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Walking Versus Jogging in Patients With Cardiac Problems Including Congestive Heart Failure

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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
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Walden University
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Abstract

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Health Science Self-Design Study

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Abstract

Congestive heart failure (CHF) is a growing epidemic that affects more than 50% of the world's population. CHF is a preventable disease, but prevention requires a healthy lifestyle from a young age. Most patients already diagnosed with CHF receive advice and strict instructions for care to prevent further cardiac injury. This quantitative descriptive research study was designed to address walking and jogging as the best exercises for patients diagnosed with CHF and in patients diagnosed with other cardiac problems. The results revealed that walking is the best exercise to improve patients' resting heart rate and overall cardiac function. This study also indicated that cardiac rehabilitation (CR) improved both blood pressure and heart rate, but the findings showed that CR improved heart rate most effectively. The Levine conservation model served as the foundation of the research. The Levine conservation model ensures the safety and the wholeness of a patient by protecting the interaction and adaptations of the patient's health care plan and environment through conserving and balancing energy. The social change plan for this research study is to give health care teams who care for patients with CHF or cardiac problems guidance to educate patients about CR. Increasing CR education among all health care teams could help improve many patients' quality of life, and the autonomy and empowerment given to patients may subsequently increase patients' cooperation with the treatment plan.

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Dedication

This dissertation is dedicated to my grandpa, who gave me the encouragement to do anything I put my mind to. At a very young age, my grandpa told me to write a list of things that I wanted to do through my life, and one of them was to become a doctor. Thanks to this degree, I will be able to fulfill that dream and make my grandpa proud. He has been in heaven giving me all the encouragement and power to keep strong to complete this degree. I am so grateful to have had this type of support, and I hope this research can save many lives or at least increase the quality of life in patients with cardiac problems.

Acknowledgments

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Chapter 1: Introduction to the Study

Introduction

Congestive heart failure (CHF) is the largest health disparity in the United States (Centers for Disease Control [CDC], 2014a; Healthy People 2020, 2014). A health disparity is an incidence, prevalence, mortality or morbidity rate, or burden of disease in a population (CDC, 2014a; Healthy People 2020, 2014; National Heart, Lung, and Blood Institute [NHLBI], 2014). CHF is an epidemic and the largest health disparity worldwide (World Health Organization, 2013). A new diagnosis occurs every 34 seconds and kills more people than all other diagnoses combined (Go et al., 2013). More than half of all patients diagnosed with CHF die within 5 years (Go et al., 2013). CHF is the leading cause of hospital admissions and readmissions and the leading cause of health care debt (CDC, 2014a). CHF occurs when the heart muscles weaken and cannot pump adequate amounts of blood throughout the body (Lewis, 2014).

This research study was a quantitative descriptive research study in which I used archival data from patients' charts. The design is suitable for exploring variable relationships that researchers cannot actively manipulate or control (Creswell, 2014). The study involved conducting a retrospective review of patients' charts to identify a connection between walking versus jogging and the heart rate (HR), blood pressure (BP), and cardiac output among cardiac rehabilitation (CR) patients. The focus of this study was CHF and prevention, along with methods for CHF diagnosis and the methodology of the research. The research provided more information about CR and exercises that will best improve cardiac function.

Background

Health care for patients with CHF includes a variety of interventions such as medications, in-patient and outpatient hospital care, CR, diet changes and evaluations, weight monitoring, fluid restrictions, and social support. Researchers for the World Health Organization, NHLBI, American Heart Association (AHA), and Healthy People 2020 developed methods for improving the outcomes of CHF and have tried to develop additional preventative measures. Some of the interventions under development include obesity prevention, BP management, smoking cessation, cholesterol management, and diabetes management. CHF affects approximately 24% of African American and Caucasians, 22% of Asians and Pacific Islanders, 20% of Hispanics, and 18% of American Indians and Alaskan Natives (CDC, 2014a).

Health care providers recognize CHF as preventable and manageable with compliance and lifestyle changes. Patients who are physically active, watch their diets, and exercise regularly have a low chance of being diagnosed with CHF (AHA, 2014a). Prevention of the disease is the first goal for improving patients' health. Patients diagnosed with CHF are at a greater risk of death and complications; however, the disease can be maintained. Patients can prevent further injury to the heart with diet changes, weight loss if indicated, exercising regularly, medications, and CR.

CR is an expression that refers to exercising the heart to improve its strength and function. The heart is a muscle that needs exercise to strengthen it, but CR for patients with CHF is difficult and limiting. CHF patients are weaker than patients with a normal functioning heart are. They are usually on multiple medications that make it difficult for them to reach the targeted HR during exercise. CHF patients receive less oxygen perfusion to the muscles throughout their body, which makes the patients weak, and they struggle with breathing because of the extra fluid within their lungs (Lewis, 2014). Most CHF patients are obese, which makes it difficult for them to perform any of the exercises (Lewis, 2014). Many other reasons make it difficult for patient with CHF to perform and comply with CR; however, maintaining and improving their cardiac function is most important for their treatment (AHA, 2014d).

Problem Statement

Cardiac physicians and physical therapists in CR work with patients suffering from CHF. Available research has focused on increasing exercise in patients diagnosed with CHF, but few specify the type of exercise (AHA, 2014d). Some research studies include a focus on aerobic versus anaerobic exercises and how they affect patients diagnosed with CHF, which is explained further in Chapter 2, but few researchers have looked directly at specific types of exercises such as walking, elliptical training, running, and hiking (AHA, 2014d). Patients either walk or jog as part of their rehabilitation therapy. The problem addressed in this study was a gap in research regarding the efficacy of these two types of exercises in patients with CHF.

Ulbrich et al. (2016) studied “high intensity interval (HIT) training versus moderate intensity continuous training (MICT)” (p. 1) in patients diagnosed with CHF. The study included 22 male patients diagnosed with CHF who participated in a CR program (Ulbrich et al., 2016). The patients completed 60 min of aerobic training for 3 weeks (Ulbrich et al., 2016). The patients were randomly placed in either an MICT or a

HIT group and evaluated using their peak HR and peak oxygen consumption (Ulbrich et al., 2016). Both groups of patients benefited equally form both training programs (Ulbrich et al., 2016). This research study advances knowledge on what is best for patients diagnosed with CHF by including more patients and using different forms of measurement for cardiac function (for example, the ejection fraction [EF]) to fill a gap in the literature.

Purpose of the Study

The purpose of this research was to determine what form of exercise is most beneficial in CR for patients diagnosed with cardiac problems including CHF. Researchers have provided information about CR and its significance in improving cardiac function, but no research has addressed the best types of exercise. I explored walking versus jogging to determine whether a correlation exists between length of time and type of exercise performed. The HR and the length of time the patient exercises were the independent variables, and the EF was the factor for determining cardiac function improvement or lack thereof. HR was the measuring factor used to determine whether the patient was walking or jogging. Walking and jogging are subjective; HR served as the measurement for describing the type of exercise.

Research Questions and Hypotheses

RQ1: Does less intensive exercise (HR < 120 beats per minute [bpm]) produce greater improvement in BP, HR, and EF than more intensive exercise (HR ≥ 120 bpm)?

RQ2: Does CR improve HR, BP, and EF?

$H1_0$: Longer, slower daily walks do not provide increased cardiac output for a longer time, which increases cardiac function (EF%) at a faster rate than jogging in patients diagnosed cardiac problems including CHF.

