Chronic Heart Failure
AACPR	American Association of Cardiovascular and Pulmonary Rehabilitation
FDS	Framingham Disability Study
QOL	Quality of Life
TWC	Total work capacity
LTPA	Leisure Time Physical Activity
IC	Indirect Calorimetry

Pre-CR	Pre-Cardiac Rehabilitation
Post-CR	Post-Cardiac Rehabilitation
GLTEQ	Godin Leisure-Time Exercise Questionnaire
ES	Effect Size
METs	Metabolic Equivalents
1-RM	1-Repetition Maximum
MANOVA	Multiple Analysis of Variance
UBS	Upper Body Strength
UBF	Upper Body Flexibility
LBS	Lower Body Strength
BALCORE	Balance and Coordination
END	Cardiovascular Endurance
PCS	Physical Component Score
MPA	Moderate Physical Activity
LPA	Low Physical Activity

CHAPTER I

INTRODUCTION

1.1 Problem Statement

Exercise-based Cardiac rehabilitation (CR) programs have been shown to improve health outcomes such as exercise capacity and coronary risk factors as well as reduce morbidity and mortality [1-3]. However, little is known about the effects CR programs have on daily physical function (i.e. ability to complete activities of daily living [ADL]) or physical activity patterns of patients over the age of 65 years. Furthermore, the physical consequences of coronary artery disease (CAD) may significantly limit functional independence of persons over the age of 65 years [4]. For example, among disabled elders living at home, 20% indicate heart disease is a major component of their disability [5], thus they are unable to perform ADL without experiencing cardiovascular symptoms. Ades et al. [1] demonstrated that a lack of muscular strength is significantly correlated with low self-reported physical function in older, disabled cardiac persons. They attributed this finding to the fact that most ADL (e.g. carrying groceries, cooking, climbing stairs) are more related to muscular strength rather than aerobic capacity. Therefore, an investigation focused on sub-maximal exercise parameters in elderly cardiac patients, which are most relevant to their ability to carry out ADL, would be appropriate.

Among elderly cardiac patients, the ability to carry out ADL may be a concern as numerous patients are at or near the functional threshold for independence. Many researchers have observed that older cardiac patients commonly limit physical activity due to both personal apprehension and fatigue of cardiovascular physical activities rather than for cardiac-related symptoms [6-8]. Moreover, older cardiac patients may adapt to their sedentary lifestyle. The long-term effect of a sedentary lifestyle, combined with the deconditioning often associated with recovery from a myocardial infarction (MI), may lead into a vicious cycle of inactivity and increasing disability. With a deterioration of functional ability an individual may lose the capacity to perform routine tasks; such as food preparation or climbing flights of stairs. This implies they are at risk for losing their ability to perform ADL and living independently [9, 10].

The most common cause of physical disability in the elderly is chronic disease [11]. The Framingham Disability Study [4] investigated the relationship between CAD manifestations (i.e. angina and heart failure) and physical disability in 2,576 community-dwelling older individuals. Results revealed women to be more disabled than men and that elderly women (over 70 years) with CAD (i.e. those with angina or heart failure) were found to be the most disabled.

The level of disability is most often assessed by self-report combined with performance on a graded exercise tolerance test [6, 7]. Although the relationship between disability and traditional markers of exercise capacity (e.g. maximum oxygen uptake [VO_2max]) has been studied extensively [2, 12], researchers have found a poor correlation between exercise capacity measured on the treadmill and performance of practical ADL [1, 2]. Furthermore, as described by Applegate et al. [7], self-reported assessment instruments are often insensitive to subtle but potentially important clinical changes and only measure the patient's subjective assessment of function rather than actual performance. Cardiac patients are more likely to limit their actual exercise performance due to fatigue and the fear of experiencing exercise-derived coronary symptoms than to the occurrence of cardiovascular symptoms [6, 8].

Cress et al. [13] developed a tool to overcome the limitations of self-reported measures of daily functional abilities by quantifying disability with direct measures of physical performance. The Continuous Scale – Physical Function Performance (CS-PFP) test battery is based on a series of ordinary ADL, with the patient self-selecting the speed and intensity of each task. The concept of serial task presentation provides greater insight into physical function than short, discontinuous tests. This is due to the serial task sequence which mimics normal conditions [13]. To function comfortably in daily life, an individual must be able to complete many tasks in a row, for example getting dressed, shopping, cooking and cleaning, and still have energy and time left over for leisure activities. Thus, using the CS-PFP test battery, Cress et al. [9] were able to quantify disability and identify the threshold for independence to be a global CS-PFP score of > 57 units. Individuals scoring above 57 are able to function on their own. Those individuals scoring near or below the threshold are at risk, or unable to function independently and thus may have to rely on assistance.

Multiple environmental, personal and program factors potentially influence daily functional abilities and exercise behaviour [14]. Self-efficacy (SE) is one psychosocial variable that has implications for exercise adherence. That is, greater SE is associated with higher levels of exercise adherence in both healthy and cardiac populations [15]. Some studies suggest male cardiac patients who attend CR programs have higher exercise SE at program entry as compared to women [16, 17)]. There is little literature addressing the effect CR has on exercise SE of cardiac patients over 65 years, therefore an additional goal of this study was to address this issue.

It is clear there still remains much to understand regarding the effect CR has on daily functional abilities and physical activity patterns of elderly patients. Older cardiac patients have high rates of physical function impairment and disability, thus giving rise to the possibility of dependence [18]. Traditional methods used to assess aerobic capacity and self-reported physical function scores have been shown to improve with exercise-based CR in patients over 65 years [18]. However, these methods are poorly correlated to the patient's ability to successfully perform routine tasks in their home environment [18]. The effect of exercise training on objective measures of daily physical function and subsequent physical activity in patients over 65 years has not been studied extensively [19]. Therefore, the purpose of this study was to determine the influence a CR program had on the daily functional abilities, subsequent physical activity and exercise SE of CR patients over the age of 65 years.

1.2 Significance

Clinical findings of CAD are present in > 25% of persons 65 years and older and are associated with severe limitations in functional independence in 70% of men and 45% of women [12]. Of community dwelling disabled elders, 20% report heart disease to be a major contributor to their disability [5]. Furthermore, unrecognized physical impairments and disabilities may lead to the loss of independence, an escalated use of support services and even mortality [10, 20].

Interventions, such as exercise-based CR programs, play an important role in the minimization of disability and improving function of cardiac patients [12, 18, 19]. In older cardiac patients a primary goal of CR is minimize disability thus extending independence [18]. Since older cardiac patients are significantly less fit than their younger counterparts, many are unable to perform ADL without experiencing dyspnea, angina or fatigue [12].

From a rehabilitation standpoint, improvement in physical function as a consequence of CR may not only enhance independence but lessen the societal burden of disability due to CAD in cardiac patients over 65 years.

1.3 Definition of Terms

Physical Function refers to the ability of an individual to perform routine, physical tasks essential to ADL without the considerable risk of injury [18{Brach, 2002 #4001, 20, 21].

Disability (e.g. falling, difficulty walking) or trouble carrying out socially defined tasks and impairment (e.g. limited range of motion, decreased muscular strength), either occurring individually or combined may contribute to a decline in the health and functional abilities of elderly persons [9, 18, 20].

Physical performance testing refers to the assessment of an individual's ability to complete ADL and is a useful indicator of one's functional performance or level of independence.

Physical Activity is defined as any skeletal muscle movement that causes an increase in energy expenditure (EE) above a resting basal metabolic rate, which includes a wide variety of lifestyle and occupational activities [22].

Exercise is defined as physical activity performed in a systematically dosed manner with the intention of improving health-related outcomes, such as cardiovascular fitness, muscular fitness, body composition, depression, anxiety, cognition and fatigue [23].

Physical fitness refers to a physiological state of well-being that allows one to meet the demands of daily living [24]. Physical fitness and physical activity are used interchangeably and are related in terms of their impact on morbidity and mortality, however, physical fitness is a better predictor of health outcomes [24].

Cardiac Rehabilitation as quoted by Ades in *Cardiovascular Disease in the Elderly,* "CR services are comprehensive, long-term programs involving medical evaluation, prescribed exercise, cardiac risk factors modification, education and counseling. These programs are designed to limit the physiologic and psychological effects of cardiac illness, reduce the risk for sudden death or reinfarction, control cardiac symptoms, stabilize or reverse the atherosclerotic process, and enhance the psychological and vocational status of patients with coronary heart disease" [19] (page 319). The goals of CR in elderly cardiac patients include decreasing disability, improving health-related quality of life (QOL), and to extend disability-free survival. [19]

Self-efficacy is defined by Albert Bandura as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has, but with judgments of what one can do with whatever skills one possesses" [19] (page 391). Self-efficacy can be distinguished from outcome expectancies, which concern the outcome of the act, rather than the performance of the act itself.

1.4 Objectives

Exercise-based CR programs are recognized to be an essential component to the secondary prevention of heart disease in elderly cardiac patients [25, 26]. These programs have been shown to increase exercise capacity and health-related QOL in middle-aged and older cardiac patients [2, 12]. However, additional studies are needed to assess objective measures of physical function and the effect CR has on performance of ADL in older cardiac patients. Therefore, the primary objective of this study was to determine the influence a 20 session CR program had on the physical function (i.e. ability to perform ADL) of cardiac patients over the age of 65 years. Physical function was measured using the Continuous Scale - Physical Functional Performance 10 (PFP-10) global score.

In addition, this study investigated the effect an exercise-based CR program had on physical activity (PA) patterns as determined by average daily energy expenditure (EE) obtained using the SenseWear™ Pro Armband (SWA) (Body Media, Pittsburgh, PA). Other variables from the armband included time spent in low and moderate PA as well as the average number of steps taken per day (STEPS). Finally, the effect CR had on exercise SE will be studied.

1.5 Hypothesis

Our hypothesis was that elderly post-MI patients who completed the Grey Nuns Hospital (GNH) CR program would demonstrate the following changes:

1. Improvements in physical functional performance using standardized criteria developed for older individuals (Continuous Scale - Physical Functional Performance 10 [PFP-10] global score).
2. An increase self-reported physical function as measured by the physical function domain score from the Medical Outcomes Survey Short Form 36-Item (MOS SF-36) questionnaire.
3. Increases in daily average EE, time spent in low and moderate PA and number of steps as measured by the SWA.
4. Improvements in exercise SE and domains (i.e. task, coping and scheduling SE) as measured by the Multidimensional Self-Efficacy Scale (MSES).

In addition, we expected there to be a:

5. Linear relationship between the power (i.e. PFP-10 grocery carry task) and standardized criteria used to asses functional exercise capacity of elderly persons (6 minute walk test [6MWT]).

1.6 Limitations

Although this study lacked a non-exercising control group, Miller et al. [27] demonstrated that improvements in functional capacity following cardiac events are significantly greater with a supervised exercise program than a spontaneous recovery alone. Thus, this study focused attention on the importance of CR and the effectiveness of a program, rather than the comparison between exercising and non-exercising groups.

1.7 Delimitations

This study was narrowed by the high exclusion rate, which resulted by the selection of only patients who recently suffered a MI, thus excluding angina, coronary artery bypass graft surgery (CABG) and surgical intervention patients. The restrictive eligibility criteria limited the generalizability of the study; however, the exclusion criteria may have helped to avoid any exercise-induced cardiac events and thus lowered the subject drop-out rate.

Additionally, this study only assessed the immediate impact of CR exercise programs. One of the greatest challenges with CR is the sustainability of lifestyle changes and under ideal circumstances we would have liked to include assessments at 3 and 6 months post-CR. This was omitted due to time constraints; however, this study has the potential to be carried out by a future graduate student. A positive outcome would indicate older patients do benefit from exercise-based CR program and are able to live independently.

CHAPTER II

LITERATURE REVIEW

2.1 Cardiovascular Disease

The clinical spectrum of cardiovascular disease (CVD) ranges from (1) ischemic heart disease (i.e. CAD); (2) hypertensive heart disease and pulmonary hypertensive heart disease; (3) valve disease (i.e. aortic valve stenosis, mitral valve prolapse, infective endocarditis, and rheumatic heart disease); and (4) congenital heart disease [28, 29]. Although the CVD mortality rate in Canada has been declining for four decades [30], it remains the leading cause of death among Canadians. In 2004, CVD was responsible for 32% of all deaths in Canada; of these deaths 25% were due to MI [30]. Not only does CVD result in significant morbidity and disability, it remains the leading cause of health care expenditure [31].

2.1.1 Coronary Artery Disease

Ischemic heart disease (IHD) is the term used to encompass a group of related diseases resulting from ischemia – an imbalance between the blood supply and demand of the heart for oxygenated blood [28, 29]. Because coronary artery narrowing owing to arthrosclerosis underlies myocardial ischemia, IHD is often referred to as CAD [29].

In a healthy individual at rest, oxygen in the blood is maximally extracted by the heart and an increase in myocardial oxygen demand must therefore be met by a proportional increase in myocardial blood flow. This autoregulartory response is the result of an intact, functioning endothelium, which results in coronary vasodilation in response to increased demands. Arthrosclerosis alters the functioning of the endothelium and may impair the ability of the blood vessel to dilate, as seen in some patients with CAD. In patients with CAD at rest, the narrowed coronary artery may be at or near maximal dilation, due to the poorly functioning endothelium. During periods of increased demand (e.g. increased heart rate) the narrowed artery will have limited ability to further dilate, resulting in a supply-demand mismatch and consequently ischemia [28, 29]. During ischemia, the first apparent abnormality of cardiac function is impaired myocardial relaxation (i.e. diastolic dysfunction) followed by impaired myocardial contraction (i.e. systolic dysfunction). Chest pain, or angina and ischemic electrocardiographic (ECG) changes occur relatively late in the ischemic response. Prolonged ischemia causes the cardiac myocytes to die, thus resulting in a MI. The extent of myocardial injury after occlusion of blood flow to a given region in the myocardium depends on the duration of the occlusion and the presence or absence of collateral vessels. Thus, the longer the myocardium is without oxygenated blood, the larger the area of necrosis. As little as 15 to 20 minutes after myocardial occlusion, infarction occurs which is demonstrated by the presence of necrotic myocardial tissue [29].

2.1.2 CAD Risk Factors

Previous research has identified several modifiable factors that increase the risk of CAD in people of European decent [4, 32]. However, until recently, the extent to which these risk factors differed across geographic regions and between various ethnic groups was unknown. In 2004, Yusuf et al. [33] conducted one of the largest international research studies, INTERHEART, which looked at risk factors for heart disease across various ethnicities and geographic regions. Their research led to the identification of nine common risk factors consistent across gender, various ethnicities and geographic locations; (1) smoking; (2) hypertension; (3) physical inactivity; (4) abnormal ratio of blood lipids; (5) diabetes (6) abdominal obesity; (7) stress (8,9) lack of daily consumption of fruits and vegetables. Furthermore, Yusuf et al. demonstrated smoking, hypertension and physical inactivity contributed to 90% of all initial MI, irregardless of age, gender, ethnicity or geographic location.

2.1.3 CAD Prevention

The overall objective of CAD prevention is to reduce the risk of CAD, or other atherosclerotic disease thereby reducing premature disability, morbidity and mortality [32, 34]. The American Heart Association (AHA) used data from the Framingham Heart Study to provide new insights on primary and secondary prevention of CAD and prepared charts for estimating CAD risk, which are consistent to the European Joint Task Force [32, 34]. Both task forces agree public health strategies aimed at prevention of CAD should include the reduction of tobacco use, encouragement of healthy food choices and the increase of physical activity for all age groups [32, 34].

In particular, primary prevention strategies should be focused not only on lifestyle changes but also on the medical management of blood pressure, blood lipids and diabetes [32, 34]. Secondary prevention methods should be aimed at lifestyle choices, specifically; cessation of tobacco smoking, weight control via appropriate dietary changes and participation in daily physical activity. Current guidelines suggest individuals should strive to expend a minimum of 1500 kcal/week in leisure time physical activity. This level of physical activity is associated with the lowest risk of CAD [35]. This level of EE can be accomplished by performing 30 minutes of moderate aerobic exercise (e.g. brisk walking, swimming, cycling) on most days of the week [32, 35].

The inverse relationship between physical activity and the reduction of CAD in middle-age persons has been thoroughly investigated [35-37]. Donahue et al. [37] conducted the Honolulu Heart Study; a 12 year follow-up investigating levels of physical activity and prevalence of cardiovascular events in middle-aged and elderly men. Results indicated that the most physically active middle-aged men showed the least amount of CAD. Furthermore, this report provided evidence to suggest increased physical activity is also associated with reduced heart disease in elderly men.

In a follow-up to the Honolulu Heart Study, Hakim et al. [36] investigated the health benefits of walking and prevention of CAD in middle-aged and elderly men. Results from this study confirmed previous reports [4, 32, 33] which indicated that physical activity is inversely related to CAD. Moreover, Hakim et al. suggested men who walked >1.5 mile/day were at half the risk for developing CAD as men who walked less than <0.25 mile/day. These results were similar to the findings of the Harvard Alumni Study [35] which showed that in men aged 35 to 74 years, walking led to a 20% lower risk of CAD as distance walked increased from 0.5 mile to ≥ 1.3 mile/day. Of interest was the finding that men over the age of 60 who expended $\geq$ 4,200 kJ/week had smaller increases in risk of CAD in the presence of other risk factors.

These findings suggest that encouraging elderly persons to become more active could have important health benefits. Moreover, walking is a simple form of physical activity that can be easily adopted by elderly individuals. However, there is a lack of literature pertaining to the impact leisure time physical activity has on the ability to perform ADL in the elderly population.

2.2 Cardiac Rehabilitation

Programs were first developed in the 1960's when the benefits of ambulation during extended hospitalization for coronary events were acknowledged [38]. Once leaving the hospital, patients were encouraged to continue exercise-based therapy in the home environment. However, issues pertaining to safety of unsupervised exercise immediately after discharge lead to the development of formal, physician supervised exercise-focused CR programs. By the 1980's CR had become a regular part of the outpatient therapy [38].

In 1994, the AHA stated CR programs should not only include exercise-based training but also include multifaceted strategies aimed at reducing modifiable CVD risk factors [21]. Leon et al. [25](page 369) define CR as "coordinated, multifaceted interventions designed to optimize a cardiac patient's physical, psychological, and social functioning, in addition to stabilizing, slowing, or even reversing the progression of the underlying atherosclerotic process, thereby reducing morbidity and mortality." Thus, exercise-based CR programs provide a valuable and efficient setting in which to deliver beneficial preventative care [19, 25, 26]. Since then detailed guidelines regarding CR programs have been published that outline each core component [39]. Cardiac rehabilitation now routinely includes baseline patient testing, nutritional advice, risk factor management (i.e. hyperlipidemia, hypertension, obesity, diabetes and smoking), pharmacology, psychosocial counseling, physical activity counseling and exercise-based training [25].

Candidates for CR traditionally included patients who had recently had a MI or undergone CABG, but more recently CR has been extended to include those who have undergone percutaneous transluminal coronary angioplasty (PTCA); have chronic heart failure (CHF) and heart transplant candidates or recipients [25]. Many older patients are well suited for and would gain health benefits from CR programs. Unfortunately many of these patients do not participate in CR due to lack of physician referral, transportation issues, marital status or other societal burdens [19, 26, 39].