H1: Longer, slower daily walks provide increased cardiac output for a longer time, which increases cardiac function (EF%) at a faster rate than jogging in patients diagnosed with cardiac problems including CHF.

$H2_0$: Jogging daily for a short amount of time does not increase cardiac output or increase cardiac function (EF%) at a faster rate than walking in patients diagnosed with cardiac problems including CHF.

H2: Jogging daily for a short amount of time increases cardiac output and increases cardiac function (EF%) at a faster rate than walking in patients diagnosed with cardiac problems, including CHF.

The Levine Conservation Model

The Levine conservation model is designed to promote adaptation and maintain wholeness by involving four principles of conservation: conservation of energy, conservation of structural integrity, conservation of personal integrity, and conservation of social integrity (Fawcett, 2014). Each principle is developed to conserve energy to avoid fatigue or injury to the body. Mock et al. (2007) used a conceptual model to lessen fatigue in cancer patients and used the Levine conservation model to pilot an exercise investigation among cancer patients.

The purpose of Mock et al.'s (2007) research study was to "determine the effects of a nurse directed, moderate intensity, home based exercise programme to mitigate fatigue and maintain physical functioning in individuals receiving cancer treatment" (p.1). The findings of the research study showed that the four conservation principles guided the development of an exercise program for patients diagnosed with cancer undergoing an exercise regime (Mock et al., 2007). Levine's conservation model maintains the internal aspect of a patient and embodies the external environment to ensure the integrity of the whole patient (Fawcett, 2014).

Definition of Terms

Beats per minute (*bpm*)*:* The number of times the heat beats per minute (Lewis, 2014).

Blood pressure (BP): The pressure against the arterial walls in the circulatory system (Lewis, 2014).

Cardiac output: The volume of blood pumped out of either the left or the right side of the heart (Lewis, 2014).

Cardiac rehabilitation (CR): An exercise-training regime that helps to improve the health of patients with cardiac problems (AHA, 2014d).

Cardiologists: Doctors who specialize in treating the heart and blood vessels (AHA, 2014a).

Congestive heart failure (*CHF*)*:* A condition when the heart is unable to pump an adequate amount of blood to the body, which causes decreased tissue perfusion, distension of the ventricles, edema, and shortness of breath (Lewis, 2014).

Ejection fraction (EF): The measurement of the percentage of blood exiting the heart as it contracts with every beat (AHA, 2014b).

Health care givers and providers: Licensed professions who work in the health care field and are legally able to advise, educate, and provide health care to patients (Lewis, 2014).

Health disparity: Health conditions that adversely affect groups or populations of people (CDC, 2014a).

Morbidity: Another term used for illnesses or diseases (CDC, 2014b).

Mortality: The state of susceptibility to death (CDC, 2014b).

Physical therapists: Licensed health care professionals who specialize in the musculoskeletal system and its movement (Physical Therapy Association, 2014).

Readmissions: Patients discharged from a hospital and readmitted within 30 days (AHA, 2014a).

Tissue perfusion: The blood flow from the arteries to the tissues delivering oxygen to the tissues and removing cellular waste from the tissues into the venous system (Lewis, 2014).

Significance

This study provides more information regarding the efficacy of walking or running, which health care providers could use to create more definitive treatment plans for individual patients living with CHF. Patients with CHF are at a much greater risk for developing other comorbidities that can contribute to a decrease in their health status (NHLBI, 2014). This research could potentially and positively affect rehabilitation after cardiac care (Healthy People 2020, 2014). The advantage of walking or running is its convenience to patients, who can perform CR independently in their own homes or neighborhoods. This study indicates whether walking or running provides the best form of exercise in patients with CHF. Patients with more knowledge about exercising and types of exercises understand the rationale, and this knowledge may help increase their cardiac function with an outcome to decrease future hospitalizations, mortality and morbidity rates, and health-care-related financial debt.

Assumptions and Limitations

Assumptions are a focus when developing research studies (Simon, 2011). Assumptions drive the way people think and perform on a daily basis. Often, assumptions are out of the researcher's control but are the basis of research studies. Researchers indicate if assumptions are true or untrue, which then drives changes in practice (Simon, 2011). This research study included an assumption that any exercise would improve cardiac function in a patient with CHF and that those patients actively participating in CR have improved EF. It was also safe to assume that patients diagnosed with CHF who are inactive and lack self-care have a higher mortality rate than those who are actively engaged in improving their lifestyles by eating healthy, exercising, taking prescribed medications, and following physicians' orders. I developed this research to determine whether walking or jogging is better when improving cardiac function in a patient with CHF. The research included the following assumptions:

1. CR and secondary prevention (SR) programs would increase the knowledge and awareness of CR and CHF.
2. The Levine conservation model would construct a structural variable factor model that could influence behavior changes.

3. Staff members in CR facilities monitor patients closely, obtain patients' HR and BP, and obtain patients' EF before and after the CR/SP prescription.
4. The research data collected would be secured, and the confidentiality of the patient would be maintained to meet Health Insurance Portability and Accountability Act standards.
5. The information collected from the patients' charts would be the only information needed to answer the research questions to maintain the integrity and privacy of the patients.
6. The sample would be representative of all patients diagnosed with CHF who are actively participating in CR.

Delimitations are factors controlled by the researcher, including the objectives, research questions, variables of interest, and theoretical perspectives (Simon, 2011). The delimitations of this research study included charts of patients who were unable to walk and jog. These patients were not able to perform the basic duties necessary to completing the study. Other delimitations included charts of patients not released from their cardiologist to perform CR. The data from patients at risk for further injury were not part of the study. Last, the study did not include patients with an EF above 45%. Patients with an EF above 40% had a stronger functioning heart, and the results could have interfered with the validity of the research.

The limitations of the study included patients' lack of compliance to CR for the prescribed length of time. Another limitation was medications regimes that would not allow a heart to increase in rate and pressure, which is important for improving cardiac function. The staff members at CR centers monitor and record patients' progress and assessments, but one major limitation for this research study was missing information from patient charts. For example, a patient diagnosed with CHF who received CR for a set amount of time did not have a current EF. EF was the dependent variable in determining change of patients' cardiac function in CR. This limitation could have limited the diagnostic information needed to get a reliable conclusion. General limitations included the sample size not properly representing the population and the predictability of the research not being structured enough to effect social change.

Nature of the Study

This descriptive quantitative research study included a multivariate analysis to compare and contrast three dependent variables. The retrospective data were obtained at Queen's Medical Cardiac Rehabilitation Center. A research institutional review committee approval was obtained with an amendment to include all patients participating in CR diagnosed with CHF and cardiac problems. The dependent variables were patients diagnosed with CHF, patients diagnosed with other cardiac problems, and the EF%. The independent variables were pre- and post-CR HR, pre- and post-cardiac BP, amount of time patient participated in CR, average time exercised per session, and type of exercise.

Summary

CHF affects the quality of many individuals' lives. Producing research to decrease the probability of this disease worsening is important. Leedy and Ormrod (2005) posited that solutions to problems are imminent and the world needs changes and advancements that will make it better, which increases aspects of research activity. CHF is the leading cause of decreased patient safety, health care debt, worsening health, highest morbidity and mortality rates, and decreased social aspects. However, research advancement has the capability of increasing patient safety, decreasing health care financial debt, improving health, decreasing morbidity and mortality rates, and improving social aspects. The findings from this research study show how CR has the capability to improve cardiac function in patients with CHF through specifying what exercise is best.