2.2.1 Exercise-Based CR: Safety Considerations

The safety of medically supervised exercise-based CR programs is well established [40-43]. The results from a 9 year follow-up survey of a single-centre CR program suggest there is a low frequency of cardiovascular complications during exercise-based rehabilitation [40]. Four major complications (3 cardiac arrests and 1 MI) resulted in a frequency of 1 major complication per 67,126 patient exercise hours. Franklin et al. [41] followed the incidence of cardiovascular complications in a single-centre CR program over 16 years. His group found 5 major complications (2 cardiac arrests and 3 MI), resulting in a frequency of 1 major complication per 58,451 patient exercise hours. These results are consistent with previous research by Haskell in 1978 [42] and Van Camp in 1986 [43] where frequency of cardiovascular complications where found to be 1 per 26,715 patient hours of exercise and 1 per 81,101, respectively. The inclusion of CHF patients, older individuals and heart transplant recipients has not lead to an increase in the frequency of adverse effects [41].

2.2.2 Exercise-Based CR: Exercise Prescription

Prescribed exercise for patients with CAD has progressed from standardized programs for all cardiac patients to individualized programs based on the clinical evaluation as well as goals and resources [39, 44]. Historically, walking and cycle ergometry were the preferred modalities with exercise intensity set at 65 to 85% of the maximal measured heart rate 2 to 4 times a week for 30 to 45 minutes per session [39].

Exercise guidelines set out by the AHA and the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) in 2000 recommend cardiac patients perform aerobic exercise via various modalities (i.e. walking, treadmill, cycling, rowing, stair climbing and arm ergometry) three to five times a week at an intensity of 50 to 80% heart rate reserve for 30 to 60 minutes per session [44]. These guidelines are concurrent with guidelines recently updated in the last three years [45].

In the past, CR programs have focused on aerobic lower-body exercise; however current research suggests resistance training, in addition to aerobic training, has a favorable effect on health and coronary risk factors of heart patients [44, 46, 47]. Furthermore, resistance training improves overall muscular strength and endurance and can decrease myocardial demands during ADL (e.g. carrying groceries, lifting heavy objects) [45-48]. Moreover, the increase in muscular strength is likely to promote independence, self-esteem and prevent falls, particularly in older cardiac patients [9, 46, 47].

Resistance exercise guidelines advocated by the AHA / AACVPR state resistance exercise can be done using various means (i.e. elastic bands, cuff/hand weights, dumbbells, free weights, wall pulleys or weight machines) two to three times per week. Intensity is set at 30 – 40% of the 1-repetition maximum (1-RM) for the upper body and 40 – 50 % 1-RM for the lower body exercises (where RM is the “maximal weight that the subject can lift for 1 exercise” [45] with 12 – 15 repetitions in one set repeated for one to three sets of 6 to 10 different upper- and lower-body exercises with a total time for the session not more than 20 to 30 minutes [44, 45].

2.2.3 Exercise-Based CR: Referral and Adherence

Despite the well-known efficacy of CR, previous studies suggest less than 30% of all eligible patients attend CR and even fewer patients complete this program [49, 50]. Ades et al. [49] investigated the outpatient CR participation in 226 older coronary patients (ages $\geq$ 62 years) and found the participation rate to be 21%. Blackburn et al. [50] carried out a retrospective review of CR participation in 3,331 coronary patients from a large tertiary heart centre and found 11% of eligible patients participated in CR. Explanations for the poor participation rate are not well established [19, 51], however, some literature suggests health-care system related factors (e.g. previous admission to CR, admission to hospital having a CR program, lack of awareness of CR programs by the physician) contribute to low referral rates [51, 52]. Heath-service and personal factors, such as longer transportation time to CR facilities, denial of illness, and history of more serious co-morbidities (e.g. dyslipidemia, smoking) are also associated with lower participation rates [18, 50, 53]. Grace et al. [53] conducted a retrospective mail-out survey and chart review of cardiac patients attending a tertiary care centre to determine the factors associated with CR enrollment. Of the 272 subjects, 199 (73%) attended a CR assessment. Reasons for the high attendance rate of heart patients included a lower denial of illness, fewer cost / transportation barriers to CR and a high self-perceived health status. Ratchford et al. [54] evaluated the attendance and adherence patterns of 1,030 coronary patients to a home-based CR program. The overall participation rate in this study was 41% and nearly three quarters (74%) of patients adhered to the program. Factors positively associated with CR participation were diagnosis of two or more coronary events (i.e. stronger motivation to finish the program), absence of co-morbid conditions (e.g. dyslipidemia, smoking) and strong physician recommendation. Additionally, these findings suggested attendance and compliance were similar for men and women. Conversely, some researcher [51, 52, 55] found older patients were less likely to participate in CR programs.

Older patients, particularly those over the age of 75 years are less likely to be referred to CR [18, 49, 51, 52, 55]. In the elderly, the most powerful predicator of CR participation is the strength of the physician's recommendation for participation [19, 49]. Furthermore, older women are the least likely to be referred to a CR program by their physician [19, 51-53, 55. Cottin et al. {Cottin, 2004 #4021] carried out PREVENIR, the French nationwide, multi-centred survey, where data on 1,394 cardiac subjects was collected from medical records at baseline and at six months follow-up. Of the 1,394 patients, only 310 (22%) participated in CR. Significant differences in patient characteristics were found between CR and non-CR groups. The CR participants were younger and predominantly male. Grace et al. [53] also found CR participation rates to be lowest amongst older patients, specifically older women. They explored the reasons for gender differences and attributed them to factors which are more common to females, such as; risk for mild depression, self-esteem problems and lower incomes [53].

2.3 Disability in Older Coronary Patients

Elderly patients with CAD have higher rates of disability, recurrent coronary events and increased use of health-care resources [1, 11, 19]. The probability of developing physical disability increases in older cardiac patients who suffer from multiple diseases. As the number of diseases increase, there is an increased risk of difficulty with mobility and carrying out ADL [11]. For community-dwelling older cardiac patients, disability rates in older women are particularly high [1, 4]. With the aging population more cases of CVD and disability will be seen [30]. Thus, there is an urgent need to develop strategies to reduce the societal burden due to CAD in the elderly population. Exercise-based CR, intended to decrease disability in older heart patients, will hold an increasingly important role as the size of the elderly population continues to grow.

2.3.1 Physical Function in Older Coronary Patients: Pre Exercise-based Training

Angina and exertional dyspnea are the fundamental symptoms of CAD [4, 39]. In the presence of atherosclerosis of the coronary arteries, exercised-induced increases in blood flow are limited by atherosclerotic plaques (i.e. atheromata) eventually leading to a narrowing of the coronary lumen and dysfunctional endothelium responses, causing vasoconstriction on exertion [28, 29]. Left ventricle dysfunction leads to exertional dyspnea, thus limiting the capacity for exercise [1, 39]. Moreover, patients who have suffered a MI tend to limit their physical activities due to fear associated with cardiovascular symptoms and unfavorable consequences, leading to a cycle of inactivity and deconditioning [1, 39].

Among older cardiac patients, higher rates of self-reported physical disability, defined by a reduced capacity to perform ADL, are found as compared to persons without CAD [1]. This finding is consistent with the results from the Framingham Disability Study (FDS) [4]. The FDS investigated the relationship between CAD and disability in 2,576 community-dwelling older men and women (ages 55-88 years), with and without CAD. Original data was collected from 5,209 individuals residing in Framingham, Massachusetts from 1948 – 1951. Information pertaining to potential CAD risk factors and disease manifestations were obtained every 2 years via phone interview, physical examinations and laboratory tests over 31 years.

The goal of the FDS was to draw quantitative conclusions regarding levels of physical and social disability based on patients self-reports. The measures of disability were primarily centred on three questions: “Are you able to walk up and down stairs to the second floor without help?” “Are you able to walk half a mile without help? That’s about 8 ordinary blocks” and “Are you able to do heavy work around the house, like shoveling snow or washing windows, walls, or floors without help?” [4](page 1364). The scale ranged from 0 to 3, indicating the number of activities the subject could not do without help (e.g. the higher the score, the higher the disability); a score of 0 reflected no disability.

In 1976 - 1978, surviving FDS subjects were interviewed and asked to report their current level of functioning [56]. Consistent with the literature of that period, results indicated a steady increase in physical disability occurs with advancing age; however, the magnitude of the risk was not as large as conventional theories suggested. After 31 years, subject-reported physical disability was again followed-up. Results indicated that a greater percentage of women reported disability then men and the presence of CAD was a major predictor of disability in both men and women [4]. In the 70 to 88 year age group, 49% of men and 79% of women with CAD were disabled compared with 27% of men and 49% of women without CAD. Furthermore, among cardiac patients, angina was found to be a better predictor of disability in each age group and gender versus other CAD risk factors. In angina patients over the age of 70 years, disability was reported in 84% of women and 56% of men [4]. Complicated angina (defined by Pinsky et al. as “angina accompanied by coronary insufficiency, myocardial infarction, or both" [4] [page 1364]) was a stronger predictor of disability than uncomplicated angina, possibly due to myocardial complications of MI [4].

The Framingham results are in agreement with other studies on this topic. Chirikos and Nickel [57] investigated 976 men and women hospitalized for either MI or unstable angina. Analysis demonstrated the presence of CAD, in particular angina, was predictive of disability at 6, 18, and 24 months of follow-up. The Medical Outcomes Study [58], a survey of 9,385 older individuals, looked at the impact of various chronic diseases on self-reported physical function and well-being. Findings determined CAD had the greatest overall impact on physical function when compared to other diseases.

As stated above, older female coronary patients are found to have higher disability rates then older male patients [1, 4, 18]. Ades et al. [1] studied the determinants of disability in 51 community-dwelling older cardiac individuals (ages $\geq$ 65 years). The Medical Outcomes Study Short Form (MOS-SF) physical function section was used to measure the primary outcome variable; subject's self-reported physical function score (scale 0 to 100; 100 = no disability). Secondary variables included ejection fraction, peak aerobic capacity, maximum muscular strength, depression scores and body composition. The mean physical function score was found to be 74 (S.D. $\pm$ 21), further, women had lower self-reported physical function scores than male patients, (64 $\pm$ 22 versus 78 $\pm$ 20). The difference between men and women was not attributed to age, depression scores, ejection fraction or co-morbidities. Ades et al. concluded the differences were related to the combined effect of lower measures of peak aerobic capacity, aerobic endurance and muscular strength.

In summary, the presence of CAD is a strong predictor of disability in the elderly. Disability rates are highest among women, the very old aged and in the accompaniment of angina.

2.3.2 Physical Function in Older Coronary Patients: Post Exercise-based Training

The goals of exercise-based CR in older patients are to decrease disability, extend disability-free survival and maintain independent living [25]. For the elderly, exercise-based programs need to take into account co-morbidities (e.g. arthritis, diabetes, osteoporosis), which can alter modalities and exercise intensities. Thus, one focus of exercise-based CR programs is to enhance physical function and quality of life (QOL) that may aid in the ability of elderly patients to live independently. Since most ADL (e.g. carrying groceries, walking up stairs, doing laundry) rely more on muscular strength than aerobic capacity, CR programs may want to focus on improving aerobic capacities via resistance training. Furthermore, the performance of ADL is done at sub-maximal levels of exertion, thus the capability of elderly heart patients to carry out such tasks without experiencing cardiovascular symptoms is related to improvements in muscular strength and muscular endurance [25].

Physical performance testing objectively measures the patient’s ability to perform ADL in a laboratory setting. However, few studies have used physical performance testing to assess physical function and disability in elderly cardiac patients [8, 48]. Brochu et al. [8] investigated whether disabled, older cardiac women could perform resistance training at intensity sufficient to improve self-reported and measured physical function. Compared to the age and disability-matched controls, the resistance-training groups showed significant overall improvements in strength, balance, coordination, endurance and overall physical function as measured by the CS-PFP test. This study clearly highlights the fact that disabled, older cardiac women are able to perform resistance training at intensity sufficient to improve muscular strength and that this results in improved measured performance of ADL.

Ades et al. [48] carried out a similar study looking at the effect a 6 month resistance training program had on older cardiac women. Their randomized controlled study included 42 women with CAD, age $\geq$ 65 years compared to an age and physical function-matched control group. Subjects were randomized into either the resistance-training intervention for 6 months, meeting 3 times / week to perform 2 sets of 10 repetitions of 8 resistance exercises, or the control group, meeting 3 times / week to perform light yoga and breathing exercises. Results showed strength training improved the performance of household activities simulated in the laboratory. The time it took to perform activities such as climbing a set of stairs, bed making and carrying groceries improved after the resistance training intervention. Resistance training was also found to improve endurance activities such as the 6MWT and stair climbing, as well as activities that involved flexibility (i.e. putting on a jacket, floor sweeping, laundry unloading / loading and vacuuming). Thus, it was concluded that participation in an intense resistance training program improved the performance of a wide range of household tasks by elderly cardiac women.

Although the effect of exercise-based CR on treadmill-derived measures of exercise capacity are poorly correlated to the physical functioning of elderly cardiac patients in the home setting [1, 2], there is extensive literature demonstrating exercise-based CR improves exercise capacity in the elderly [2, 3, 12, 59, 60]. In a study of 45 CR out-patients, baseline and follow-up aerobic capacity was compared between “younger old” (< 70 years) and “older old” (≥ 70 years) patients [12]. Maximal aerobic capacity was determined by a symptom-limited treadmill test using the Balke protocol at baseline and 12 weeks follow-up. At baseline, VO_{2max} was 19.4 ± 5 mL/kg/min, after 12 weeks of CR it had increased 16% to 22.8 ± 8 mL/kg/min. Furthermore, the duration of maximal treadmill exercise increased 54% from 9 ± 4 min to 14 ± 4 min at 3 months follow-up.

In a study by Lavie et al. [59], a comparison was made between 54 patients ≥ 75 years and 229 younger patients (≤ 60 years) who completed an out-patient CR program. At baseline and within 1 week of completing the 12 week CR program, exercise capacity (i.e. estimated METs), was assessed. Although the results of this study showed that exercise tolerance was lower at baseline in the elderly than younger patients (4.4 ± 1.6 versus 7.6 ± 3.1 METs, respectively), the benefits of exercise-based CR were similar, with a 39% increase in exercise tolerance in the elderly compared with 31% increase in the younger patients (6.2 ± 2.6 METs versus 10.0 ± 3.8 METs, respectively). Lavie et al. were one of the first groups to demonstrate the benefits of exercise-based CR programs in elderly patients. These finding suggest that elderly patients should be referred to and encouraged to participate in exercise-based CR programs.

Finally, in 2003, Marchionni et al [3] published the results from the Cardiac Rehabilitation in advanced Age (CR-AGE) randomized controlled trial, which investigated the efficacy of CR across three age groups: middle-aged coronary patients (46 – 65 years), older (66 – 75 years) and very old (> 75 years) patients. Within each age group, subjects were randomized into 2 month hospital-based CR, 2 month home-based CR or no CR. Subjects were recruited until each group included 30 age- and gender-matched participants. Total work capacity (TWC) was measured using cycle ergometry at baseline, after CR, and 6 and 12 months later. Results showed that compared with no CR, exercise-based CR improved exercise tolerance in all age categories, including the very old, even in patients as old as 86 years. Immediately after CR, subjects in all three categories increased TWC compared to the control group. Perhaps what is the most important finding from this study was that at 12 months post CR, patients in the very old age category retained their improved TWC if they had been randomized to the home-based exercise group but not the hospital-based group or to the control. This suggests patients in the home-based CR group may have learned skills to help them maintain a long-term home-based exercise program compared to patients whose first two months of CR were done in the hospital.

2.4 Assessment of Physical Performance

Assessment of physical performance has recently shifted from self-reported questionnaires to objective, performance-based assessment of specific tasks [61, 62]. Many researchers and clinicians find objective physical performance measures helpful due to the potential to identify the site and severity of functional disability, sensitivity to change and validity of the test [61, 62]. Specifically in exercise studies, it is often difficult to show that increasing strength and endurance affects function in older adults [61]. Hence, does the exercise have an effect on the physical functioning in older adults or are the traditional assessment tools sensitive enough to detect differences? Furthermore, many studies looking at disability in cardiac patients have used self-reported questionnaires to measure physical function [2, 4, 57], and have been found to be easy to administer and reliable [6, 7]. However, self-reported assessment instruments are often unable to detect small, but very important clinical changes and only measure the patient's subjective assessment of function rather than the actual performance [7]. Moreover, CAD patients have been described as more likely to curtail their ADL and physical activity due to apprehension regarding safety [7] rather than because of the incidence of symptoms associated with CAD (e.g. dyspnea). Thus, they may under-report their physical capacity.

2.4.1 Assessment of Physical Function

Currently there is no "gold standard" used to measure physical function, however several instruments can be used in conjunction to measure various capacities. For example, cardiovascular fitness can be determined using an ergometer and a metabolic cart to measure VO_{2max}. Maximal muscular strength can be measured in the laboratory using an isokinetic dynamometer, such as the Kin/Com. The force generated by the quadriceps muscles during the isokinetic contractions on the Kin/Com is important to functional ability in stair climbing and rising from a chair [62]. Finally, neurological function is assessed in a controlled environment using step reaction time and balance time.

Cress and colleagues [62] developed a unique, reliable and valid tool to assess physical function performance known as the Continuous Scale – Physical Function Performance (CS-PFP) test battery. The CS-PFP test battery is an instrument based on ADL, tested at sub-maximal effort, with the patient self-selecting the speed and intensity of each task. Sixteen everyday tasks were chosen to represent daily activities essential to independence, the tasks are ordered from easiest (personal) to moderate (household) to most difficult (mobility). The concept of serial task presentation provides greater insight into physical function than short, discontinuous tests due to the serial task sequence which mimics normal conditions [61]. To function comfortably in daily life, an individual must be able to complete many tasks in a row, for example getting dressed, shopping, cooking and cleaning and still have energy and time left over for leisure activities.

Although the CS-PFP presents many appealing features for measuring physical function across a wide range of functional abilities [62], researchers found the duration of the test and applicability in the community setting to be limitations. In order to enhance the applicability of the test, Cress and colleagues developed a shorter version of the CS-PFP known as the Physical Functional Performance 10 Test (PFP-10) [63]. The PFP-10 consists of 10 of the original 16 tasks and requires less time and space, therefore it can easily be implemented in the community setting. Furthermore, as compared to the CS-PFP the PFP-10 was found to be valid, reliable and retained the serial testing of function, an important indicator of functional capacity [63].

Performance on each of the tasks is scored 0 to 100 and used to calculate a total score and five domain scores; upper body strength, upper body flexibility, lower body strength, balance and coordination and endurance. Using the CS-PFP and PFP-10 test batteries, Cress et al. were able to identify threshold values which correspond to independence. The total PFP-10 score of 57 corresponds to a physical performance threshold [10, 61, 62]. Those individuals scoring above the threshold are classified as high functioning, where those scoring around or below the threshold value are classified as low functioning and have a higher probability of becoming dependent [10, 62]. These results hold important implications for the determination of preclinical disability which is associated with an increased risk of dependency. Early detection of these individuals can allow for immediate interventions in order to remain independent.