Chapter 1 included the purpose of the research study and the problem that indicated why the research study was necessary. Chapter 1 also included the hypotheses and research questions, the assumptions and limitations, and a background of the concept and why CR is important to advancing health care. In Chapter 2, I will discuss previous research involving exercise and cardiac functions. Chapter 2 will also include former practices and current practices to improve the cardiac function of healthy, abnormal, and congestive hearts. Chapter 2 reveals the research gap in CHF and the types of exercises that are most beneficial to improving cardiac function.

Chapter 2: Literature Review

Introduction

One in every three patients is diagnosed with CHF every day, and CHF is the leading cause of hospitalizations (Go et al., 2013). Of those patients discharged, more than half are readmitted within 30 days (Go et al., 2013). Health care givers are continually trying to develop methods to improve patient outcomes and to keep patients out of the hospital. CR is one of the main methods of improving patients' cardiac health. Cardiac physicians and physical therapists continuously work with patients suffering from CHF by providing CR and cardiac health education, but readmissions remain high.

The purpose of this research was to determine the form of exercise that is most beneficial in CR. Patients either walk or run as part of their rehabilitation therapy. The problem involved a gap in research regarding the efficacy of these two types of exercises in patients with CHF. The focus of available research has been on increasing exercise in patients diagnosed with CHF, but no one specified the type of exercise (AHA, 2014d). The topics in the literature review include defining CHF, continuum of care, and CR.

Sources of Articles

Exploring CHF in this study started with the AHA and Healthy People 2020. Research continued using EBSCO, Medline, ProQuest, Google Scholar, and CINAHL databases through Walden University's library. The topics appeared in research published between 2012 and 2017, and the terms included *CHF*, *CHF and cardiac rehabilitation*, *cardiac rehabilitation*, *cardiac rehabilitation and insurance coverage*, *CHF and hospitalizations*, and *outpatient cardiac rehabilitation*. The terms used within the initial search included *CHF*, *heart failure*, or *congestive heart failure*. The terms within the second search included *cardiac rehabilitation*, *exercise*, and *cardiac rehab*. A list of the search terms and results appears in Table 1.

Table 1

Search Terms and Results

Search term	Results				
	PubMed	EBSCO/Medline	ProQuest	CINAHL	Google Scholar
CHF	2980	8471	9866	202	30,800
CHF and cardiac rehabilitation	225	47	24	20	17,000
Cardiac rehabilitation	5979	2962	2140	1665	907,000
Cardiac rehabilitation and insurance coverage	13	4	6	3	27,100
CHF and hospitalizations	427	189	204	56	32,100
Outpatient cardiac rehabilitation	341	116	247	84	68,600
Levine conservation model			1959	34	119,000
Left ventricle EF and exercise training					11,000

Note. CHF, congestive heart failure; EF, ejection fraction.

These databases were vital in finding the appropriate information for this research study. Combining CHF and CR was significant. Searches using these two topics provided most of the information needed to complete the literature review. The literature review includes three main areas: physical activity and its benefits on a normal healthy heart; CR and prescribing and monitoring CR; and CHF, its diagnosis, and critical aspects of its maintenance inside and outside the hospital. Other topics discussed include CHF and CR and the different types of research performed for improving patient outcomes and improving compliance with CR. Each section is critical for understanding the function of the heart when participating in any physical activity and the ways physical activity can affect patient outcomes.

Physical Activity and Its Benefits

Physical fitness, also known as exercise, refers to planned activity that has a repetitive nature that increases HR and breathing patterns (Caspersen, Powell, & Christenson, 1985). Physical fitness is important to the overall health of the body and can improve cardiac function (Shiraev & Barclay, 2012). There are many different types of exercises categorized by intensity and time practiced. For example, jogging for a long time and maintaining an increased HR refers to continuous medium intensity training. Another category is high-intensity interval training, also known as circuit training. This form of training involves exercising for a short period doing an activity that requires the HR to increase well above the normal HR. Exercise can also be aerobic or anaerobic. Aerobic training refers to exercising that depends on adequate oxygen to meet the energy needs of the body. These exercises consist of running, walking, biking, and so forth. Anaerobic is short high-intensity activity such that the demand for oxygen exceeds the available oxygen supply. Unlike aerobic exercising, anaerobic depends on oxygen from the air (breathing) rather than from the muscles. Examples of anaerobic exercises are weight lifting, isometrics, or any rapid burst of hard exercise.

All forms of exercise have many factors that improve cardiac function in both healthy and sick hearts (Shiraev & Barclay, 2012). Trained healthy subjects have reduced HRs and lower resting systolic BP (Pigozzi et al., 2001). Individuals who are actively training have a faster recovery time after exercise (Cornelissen, Verheyden, Aubert, &

Fagard, 2010). For example, after exercising, a person's HR and systolic BP will return to normal quicker and maintain lower levels during rest (Cornelissen et al., 2010). The normal systolic BP of a healthy adult is 120 bpm, and the HR is 60 bpm (Lewis, 2014). During exercise, both the BP and the HR increase to meet the body's need for increased blood and oxygen supply. Aerobic exercising among healthy young adults enhances the autonomic regulation of the heart (Sloan et al., 2009). The autonomic regulation of the cardiovascular function is the homeostatic process of the barosensory (mechanical) and the chemosensory (chemical) receptors. They are highly involved in the regulation of the pressures of the arterial system and the oxygen and carbon dioxide levels within the blood serum (Lewis, 2014). Pigozzi et al. (2001) identified that the lung function and the heart function greatly decreased during sleep in subjects who are actively exercising.

Cardiac Rehabilitation

Exercise for Cardiac Patients

CR has been part of the process to improve cardiac health for the past 50 years (American Association of Cardiovascular and Pulmonary Rehabilitation [AACVPR], 2013). Over the past decade, health care providers have used intermittent high-intensity aerobic training in patients with CHF. During this form of training, the goal is to achieve 95% of the peak HR; however, an adequate investigation of this form of CR has not been completed (AACVPR, 2013). Health care providers should be able to identify lack of improvement and modify the exercise regime so that there is consistent improvement in cardiac function. Low-cost, high-quality lifestyle habits will help patients move toward personal responsibility and disease management. Health care professionals look at CR as a risk intervention to encourage healthy behavior patterns and disease management (Lavie et al., 2009). Disease management includes implementing health care education, increasing physical activity, urging symptom recognition, and decreasing disease morbidity and mortality (Lavie, Thomas, Squires, Allison, & Milani, 2009). Within the past 20 years, hospitalizations of patients experiencing any cardiovascular disease (CVD) have decreased because of cardiovascular preventative care (Smith et al., 2006). CR/SP is designed to improve cardiac function through CR, healthy lifestyle changes, disease knowledge, and patient support (Smith et al., 2006). Fifty percent of patients enrolled in CR/SP improved their overall health and maintained their adherence to the lifestyle changes recommended by their health care providers (Lavie et al., 2009), and the cost effectiveness of CR greatly affects the quality of life in patients diagnosed with CHF (Rincón et al., 2016). Sandri, Schuler, Mangner, and Kirsch (2016) revealed that CR is especially important in older patients because of the normal age-dependent decline. CR is the one intervention that improves quality of life and cardiac function.