2.4.2 Assessment of Objective Physical Activity

One of the difficulties physical activity researchers and clinicians face is the ability to accurately quantify EE during leisure time physical activity (LTPA) in community-dwelling individuals [64, 65]. Examples of devices and techniques include pedometers and physical activity recall questionnaires. Both methods have strengths as well as limitations concerning accuracy, portability, reliability and validity [64-66]. For example, physical activity records and questionnaires offer a convenient, inexpensive estimate of physical activity or EE. However, over- or under-estimation of activity is typically significant (mean range from 8 to 62%) [67, 68] and assessment of individual physical activity is often poor [68]. The most accurate and commonly used "gold standard" in the exercise laboratory is indirect calorimetry (i.e. metabolic cart) and doubly labeled water to determine EE during; bouts of exercise and over time, respectively [64-66]. Both techniques are expensive, require trained technicians and specialized equipment, therefore the problem of having an inexpensive and practical device still remains.

A new device, the SenseWear™ Pro Armband (SWA) was developed to assess ambulatory physical activity. The device is worn on the right upper arm over the triceps muscle and monitors various physiological and movement variables. Data from a variety of sensors provide information on a number of parameters including heat flux, accelerometer, galvanic skin response, skin temperature, near-body temperature. These data when combined with demographic characteristics such as; gender, height, weight, handiness and smoking status are used to estimate EE using algorithms provided by the manufacturer [64, 65, 69]. These sensors continuously gather data which is used to estimate caloric expenditure, duration of physical activity, and number of steps taken. What separates the SWA from other portable EE devices is the inclusion of the heat flux sensor [64]. Heat production and heat loss are by-products of metabolism and EE, and therefore the inclusive of this parameter has the potential to improve the estimation of EE when coupled with other parameters such as accelerometry. Furthermore, the portability of the SWA makes it an ideal device to monitor EE and exercise adherence for both clinical and healthy populations [65].

In order to assess the accuracy of the SWA to measure EE during exercise, Jakicic et al. [64] compared EE estimates from the SWA to indirect calorimetry (IC). Forty healthy individuals performed four exercises (i.e. walking, cycling, stepping and arm ergometry) with each exercise lasting 20 – 30 minutes and workload increasing every 10 minutes while wearing the SWA. Energy expenditure (determined from the SWA using exercise-specific algorithms) was then compared to EE determined from indirect calorimetry. Study results demonstrated there was no significant difference in total EE estimated using the SWA and total EE estimated determined by IC during any of the modes of exercise. Thus, when exercise-specific algorithms are used, the SWA provides an accurate estimate of EE when compared to indirect calorimetry during exercise.

Fruin et al. [66] examined the reliability and validity of the SWA during rest and exercise as compared with indirect calorimetry. Energy expenditure was assessed with SWA and indirect calorimetry in 13 males during two rest and one 40 minute sub-maximal cycle ergometry sessions. In a subsequent study, 20 adults performed sub-maximal treadmill walking for 30 minutes with SWA and indirect calorimetry measuring EE. At rest, no significant differences were found between EE measurements from the SWA (1.3 ± 0.1 kcal/min) and IC (1.3 ± 0.1 kcal/min). Thus the SWA EE estimation was found to be valid during rest. Furthermore, significant differences in EE estimates were not found between the SWA and the IC throughout the cycling protocol. Finally, during the walking protocol the SWA was found to correlate moderately to IC ($r = 0.47 – 0.69$). The results of this study indicate that the SWA can provide valid and reliable estimates of resting EE and generated similar mean estimates of EE as indirect calorimetry on the cycle ergometry. Compared to reports on triaxial accelerometers, the SWA generated similar EE estimates for walking when exercise-specific algorithms were used.

In summary, the SWA is user-friendly in terms of easy attachment, minimal discomfort and little or no interference in activity. Studies [64, 65] have provided initial evidence to suggest, along with exercise-specific algorithms, the SWA is a valid device and can provide accurate estimates of EE during rest and exercise.

2.5 Self-efficacy and Cardiac Rehabilitation

Psychological constructs such as SE have been shown to influence the taking up and sustaining of healthy behaviors in patients of all ages [70, 71]. Self-efficacy refers to a person's belief that he or she is able to engage in certain behaviours [15]. Self-efficacy in cardiac patients has been studied to determine its relevance in behaviors involved in CR. The majority of SE research is focused on middle-aged cardiac patients [16, 70].

Blanchard et al. [16] looked at the implications of barrier efficacy (i.e. confidence in one's ability to perform basic tasks under difficult circumstances) on the gender-exercise adherence relationship during an out-patient exercise-based CR program. The primary hypothesis was that men would have higher barrier efficacy and exercise adherence compared to women. Second, they hypothesized that barrier efficacy would act as a "mediator" to the gender-exercise adherence relationship. Their hypotheses stemmed from Bandura's suggestions that individuals who are confident in their beliefs to deal with fundamental situational difficulties will be more likely to overcome obstacles (e.g. exercise barriers) and "persist in the face of adversity" [16] (page 108), whereas those who are not confident in their abilities will disengage from a behaviour if they feel they will not be successful. Barrier efficacy and exercise adherence during CR was evaluated in 98 patients recruited from a tertiary rehabilitation centre. Results showed that men had a significantly higher exercise adherence rate to CR than women (88% versus 80% respectively). Furthermore, as hypothesized, men had significantly higher barrier efficacy than women, suggesting men were more confident they could exercise when experiencing; fear of cardiovascular symptoms, back pain, medication side effects, lack of time, angina-chest pain or monetary concerns. The findings from this study suggest that barrier efficacy did intervene in the gender-exercise relationship. Specifically, men had higher barrier efficacy, which was found to be associated with higher CR exercise adherence.

Gardner et al. [17] also looked at the effect CR had on SE for gender in middle-aged cardiac patients, but then stratified the 472 patient-sample by diagnosis to include CABG, MI and PCTA. The authors hypothesized that women would have lower QOL and SE scores than men, but would have similar rates of improvement in scoring; that patients undergoing revascularization would have lower QOL and SE scores at baseline, but would show greater improvements in scores than patients with MI or PCTA; and caloric expenditure would positively predict SE scores. Quality of life, SE and caloric expenditure were measured at baseline and again at follow-up of 12 weeks post exercise-based CR. Self-efficacy was assessed by a seven item questionnaire divided into two categories: ambulatory items (e.g. walking distance, stair climbing) and muscular items (e.g. lifting, lifting and carrying). Caloric expenditure was extrapolated from workload data (i.e. duration and intensity) and estimated using a computer program and published equations. Results showed that men had a greater rating of SE during CR. While women reported low baseline and follow-up SE ratings, they showed similar degrees of improvement to men. Improvements in SE paralleled caloric expenditure during the exercise sessions, as observed from patients in the surgical intervention group who started at a lower caloric expenditure and demonstrated the greatest improvement. These finding suggest exercise-based CR programs may provide a boost to SE with respect to exercise adoption and sustainability. Furthermore, an increase in SE may create a self-enhancing cycle: through exercise, improvements in SE facilitate further increases in exercise compliance.

Most research examining the effect CR has on SE is focused on middle-aged cardiac patients [16, 17, 25] though changes in SE and thus behaviour related to independent living, maybe more relevant to the elderly patients. Although there is a considerable amount of research investigating SE, QOL and exercise adherence in cardiac patients [16, 17, 70, 71], few studies have looked at the change in SE observed in elderly patients before and after undergoing cardiac procedures [72, 73].

Sullivan et al. [72] investigated the role of SE in physical function of elderly patients with CAD undergoing cardiac catheterization. Physical function was self-reported using the MOS-SF 36 questionnaire and SE was measured by the 13 item Cardiac SE Questionnaire. Both measures were assessed at baseline (pre-cardiac catheterization) and at 6 months follow-up. Results demonstrated that SE had a lasting effect on self-reported physical function in elderly CAD patients. Thus, SE did predict self-reported physical function of elderly cardiac patients; patients with worse physical functioning at 6 months follow-up initially had worse functioning and reported lower SE scores with respect to maintaining function. From a public health point of view, this study demonstrated the functional decline that's associated with CAD in older individuals is linked with SE. Older adults with high SE for adhering to healthy behaviour have in turn less risky lifestyle choices and better health.

Carroll [73] studied SE expectations of elderly patients recovering from CABG. Lower functioning cardiac patients (i.e. New York Heart Association class 3 or 4) were assessed before surgery, at discharge and again at 6 and 12 weeks post-CABG. Self-efficacy expectation was assessed using Jenkins SE Expectation Scales, a set of 4 individual scales used to evaluate SE expectations for various behaviours (i.e. walking, stair climbing, general activities, and roles and relationships). Patients were asked to rate their confidence in their ability to perform the activity from no confidence (0) to totally confident (10). Results demonstrated SE expectation for all behaviours measured did significantly increase over time. At 12 weeks post-surgery, the mean SE expectation for walking 3 miles was 7.5 (S.D. ± 2.8) versus the pre-surgery score of 4.8 (S.D. ± 3.0) ($p < 0.01$). These findings support Bandura's theory [15]; SE expectations were predictive of resultant behaviour performance at 6 and 12 weeks post-surgery, thus SE expectation can predict behaviour performance.

2.6 Summary

Older cardiac patients have high rates of physical function impairments and disability [4]. There have been relatively few studies investigating the effects of CR on physical function and the ability to carry out ADL in elderly cardiac subjects. Exercise-based outpatient CR appears to be safe in older and very old cardiac patients [40-42]. Furthermore, numerous studies have shown exercise-based CR improves treadmill-based maximal aerobic capacity; [2, 3, 12, 59, 60] however maximal aerobic capacity does not always correlate with the degree of participation in ADL for this population [1, 2].

Resistance training when combined with aerobic training has been shown to increase muscular strength, power and endurance in elderly individuals, thus improving mobility, which in turn prevents falls and fractures [8, 12]. Moreover, enhanced muscular fitness may allow elderly cardiac patients to perform ADL with less effort and extend their functional independence. Only a few studies have used physical performance tests to determine the physical function in elderly cardiac patients [8, 12]. The CS-PFP and PFP-10 were designed and validated for the measurement of physical function across a wide range of functional abilities [9, 10, 61-63]. It is highly correlated with peak VO_2 and strength testing in elderly CAD patients and is sensitive to change brought about by exercise [8, 49, 63]. As noted in the literature, controlled studies are needed to objectively evaluate the benefits of exercise-based CR on performance of ADL in elderly cardiac subjects.

In addition, there has been little attention paid to the role of psychosocial factors (i.e. SE) in cardiovascular disability in elderly patients [72]. Few studies have examined the role SE has on elderly cardiac patients participating in exercise-based CR programs. However, research from younger cardiac patients has shown self-reported SE to predict future exercise behaviour [17]. As exercise-based CR has been shown to not only improve physical function as measured by symptom-limiting exercise treadmill tests in middle-aged cardiac patients [74, 75], these programs also provide a boost to SE in relation to exercise adherence and maintenance [17]. However, little is known regarding the impact exercise-based CR programs has on the SE of elderly cardiac patients.

CHAPTER III

METHODOLOGY

3.1 Design and General Description

This study used a prospective, repeated-measures design to investigate the influence a CR exercise program had on the physical function, PA patterns and exercise SE in older cardiac patients (Figure 3.1). Data was collected prior to the start of CR (pre-CR) and again after completing of a 20 session CR program (post-CR).

Figure 3.1: Study design. PFP-10 refers to the Continuous Scale-Physical Functional Performance 10 test battery, SWA refers to SenseWear™ Pro Armband, MOS SF-36 refers to Medical Outcome Study 36-Item Short Form questionnaire, GLTEQ refers to Godin Leisure-Time Exercise Questionnaire, MSES refers to Multidimensional Self-efficacy Scale.

3.1.1 Participants

After approval from the University of Alberta's Health Research Ethics Board, (Appendix A) patients who had recently experienced a MI were recruited from the CR program at the GNH. The study population included patients age 65 years and older. Confirmation of a prior MI was based on evidence of elevated enzyme levels (including creatine kinase–MB and troponin I or T) [76].

Exclusion criteria included 1) New York Heart Association functional classification class III or IV 2) hospitalization for an unstable acute coronary syndrome; 3) exercise-limiting non-cardiac co-morbidity (i.e., orthopedic, neuromuscular, peripheral vascular, cerebrovascular); 4) uncontrolled hypertension (resting, seated blood pressure ≥ 160 systolic or ≥ 90 diastolic); 5) previous CABG surgery; 6) participation in an organized CR program within the previous 3 months; 7) dementia; and 8) profound language barrier. All subjects were asked to provide written informed consent (see Appendix B).

After a graduate student or CR nurse reviewed the patient' file for exclusion criterion, information regarding the research study was explained to eligible patients during their consultation with the cardiologist (see Appendix C). If interested, the protocol was reviewed and any questions the patient had were answered. Upon receiving written informed consent, demographic information such as; gender, date of birth (i.e. age), height, weight and living status was documented and an appointment was set to commence data collection. All study patients received a copy of their written informed consent.

3.1.2 Sample Size

Effect size is a ratio of the difference between groups to the standard deviation, which is expressed in standard deviation units and is calculated by [77]:

$$ES = \frac{[Xe - Xc]}{\sigma}$$

Where:
ES = Effect Size
Xe = mean of the experimental group
Xc = mean of the control group
σ = standard deviation

Based on the literature regarding the effect of exercise training on physical functional performance as measured by the CS-PFP global score in elderly cardiac subjects [8], a large effect size of 0.89 standard deviations was expected (i.e. the difference between the mean global CS-PFP score of the experimental group and the mean global CS-PFP score of the control group is estimated to be 0.89 standard deviations). However, effect sizes of previous literature investigating self-reported physical function measured by the MOS SF-36 physical function score, maximal exercise capacity determined by VO_2max (i.e. mL/kg/min) and sub-maximal exercise capacity assessed by average time spent during sub-maximal exercise (i.e. minutes) in elderly patients range from 0.7 to 0.83 to 1.1 standard deviations, respectively [2, 12]. Therefore, an effect size of 0.80 was used to calculate sample size.

Exercise physiology researchers often use the degree to which a phenomenon actually exists in a population (i.e. effect size) to determine sample size [77]. As previously stated, by using a large effect size of 0.80 standard deviations, exercise-based CR was expected to have a large effect on the elderly individual's ability to carry out ADL. According to Cohen, the four parameters of statistical inference are; sample size (n), significance criteria (α), effect size (ES) and power. They are related such as any one of the parameters is a function of the other three, thus when any three of the parameters are fixed, the forth is determined [77]. Therefore sample size was determined from Cohen's sample size tables specifying "n" as a function of ES, α and power. Using an effect size of 0.80, α of 0.05 and a power of 0.80, a sample size of 20 subjects was required [77](page 54).

3.2 Testing Protocol

Data collection took place at the patient's home and the GNH. The following tasks were completed at baseline and again after completion of the 20 session CR program.

Physical Function Performance. Physical function was measured using the PFP-10 test battery. The PFP-10 consisted of 10 test items and was developed from data collected on older adults and has been validated over a broad range of functional levels [13, 62, 63]. The PFP-10 was designed to provide an in-depth measure of physical function directly relating to ADL. The battery included 10 everyday tasks that progressed from easiest (personal tasks) to moderate (household tasks) to most difficult (mobility tasks). The tasks were classified according to five specific domains: upper body strength, upper body flexibility, lower body strength, balance and coordination and cardiovascular endurance. Each task was sub-maximal with the speed and intensity self selected by the patient. The patient was allowed to rest at any point during the test and was encouraged to stop the test if any tightness in the chest, pain radiating down the left arm, pain the lower jaw or at the base of the left scapulae was experienced. Testing adhered to a standardized format with scripted dialogue and standardized test materials [62, 63].

The 10 everyday tasks used to represent ADL essential to independence were as follows: carrying a weighted pot a distance of 1 meter; putting on and removing a jacket; bending down and picking up four scarves from the floor; placing and removing a sponge from the highest placement of an adjustable shelf; sweeping a set amount of kitty litter into a dustpan; transferring 7.7 kg of laundry and sandbags from the washer to the dryer and then to a basket which is then set on the dryer; placing groceries into one or two bags and carrying the groceries a distance of 52.3 meters, which includes ascending and descending a set of four stairs and opening a closed door; walking as far as possible in 6 minutes; and climbing a set of four stairs.

All tasks were quantified by a combination of time, distance or weight. Every task was scored 1 -100 ("0" scoring as the lower extremity and "100" scoring as the upper extremity), based on empirical data collected from older adults with a broad range of functional capabilities, according to the following formula [13]:

Observed score = (observed scored – lower limit) / (upper limit – lower limit) x 100

Tasks not attempted by the subject were scored as 0 [13].

Using the PFP-10 test battery, Cress et al [61, 63] were able to identify threshold values which correspond to independence. The total PFP-10 score of 57 units corresponds to a physical performance threshold [9, 61]. Those individuals scoring above that threshold were classified as high functioning, where those scoring around or below the threshold value were classified as low functioning with the possibility of becoming dependent [9, 10].

Test-retest correlations for the PFP-10 range from $r = 0.84 – 0.97$ and inter-rater reliability ranging from $r = 0.92 – 0.99$ (4). Cronbach's alpha ranged from 0.74 – 0.97 for the PFP-10 indicating good internal consistency, as defined by a Cronbach's alpha of 0.60 or greater [9, 13].

Objective physical activity was measured using the SWA. The SWA was worn by the patient on the back of the right triceps muscle for three consecutive days (including one weekend day) in the home environment. Energy expenditure was calculated using an algorithm which integrated data from a heat flux sensor, dual axial accelerometer, the galvanic skin response, skin temperature, near-body temperature and demographic characteristics (i.e. gender, age, height, weight, smoking status and handiness). The SWA also provided information on STEPS and time spent in low (< 3 METs; walking at 2.0 mph, bowling, ironing and watering the garden; [24, 78] or moderate (3-6 METs; walking at 3.5 mph, golfing, mowing the lawn and weeding the garden; [24, 78] daily PA. Data were downloaded onto our computer in order to evaluate the patient's physical activity.

Predicted Peak Oxygen uptake (VO_{2peak}) was calculated using the equation derived by Cahalin et al. [79]. This group found the distance ambulated during the 6MWT could predict peak VO_2 in cardiac patients using the following equation, adjusted for age and gender ($r = 0.64$; $r^2 = 0.42$; $p < 0.0001$):

$$\text{Peak } VO_2 = 0.03 \times \text{distance (m)} + 3.98$$

Self-reported physical function was measured using the MOS SF-36 questionnaire (see Appendix D). The MOS SF-36 has been extensively studied in various populations [58, 80-82]. The MOS SF-36 includes scores in eight domains:

physical functioning, role functioning, bodily pain, general health, vitality (i.e. energy and fatigue), social functioning, mental health and reported health transition. The MOS SF-36 yields a total score for each of these domains, as well as summary scores for both physical and mental health [80].