CR begins within the acute-care inpatient setting to decrease patients' length of stay (AACVPR, 2013). Length of stay plays a major role in adequate CR because of the time that health care providers must spend with patients. Prioritization of cardiac risk factors, medical management, and physical activity is imperative to the success of the daily plan to complete the main goals (Riley et al., 2007). Health care providers also need to concentrate on daily care, evaluation of mobilization, readiness for discharge, and outpatient referrals to CR/SP programming (Gibbons et al., 2002). Initial CR/SP assessment stems from the progression of patients' daily activities. Before beginning any

CR, an initial evaluation is necessary for assessment and documentation (Gibbons et al., 2002). The assessment consists of heart and lung sounds, palpation of peripheral pulses, HR, BP, and cardiac rhythm (Gibbons et al., 2002). Daily assessments must include a chart review of the cardiac rhythm, HR, BP, and current status of the patient to ensure progression for discharge outpatient CR/SP (Gibbons et al., 2002).

Cardiovascular continuum of care is important for the overall health of patients. The process includes multiple steps, and the initial step involves covering the treatments and addressing the CVD event experienced (AACVPR, 2013). The second step is the initiation of SR therapies within a longer term treatment plan that addresses the medical therapies that started before the patient was discharged from the hospital (AACVPR, 2013). The third step includes early outpatient CR. This step is consistent with the 36 sessions of rehabilitation that follow a CVD event (AACVPR, 2013). This step is important because it provides patient-added support and guidance in lifestyle changes and exercise plans within an outpatient setting (AACVPR, 2013). Patients often feel overwhelmed at discharge because of the amount of information provided to them, and patients with a new diagnosis of CVD can become withdrawn and not cooperate with the prescribed treatments (Okun & Karoly, 2007; Riley, Stewart, & Grace, 2007). CR can help promote cooperation and further understanding of CVD and improve outcomes throughout the continuum of care. The fourth step includes the long-term CR/SP, which provides long-term care of patients after they have completed the 36 early outpatient sessions, which helps provide patients with support and continuous knowledge of the CVD process and medical management (AACVPR, 2013).

Psychological considerations are major factors reviewed when evaluating a patient entering CR (Hughes, Bon-Wilson, Eichenauer, & Feltz, (2010). Recovering from any cardiac injury or disease has multiple consequences and requires lifestyle changes that can cause patients to become depressed, anxious, and isolated (AACVPR, 2013). Each secondary diagnosis can affect the recovery process of the patient diagnosed with CVD. A SR program linked with CR addresses these issues and offers patients support in their lifestyle changes and a full understanding of the disease process. The structure of SR serves to evaluate and adjust patients' lifestyle to meet the objectives set by the cardiologist prescribing CR (AACVPR, 2013). Supporting and encouraging patients is equally as important on the psychological level as on the physical level (Hughes et al., 2010). Cooperation and compliance of patients within CR is the key factor for improving their overall health (Oldridge & Pashkow, 1993).

Stratification of Risk

Each risk factor identified is an added risk to address before patients with CVD start to exercise. Stratification of risk for cardiac events during exercise identifies these risks, and an individualized exercise plan is developed based on the outcome goals for the patient (de Groote et al., 2004). The goal of this program is to achieve physiological, symptomatic, psychological, and vocational benefits of physical activity (AACVPR, 2013). CR/SP was designed to decrease many of these risks and provide optimal benefits for patients by offering support, education, and health guidance. Stratification of risk helps to identify the lowest, moderate, and highest risk patients to develop a safe and adaptive exercise regime (AACVPR, 2013). Caution is necessary when initiating exercise for any cardiac patients, as these patients are at a much higher risk for injury and further damage to the cardiac muscle; however, exercise has also been the number one intervention that has helped to improve cardiac muscle and strengthen patients so they can have a more normal life (Foster & Porcari, 2001; Papademetriou et al., 2002). The following stratification of risk categories from the AACVPR (2014) categorizes the patients for the risk of further cardiac injury.

Lowest risk for exercise participation:

- Absence of complex ventricular dysrhythmias
- Absence of angina or other significant symptoms
- Presence of normal hemodynamics during exercise
- Functional capacity of greater than 7 metabolic equivalents (METs)

Nonexercise testing findings:

- Rest ejection fraction of greater than 50%
- Uncomplicated myocardial infarction or revascularization procedure
- Absence of CHF
- Absence of complicated ventricular arrhythmias at rest
- Absence of signs and symptoms of postevent of postprocedure ischemia
- Absence of clinical depression

Moderate risk for exercise participation

- Presence of angina or other significant symptoms
- Mild or moderate level of silent ischemia during exercise
- Functional capacity of less than 5 METs

Nonexercise testing findings:

- Rest ejection fraction of 40-49%

High risk for exercise participation

- Presence of complex ventricular arrhythmias
- Presence of angina or other significant symptoms
- High level of silent ischemia
- Presence of abnormal hemodynamics with exercise testing

Nonexercise testing findings:

- Rest ejection fraction of less than 40%
- History of cardiac arrest
- Complex dysrhythmias
- Complicated myocardial ischemia
- Presence of CHF
- Presence of sign and symptoms of postevent ischemia
- Presence of clinical depression

Measurement of Exercise

Measurement of exercise is highly developed and referred to as metabolic equivalent (MET; AACVPR, 2013). MET is a numeric measurement of physical activity that measures 3.5 mL/kg/min O_2 (AACVPR, 2013). For example, 1 MET is equal to the amount of work the body performs at rest. For example, for a patient who weighs 100 kg and exercises 3 days a week for 30 min, the net caloric expenditure would be approximately 480 kcal/week. As the patient begins to perform more physical activities, the METs increase; however, the optimal METs for patients with CVD have not been evaluated (AACVPR, 2013). Initial exercise intensity for a patient with CVD is about 2-4 METs, which increases to about 4-7 METs for about 30 min (AACVPR, 2013; Williams, 2001). A gradual increase is the key factor for maintaining safety for patients, including their physiological responses and fatigue at each workload level (American College of Sports Medicine [ACSM], 2014).

Cardiac exercise referrals or a prescription refers to the parameters involving intensity, duration, and frequency (ACSM, 2014). The exercise regime includes a gradual increase to 180-360 METs per week (AACVPR, 2013). The target time of exercise for these patients usually is about 20-60 min per session (AACVPR, 2013). Patients not used to exercising begin intermittent or circuit training (Savage et al., 2005). Over several weeks, the length of rest periods decreases until reaching a goal of 30 min of continuous exercise and the intensity of the exercise is usually a progression that increases gradually about 40-80% of the HR reserve (AACVPR, 2013; Wannamethee, Shaper, & Walker, 2000). The measurement for the intensity of physical activity is rate of perceived excretion (RPE). RPE is a scale range of 6 to 20 of the peak HR safely obtained from a symptom-limited maximal exercise test (AACVPR, 2013). For example, look at a patient who exercises and reaches an HR from 100 to 110. If cardiac symptoms start at 111 bpm, the patient's RPE is 15. The RPE scale is in Figure 1.