In order to assess distinct aspects of physical function, the MOS SF-36 included 10 items evaluating one's perceived ability to carry out ADL [83]. Examples of questions used to assess physical function included: "The following items are about activities you might do during a typical day. Does you health now limit you in these activities: vigorous activities (e.g. running, lifting heavy objects), moderate activities (e.g. moving a table, vacuuming), lifting or carrying groceries, climbing several flights of stairs, climbing one flight of stairs, bending, kneeling or stooping, walking more than a kilometer, walking several blocks, walking one block and bathing or dressing yourself?" Patients were asked to respond to each question using a three point scale, ranging from being fully limited, somewhat limited to not at all limited. In order to assess general health, the MOS SF-36 used the following question: "In general, would you say your health is: excellent, very good, good, fair or poor" and "Compared to one year ago, how would you rate your health in general now? Much better now, somewhat better, about the same, somewhat worse and much worse." The MOS SF-36 used a four-item measure of vitality to assess the patients' subjective well-being. Using the phrase "During the past four weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?" Patients were asked to respond yes or no to the following questions: “Cut down on the amount of time you spent on work or other activities, accomplished less than you would like, were limited to the kind of work or other activities and had difficulty performing the work or other activities?”

Scores are stable, as reported by Ware et al. [80] who showed the test-retest reliability was $r = 0.73 – 0.96$ and the scale is internally consistent as demonstrated by a Cronbach’s alpha = 0.90. Total time to complete the questionnaire was estimated to be 5 minutes.

S*elf-reported Physical Activity* was measured using the Godin Leisure-Time Exercise Questionnaire (GLTEQ; see Appendix E). The GLTEQ has been shown to be a reliable and valid measure of LTPA and applied across a variety of populations [84, 85]. Researchers have found the GLTEQ to be an effective tool if the change in an individual’s exercise behaviour over time is of interest, especially if the time-frame of recall is seven days [84]. Patients were asked to record how frequently they participated in mild, moderate and strenuous activity for more than 15 minute bouts over a 7 day period. An overall activity score is calculated as = (9 * (number of strenuous exercise episodes)) + (5 * (number of moderate exercise episodes)) + (3 * (number of mild exercise episodes)). Thus, an effective CR program will have resulted in an increase in the activity score.

Self-reported exercise self-efficacy was measured using the MSES (see Appendix F). The MSES was designed to assess three domains of SE; task, coping and scheduling, which are thought to be significant when maintaining physical exercise behaviour [86]. The MSES contained 9 items, all beginning with the phrase “how confident are you that you can…” followed by statements pertaining to task, coping and scheduling aspects of exercise behaviour (i.e. "…arrange your schedule to include regular exercise", "….do your exercise when you lack energy" and "…"follow directions to complete the exercise"). Patients were asked to think of exercise as "walking at a moderate intensity three times a week for about 30 minutes" when responding to each item. All responses were scored on a 100% confidence scale, ranging from 0% (no confidence) to 100% (complete confidence). The MSES was studied by Rodgers et al. [86] across different populations and was found to be both reliable and valid.

3.3 Cardiac Rehabilitation Exercise Program

The CR program consisted of 20 sessions; patients chose to attend three sessions a week over 7 weeks or twice a week for 10 weeks. The initial 8 sessions of the CR program were aerobically based. Patients performed 40 minutes of continuous cardiovascular activity on two modalities of their choice (i.e. treadmill, stationary bike, recumbent bike, elliptical trainer, arm ergometer). Typical aerobic sessions consisted of a five minute warm-up (speed less than 2.0 mph, 0% incline on the treadmill or less than 50 rpm on the bike), 30 minutes steady state at 13-15 rate of perceived exertion (RPE) on the Borg Rating of Perceived Exertion (Borg) on two different pieces of exercise equipment and a five minute cool-down using the same exercise guidelines followed for the warm-up. Sessions 9-20 incorporated 20 minutes of resistance training following the aerobic component. Demonstrations of the correct technique for each resistance activity were given prior to the initial strength assessment. Initial workloads were calculated using 40% of the patient's 1-repetition maximum (1-RM) load lifted.

The progressive resistance training program included one to two sets of 8-12 repetitions, gradually increasing both the repetitions and resistance. The following free weight exercises were completed: standing shoulder press, upright row, arm curls, triceps extension, quadriceps curls and hamstring curls.

Failure to achieve an 80% compliance rate to the CR program (both in terms of attendance and intensity) was considered a ‘drop out’.

3.4 Statistical Analysis

The dependent variables were; physical functional performance (i.e. measured as the PFP-10 global score), spontaneous PA (i.e. measured as average daily EE, duration of daily time spent in low and moderate PA, number of steps/day determined by the SWA) and exercise SE (i.e. measured as self-reported scores from the MSES). The independent variable was CR. The following methods were used to assess the study’s goals:

- Hypothesis 1: A paired t-test was used to compare the difference between mean physical function performance scores as measured by the PFP-10 global score.
- Hypothesis 2: A paired t-test was used to compare the difference between means in self-reported physical function as measured by the physical function domain score from the MOS SF-36 questionnaire.
- Hypothesis 3: A paired t-test was used to compare the difference between means in daily average EE. A paired t-test was also used to compare changes in time spent in low PA and the dependent t-test was used to compare changes in the mean time spent in moderate PA post-CR.

Finally, a dependent t-test was used to compare the differences in mean number of steps/day post-CR collected through the use of the SWA.

- Hypothesis 4: A multiple analysis of variance (MANOVA) was used to determine changes within patients pertaining to exercise SE as measured by the MSES. Partial eta-square (η^2) values were reported as effect sizes, which represented the proportion of variance in a dependent variable (i.e. exercise SE) explained by a factor (i.e. time). According to Cohen, when considering analysis of variance, $\eta^2 = 0.10$ corresponds to a small effect size, $\eta^2 = 0.25$ represents a medium effect size, or an "effect likely to be visible to the naked eye of a careful observer" [87] (page 156) and $\eta^2 = 0.40$ is considered a large effect size [87].
- Hypothesis 5: Simple regression analysis was used to determine the relationship between power output (from the PFP-10 groceries carry task) and the 6-MWT.

Pearson Product Correlation was used to measure association between the:

- PFP-10 and 6MWT; MOS SF-36; EE (as measured by the SWA); SE (i.e. Task Se, Coping SE, Scheduling SE)
- MOS SF-36 and 6MWT; PFP-10; EE; SE
- Daily average EE and 6MWT; PFP-10; MOS SF-36; SE
- SE and 6MWT; PFP-10; MOS SF-36; EE

Analyses were conducted using SPSS Version 14.0 software program. The significance level was set at P = 0.05. In the event of missing data, the subject was excluded the study and any previous data was omitted from analysis.

CHAPTER IV

RESULTS

4.1 Participants

Over a period of 9 months 29 patients were recruited into the study. From this sample, 22 completed the study while 7 patients dropped out. Of the 7 patients who withdrew from the study, four dropped out of the CR program while three developed cardiac medical issues not related to the CR program (i.e. re-admission to the hospital for acute unstable coronary syndrome or CABG surgery). Descriptive information on the remaining 22 patients who completed the study is presented in Table 4.1.

The mean age of the patients (10 female; 12 male) was 75 ± 6.3 years and all had suffered a recent MI. Patients started CR 4 to 6 weeks after experiencing the MI. There were no changes in medications over the course of the study and all medications taken by the study patients are listed in Appendix G. Nineteen patients lived in single-family homes, thus these patients self-reported performance of household tasks including the preparation and cooking of meals, grocery shopping and house cleaning. Three patients resided in a congregate care facility where various support services (e.g. meal service and light housework) were provided and professional care assistance could be readily obtained.

Table 4.1. Patient characteristics.

Patient	Gender (M/F)	Age (yrs)	Weight (kg)	Height (cm)	BMI	MI	Co-morbidities
1	F	88	46.2	155	19.2	Anterior	HT, OA
2	F	72	66.2	165	24.3	NSTEMI	Diabetes, HT, DYSL
3	M	77	103.0	173	34.4	Circumflex	DYSL, GERD
4	M	66	70.6	181	21.6	Anterior	MS
5	F	81	73.9	168	26.2	NSTEMI	TIA, HT, DYSL, LSS
6	M	68	93.9	180	29.0	Inf STEMI	HT, DYSL
7	F	69	68.1	158	27.3	Anterior	HT, DYSL
8	M	71	84.8	175	27.7	Inf STEMI	HT, DYSL, Diabetes
9	M	77	86.0	180	26.5	Inf STEMI	DYSL, OA, AF
10	F	71	96.8	161	37.3	STEMI	HT, DYSL, Anxiety, Depression
11	M	71	98.0	176	31.*6	NSTEMI	HT, Diabetes
12	F	72	71.2	160	28.2	NSTEMI	HT, Diabetes, HTH, GERD, Bradyarrhythmia
13	F	81	71.5	160	27.9	Inf STEMI	HT, Diabetes, DYSL, breast cancer
14	M	76	110.5	180	34.1	NSTEMI	HT
15	F	84	52.3	168	18.5	NSTEMI	RA
16	M	72	100.0	168	35.4	NSTEMI	HT, RA, DYSL, GERD
17	M	65	89.6	175	29.3	Inf STEMI	NONE
18	F	82	62.6	162	23.9	NSTEMI	HT, OA, DYSL
19	M	81	60.0	177	19.2	Ant STEMI	Migraine
20	F	66	70.9	159	28.0	Inferior	NONE
21	M	78	79.5	166	28.9	Anterior	HTH
22	M	73	95.5	176	30.8	NSTEMI	OA, Hiatus hernia
Mean	-	74.6	84.0	169.5	27.7	-	-
SD	-	6.3	26.7	8.3	5.2	-	-

BMI = Body Mass Index; MI = Myocardial Infarction; STEMI = ST Elevation MI; NSTEMI = Non ST Segment Elevation; Inf STEMI = Inferior STEMI; HT = Hypertension; OA = Osteoarthritis; DYSL = Dyslipidemia; GERD = Gastro Esophageal Reflux Disorder; MS = Multiple Sclerosis; TIA = Transient Ischemic Attack; LSS = Left Subclavian vein Steal Syndrome; AF = Atrial Fibrillation; HTH = Hypothyroidism; RA = Rheumatoid Arthritis.

4.2 Cardiac Rehabilitation Program

Compliance to the CR exercise sessions was 85%. The aerobic workload (i.e. speed / incline / resistance) was updated weekly, and the progression of aerobic activity was increased when the RPE scores dropped below 12 on the Borg scale. Using the 6MWT distance (post-CR: 478m ± 77m vs. pre-CR: 416m ± 87m; $p < 0.000$) and the predictive equation from Cahalin et al. [79] the calculated change in peak aerobic capacity as a result of the CR program increased approximately 10% (from a VO_{2peak} of 16.64 ± 2.55 to 18.37 ± 2.25 ml/kg/min; $p < 0.000$).

At the start of CR, resistance training (i.e. four upper body free weight and two lower body exercises) began at an intensity of 40% of a patient's 1-RM and increased to 80% of 1-RM by the end of the program. Patients began training with 1 set of 10 repetitions per exercise, gradually increasing to two sets of 10-12 repetitions with a two minute rest in between sets.

4.3 Physical Functional Performance Measures

4.3.1 PFP-10: Domain Scores

Post-CR, significant improvements were found in four of the five PFP-10 domains (Figure 4.1). Upper body strength, which was determined from performances on the pot carry, laundry transfer tasks and the groceries task, improved ($p < 0.000$) as did lower body strength (scarf pick up, floor sweeping, both laundry transfer tasks, floor up and down, stair climb and groceries task; $p < 0.000$). Improvements were also observed for balance and coordination (i.e. pot carry, jacket, floor sweep and groceries task; $p = 0.003$) and cardiovascular endurance (the grocery carry task and the 6MWT; $p = 0.001$). The one domain score that did not improve post-CR was upper body flexibility (the jacket and reach tasks).

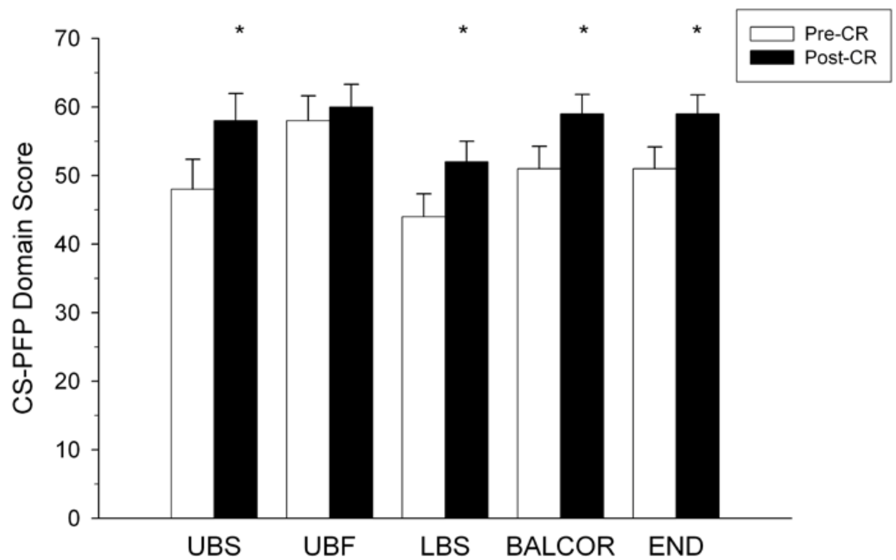

Figure 4.1. Performance on the Continuous Scale-Physical Functional Performance (CS-PFP) test battery pre- and post-cardiac rehabilitation (CR). Domain scores: upper body strength (UBS), upper body flexibility (UBF), lower body strength (LBS), balance and coordination (BALCOR) and cardiovascular endurance (END). All values are expressed as mean ± standard error of the mean. Significance = * $p \leq 0.05$.

Prior to CR, when domain scores were analyzed according to gender, females scored lower than males in upper and lower body strength, balance and coordination and cardiovascular endurance (see Table 4.2). However, post-CR the only gender difference observed was for upper body strength.

Table 4.2. Performance on the Continuous Scale-Physical Functional Performance 10 Test pre- and post-cardiac rehabilitation.

	Female (n = 10)	Male (n = 12)	*P* Value
Global score			
Pre	42 ± 12[a]	59 ± 16[b]	0.01*
Post	53 ± 14[b]	63 ± 13[b]	0.07
Upper body strength score			
Pre	33 ± 11[a]	61 ± 18[c]	0.00*
Post	46 ± 15[b]	67 ± 16[d]	0.01*
Upper body flexibility score			
Pre	60 ± 20[a]	56 ± 14[a]	0.59
Post	63 ± 21[a]	58 ± 10[a]	0.53
Lower body strength score			
Pre	35 ± 11[a]	52 ± 15[b]	0.01*
Post	46 ± 14[b]	57 ± 13[b]	0.07
Balance + coordination score			
Pre	44 ± 14[a]	57 ± 14[b]	0.05*
Post	56 ± 15[b]	62 ± 12[b]	0.29
Endurance score			
Pre	44 ± 14[a]	57 ± 13[b]	0.03*
Post	55 ± 14[b]	62 ± 12[b]	0.23

Values are means ± standard deviation. n = number of patients. A one-way analysis of variance was used for the comparison within groups. * = significant differences between groups; $P < 0.05$. Values with different suffix = significant difference over time ($p < 0.05$).

4.3.2 PFP-10: Global Score

Following-CR, PFP-10 global scores increased ($p = 0.001$; see Figure 4.2). Furthermore, 15 patients initially scored below the PFP-10 threshold of independence (i.e. global score < 57). Post-CR, only 10 patients scored below this threshold (ES = 0.50).

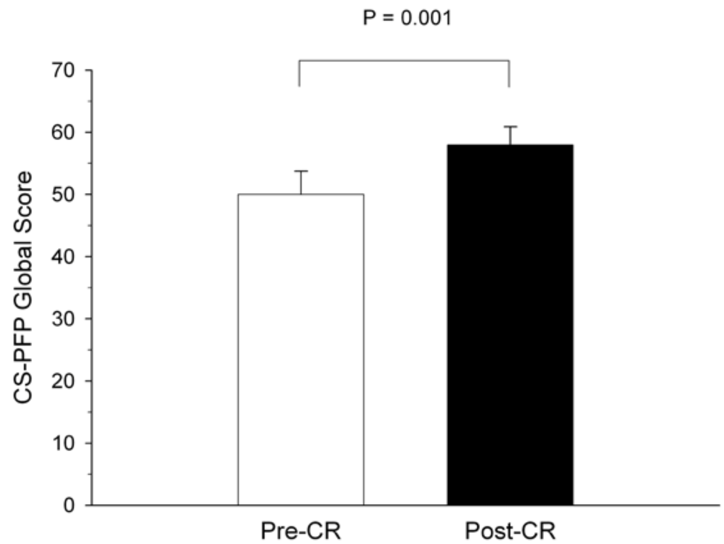

Figure 4.2. Global scores on the Continuous Scale-Physical Functional Performance 10 (CS-PFP) test battery pre- and post-cardiac rehabilitation (CR). All values are expressed as mean ± standard error of the mean.

When the data were analyzed based on gender, females demonstrated a poorer PFP-10 performance pre-CR, however after CR this gender difference was not observed (see Figure 4.3). Furthermore, repeated measures analysis found the interaction between time and gender not significant at $p < 0.05$.

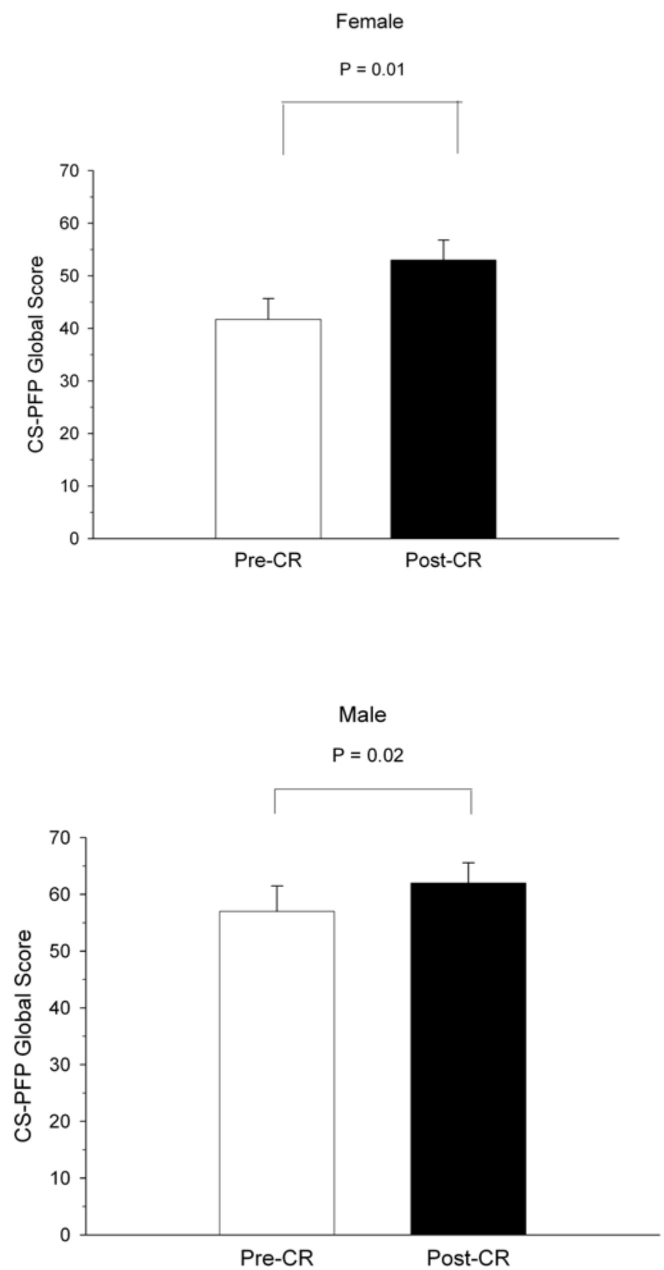

Figure 4.3. Continuous Scale-Physical Functional Performance (CS-PFP) test battery global scores pre- and post-cardiac rehabilitation (CR). Values are expressed as mean ± standard error of the mean.

4.3.3 MOS SF-36: Self-reported Physical Function

For the overall sample, no differences were found in the self-reported physical function domain post-CR ($p = 0.57$; see Table 4.3). Moreover, no improvements were found across gender with CR (see Figure 4.4). Although there was a trend for patients to report high general health domain scores post-CR, the change was not significant ($p > 0.05$). Analysis according to gender showed there were no differences post-CR observed in females (66 ± 17 vs. 63 ± 16; $p = 0.43$) or males (78 ± 19 vs. 73 ± 20; $p = 0.18$).

No differences in the role-physical and bodily pain domain scores were observed post-CR ($p = 0.32$ and $p = 0.81$, respectively). When the role-physical domain score was analyzed based on gender no improvements were found for females (post-CR: 42 ± 47 vs. 36 ± 42; $p = 0.73$) or males (post-CR: 48 ± 48 vs. 71 ± 45; $p = 0.12$). Similarly, there was no gender differences in the bodily pain domain scores as a result of CR (68 ± 23 vs. 57 ± 29; $p = 0.21$ and 72 ± 26 vs. 78 ± 21; $p = 0.32$, respectively). Furthermore, the physical component score (PCS; physical function, general health, role-physical and bodily pain domains) did not improve after CR (44 ± 10 vs. 42 ± 9; $p = 0.12$) nor were there any changes post-CR in the PCS when female (41 ± 11 vs. 38 ± 8; $p = 0.38$) or male patients (47 ± 9 vs. 45 ± 8; $p = 0.21$) were analyzed separately.

Table 4.3. Impact of Cardiac Rehabilitation (CR) on the physical health components on the Medical Outcomes Study 36-Item Short Form (MOS SF-36) questionnaire.

	Pre-CR (n = 22)	Post-CR (n = 22)	*P* Value
MOS SF-36 questionnaire			
Physical function	67 ± 22	68 ± 20	0.57
General health	68 ± 18	73 ± 19	0.11
Role-physical	45 ± 47	56 ± 46	0.32
Bodily pain	69 ± 26	71 ± 24	0.81

Values are means ± standard deviation. n = number of patients. No significant differences ($P > 0.05$) were observed within groups' post-CR.

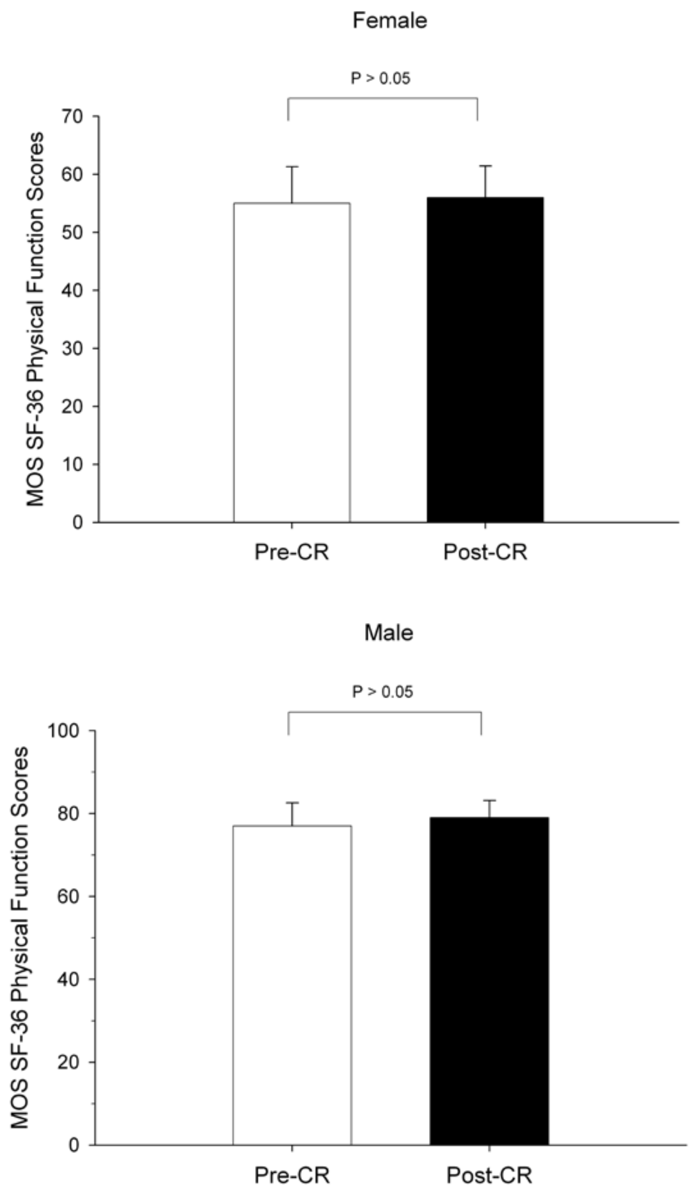

Figure 4.4. Medical Outcomes Study 36-Item Short Form (MOS SF-36) questionnaire physical function scores for female and male patients' pre- and post-cardiac rehabilitation. Values are expressed as mean ± standard error of the mean.

4.4 Subsequent Physical Activity

4.4.1 Energy Expenditure

Participation in the CR program did not affect the average EE over a three day period (p = 0.15; see Table 4.4). Indeed, EE remained unchanged for both female (1840 ± 295 vs. 1744 ± 258 kcal/day; p = 0.16) and male patients (2707 ± 633 vs. 2458 ± 420 kcal/day; p = 0.27) post-CR.

4.4.2 Ambulatory Activity

In keeping with the EE data, no differences were found in the average number of STEPS taken over a three day period following CR (p = 0.31; see Table 4.4). Neither women nor men demonstrated a change in their step count post-CR (5307 ± 2448 vs. 4955 ± 2490 steps/day; p = 0.69 and 5976 ± 2188 vs. 5305 ± 2285 steps/day; p = 0.35, respectively).

4.4.3 Physical Activity

Data from the SWA indicated that post-CR the patients remained quite sedentary (Table 4.4). For men the amount of time spent in activities $\leq$ 3 METs was 22.0 ± 1.26 hours/day pre-CR and 20.6 ± 3.1 post-CR; p = 0.09. Women also continued to be very sedentary (pre-CR: 21.3 ± 3.2 hours/day vs. post-CR: 22.0 ± 2.3 hours/day; p = 0.56). Similarly, the daily duration patients spent in MPA post-CR remained unchanged (i.e. activities ranging from 3 – 6 METs; p = 0.58). Prior to the exercise program, patients spent between 6 and 96 minutes / day performing MPA while post-CR the range was 0 to 171 minutes/day. After CR women actually spent less time performing MPA (0.57 ± 0.43 hours/day vs. 0.71 ± 0.76 hours/day pre-CR; p = 0.53), while the males increased their MPA from 0.96 ± 0.76 hours/day pre-CR to 1.67 ± 1.6 hours/day post-CR, however the increase was not significant (p = 0.20).

Table 4.4. Daily physical activity as determined by the SenseWear™ Pro Armband (SWA) and the Godin Leisure-time Activity Questionnaire (GLTQ) pre- and post-cardiac rehabilitation (CR).

	Pre-CR (n = 22)	Post-CR (n = 22)	*P* Value
SWA			
Energy Expenditure (kcal/day)	2151 ± 500	2336 ± 669	0.15
Steps/day	5155 ± 2320	5689 ± 2268	0.31
Moderate Physical Activity (hr:min)	0.85 ± 0.75	1.20 ± 1.31	0.58
Low Physical Activity (hr:min)	21.7 ± 2.3	21.2 ± 2.8	0.73
GLTQ			
Self-reported Leisure-time Activity Score	17 ± 14	42 ± 41	0.01*

Values are means ± standard deviation. n = number of patients. Low physical activity (i.e. activities ranging from 0 – 3 METs) and moderate physical activity (i.e. activities ranging from 3 – 6 METs). * = significant differences within groups; $P < 0.05$.

Data from the SWA is contrasted by the self-reported LTPA data. Using the Godin LTPA questionnaire, patients reported a considerable increase in LTPA post-CR ($p = 0.01$; see Table 4.4). The increase in self reported LTPA may be attributed to the responses of the male patients where self-reported PA scores increased from 18 ± 13 pre-CR to 40 ± 28 post-CR ($p = 0.02$), while the women's scores (pre-CR: 16 ± 15 vs. post-CR; 44 ± 54) remained unchanged ($p = 0.12$).

4.5 Cardiac Rehabilitation and Exercise Self-efficacy

Post-CR, patients did not significantly improved their overall exercise SE scores ($F(3,19) = 2.49$, $p = 0.09$, $\eta^2 = 0.28$; see Table 4.5). Coping SE and scheduling SE slightly improved post-CR ($p = 0.07$, $\eta^2 = 0.15$ and $p = 0.08$, $\eta^2 = 0.14$, respectively), whereas task SE did not.

Table 4.5. Self-efficacy (SE) scores as measured by the Multidimensional Scale for Self-efficacy pre- and post-cardiac rehabilitation (CR).

	Pre-CR (n = 22)	Post-CR (n = 22)	F(3,19)	η^2	*P Value*
Task SE	77 ± 19	81 ± 20	0.62	0.03	0.44
Coping SE	44 ± 29	57 ± 26	3.73	0.15	0.07
Scheduling SE	60 ± 26	72 ± 26	3.41	0.14	0.08

Values are means ± standard deviation. n = number of patients. A multiple analysis of variance was used for the comparison within groups. η^2 = effect size. No significant differences ($P > 0.05$) were observed within groups' post-CR.

Females, compared to males, scored lower for task, coping and scheduling SE scores both prior to and following CR (see Table 4.6). Female's scheduling SE scores increased significantly post-CR ($p < 0.01$, $\eta^2 = 0.56$) whereas task and coping SE did not change. Male's task, coping and scheduling SE scores did not change post-CR.

Table 4.6. Female and male self-efficacy (SE) scores as measured by the Multidimensional Scale for Self-efficacy pre- and post-cardiac rehabilitation.

	Female (n = 10)	F(3,7)	η^2	*P* Value	Male (n = 12)	F(3,9)	η^2	*P Value*
Task SE								
Pre	66 ± 19				86 ± 13			
Post	75 ± 25	0.65	0.07	0.44	86 ± 13	0.01	0.00	0.94
Coping SE								
Pre	34 ± 28				53 ± 27			
Post	46 ± 29	0.98	0.10	0.35	66 ± 21	3.41	0.24	0.08
Scheduling SE								
Pre	54 ± 24				65 ± 28			
Post	77 ± 16	11.35	0.56	0.01*	68 ± 32	0.08	0.07	0.78

Values are means ± standard deviation. n = number of patients. η^2 = effect size. Significant differences: * = $P < 0.05$.

4.6 Cardiac Rehabilitation: Predicting Physical Function

As shown in Figure 4.5, a clear linear relationship exists between the power output (i.e. from the PFP-10 grocery carry task) and the distance walked during the 6MWT ($r = 0.671$, p = 0.001). Linear regression analysis was used to predict physical function from the 6MWT (see equation below). Results suggest if the distance ambulated during the 6MWT increases by 10 meters, power will increase by 62.5 kg*m/min (p = 0.001).

$$Y = - 1875 + 6.25x$$

$$r = 0.671;\ r^2 = 0.451;\ p = 0.001$$

Where Y = Power output (kg*m/min); x = distance ambulated during 6MWT (m); 6.25 = β_0; slope of the regression line; -1875 = Y intercept of the regression line (see Figure 4.5).

The strongest positive relationship was the 6MWT and PFP-10 global score (*r* = 0.650, p = 0.001; see Table 4.7). Conversely, a strong negative relationship was found between the age and PFP-10 global score, post-CR (*r* = -0.701, p < 0.000). Modest positive correlations included the MOS SF-36 physical function score and coping SE (p = 0.001); MOS SF-36 physical function score and the PFP-10 global score (p = 0.004); MOS SF-36 physical function score and 6MWT (p = 0.005); and the MOS SF-36 and task SE (p = 0.023; see Table 4.7). Surprisingly, the correlations between average daily EE and the PFP-10 global score or 6MWT were non-significant (*r* = 0.204 and *r* = 0.316, respectively).

Figure 4.5. Association between power (i.e. PFP-10 grocery carry task) and 6 minute walk test and the global, post-CR.

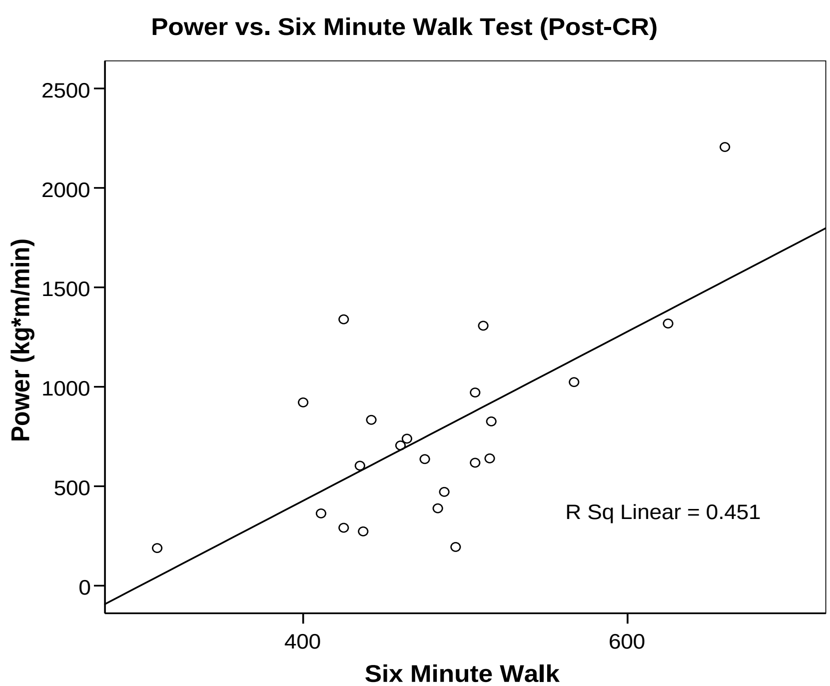

Table 4.7. Person correlations demonstrating the relationships between physical function, physical activity and exercise self-efficacy (SE) post-cardiac rehabilitation.

	6MWT	PFP-10 global score	MOS SF-36: Physical Function	Daily average EE	Task SE	Coping SE	Schedule SE
6MWT	1.00						
PFP-10 global score	0.650**	1.00					
MOS SF-36: Physical Function	0.577**	0.591*	1.00				
Daily average EE	0.316	0.204	0.118	1.00			
Task SE	0.136	0.208	0.482*	0.180	1.00		
Coping SE	0.356	0.303	0.645**	0.237	0.825**	1.00	
Scheduling SE	0.071	0.142	0.256	-0.282	0.591**	0.547**	1.00

6MWT = 6-minute walk test (m). PFP-10 = Continuous Scale-Physical Function Performance 10 test battery. MOS SF-36 = Medical Outcomes Study 36-Item Short Form Questionnaire.EE = Energy Expenditure as measured by the SenseWear™ Pro Armband. * = Correlation is significant at the 0.05 level (2-tailed). ** = Correlation is significant at the 0.01 level (2-tailed).

CHAPTER V

DISCUSSION

5.1 Study Overview

This study examined the impact a CR program had on elderly post-MI patients' ability to perform common household tasks. Physical function was measured using an objective test (i.e. PFP-10) and a self-reported measure (i.e. MOS SF-36) prior to and after completing a 20 session aerobic/resistance-based CR program. Objective measures of PA patterns and subjective measures of physical function, LTPA and SE were also evaluated pre- and post-CR. The primary hypothesis stated that post-CR elderly patients' physical functional performance (as measured by the PFP-10 global score) would improve. Additionally, we expected there to be a linear relationship between physical functional performance and standardized criteria used to assess functional exercise capacity of elderly persons (i.e. 6MWT).The secondary hypothesis was that self-reported physical function using the MOS SF-36 questionnaire would improve. The tertiary hypotheses were: a) there would be an increase in daily average EE, time spent in low and moderate PA and number of steps taken /day as measured by the SWA post CR; and b) that exercise SE as measured by the MSES would improve after CR.

5.2 Physical Functional Performance Measures

5.2.1 PFP-10

Results demonstrated patients' global physical function score increased after completing the CR program (see Figure 4.2); therefore, the primary hypothesis was accepted. Previous studies [8, 48] have reported that the functional abilities of elderly cardiac female patients can improve after completing a 6 month aerobic/resistance training program, exercising three times/week. To our knowledge, our group is the first to report the functional abilities of older female and male cardiac patients can improve after completing a 20 session aerobic/resistance-based exercise program exercising two or three times/week. The resistance protocol followed by the GNH CR program is in accordance with the minimal standards for resistance training suggested by the American Heart Association [88]. These guidelines include using 8-10 different exercises and recommend one set (moderate to maximal effort) of 8 - 12 repetitions / exercise performed two to three times/week. Thus, the results of the current investigation suggest a 6 to 8 week CR program which incorporates resistance training can improve the ability of elderly patients to perform ADL.

In one study by Bronchu et al. [8], physical functional performance was measured using the CS-PFP before and after a 6 month resistance training program, where 25 female cardiac patients exercised three times/week. Results showed elderly female patients performed resistance training at an intensity which produced an increase in strength and performance of ADL. Post-CR, PFP-10 global scores from the present study were similar to those observed by Bronchu et al. (59 ± 14 and 59 ± 10, respectively). These findings are consistent with Ades et al. [48] who also demonstrated resistance training three times/week improved the physical functional performance of elderly female cardiac patients as measured by the CS-PFP. The results from Ades et al. highlight the need to include strengthenhancing interventions during CR in order to enhance physical functional performance in elderly cardiac patients.

The present findings illustrate that improvements in physical function may positively impact older cardiac patients ability to successfully carry out ADL. Further, objectively-based test batteries such as the PFP-10 are necessary in order to provide accurate and useful information in a CR setting.