Rating number	Perceived excretion
6	Very, very light
7	
8	Very light (you feel comfortable)

9	
10	Light
11	
12	Somewhat hard (you feel tired but you can keep going)
13	
14	Hard
15	
16	Very hard (you feel very tired, and you are pushing yourself to continue)
17	
18	
19	Very, very hard (the most difficult exercise you have ever done)
20	

Figure 1. Rate of perceived excretion scale. From *Guidelines for Cardiac Rehabilitation and Secondary Prevention programs* (5th ed., p. 67, by AACVPR, 2013, Champaign, IL: Human Kinetics.

Normal prescriptions for patients in CR/SP for CVD do not include resistance training, but resistance training can be beneficial in some patients (AACVPR, 2013; ACSM, 2014). Resistance training increases improvement by 20-30% in both muscle strength and endurance, without any adverse effects on hemodynamic or left ventricular characteristics (i.e., left ventricular EF, left ventricular end-diastolic volume; AACVPR, 2013). Patients must be able to tolerate aerobic exercise before any resistance training is added to their exercise regime (Hunt et al., 2009; Milani & Lavie, 2003). The intensity of resistance training is measured in 1 repetition maximum (1RM), which is the maximum force generated within one muscular contraction (AACVPR, 2013). For example, look at a patient who participates in resistance training who is going to weight train her biceps. If the maximum weight that she can lift is 18 kg (40 lb), and she lifts 15 kg (33 lb), she is lifting 20% 1RM of her upper body. The summary of exercise prescription for patients with CVD and CHF appears in Table 2.

Table 2

Summary of Exercise Prescription for Patients With Cardiovascular Disease and Congestive Heart Failure

Type of training	Description	Intensity	Frequency	Duration
Cardiorespiratory endurance	Dynamic activities involving large muscle groups	40-80% of HRR RPE 11 to 14 (where HRR is not appropriate)	Minimum of 3 days per week, but preferably on a daily basis	20 to 60 min per session
Resistance training	8 to 10 muscle-specific exercises involving resistance bands, weight machines, handheld weights, or combination; begin with one set of 10 to 15 repetitions	50% to 70% 1RM for lifts involving the hips and lower body; 40% to 70% 1RM involving the upper body	2 or 3 days a week	20 to 30 min per session; contraction should be performed in a rhythmical manner at a moderate slow controlled speed

Note. HRR, heart rate reserve; RPE, rate of perceived excretion; 1RM, 1 repetition maximum. From *Guidelines for Cardiac Rehabilitation and Secondary Prevention programs* (5th ed., p. 175), by AACVPR, 2013, Champaign, IL: Human Kinetics.

Congestive Heart Failure

Understanding Congestive Heart Failure

In CHF, the chambers within the heart enlarge or the heart muscle thickens, depending upon the underlying cause. Enlarged heart chambers are dilated cardiomyopathy and a thickened heart muscle that makes the heart noncompliant for filling is called hypertrophic cardiomyopathy. CHF can cause multiple signs and symptoms such as shortness of breath, generalized edema (swelling), generalized weakness, pulmonary edema (fluid in the lungs), and changes within vital signs (Lewis, 2014). An X-ray view of a normal heart is on the left of Figure 2 a CHF heart is on the right.

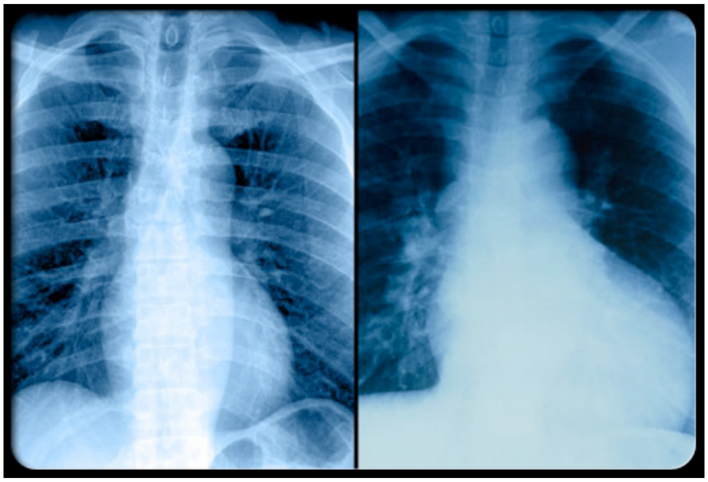

Figure 2. Normal heart on the left and a heart with congestive heart failure on the right.

Patients diagnosed with CHF have a progressive or worsening disease that causes the ventricles to decrease in function, and further ventricular remodeling continues. One of the most clinical manifestations that patients experience is fatigue. Fatigue results directly from the decreased blood circulating throughout the body, the decreased oxygenation of the tissues, and anemia (decreased red blood cells; Lewis, 2014). As the disease worsens, dyspnea (inability to breath) develops due to the increased pulmonary pressures (Lewis, 2014). Patients with CHF have an increased amount of fluid developing from the cardiac muscle remodeling, and the increased fluids cause damage to surrounding organs (Lewis, 2014). For example, the lungs start to fill with fluid, which causes the patient to have difficulty breathing, and the patient starts to develop major generalized edema (swelling throughout the body). Increasing fluids is the heart's method for trying to keep the cardiac output within its normal limits.

Classifications of Congestive Heart Failure

Researchers at the AHA, American College of Cardiology Foundation, and New York Heart Association developed functional classifications of CHF and the stages of heart failure. Class I consists of no limitations of physical activity, and patients do not experience fatigue and dyspnea (Lewis, 2014). Class II includes slight limitations of physical activity with no symptoms at rest (Lewis, 2014). Class III includes a marked limitation of physical activity but feeling comfortable at rest; patients will experience some fatigue and dyspnea with regular activity (Lewis, 2014). Class IV refers to the inability to carry on any physical activity and cannot rest without discomfort and dyspnea (Lewis, 2014). These classifications can help clinicians to address patients' risks and treat them accordingly to prevent further progression of the disease (AHA, 2014d).

Causes of CHF include blocked blood vessels (coronary artery disease) within the heart, a weakened heart muscle caused by damaged heart valves, high BP, infections caused by viruses, toxins such as alcohol and cocaine, genetic diseases, or many other diseases processes (Lewis, 2014). Treatment of CHF depends on what initially caused the disease and then on treating the cause. However, most heart failure patients must be on medications proven in multiple clinical trials. Researchers at the American College of Cardiology have provided guidelines regarding what medications to use depending upon EF and clinical symptoms of the patient. The most commonly used medications in this population include beta-blockers, angiotensin-converting-enzyme inhibitors, angiotensin receptor blockers, spironolactone, and Lasix.

Diagnostics of Congestive Heart Failure

Diagnosing CHF commonly involves conducting a thorough history and physical; some of the signs that present are jugular venous distension; S3 heart sounds, which suggest acute CHF; and more recently elevation of the biomarker B-type natriuretic peptide (BNP), which is suggestive of CHF but not necessarily always as its normal value will correlate with heart failure (for example, obese heart failure patients have normal BNP values); most pertinently the most effective way of determining if a patient has CHF is by a 2D echocardiogram.

An echocardiogram is a noninvasive study that uses ultrasound waves to record the movement of the structures of the heart (Lewis, 2014). An echocardiogram provides information about the valvular structures and motion, cardiac chamber size and contents, ventricular and septal motion and thickness, pericardial sac, and the ascending aorta. An echocardiogram can also give the EF, which is the percentage of end-diastolic blood volume ejected from the heart in a single heartbeat (systole; Lewis, 2014).