The CS-PFP as well as the PFP-10 define a ‘threshold of independence’ as a score of 57 or higher [9]. Those patients who scored 14 units above the threshold (i.e. global PFP-10 score = 71) were classified as high functioning, whereas those who scored 9.6 units below the threshold value (i.e. global PFP-10 score = 47.4) were classified as low functioning [10]. In the present study, the completion of the CR program resulted in one additional patient being classified as high functioning (pre-CR n = 3, post-CR n = 4). More importantly, 6 patients who were initially categorized as low functioning were no longer categorized as such post-CR (pre-CR n = 10, post-CR n = 4). This observation is important as the low functioning patients are more likely to become physically dependent. Furthermore, prior to CR a total of 15 patients scored below the threshold for independent living, post-CR only 10 patients remained below the threshold (ES = 0.50). In other words, pre-CR our sample fell below the threshold of independence and was considered to have a high probability of becoming dependent on others to assist with household tasks. However, post-CR patients’ scored above the threshold of independence, thus were regarded as having a low probability of becoming dependent on others. This suggests that a 20 session CR program which incorporates aerobic and resistance exercise may be sufficient to moderately enhance elderly patients' ability to live independently.

Figure 4.1 illustrates the specific domain scores which improved post-CR. Given the nature of the resistance training it was not surprisingly that patients' upper and lower body strength improved after completing CR (Figure 4.1). Fragnoli-Munn et al. [89] also reported elderly cardiac patients' improved muscular strength after completing a 12 week aerobic/resistance program. In that study, the resistance portion of the exercise program consisted of one set of 10 reps performed at 50% 1-RM of the following exercises: leg extension, leg flexion, bench press, shoulder press, lateral pulldown and biceps curls. Results showed muscular strength as measured by the 1-RM for leg extension and bench press improved by 35% and 14%, respectively. Thus, these researchers concluded strength gains can be seen in elderly cardiac patients and resistance training should commence or continue immediately post-CR.

Many of the aerobic and resistance exercises performed during CR (e.g. walking on the treadmill, standing free weight shoulder press, upright row, biceps curls and triceps extension) require body stability and the use of core stabilizer muscles. Upon completion of the program it was therefore not surprising to observe the improvement in balance and coordination. Our results are consistent to those reported by Bronchu et al. [8] and Ades et al. [48]; both reported significant improvements in balance and coordination as measured by the CS-PFP post-aerobic/resistance exercise intervention. The loss of musculoskeletal fitness, including balance and coordination, is of great importance to elderly patients with respect to their ability to maintain independent living [9, 24]. For the elderly population, many ADL do not require large aerobic capacities but rely on one or more musculoskeletal components [24]. The loss of bone and muscle strength often leads to serious and life-threatening injuries, such as osteoporotic hip fractures and falls [24, 90]. Six months after a hip fracture, many elderly patients may still require assistance with ADL [91]. Furthermore, research has found the lifetime risk of hip fracture (1 in 6) is much greater than the lifetime risk of breast cancer (1 in 9), and the mortality associated with hip fracture is higher [92]. Research has demonstrated that regular exercise (e.g. walking, stair climbing, dancing and resistance training) may be one of the most important methods to prevent osteoporotic fractures and falls in the elderly [93].

A primary focus of CR programs is to improve patients' cardiovascular endurance using aerobic-based modalities [39]; therefore an improvement in cardiovascular endurance was anticipated. Our results are in accordance with those of Stahle et al. [94] who reported the aerobic capacity of elderly post-MI patients improved after a three month supervised exercise intervention. In that study, 101 patients were recruited from an outpatient cardiac clinic and randomized into either the intervention or control group. The intervention group met three times/week for three months to perform 50 minutes of aerobic activity. The control group received verbal and written instructions regarding the importance of PA, and were encouraged to re-start their usual PA routine as soon as they felt fit enough to do so. Maximal exercise capacity was measured using a bike ergometer at baseline, three and 12 months follow-up. Results showed exercise capacity did not differ between groups at baseline, however at three months follow-up the intervention group significantly improved exercise capacity by 15% whereas the control group did not show any change. Thus, the main finding reported from Stahle et al. was the exercise capacity of elderly post-MI patients does improve after an aerobic-based exercise intervention. The 6MWT test is also a useful assessment tool to measure the aerobic capacity of elderly patients. Patients in our study demonstrated a 15% improvement in aerobic capacity as measured by the 6MWT. Other researchers [8, 48, 95] found the distance ambulated during the 6MWT improved by 13 - 15% post-aerobic/resistance training.

As the CR program was not designed to improve upper body flexibility, improvements in this domain post-CR were not expected. Our results are consistent with Bronchu et al. [8] who also reported the flexibility of elderly cardiac patients did not improve after a 6 month aerobic/resistance exercise intervention. However, our results contradict those of Ades et al. [48] who observed improved flexibility scores after a 6 month aerobic/resistance exercise program. This difference could be due to the fact the control group in Ades' study was not inactive, but rather, participated in a program of light yoga and stretching.

Table 4.2 presents the data showing females scored below male patients in four of the five domains prior to CR. These findings are consistent with those of Fragnoli-Munn et al. [89] who observed that the 1-RM of leg extension and bench press strength of female patients was 62 and 54% (respectively) of their male counterparts. Interestingly, in our study, females demonstrated a greater relative benefit from strength training than the men, increasing their upper body score by 29% (vs. 9% in men). Fragnoli-Munn reported elderly women increased their 1-RM for leg extension by 66% compared to 29% by men, while bench press scores increased by 29% compared to 10% by men. Although women demonstrated lower physical functional performance measures pre- and post-CR (i.e. global PFP-10 scores), a significant difference in the relative change in physical performance between women and men was not found. In other words, the rate at which women's global scores increased was not different from the rate of improvement shown in men.

As physical disabilities (e.g. the inability to climb stairs without help) [4] and muscular strength are often limiting factors observed in elderly female patients [18, 39], resistance training for females is particularly important. As our data suggest, female patients did benefit from resistance training as demonstrated by the increased muscular strength and improved performance of ADL. It has also been demonstrated that as women pass through menopause muscle mass decreases, fat mass increases, and total physical activity decreases [96]; these factors may have contributed to the lower domain and physical function scores observed in women at baseline. However, the lower scores pre-CR may have allowed for females to make greater improvements post-CR. The same improvements were not noted in the male patients. This subgroup has been reported to have an enhanced exercise capacity and lower rates of disability as compared to elderly female cardiac patients [4]. For example, disability rates reported in the Framingham Disability Study [4] in men and women ages 70 to 88 years with CAD were 49% and 79%, respectively. Thus, the higher PFP-10 scores observed in men (see Table 4.2) prior to CR may have placed them in a more challenging position to make significant strength and cardiovascular endurance gains post-CR.

5.2.2 MOS SF-36: Self-reported Physical Function

The secondary hypothesis indicated self-reported measures of physical function would improve post-CR. Although patients did report slightly higher MOS SF-36 physical function scores post-CR (Table 4.3) the small increase was not significant. Thus, the secondary hypothesis was rejected. Our findings suggest the actual measured performance of daily activities increased with resistance training, whereas the self-reported MOS SF-36 physical function scores did not.

Few studies have compared field-based test batteries with self-reported measures to assess physical functional ability of elderly cardiac patients [8, 48, 97]. Most of the current research pertaining to physical function in elderly patients is derived from self-reported physical function questionnaires alone [1, 4, 59, 70]. However, as noted in our study, results from self-reported measures often contradict those of performance-based measures. Ades et al. [48] documented similar findings when the physical function of elderly cardiac patients' was measured objectively and subjectively prior to and after a resistance training intervention. Patients in the resistance training group demonstrated improvements post-intervention in all PFP-10 domain scores whereas none of the five domain scores increased in the control group. Self-reported physical function was assessed using the MOS SF-36 questionnaire. The MOS SF-36 physical function score did not change in either group after training. Thus, the self-reported measure of physical function appears to be insensitive to an increase in strength. This discrepancy may be attributed to the fact that while patients' objectively measured ability to perform ADL improved, they may choose to continue with their habitual routines and not take on any new daily activities despite their improved capacity to perform [48].

Cress and colleagues [61] reported similar findings pertaining to the effect of exercise on physical functional performance in independent elderly adults (aged ≥ 75 years). Again, both objective and subjective measures of physical function were assessed using the CS-PFP and MOS SF-36, respectively. Patients were randomized into an aerobic/resistance exercise group or a control group. After 6 months of training, the exercise group demonstrated an improvement in the CS-PFP global score by 14%, whereas no improvement was seen in the control group. Furthermore, patients in the exercise group improved their domain scores for upper and lower body strength and cardiovascular endurance. All five domain scores remained unchanged from baseline measures in the control group. In addition, only the training group improved the distance ambulated during the 6MWT by 13% (pre: 382 ± 112m vs. post: 440 ± 99m). Conversely, the MOS SF-36 physical function domain score did not improve in either group. These findings are consistent with our group: post-CR, patients' demonstrated improvements in the global PFP-10 and 6MWT scores (14 and 12%, respectively), whereas self-reported MOS SF-36 physical function scores remained unchanged.

A self-reported functional limitation score of ≤ 85 units on the MOS SF-36 physical function domain was used as an indication of dependency. Other researchers [4, 8] have also used a MOS SF-36 functional limitation score of ≤ 85 units to indicate dependency. The observed MOS SF-36 physical function scores pre- and post-CR were 67 ± 22 and 68 ± 20, respectively; thus our entire sample was considered reliant on assistance with daily activities. These observations contrast our objective measure of physical function which showed post-CR, patients had a low probability of becoming dependent on others for assistance with ADL. Our data are the first to show that using an objective, performance-based measure of physical function may be a more useful tool in the rehabilitation setting to classifying patients based on functional ability. Although patients did demonstrate an improved performance of ADL, an improvement in self-reported physical function was not observed. Thus, the subjective measure is a useful tool when considering the self-perceived abilities of the patient.

There has been relatively little research on whether CR prevents or reverses disability in elderly cardiac patients (age ≥ 75 years). Additional investigations are needed to objectively assess benefits of exercise-based CR on the performance of ADL in elderly patients.

5.3 Subsequent Physical Activity

The tertiary hypothesis stated elderly patients' would increase their daily EE, duration of low and moderate PA and STEPS as measured by the SWA post-CR. Changes were not observed in EE, low or moderate PA and STEPS (see Table 4.4), thus the tertiary hypothesis was rejected.

Subsequent PA was also measured subjectively using a self-reported record of daily low, moderate and high PA. Post-CR, patients reported significantly higher scores. These data are consistent with the literature stating self-reported levels of PA increase post-exercise intervention in cardiac and healthy populations [98, 99]. However, when objectively quantifying subsequent PA using the SWA, no change in PA was seen post-CR. Other researchers [98, 100, 101, 102] have used low cost PA intervention tools (e.g. pedometers, uniaxial accelerometers) to objectively evaluate the PA levels of cardiac patients based on the number of steps/day or EE. Our group is the first to compare subsequent PA levels of elderly cardiac patients using the SWA before and after an exercise-based CR program.

The SWA data suggests that our patients are not meeting the current public health PA guidelines. As the adoption of PA into daily life is quite difficult for the younger population, it is anticipated to be even more of a challenge for elderly individuals [103]. According to Tudor-Locke et al. [100], < 5000 STEPS is associated with a sedentary adult lifestyle. When assessing and classifying PA, these researchers advocate a ‘zone’ approach to account for the variation observed in step count between gender and age differences. Daily activities are related to 5000 – 7499 STEPS and can be considered ‘low active’ and 7500 – 9999 STEPS may include some elevated occupational activity demands, but nonetheless is classified as ‘somewhat active’. According to these guidelines, our patients continued to lead ‘low active’ lifestyles following completion of CR. Furthermore, an increase of 3000 – 4000 steps during a 30 minute bout of moderate-intensity walking has been proposed to meet current public health recommendations of ≥ 30 minutes moderate-intensity PA most days of the week [100]. Our patients increased an average of 457 steps/day, thus failing to meet the current guidelines for active living.

Two studies [101, 102] investigated the PA levels and patterns of cardiac patients participating in hospital-based CR program using uniaxial accelerometers. Patients from the study done by Jones et al. [102] wore an accelerometer for 7 consecutive days where EE was assessed on days they attended CR as well as on days not attending CR (non-CR). Results illustrated PA levels were significantly higher on CR days than non-CR days (10, 087 ± 631 vs. 5,287 ± 520 steps/day, respectively). The step count demonstrated by Jones' patients on non-CR days is consistent with the step count found in our sample pre- and post-CR (5155 ± 2320 and 5689 ± 2268, respectively). These findings suggest there is clearly a need for CR therapists to educate patients and reinforce the importance of increasing EE and commit to regular PA outside of the hospital in order to obtain cardio-protective health benefits. Results from Jones et al. [102] and our study are also consistent with those of Ayabe et al. [101] who reported cardiac patients participating in a hospital-based CR program had lower EE and time in moderate PA (i.e. 3 – 6 METs) on days away from CR. On CR days, these patients expended 299 ± 161 kcal/day with 27.5 minutes spent at moderate intensity. While on non-CR days, patients only expended 176 ± 112 kcal/day, with 11 minutes spent in moderate PA. Thus, it was concluded that patients required additional PA outside the CR program in order to meet the public health recommendations for obtaining health benefits. Our patients demonstrated similar results as insufficient levels of PA were achieved in order to attain health benefits. In our study, the number of steps/day coincided with the results pertaining to EE and time spent in LPA and MPA. Post-CR, patients did not demonstrate a change in EE with an increase in daily EE of only 185 kcal/day, which is consistent with the value reported by Ayabe et al. [101] (i.e. 176 ± 112 kcal/day). Moreover, time spent in activities < 3 METs (e.g. LPA: light walking, bowling or gardening) or between 3-6 METs (e.g. MPA: brisk walking and lawn mowing) [78] did not change, implying PA patters did not change. These results are concerning as previous studies have reported after the completion of an exercise intervention, cardiac patients do not engage in a sufficient volume of PA in order to slow CAD progression [101, 102]. The low levels of PA demonstrated by our patients may be associated with a sedentary lifestyle, which may lead to further inactivity and disability, and perhaps to the loss of functional independence.

It is interesting to compare the objectively measured PA levels post-CR with the subjective results. As previously mentioned, the objective tool demonstrated no change in PA levels, whereas patients reported themselves to have a substantial increase in daily PA (see Table 4.4). Applegate et al. [7] suggested that patients may have a misperception of their volume of PA. The data from the SWA support Applegate's findings; despite completing a 20 session exercise-based CR program, patients limited their PA and did not appear to continue exercise outside of the hospital environment. Moreover, post-CR a significant increase in self-reported PA was found in male patients, while no change was seen in female patients. Physical activity patterns of men and women across the lifespan have been widely studied [104-106]. In a cross-sectional study by Caspersen et al. [104] data from the 1991 National Health Interview Survey – Health Promotion/Disease Prevention was evaluated. Results indicated men more often reported regular, sustained physical activity than did women (27% vs. 21%). Furthermore, after age 74, the prevalence of regular, sustained physical activity began to decline substantially for both sexes, but the decline was more pronounced for women. These results are consistent with our finding of elderly male patients self-reporting higher activity levels than women.

Findings from our study suggest cardiac patients participating in a hospital-based CR program were performing insufficient levels of PA in order to attain health benefits. Future studies may wish to focus on the implementation of individually-based home exercise programs immediately following the completion of CR. Initially, home visits from an exercise therapist may be cornerstone to the continuation of home-based exercise by elderly patients and may improve the likelihood that elderly patients will continue with daily exercise [3, 19, 94, 107].

5.4 Exercise Self-efficacy

5.4.1 MSES

The tertiary hypothesis also stated exercise SE would improve after CR as measured by the MSES. The MSES defines SE as having three domains: task, coping and scheduling SE. We predicted SE, as a global measure as well as each domain would improve post-CR. However, changes in SE or the domains were not seen (see Table 4.5), thus the hypothesis was rejected.

A number of groups have examined the role of SE in middle-aged cardiac patients during exercise interventions [16, 17, 70, 108]. Beniamini et al. [108] reported task SE increased in middle-aged cardiac patients (age 59 ± 12 years) after completing a 12 week exercise intervention. Task SE was measured prior to and upon completion of the exercise intervention (strength training) using a SE scale developed by Ewart and Taylor. The scale measured the confidence one had in his/her ability to perform the fundamental aspects of various tasks (i.e. walking various distances, jogging, stair climbing, lift objects of various weights, and doing push-ups). Baseline measures indicated there were no differences in task SE between the experimental and control groups (flexibility training). However, after 12 weeks of training, a significant improvement in task SE was observed in the strength training group (i.e. 30 – 100% improvement), whereas no change was seen in the flexibility group. These researchers concluded a high intensity strength program can improve the SE of cardiac patients more so than a low intensity strength training program, and is an effective intervention for middle-ages cardiac patients.

We are the first group to investigate elderly cardiac patients' exercise SE (i.e. task, schedule and coping SE) both pre- and post-CR. Our results indicated the highest scores were reported for task SE, however a change was not observed following CR as baseline scores were already quite high (77 ± 19). This suggested our sample was already quite confident in performing the elemental aspects of an exercise-based task. When comparing post-CR values of coping and scheduling SE, patients reported higher scheduling SE scores (see Table 4.5). A possible explanation is that our patients were faced with daily scheduling challenges, thus were able to learn how to make appropriate scheduling decisions. After the continual exposure to these barriers, their confidence in their ability to schedule exercise into daily life improved which was reflected by a higher post-CR scheduling SE score (see Table 4.5). Although a small effect in coping SE was observed post-CR, the change in coping SE was not large enough to be significant. Furthermore, Schwarzer and Renner's [109] have suggested that coping SE becomes a more important determinant of SE the longer the individual continues to exercise and acquires skills.

Sullivan et al. [72] found SE associated with maintaining function helped predict physical function of cardiac patients undergoing cardiac catheterization. Although this group included patients aged 45 – 80 years, analysis of elderly patients (65 – 79 years) was done separately. Findings suggested exercise programs designed for elderly patients with chronic diseases may not only improve the physical condition, but also may boost exercise SE. According to Sullivan, this increase in exercise SE is thought to decrease the elderly cardiac patients' probability of requiring assistance with ADL. The research by Carroll [73] also relates to the effect SE has on elderly patients' ability to perform ADL. Her work demonstrated SE expectations for behaviours relating to ADL significantly improved post-cardiac surgery in cardiac patients aged 65 – 87 years.

Specifically, behaviours associated with stair climbing, walking and general activities, all which improved over the recovery time.