The EF of the heart is the measurement of the blood pumped out of the left ventricle to the body (AHA, 2014d). The left ventricle is the largest chamber of the heart, and the muscle within this region is the strongest of all chambers (Lewis, 2014). The normal EF of the left ventricle ranges from 55% to 70%, and a patient diagnosed with CHF ranges from <55% (AHA, 2014b). The lower the percentage of EF, the worse the cardiac muscle is functioning, which indicates decreased blood flow throughout the body.

Evaluating the EF is important when evaluating the progression or digression of the cardiac function. Researchers at the AHA (2014b) and NHLBI (2014) determined that patients with an EF <30% have a higher incidence of developing arrhythmias that increase the risk of death by 100%. BP can be the cause of CHF, or it can worsen the disease. The increase in BP within the heart causes strain within the cardiac chambers, which stretches the cardiac muscle (Lewis, 2014). The body has a natural reaction to this strain, and BNP is released from the brain to decrease the BP (Ford, Pruitt, Parker, & Reimels, 2004). The BNP causes the intravascular (within the arterial and venous system) fluid to move extravascular (outside the arterial and venous system; Ford et al., 2004). The movement of the fluid decreases the BP within the cardiac system to decrease the workload on the heart (Ford et al., 2004). The symptoms that the patient experiences to this fluid shift are increased edema (swelling), pulmonary edema (fluid within the lungs), and electrolyte imbalances (Lewis, 2014).

Continuum of Care

Morbidity and Mortality of Congestive Heart Failure

The morbidity and mortality rates of patients with CHF are at an all-time high. CHF is one of the major causes of death within the United States and kills about 380,000 individuals per year (AHA, 2014c). About half of the individuals diagnosed with CHF will die within 5 years (CDC, 2014a). CHF is diagnosed in a new individual about once every 34 seconds within the United States, and CHF continues to remain the most common reason for hospitalizations (AHA, 2014c; CDC, 2014a). According to federal data, the total costs of patients being hospitalized with CHF is approximately $32 billion each year and continues to rise (CDC, 2014a).

It is critical that patients entering the hospital maintain their overall health and cardiac function. CHF patients receive many different medications, CR, cardiac health education, diet education and implementation, and care of any other symptoms that they may be experiencing. To ensure health care providers are providing adequate evidence-based care, the Joint Commission developed a set of standards that provide patients with the best care based on their diagnosis. The focus of these standards is increasing positive outcomes of the disease and decreasing readmissions. The Joint Commission has continued to accredit hospitals for over 60 years, and it maintains the excellence, performance, and accountability of the hospitals (Joint Commission, 2014a). The Joint Commission plays a major role in the welfare of the patients and in the organization of the hospitals.

The medications prescribed to patients with CHF help to maintain cardiac function and provide support to cardiac muscles in maintaining fluid volume, contractibility, decreased BP, and regularity to the heartbeat (Lewis, 2014). Many of the medications, such as beta-blockers, decrease the HR and BP and angiotensin-converting-enzyme inhibitors decrease BP through vasodilatation (Lewis, 2014). Diuretics decrease fluid volume within the body to decrease the BP and to prevent any extra fluid from entering the lungs or causing edema (Lewis, 2014). Many of the medications maintain equilibrium of the heart to maintain its baseline function.

Diet and weight control are two factors that are important in patients with CHF because they can cause increased damage to the cardiac function (Lewis, 2014). Teaching the proper diet not only consists of what foods patients can and cannot eat but also involves developing a diet plan that patients are going to adhere to. Sodium is the most important electrolyte that patients with CHF have to monitor because sodium attracts fluid (Lewis, 2014). Patients with CHF must maintain a low-sodium diet and monitor fluid intake because increased fluid could cause increased edema and damage to the heart (Lewis, 2014).

The standards of CHF focus mostly on discharge instructions and on ensuring patients have basic knowledge of the disease and know how to prevent further injury. In 2013, the Joint Commission provided six mandatory core measures for patients diagnosed with CHF. First, beta-blocker therapy (i.e., Bisoprolol, Metoprolol, Coreg) must be prescribed at discharge (Joint Commission, 2014b). Second, patients must arrange a postdischarge appointment with their cardiologist or primary care physician (Joint Commission, 2014b). Third, the patients' records must be sent to the next provider within 7 days (Joint Commission, 2014b). Fourth, advance directives and advance care planning must be discussed with the patient and documented within the chart. Fifth, the advance directive must be executed (Joint Commission, 2014b). Finally, a postdischarge evaluation must be conducted and documented within 72 hours after hospital discharge (Joint Commission, 2014b).

The collaborative goals in treating patients with CHF is to treat the underlying cause, reduce symptoms, maximize cardiac output, improve ventricular function, improve quality of life, preserve organ function, and improve mortality and morbidity risks. To do this, clinicians work together to decrease edema (swelling), increase exercise tolerance, and increase adherence to the medication regimen.

Early outpatient exercise programs usually start within 1-3 weeks after patients are discharged from the hospital and are usually for 36 sessions scheduled about 3 times per week (AACVPR, 2013). If medically necessary, a cardiologist could ask for more sessions. Patients must always be supervised, and if they are higher risk patients, they must be put on duration restrictions (AACVPR, 2013). During each exercise session, health care providers monitor patients' body weight, BP, HR, medication adherence, and electrocardiogram (if indicated; AACVPR, 2013). The intensity and duration of the exercise will be adjusted based on patients' response to the activity. An example of a long-term outpatient program daily exercise record is in Appendix A.

Less than 50% of adults do not participate in any physical activity, and a sedentary lifestyle leads to increased risks for CVD (AACVPR, 2013). CVD is a class of diseases that occur within the heart, such as CHF, coronary artery disease, and myocardial infarction (heart attack; AHA, 2014d). Further evidence has shown that low physical activity is relevant to both primary and secondary risks of other forms of heart disease (AACVPR, 2013). Physical activity alters hypertension (high BP), hypercholesterolemia (high cholesterol), obesity, smoking, and Type 2 diabetes (AACVPR, 2013). Each of these diagnoses is a risk factor for developing CHF or for worsening CHF (Lewis, 2014). Living a sedentary lifestyle can dramatically alter the health of a heart. Katzmarzyk, Church, and Craig (2009) indicated that a direct link exists between physical activity and CVD after studying 17,013 Canadians between 18 and 90 years old for approximately 5 years, where 4,512 participated in moderate to vigorous physical activity and others reported leisure time as a form of physical activity. The findings indicated that the individuals who participated in moderate to vigorous physical activity reported having a 75% lower chance of having any of the risk factors for CVD (Katzmarzyk et al., 2009).

The ability to tailor an exercise regime depends on human behavior. Five key characteristics help determine if patients are ready to change to improve their health. The first is cognitive characteristics, which consist of the knowledge base and the ability of the patient to process and retain new information about the disease process (AACVPR, 2013). The second is behavioral characteristics, which identify risk behaviors that put patients in danger of program failure (AACVPR, 2013). The third type of characteristic is psychological or motivational characteristics, which includes the self-confidence to change (AACVPR, 2013). The fourth characteristic includes demographic characteristics such as age, gender, race or ethnicity, culture, and linguistic differences (AACVPR, 2013). Finally, the fifth characteristic is environmental surroundings, which includes the support of family, friends, social networks, health care providers, and access to health care programs (AACVPR, 2013). Each of the characteristics is vital for developing change among patients to remain consistent and cooperative within the CR program.