5.5 Summary

Cardiac rehabilitation programs which incorporate both aerobic and resistance activities may enhance the ability of the elderly patient to live independently. Prior to CR, our patient's mean global PFP-10 score fell below the threshold of independence, indicating the possibility of preclinical disability. Post-CR, patients scored above the threshold demonstrating an objectively measured improved physical capacity. However, subjectively measured physical function did not reflect an improved capacity to perform; self-reported physical functions scores remained unchanged after CR. Additionally, coping and scheduling SE did not show statistical significance (i.e. $p < 0.05$), however, results indicated CR had a positive effect on patients' confidence in their ability to perform and schedule PA in their daily life. As the duration between testing times was short (i.e. 6-8 weeks), an order effect may explain the discrepancy in objective and subjective results. A longer time interval may be necessary before ADL in the home environment become noticeably easier to the patient as result of their improved psychological constructs and increased physical capacity. Follow-up at twelve and 6 months is necessary to evaluate any effect of time.

5.6 Limitations

A major limitation of our study was sample size. Although the estimated 20+ patients were recruited and tested, a larger sample pool would increase the generalizability of the study. However, the retrospective power calculation for the primary outcome measure (i.e. PFP-10 global score) indicated the actual power to be 97.5%, exceeding the anticipated 80%. Although the sample size was small, the power was large enough to avoid making a type II error (i.e. stating a difference when a difference did not exist). Furthermore, while some outcomes measures may have been narrowed by a small sample size, the high exclusion rate, which resulted from extensive exclusion criteria, may have resulted in fewer exercise-induced cardiac events and thus fewer drop-outs.

An additional limitation is the aerobic-only exercising control group. Ideally, the aerobic/resistance training group would have been compared to an age- and gender-matched aerobic only training group. However, as CR programs are moving towards including resistance training [44, 46, 110], the clinician must attempt to reinforce the importance of increasing caloric expenditure and motivate patients to initiate and commit to increasing PA [110]. The CR program at the GNH does include resistance training; therefore it would have been unfair to withhold the resistance portion of the program from any of our patients. Nonetheless, we were still able to highlight the need for exercise-based CR programs which not only improved the functional performance of elderly patients, but also decreased the risk of dependency.

5.7 Future Considerations

The current study should serve as 'landmark' investigation on which to study the value of aerobic/resistance-based CR programs aimed at improving the physical function of elderly cardiac patients. Future research in this area should include age- and gender-matched controls (i.e. patients solely participating in aerobic-based CR programs) for comparison to those participating in aerobic/resistance-based CR programs. Additionally, follow-up at 6 and 12 months post-CR should be considered to better understand if physical function and independence is maintained outside of a supervised exercise environment.

REFERENCES CITED

1. Ades PA, Savage PD, Tischler MD, Poehlman ET, Dee J, Niggel J. Determinants of disability in older coronary patients. *Am Heart J*. Jan 2002;143(1):151-156.

2. Ades PA, Maloney A, Savage P, Carhart RL, Jr. Determinants of physical functioning in coronary patients: response to cardiac rehabilitation. *Arch Intern Med*. Oct 25 1999;159(19):2357-2360.

3. Marchionni N, Fattirolli F, Fumagalli S, et al. Improved exercise tolerance and quality of life with cardiac rehabilitation of older patients after myocardial infarction: results of a randomized, controlled trial. *Circulation*. May 6 2003;107(17):2201-2206.

4. Pinsky JL, Jette AM, Branch LG, Kannel WB, Feinleib M. The Framingham Disability Study: relationship of various coronary heart disease manifestations to disability in older persons living in the community. *Am J Public Health*. Nov 1990;80(11):1363-1367.

5. Kennedy R, Andrews G, Caird F. Ischemic Heart Disease. *Br Heart J*. 1977;39:1121-1127.

6. Jette DU, Downing J. Health status of individuals entering a cardiac rehabilitation program as measured by the medical outcomes study 36-item short-form survey (SF-36). *Phys Ther*. Jun 1994;74(6):521-527.

7. Applegate WB, Blass JP, Williams TF. Instruments for the functional assessment of older patients. *N Engl J Med*. Apr 26 1990;322(17):1207-1214.

8. Bronchu M, Savage P, Lee M, et al. Effects of resistance training on physical function in older disabled women with coronary heart disease. *J Appl Physiol*. Feb 2002;92(2):672-678.

9. Cress ME, Meyer M. Maximal voluntary and functional performance levels needed for independence in adults aged 65 to 97 years. *Phys Ther*. Jan 2003;83(1):37-48.

10. Petrella JK, Cress ME. Daily ambulation activity and task performance in community-dwelling older adults aged 63-71 years with preclinical disability. *J Gerontol A Biol Sci Med Sci*. Mar 2004;59(3):264-267.

11. Fried LP, Bandeen-Roche K, Kasper JD, Guralnik JM. Association of comorbidity with disability in older women: the Women's Health and Aging Study. *J Clin Epidemiol*. Jan 1999;52(1):27-37.

12. Ades PA, Waldmann ML, Poehlman ET, et al. Exercise conditioning in older coronary patients. Submaximal lactate response and endurance capacity. *Circulation*. Aug 1993;88(2):572-577.

13. Cress ME. Quantifying physical functional performance in older adults. *Muscle Nerve Suppl*. 1997;5:S17-20.

14. Anderson C. When more is better: number of motives and reasons for quitting as correlates of physical activity in women. *Heath Education Research*. 2003;18:525-537.

15. Bandura A. *Social Foundations of Thought and Action*. New Jersey: Prentice-Hall; 1986.

16. Blanchard CM, Rodgers WM, Courneya KS, Daub B, Black B. Self-efficacy and mood in cardiac rehabilitation: should gender be considered? *Behav Med*. Winter 2002;27(4):149-160.

17. Gardner JK, McConnell TR, Klinger TA, Herman CP, Hauck CA, Laubach Jr CA. Quality of life and self-efficacy: gender and diagnoses considerations for management during cardiac rehabilitation. *J Cardiopulm Rehabil*. Jul-Aug 2003;23(4):299-306.

18. Audelin MC, Savage PD, Ades PA. Exercise-based cardiac rehabilitation for very old patients (> or =75 years): focus on physical function. *J Cardiopulm Rehabil Prev*. May-Jun 2008;28(3):163-173.

19. Ades PA. Cardiac Rehabilitation in Older Cardiac Patients. Cardiovascular Disease in the Elderly. Totowa: Humana Press; 2005:319-334.

20. Brach JS, VanSwearingen JM. Physical impairment and disability: relationship to performance of activities of daily living in community-dwelling older men. *Phys Ther*. Aug 2002;82(8):752-761.

21. Cardiac rehabilitation programs. A statement for healthcare professionals from the American Heart Association. *Circulation*. Sep 1994;90(3):1602-1610.

22. Hoffman M, Ryan JL, Figueroa-Moseley CD, Jean-Pierre P, Morrow GR. Cancer-related fatigue: the scale of the problem. *Oncologist*. 2007;12 Suppl 1:4-10.

23. McArdle WD, Katch FI, Katch VL. *Exercise Physiology: energy, nutrition and human performance*. 4 ed. Baltimore: Williams & Wilkins; 2006.

24. Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: the evidence. *Cmaj*. Mar 14 2006;174(6):801-809.

25. Leon A, Franklin B, Costa F, Balady G, Berra K. Cardiac Rehabilitation and secondary prevention of coronary heart disease. *Circ J*. 2005;111:369-376.

26. Williams MA, Fleg JL, Ades PA, et al. Secondary prevention of coronary heart disease in the elderly (with emphasis on patients > or =75 years of age): an American Heart Association scientific statement from the Council on Clinical Cardiology Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention. *Circulation*. Apr 9 2002;105(14):1735-1743.

27. Miller NH, Haskell WL, Berra K, DeBusk RF. Home versus group exercise training for increasing functional capacity after myocardial infarction. *Circulation*. Oct 1984;70(4):645-649.

28. Awtry E, Loscalazo J. Coronary Heart Disease. Cecil essentials of medicine. 6th ed. Philadelphia: Saunders; 2004.

29. Schoen F. The Heart. Robins: Pathological Basis of Disease. 5th ed. Philadelphia: Saunders; 1994.

30. Canada HaSFo. Cardiovascular Disease [Web page]. Accessed June 15, 2008.

31. Manuel DG, Leung M, Nguyen K, Tanuseputro P, Johansen H. Burden of cardiovascular disease in Canada. *Can J Cardiol*. Aug 2003;19(9):997-1004.

32. Grundy SM, Balady GJ, Criqui MH, et al. Primary prevention of coronary heart disease: guidance from Framingham: a statement for healthcare professionals from the AHA Task Force on Risk Reduction. American Heart Association. *Circulation*. May 12 1998;97(18):1876-1887.

33. Yusuf S, Hawken S, Ounpuu S, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet*. Sep 11-17 2004;364(9438):937-952.

34. Wood D, De Backer G, Faergeman O, Graham I, Mancia G, Pyorala K. Prevention of coronary heart disease in clinical practice. Summary of recommendations of the Second Joint Task Force of European and other Societies on Coronary Prevention. *Blood Press*. Nov 1998;7(5-6):262-269.

35. Sesso HD, Paffenbarger RS, Jr., Lee IM. Physical activity and coronary heart disease in men: The Harvard Alumni Health Study. *Circulation*. Aug 29 2000;102(9):975-980.

36. Hakim AA, Curb JD, Petrovitch H, et al. Effects of walking on coronary heart disease in elderly men: the Honolulu Heart Program. *Circulation*. Jul 6 1999;100(1):9-13.

37. Donahue R, Abbott D, Reed DM, Yano K. Physical activity and coronary heart disease in middle-aged and elderly men: The Honolulu Heart Program. *Circ J*. 1988;100:9-13.

38. Pashkow FJ. Issues in contemporary cardiac rehabilitation: a historical perspective. *J Am Coll Cardiol*. Mar 1 1993;21(3):822-834.

39. Ades PA. Cardiac rehabilitation and secondary prevention of coronary heart disease. *N Engl J Med*. Sep 20 2001;345(12):892-902.

40. Vongvanich P, Paul-Labrador MJ, Merz CN. Safety of medically supervised exercise in a cardiac rehabilitation center. *Am J Cardiol*. Jun 15 1996;77(15):1383-1385.

41. Franklin BA, Bonzheim K, Gordon S, Timmis GC. Safety of medically supervised outpatient cardiac rehabilitation exercise therapy: a 16-year follow-up. *Chest*. Sep 1998;114(3):902-906.

42. Haskell WL. Cardiovascular complications during exercise training of cardiac patients. *Circulation*. May 1978;57(5):920-924.

43. Van Camp SP, Peterson RA. Cardiovascular complications of outpatient cardiac rehabilitation programs. *Jama*. Sep 5 1986;256(9):1160-1163.

44. Balady GJ, Ades PA, Comoss P, et al. Core components of cardiac rehabilitation/secondary prevention programs: A statement for healthcare professionals from the American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation Writing Group. *Circulation*. Aug 29 2000;102(9):1069-1073.

45. Thompson PD. Exercise prescription and proscription for patients with coronary artery disease. *Circulation*. Oct 11 2005;112(15):2354-2363.

46. Williams M. Exercise Testing in Cardiac Rehabilitation. *Cardiol Clin*. 2001;19(3):415-431.

47. Pollock ML, Evans WJ. Resistance training for health and disease: introduction. *Med Sci Sports Exerc*. Jan 1999;31(1):10-11.

48. Ades PA, Savage PD, Cress ME, Brochu M, Lee NM, Poehlman ET. Resistance training on physical performance in disabled older female cardiac patients. *Med Sci Sports Exerc*. Aug 2003;35(8):1265-1270.

49. Ades PA, Waldmann ML, Polk DM, Coflesky JT. Referral patterns and exercise response in the rehabilitation of female coronary patients aged greater than or equal to 62 years. *Am J Cardiol*. Jun 1 1992;69(17):1422-1425.

50. Blackburn GG, Foody JM, Sprecher DL, Park E, Apperson-Hansen C, Pashkow FJ. Cardiac rehabilitation participation patterns in a large, tertiary care center: evidence for selection bias. *J Cardiopulm Rehabil*. May-Jun 2000;20(3):189-195.

51. Cortes O, Arthur HM. Determinants of referral to cardiac rehabilitation programs in patients with coronary artery disease: a systematic review. *Am Heart J*. Feb 2006;151(2):249-256.

52. Cottin Y, Cambou JP, Casillas JM, Ferrieres J, Cantet C, Danchin N. Specific profile and referral bias of rehabilitated patients after an acute coronary syndrome. *J Cardiopulm Rehabil*. Jan-Feb 2004;24(1):38-44.

53. Grace SL, Evindar A, Kung TN, Scholey PE, Stewart DE. Automatic referral to cardiac rehabilitation. *Med Care*. Jul 2004;42(7):661-669.

54. Ratchford AM, Hamman RF, Regensteiner JG, Magid DJ, Gallagher SB, Merenich JA. Attendance and graduation patterns in a group-model health maintenance organization alternative cardiac rehabilitation program. *J Cardiopulm Rehabil*. May-Jun 2004;24(3):150-156.

55. Johnson N, Fisher J, Nagle A, Inder K, Wiggers J. Factors associated with referral to outpatient cardiac rehabilitation services. *J Cardiopulm Rehabil*. May-Jun 2004;24(3):165-170.

56. Jette AM, Branch LG. The Framingham Disability Study: II. Physical disability among the aging. *Am J Public Health*. Nov 1981;71(11):1211-1216.

57. Chirikos TN, Nickel JT. Socioeconomic determinants of continuing functional disablement from chronic disease episodes. *Soc Sci Med*. 1986;22(12):1329-1335.

58. Stewart AL, Hays RD, Ware JE, Jr. The MOS short-form general health survey. Reliability and validity in a patient population. *Med Care*. Jul 1988;26(7):724-735.

59. Lavie CJ, Milani RV. Effects of cardiac rehabilitation and exercise training in obese patients with coronary artery disease. *Chest*. Jan 1996;109(1):52-56.

60. Balady GJ, Jette D, Scheer J, Downing J. Changes in exercise capacity following cardiac rehabilitation in patients stratified according to age and gender. Results of the Massachusetts Association of Cardiovascular and Pulmonary Rehabilitation Multicenter Database. *J Cardiopulm Rehabil*. Jan-Feb 1996;16(1):38-46.

61. Cress ME, Buchner D, Kent A, Questad KA, Esselman PC, deLateur BJ. Exercise: effects on physical performance in performance in independent older adults. *J of Gerontology*. 1999;50A(5):242-248.

62. Cress ME, Buchner DM, Questad KA, Esselman PC, deLateur BJ, Schwartz RS. Continuous-scale physical functional performance in healthy older adults: a validation study. *Arch Phys Med Rehabil*. Dec 1996;77(12):1243-1250.

63. Cress ME, Petrella JK, Moore TL, Schenkman ML. Continuous-scale physical functional performance test: validity, reliability, and sensitivity of data for the short version. *Phys Ther*. Apr 2005;85(4):323-335.

64. Jakicic JM, Marcus M, Gallagher KI, et al. Evaluation of the SenseWear Pro Armband to assess energy expenditure during exercise. *Med Sci Sports Exerc*. May 2004;36(5):897-904.

65. Cole PJ, LeMura LM, Klinger TA, Strohecker K, McConnell TR. Measuring energy expenditure in cardiac patients using the Body Media

Armband versus indirect calorimetry. A validation study. *J Sports Med Phys Fitness*. Sep 2004;44(3):262-271.

66. Fruin ML, Rankin JW. Validity of a multi-sensor armband in estimating rest and exercise energy expenditure. *Med Sci Sports Exerc*. Jun 2004;36(6):1063-1069.

67. Conway JM, Seale JL, Jacobs DR, Jr., Irwin ML, Ainsworth BE. Comparison of energy expenditure estimates from doubly labeled water, a physical activity questionnaire, and physical activity records. *Am J Clin Nutr*. Mar 2002;75(3):519-525.

68. Starling RD, Matthews DE, Ades PA, Poehlman ET. Assessment of physical activity in older individuals: a doubly labeled water study. *J Appl Physiol*. Jun 1999;86(6):2090-2096.

69. Malavolti M, Pietrobelli A, Dugoni M, et al. A new device for measuring resting energy expenditure (REE) in healthy subjects. *Nutr Metab Cardiovasc Dis*. Jun 2007;17(5):338-343.

70. Lavie CJ, Milani RV. Effects of cardiac rehabilitation and exercise training on exercise capacity, coronary risk factors, behavioral characteristics, and quality of life in women. *Am J Cardiol*. Feb 15 1995;75(5):340-343.

71. Lavie CJ, Milani RV. Effects of cardiac rehabilitation programs on exercise capacity, coronary risk factors, behavioral characteristics, and quality of life in a large elderly cohort. *Am J Cardiol*. Jul 15 1995;76(3):177-179.

72. Sullivan MD, LaCroix AZ, Russo J, Katon WJ. Self-efficacy and self-reported functional status in coronary heart disease: a six-month prospective study. *Psychosom Med*. Jul-Aug 1998;60(4):473-478.

73. Carroll DL. The importance of self-efficacy expectations in elderly patients recovering from coronary artery bypass surgery. *Heart Lung*. Jan-Feb 1995;24(1):50-59.

74. McNeer JF, Margolis JR, Lee KL, et al. The role of the exercise test in the evaluation of patients for ischemic heart disease. *Circulation*. Jan 1978;57(1):64-70.

75. Vanhees L, Fagard R, Thijs L, Amery A. Prognostic value of training-induced change in peak exercise capacity in patients with myocardial infarcts and patients with coronary bypass surgery. *Am J Cardiol*. Nov 15 1995;76(14):1014-1019.

76. Achar A, Kundu S, Norcross W. Diagnosis of acute coronary syndrome. *Am Fam Physician*. 2005;72:199-126.

77. Glass G, Hopkins K. *Statistical Methods in Education and Psychology*. 3rd ed. Boston: Allyn and Bacon; 1997.

78. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc*. Sep 2000;32(9 Suppl):S498-504.

79. Cahalin LP, Mathier MA, Semigran MJ, Dec GW, DiSalvo TG. The six-minute walk test predicts peak oxygen uptake and survival in patients with advanced heart failure. *Chest*. Aug 1996;110(2):325-332.

80. Ware J, Snow KK, Kosinsky M, and Gandek B (Eds). *SF-36 Health Survey Mannual and Interpretation Guide*. Boston MA: Nimrod; 1993.

81. Sutton M, Plappert T, Spiegel A, et al. Early postoperative changes in left ventricular chamber size, architecture, and function in aortic stenosis and aortic regurgitation and their relation to intraoperative changes in afterload: a prospective two-dimensional echocardiographic study. *Circulation*. Jul 1987;76(1):77-89.

82. Tarlov AR, Ware JE, Jr., Greenfield S, Nelson EC, Perrin E, Zubkoff M. The Medical Outcomes Study. An application of methods for monitoring the results of medical care. *Jama*. Aug 18 1989;262(7):925-930.

83. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. Jun 1992;30(6):473-483.

84. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci*. Sep 1985;10(3):141-146.

85. Sallis JF, Buono MJ, Roby JJ, Micale FG, Nelson JA. Seven-day recall and other physical activity self-reports in children and adolescents. *Med Sci Sports Exerc*. Jan 1993;25(1):99-108.

86. Rodgers WM, Wilson PM, Hall CR, Fraser SN, Murray TC. Evidence for a multidimensional self-efficacy for exercise scale. *Res Q Exerc Sport*. Jun 2008;79(2):222-234.

87. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.

88. Fletcher GF, Balady G, Blair SN, et al. Statement on exercise: benefits and recommendations for physical activity programs for all Americans. A statement for health professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology, American Heart Association. *Circulation*. Aug 15 1996;94(4):857-862.

89. Fragnoli-Munn K, Savage PD, Ades PA. Combined resistive-aerobic training in older patients with coronary artery disease early after myocardial infarction. *J Cardiopulm Rehabil*. Nov-Dec 1998;18(6):416-420.

90. Roberts R, Roberts SB. *Fundemental prinicles of exercise physiology for fitness, performance and health*. Boston: McGraw-Hill; 2000.

91. Marottoli RA, Berkman LF, Cooney LM, Jr. Decline in physical function following hip fracture. *J Am Geriatr Soc*. Sep 1992;40(9):861-866.

92. Taylor AW, Johnson MJ. *Physiology of exericse and health aging*. Windsor: Human Kinetics; 2008.

93. Kannus P. Preventing osteoporosis, falls, and fractures among elderly people. Promotion of lifelong physical activity is essential. *Bmj*. Jan 23 1999;318(7178):205-206.

94. Stahle A, Mattsson E, Ryden L, Unden A, Nordlander R. Improved physical fitness and quality of life following training of elderly patients after acute coronary events. A 1 year follow-up randomized controlled study. *Eur Heart J*. Oct 1999;20(20):1475-1484.

95. Maniar S, Sanderson BK, Bittner V. Comparison of baseline characteristics and outcomes in younger and older patients completing cardiac rehabilitation. *J Cardiopulm Rehabil Prev*. Jul-Aug 2009;29(4):220-229.

96. Poehlman ET, Toth MJ, Gardner AW. Changes in energy balance and body composition at menopause: a controlled longitudinal study. *Ann Intern Med*. Nov 1 1995;123(9):673-675.

97. Pepin V, Phillips WT, Swan PD. Functional fitness assessment of older cardiac rehabilitation patients. *J Cardiopulm Rehabil*. Jan-Feb 2004;24(1):34-37.

98. Dunn AL, Marcus BH, Kampert JB, Garcia ME, Kohl HW, 3rd, Blair SN. Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness: a randomized trial. *Jama*. Jan 27 1999;281(4):327-334.

99. Schairer JR, Keteyian SJ, Ehrman JK, Brawner CA, Berkebile ND. Leisure time physical activity of patients in maintenance cardiac rehabilitation. *J Cardiopulm Rehabil*. Jul-Aug 2003;23(4):260-265.

100. Tudor-Locke C, Bassett DR, Jr. How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Med*. 2004;34(1):1-8.

101. Ayabe M, Brubaker PH, Dobrosielski D, et al. The physical activity patterns of cardiac rehabilitation program participants. *J Cardiopulm Rehabil*. Mar-Apr 2004;24(2):80-86.

102. Jones NL, Schneider PL, Kaminsky LA, Riggin K, Taylor AM. An assessment of the total amount of physical activity of patients participating in a phase III cardiac rehabilitation program. *J Cardiopulm Rehabil Prev*. Mar-Apr 2007;27(2):81-85.

103. Moore SM, Dolansky MA, Ruland CM, Pashkow FJ, Blackburn GG. Predictors of women's exercise maintenance after cardiac rehabilitation. *J Cardiopulm Rehabil*. Jan-Feb 2003;23(1):40-49.

104. Casperson C, Pereria M, Curran K. Changes in physical activity patterns in the United States, by sex and cross-sectional age. *Medicine and Science in Sport and Exercise*. 2000;32(8):1601-1608.

105. Sallis JF. Age-related decline in physical activity: a synthesis of human and animal studies. *Med Sci Sports Exerc*. Sep 2000;32(9):1598-1600.

106. Telama R, Leskinen E, Yang X. Stability of habitual physical activity and sport participation: a longitudinal tracking study. *Scand J Med Sci Sports*. Dec 1996;6(6):371-378.

107. Jette AM, Lachman M, Giorgetti MM, et al. Exercise--it's never too late: the strong-for-life program. *Am J Public Health*. Jan 1999;89(1):66-72.

108. Beniamini Y, Rubenstein JJ, Zaichkowsky LD, Crim MC. Effects of high-intensity strength training on quality-of-life parameters in cardiac rehabilitation patients. *Am J Cardiol*. Oct 1 1997;80(7):841-846.

109. Schwartzer R, Renner B. Social-cognitive predictors of health behaviour: action self-efficacy and coping self-efficacy. *Health Psychology*. 2000;29(2):105-114.

110. Pollock ML, Franklin BA, Balady GJ, et al. AHA Science Advisory. Resistance exercise in individuals with and without cardiovascular disease: benefits, rationale, safety, and prescription: An advisory from the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, American Heart Association; Position paper endorsed by the American College of Sports Medicine. *Circulation*. Feb 22 2000;101(7):828-833.

APPENDIX A

June 16, 2008

Dr. Bob Haennel
Physical Therapy File#
B-300508
2-50 Corbett Hall

Re: Determining the Impact of Cardiac Rehabilitation on Physical Activity and Function Ability in Elderly Cardiac Patients

Dear Dr. Haennel:

Thank you for Ms. Megan Johnston's email correspondence dated June 11th, 2008, which addressed the requested revisions to the above-mentioned study. These changes have been reviewed and approved on behalf of the Research Ethics Board. Your approval letter is enclosed.

In order to comply with the Health Information Act, a copy of the approval form is being sent to the Office of the Information and Privacy Commissioner.

Next year, a few weeks prior to the expiration of your approval, a Progress Report will be sent to you for completion. If there have been no major changes in the protocol, your approval will be renewed for another year. All protocols may be subject to re-evaluation after three years.

For studies where investigators must obtain informed consent, signed copies of the consent form must be retained, and be available on request. They should be kept for the duration of the project and for a full calendar year following its completion.

Approval by the Health Research Ethics Board does not encompass authorization to access the patients, staff or resources of Capital Health or other local health care institutions for the purposes of research. Enquiries regarding Capital Health administrative approval, and operational approval for areas impacted by research, should be directed to the Capital Health Regional Research Administration office, #1800 College Plaza, phone 407-6041.

Sincerely,

Charmaine N. Kabatoff
Senior Administrator
Health Research Ethics Board (Panel B)

APPENDIX B

CONSENT FORM

Determining the Impact of Cardiac Rehabilitation on Physical Activity and Function Ability in Elderly Cardiac Patients

PRINCIPAL INVESTIGATOR:

RG HANNEL, PHD   Faculty of Rehabilitation Medicine   492-2889

CO-INVESTIGATORS:

M. Johnston M.Sc Candidate	Faculty of Rehabilitation Medicine 492-2609
W. Rodgers Ph.D	U of A, Physical Education 492-2677
M. Senaratne M.D., FRCPC	Division of Cardiology 735-7074 Grey Nuns Hospital

---

Do you understand that you have been asked to be in a research study?
Yes   No

Have you received and read a copy of the attached Information Sheet?
Yes   No

Do you understand the benefits and risks involved in taking part in this research study?
Yes   No

Have you had an opportunity to ask questions and discuss this study?
Yes   No

Do you understand that you are free to refuse to participate, or to withdraw from the study at any time, without consequence, and that your information will be withdrawn at your request?

Yes No

Has the issue of confidentiality been explained to you? Do you understand who will have access to your information?

Yes No

Do you want the investigator(s) to inform your family doctor or specialist that you are participating in this research study. If so, please provide your doctor's name: ______________________________

Yes No

I understand withdraw from this study will not affect my current or future Medical care

Yes No

This study was explained to me by: ______________________________

I agree to take part in this study.

___________________________ ___________________________

Signature of Research Participant Date

____

Printed Name

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

___________________________________ ____________________

Signature of Investigator or Designee Date

APPENDIX C

INFORMATION SHEET

DETERMINING THE IMPACT OF CARDIAC REHABILITATION ON PHYSICAL ACTIVITY AND FUNCTION ABILITY IN ELDERLY CARDIAC PATIENTS

PRINICPLE INVESTIGATOR:

R. Haennel Ph.D FACSM	U of A, Rehabilitation Medicine	492-2889

CO-INVESTIGATORS:

M. Johnston M.Sc Candidate	U of A, Rehabilitation Medicine	492-2609
W. Rodgers Ph.D	U of A, Physical Education	492-2677
M. Senaratne M.D., FRCPC	Division of Cardiology Grey Nuns Hospital	735-7074

BACKGROUND: Elderly patients recovering from a heart attack are encouraged to participate in exercise training, which includes walking and cycling, as part of their rehabilitation. Participation in such a program helps improve your ability to exercise. However it is not known the extent to which such programs improve a person's ability to perform activities of daily living.

PURPOSE: You are being asked to participate in a study that will establish the effect of cardiac rehabilitation has on your physical activity level.

DESCRIPTION OF THE STUDY
If you decide to participate in this study, the total time commitment will be approximately 2 hours on two separate occasions. Participation in this study will not affect/influence your treatment at your cardiac rehabilitation centre

RESEARCH PROCEDURES
Baseline testing (first week)
Before beginning the cardiac rehabilitation exercise training you will complete the following tests over a one week period:

Wear an activity sensor armband. You will be given an armband to wear for three consecutive days (one weekend day and two weekday days). The arm band collects information about your daily activity. The armband is worn on the back of your upper arm, where it can be easily placed underneath clothing. The arm band is worn at all times of the day and night (i.e. at work, during exercise, while sleeping) except when entering water (i.e. showering or swimming). After three days a member of the research team will pick up the armband from you.

Activities of Daily Living Test. Once the arm band task is completed, you will complete 10 activities of daily living. You will be asked to carry out each of the following tasks: carrying a weighted pot, putting on and taking off a jacket, picking up four scarves, sweeping the floor, transferring laundry from a washer to a dryer, transferring clothes from dryer to a basket, sitting down and standing from the floor, carrying groceries, climbing up and down a set of four stairs and a 6 minute walk. For each task, you choose the speed and intensity at which you feel you can safely finish the task. A tester will be present throughout the entire test to guide you. You may take a break at any point during the test. If you feel one task is too difficult, you may skip it and move on to the next task. The test will be carried out at the hospital where you are participating in cardiac rehabilitation or at the University of Alberta.

Quality of Life Questionnaire. You will be asked to fill out a quality of life questionnaire. It will ask you questions about your ability to do activities of daily living, any body pain you may have and general health. It will take about 5 minutes to complete.

Exercise Self Efficacy. You will be asked to fill out the Self Efficacy for Exercise scale. This scale will ask you to answer 9 questions about how confident you are when you are exercising at a moderate level. It will take about 5 minutes to complete.

Physical Activity Record. You will be asked to fill out an activity log which will ask you questions about your physical activity for the last 7 days. It will ask you to remember how many times in the past 7 days you spent doing easy, moderate and hard activity for 15 minutes. It will take about 5 minutes to complete.

Follow-up testing (8 weeks after starting Cardiac Rehabilitation)
The same tests that were done at baseline will be repeated at 8 weeks after starting the cardiac rehabilitation program.

POSSIBLE BENEFITS
If you wish to see your results from this study, you will be given information about your results and a research assistant will sit down and explain them to you. There may not be any direct personal benefits from this study.

POSSIBLE RISKS

The exercises that you will perform are generally safe. All testing sessions will be performed under appropriate supervision. Data from people with and without heart disease suggests that the possibility of having a heart attack or dying during a maximal effort treadmill test is 1 in 10,000 tests. In this study the risk is lower as all exercises you perform will be done at a very low level of effort. All testing will be done under the supervision of qualified personnel, and you may stop the test at any time.

COSTS
You will be reimbursed for all travel and parking expenses associated with all appointments at the University of Alberta.

CONFIDENTIALITY
Only researchers in this study will have access to your records. It is possible that your health information may be inspected or copied for quality assurance by the University of Alberta Health Research Ethics Board. In this case disclosure of your health information will follow the Alberta Health Information Act.

All records will be kept in a locked drawer at the University of Alberta. Records must be kept for seven years, and after that will be destroyed.

WITHDRAW
You are free to withdraw from the research study at any time. If you withdraw from the study or it is discontinued at any time, the quality of your medical care will not be affected

CONTACT NAMES AND TELEPHONE NUMBERS
If you have concerns about any aspect of this study, you may contact the Caritas Research Centre at the Caritas Health Group at (780) 735-2274. This office has no affiliation with the study or its investigators.

Please contact any of the individuals identified below if you have any questions or concerns:

Robert Haennel, PhD — Office: 780-492-2889

Megan Johnston, 2009 M.Sc Candidate — Office: 780-492-2609

APPENDIX D

SF-36 HEALTH SURVEY

INSTRUCTIONS: This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

Answer every question by marking the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

1. In general, would you say your health is:

   Excellent

   Very good

   Good

   Fair

   Poor

2. Compared to one year ago, how would you rate your health in general now?

   Much better now than one year ago

   Somewhat better now than one year ago

   About the same as one year ago

   Somewhat worse now than one year ago

   Much worse now than one year ago

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

(circle one number on each line)

ACTIVITIES	**Yes, Limited A Lot**	**Yes, Limited A Little**	**No, Not Limited At All**
a. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3
c. Lifting or carrying groceries	1	2	3
d. Climbing **several** flights of stairs	1	2	3
e. Climbing **one** flight of stairs	1	2	3
f. Bending, kneeling, or stooping	1	2	3
g. Walking **more than a kilometre**	1	2	3
h. Walking **several blocks**	1	2	3
i. Walking **one block**	1	2	3
j. Bathing or dressing yourself	1	2	3

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

(circle one number on each line)

	YES	**NO**
a. Cut down on the **amount of time** you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2
c. Were limited in the **kind** of work or other activities	1	2
d. Had **difficulty** performing the work or other activities (for example, it took extra effort)	1	2

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

(circle one number on each line)

	YES	NO
a. Cut down the **amount of time** you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2
c. Didn't do work or other activities as **carefully** as usual	1	2

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

Not at all

Slightly

Moderately

Quite a bit

Extremely

7. How much bodily pain have you had during the past 4 weeks?

None

Very mild

Mild

Moderate

Severe

Very severe

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

Not at all

A little bit

Moderately

Quite a bit

Extremely

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks -

(circle one number on each line)

	All of the Time	**Most of the Time**	**A Good Bit of the Time**	**Some of the Time**	**A Little of the Time**	**None of the Time**
a. Did you feel full of pep?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6
f. Have you felt downhearted and blue?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6
h. Have you been a happy person?	1	2	3	4	5	6
i. Did you feel tired?	1	2	3	4	5	6

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

All of the time

Most of the time

Some of the time

A little of the time

None of the time

11. How TRUE or FALSE is each of the following statements for you?

(circle one number on each line)

	Definitely True	**Mostly True**	**Don't Know**	**Mostly False**	**Definitely False**
a. I seem to get sick a little easier than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

APPENDIX E

Godin Leisure-Time Exercise Questionnaire

1. During a typical **7-Day period** (a week), how many times on the average do you do the
following kinds of exercise for **more than 15 minutes** during your free time (write on each line the appropriate number).

Times Per Week

a) STRENUOUS EXERCISE (HEART BEATS RAPIDLY) __________

(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

b) MODERATE EXERCISE (NOT EXHAUSTING) __________

(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

c) MILD EXERCISE (MINIMAL EFFORT) __________

(e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)

2. During a typical **7-Day period** (a week), in your leisure time, how often do you engage in any regular activity **long enough to work up a sweat** (heart beats rapidly)?

OFTEN	SOMETIMES	NEVER/RARELY
1. □	2. □	3. □

APPENDIX F

Self-Efficacy for Exercise

Please indicate HOW CONFIDENT YOU ARE THAT YOU CAN PERFORM each of the exercise related tasks below. When you think of exercise, think of walking at a moderate intensity three times per week for about 30 minutes

0%	10 %	20 %	30 %	40 %	50 %	60 %	70 %	80 %	90 %	100 %
No confidence										Complete Confidence
How confident are you that you can…….										

Complete your exercise using proper technique	%
Follow directions to complete the exercise	%
Perform all of the movements required for your	%
Exercise when you feel discomfort from the	%
Do your exercise when you lack energy	%
Include exercise in your daily routine	%
Exercise consistently every day of the week	%
Do your exercise when you don’t feel well	%
Arrange your schedule to include regular exercise	%

APPENDIX G

Patient Medications

Patient	Medication
1	ASA, Plavix, Ramipril, Metoprolol, Calcium, Glucosamine, Fosamax, Omega 3
2	ASA, Plavix, Metoprolol, Lipitor, Zestoretic, Synthroid, Metformin, Nitro spray
3	ASA, Plavix, Prevacid, Gabapentin, Diovan, Flomax, Ferrous Gluconate, Nitro spray
4	ASA, Plavix, Metoprolol, Cozaar, Lipitor, Nitro Spray
5	ASA, Plavix, Ramipril, Monocor, Ferrous Ferrate, Pentoloc, Lasix, Lipitor, Coumadin, Norvasc, Vitamin D, Calcium, Nitro spray
6	ASA, Plavix, Metoprolol, Lipitor, Diovan, Vitamin D
7	ASA, Plavix, Monocor, Ramipril, Lipitor, Losec, Vitamin D, Calcium, Omega 3, Nitro spray
8	ASA, Metoprolol, Clopidogrol, Metformin, Crestor, Gliclazide, Nitro spray
9	ASA, Plavix, Altace, Metoprolol, Lipitor, Coumadin,
10	ASA, Plavix, Ramipril, Metoprolol, Lipitor, Pantoloc
11	ASA, Metoprolol, Lipitor, Clopidogrol, Nitro Spray
12	ASA, Plavix, Ferrous Gluconate, Crestor, Atacand, Synthroid, Fenofibrate Prevacid, Lasix, Ceremezpine, Norvasc, Folic Acid, Insulin, Ezetrol
13	ASA, Rosuvastatin, Metoprolol, Metformin, Fosinopril, Glyburide, Piolitazone, Vitamin D, Calcium Carbonate
14	ASA, Ramipril, Metoprolol, Lipitor, Warfarin
15	ASA, Ramipril, Plavix, Metoprolol, Lipitor, Vitamin D, Calcium Carbonate, Methotrexate, Nitro spray
16	ASA, Lipitor, Methotrexate, Rabeprazole, Coversyl, Indapamide
17	ASA, Ramipril, Plavix, Metoprolol, Lipitor, Fish Oil
18	ASA, Synthroid, Plavix, Metoprolol, Lipitor, Metformin, Diovan, Nitro Spray
19	ASA, Ramipril, Plavix, Metoprolol, Zocar, Nitro Spray
20	ASA, Ramipril, Plavix, Metoprolol, Lipitor
21	ASA, Plavix, Metoprolol, Lipitor, Synthroid, Betaderm, Hydrocortisone cream, Diovan, Coumadin, Pantoloc, Nitro Spray
22	ASA, Altace, Plavix, Metoprolol, Lipitor, Pantaloc, Glucosamine, Fish Oil, Nitro Spray

ASA = acetylsalicylic acid