The U.S. population is growing, and as the lack of employment grows with economic struggles, so does health care insurance. Health care continues to change, which makes health care access easier in some ways and more difficult in others. For example, the Patient Prevention and Affordable Care Act has provided health care insurance to many individuals, but it does not cover everyone and does not pay for every procedure (Blumenthal & Collins, 2014). Patients with terminal diseases such as CHF are usually covered within hospitals, depending on their health care insurance, but have limited coverage for outpatient health care services such as CR (Blumenthal & Collins, 2014; CMS, 2014). The readmission rate of patients with CHF continues to be over 50%, and patients' baseline health gradually decreases with each admission (CMS, 2014). Medicaid and Medicare continue to be the main form of health care insurance in patients with CHF (CMS, 2014); however, Medicaid and Medicare do not cover outpatient CR in patients diagnosed with CHF (CMS, 2014; Physical Therapy Association, 2014). Hospital readmission rates among patients who participate in some form of CR decrease by 50% (Chan, Tang, & Jones, 2008).

Aerobic and anaerobic exercises are both beneficial in CR, but Nilsson, Hellesnes, Westheim, and Risberg (2008) determined that aerobic exercises are most beneficial. Aerobic exercising can be high or low intensity to maintain an adequate oxygen supply to meet the body's needs (Lewis, 2014). Running, walking, bike riding, and swimming are a few examples of aerobic exercises. Anaerobic exercising consists of building muscle and triggers lactic acid formation (Lewis, 2011). Lactic acid is muscle waste from muscles metabolizing high amounts of glucose for energy when they are being broken down for muscle growth (Lewis, 2011).

Nilsson et al. (2008) concluded that aerobic exercises are more beneficial for patients diagnosed with CHF and that high-interval aerobic training increases cardiac function more than continuous aerobic training because of the rest period between the intervals. The rest period decreased stress within the heart, which provided patients with CHF the ability to work harder during the interval training; however, the level of intensity was not determined and the research (Nilsson et al., 2008). Nilsson et al. focused on BP and HR and monitored the 12-lead electrocardiogram of the patients during the selected aerobic/anaerobic interval training (Nilsson et al., 2008). The researchers based their conclusion of cardiac improvement solely on patients' ability to increase intensity during interval training and to maintain or show improvement in their BP and HR (Nilsson et al., 2008).

CHF weakens the heart, which can cause patients to remain fatigued and unable to perform their normal activities of daily living. Introducing CR to patients could cause further damage or decomposition to the heart and to other parts of the body (Wise & Patrick, 2012). Patient safety is the focus of implementing CR. Researchers have conducted multiple research studies to evaluate the vigorousness of activities that patients can perform while ensuring their safety. Whitehurst (2012) conducted a research study involving older adults diagnosed with CHF to evaluate high-intensity training (HIT) versus traditional endurance training (TET). HIT is a combination of exercise and rest characterized as a low-volume high-intensity exercise regime (Whitehurst, 2012). TET is a high-volume low-intensity exercise regime (Whitehurst, 2012). Whitehurst concluded that patients who participated in the HIT exercise regime were more successful in completing the program and gained greater cardiopulmonary benefits than those who participated in TET. The findings indicated that the success of the HIT regime related to the time it takes to complete the exercise plan, which keeps patients more compliant to the program. Middle-aged and older adults diagnosed with CHF have many limitations to their ability to maintain strenuous activities, but it is important that health care providers develop an individual CR plan centered on their baseline capability (Izawa et al., 2012).

Patient Compliance and Cooperation

Patient compliance and cooperation is the final step within the predictive model that is critical for success in improving the patient outcome of participating in CR. CR programs offer education, counseling, exercise plans, nursing care, and resources for improving cardiac health. Improving patients' willingness to participate in CR is the first step to success in the overall health of patients (Wang, Lin, Lee, & Wu, 2011). Patients need to understand the importance of self-care and their role in the decisions made to improve their health. Many health care professionals use the health belief model in and out of the hospital to increase patients' willingness to comply with medical advice. Self-care initiates autonomy and independence in patients' own health that will improve compliance and cooperation (Wang et al., 2011). A clear understanding of how to increase patient compliance and cooperation appears in Table 3.

Table 3

Health Belief Model Description for Increasing Patient Compliance and Cooperation

Concept	Definition	Application
Perceived susceptibility	Individuals understand that if they do not participate in cardiac rehabilitation, their heart will not get better.	Individuals know that they could die without any intervention.
Perceived severity	Individuals believe they will get worse without cardiac rehabilitation.	Individuals believe the consequences of having CHF without knowledge or treatment are

		significant enough to try to avoid.
Perceived benefits	Individuals believe the recommended cardiac rehabilitation program will help them maintain their health.	Individuals will participate in the cardiac rehabilitation program.
Perceived barriers	Individuals identify their personal barriers for not participating in cardiac rehabilitation.	Individuals will work on decreasing any barriers to not participate in the prescribed cardiac rehabilitation program.
Cues to action	Individuals will receive reminder cues for action.	Individuals will receive reminders and other messages that will help motivate them to remain on the cardiac rehabilitation program recommended.
Self-efficacy	Individuals will participate in the cardiac rehabilitation program.	Individuals will receive support and guidance in the program they are prescribed.

Social Change and Patient Compliance

Social change within any population needs an assessment, and implementation is necessary based on the readiness of the community. Implementation of CR programs throughout any population will not be successful if the community is not ready to accept change. The readiness for change within any population or patient needs an assessment for the change to be a success. The success of any health promotion program is based on community participation (Plested, Edwards, & Jumper-Therman, 2006). This section includes a discussion of the community readiness model, which is important when implementing change within a community or a group of patients. Many patients go through these stages as they are experiencing change within their lives. The implementation of CR and other lifestyle changes for patients who have never participated can be detrimental and unsuccessful if health care providers are not adequately prepared to help guide patients.

The community readiness model includes nine stages. The first stage is no awareness, which means the community leaders are not aware of the issue as a problem (Plested et al., 2006). The second stage, denial, occurs when there is little or no recognition of the issue but some of the members of the community do see or recognize the behavior (Plested et al., 2006). The third stage is vague awareness, which means that the general feeling of the community is that there is a problem and something ought to be done about it (Plested et al., 2006). The fourth stage, preplanning, is a clear recognition of the issue, and leaders and committees make efforts to address the issue but do not identify a detailed or focused plan (Plested et al., 2006). The fifth stage is preparation, which includes ongoing practical details and planning and collecting the advantages and disadvantages of prevention activities (Plested et al., 2006). The sixth stage, initiation, includes starting the action of the plan and training the leaders and staff (Plested et al., 2006). The seventh stage, stabilization, means that the programs and activities are running and fully supported by the community (Plested et al., 2006). In the eighth stage, the confirmation/expansion stage, the efforts are in place and the authorities support expanding or improving their efforts (Plested et al., 2006). In the final stage, professionalization, a detailed and sophisticated knowledge exists of the risk factors and causes of the issue, and efforts are aimed toward the general population while specific risk factors are targeted and addressed (Plested et al., 2006).

The model is designed to incorporate the culture resources and give autonomy to the community to list the health issues and methods of how the community members can improve those health issues (Plested et al., 2006). The model serves to encourage the community to formulate a plan for a program that incorporates community members' beliefs with Western medicine to address the issue to improve their health (Plested et al., 2006). Researchers can apply the model to any population when the community has reached the stage of readiness and is prepared to address the issue (Plested et al., 2006). The health belief and community readiness models are comodels to help improve the compliance and cooperation of the population. The focus of the Levine conservation model is on the wholeness of the patient by preserving the internal and external aspects of the patient's life and wellness (Fawcett, 2014). The health belief and community readiness models are important and ensure the patient and the patient's environment meet the four principles of the Levine conservation model, which are conservation of energy, conservation of structural integrity, conservation of personal integrity, and conservation of social integrity (Fawcett, 2014).

Conservation of energy balances the energy expended and conserved to prevent fatigue (Fawcett, 2014). Conserving structural integrity involves maintaining the physical body by preventing health depletion and promote healing (Fawcett, 2014). Personal integrity conservation ensures self-awareness, respect, and self-determination (Fawcett, 2014). Finally, social integrity conservation recognizes the environmental perspectives of patients, such as family, community, religious, and ethnic background (Fawcett, 2014). Each of these conservation principles guided and supported the structure of this study.

Summary

CHF is the number one cause of death, hospitalizations, and health care debt within the United States. CHF is a weakened heart that cannot provide the body with an adequate blood supply. The weakened heart lowers the baseline for patients to participate in activities for daily living. CR has shown major improvements to EF and cardiac function; however, patients suffer from the inability to access adequate outpatient CR because of a lack of health care insurance or CR knowledge. Health care professionals are an important resource for providing instructions and a plan of care that can help decrease the number of patients diagnosed with CHF from hospital readmission. Part of this plan of care consists of providing patients with an exercise regime that patients could participate in independent of a CR facility.

Chapter 2 included a review of the literature regarding CHF and CR. This chapter included discussions on how a normal heart reacts to exercise and increased demand in exercise mode. Additional topics of discussion included sick hearts not limited to CHF and the impact of CR. Chapter 3 will include the methods used in this research study to answer the research questions.

Chapter 3: Research Method

Introduction

Chapter 3 includes a description of this study’s design, sample, instrumentation, data analysis, and ethical considerations. Chapter 3 also includes an overview of the study design, including a rationale for why this particular research design was suitable. Additional topics are sample characteristics and size, instrumentation, data collection, and data analysis.

Purpose of the Study

The purpose of this research was to determine what form of exercise is most beneficial in CR for patients diagnosed with cardiac problems including CHF. Researchers have provided information about CR and its significance in improving cardiac function, but no researcher have addressed the best type of exercises. I explored walking versus jogging to determine whether a correlation exists between length of time and type of exercise performed. The HR and the length of time exercising were the independent variables, and the EF was the determining factor for determining cardiac function improvement or lack thereof. Chapter 3 includes the research design and the rationale for the design choice. Sections of the chapter include the methodology and the population. This chapter also includes the threats to validity and ethical procedures that played a role within the outcome of the research study.

Research Design and Approach

The design of this quantitative descriptive study was to correlate the difference in patients’ cardiac function when they walked versus jogged as a form of exercise. The dependent variables included patients diagnosed with CHF, patients diagnosed with other cardiac problems, and cardiac function measured by evaluating the EF. The independent variables were HR, BP, and length of time the patient exercised. HR was the measuring factor to determine if the patient was walking or jogging. Walking and jogging are subjective; I used HR as the method for measurement in describing the type of exercise. I used HR to determine the speed at which the patient was walking or jogging as a set standard of numbers for safety of the patient. The ranges were <120 bpm for walking and ≥120 bpm for the jogging pace. For example, patients who had a HR of 130 bpm were considered to be jogging.

The research methods directly aligned to the research questions within this study. For example, patients who had been walking for 30 min a day and who kept the HR at 115 bpm while walking showed either improvement or lack thereof within the EF during reevaluation. This method of evaluating patients was consistent whether patients had a higher or a lower HR while exercising for more than 30 min daily. The categories for patients were HR (<120 bpm and ≥120 bpm), time spent exercising (30-45 min and 45-90 min), and times a week the patients exercised (1-3 times and 3-7 times). In a patient with a normal heart, jogging for a long period is most beneficial because jogging maintains a higher cardiac output and helps build the cardiac muscle (Physical Therapy Association, 2014). During exercise, the HR and the BP naturally increase, which improves cardiac output and the cardiac muscle. This study determined if the results were the same in patients with CHF.

The research design included archival data to evaluate BP, HR, and EF in relation to the time the patients exercised and how high they maintained their HR during exercise. The purpose of this research design choice was to compare how different exercises (walking versus jogging) could affect a heart in heart failure by comparing the time patients exercised with the intensity (HR and BP) and the ways it played a role in the EF of the heart muscle. Multivariate analysis in IBM SPSS was suitable for interpreting the data to give measures of the relationship between the categorical dependent variables and the independent variables (PASW Statistics, 2015). Multivariate data analysis refers to the evaluation of multiple variable analysis (PASW Statistics, 2015). The multivariate analysis of variance (MANOVA) through SPSS generates a case processing summary, dependent variable encoding, categorical variable codes, classification table, variables not in the equation, an omnibus test of model coefficients, model summary, variables in the equation, and ANOVA tables (PASW Statistics, 2015).

The study included both MANOVA and multivariate analysis of covariance (MANCOVA) to test the hypotheses, which helped ensure the adequate evaluation of the data with the correct number of samples (Fox, Hunn, & Mathers, 2009). To ensure a research study is accurate and reliable, researchers can evaluate the validity and reliability of the data frequently (Frankfort-Nachmias & Nachmias, 2008). Internal validity is a measure that ensures a researcher's experimental design closely follows the principle of cause and effect (Frankfort-Nachmias & Nachmias, 2008). In contrast, external validity usually includes two distinct types: population validity and ecological validity. The population and ecologoical validity are both essential elements in judging the strength of an experimental design (Frankfort-Nachmias & Nachmias, 2008). G*Power analysis was suitable for calculating the necessary sample size based on a number of participant assumptions (Buchner, Faul, & Erdfelder, n.d.).

The G*Power analysis indicated a sample size of 721 participants would give the best results for the study. In previous research studies, the average sample size was 150-200; however, the facility that I obtained the archival data from has only been open since 2013. Thus, only 50 patient charts met the criteria of patients diagnosed with CHF. Due to the low number of participants, this research study was changed to a quantitative descriptive research study with two comparison dependent variables added for an increased *N* value. The original comparison dependent variable was the patient diagnosed with CHF and the other variable was patients diagnosed with other cardiac problems; however, there were not enough CHF patient retrospective data to give a valid analysis, so the analysis was evaluated as a combination of patients diagnosed with other cardiac problems including CHF. The study included multiple dependent variables and independent variables to achieve a more in-depth analysis to answer the research questions. The MANOVA and MANCOVA analysis allowed all dependent and independent variables to be grouped, compared, and separated for further analysis.

MANOVA analysis accentuates the "mean differences and statistical significance of differences among groups" (Tabachnick & Fidell, 2013, p. 243) and MANCOVA reveals if there are "statistically significant mean differences among groups after adjusting the newly created dependent variables (DV) for differences on one or more covariates" (Tabachnick & Fidell, 2013, p. 245). MANOVA was more suitable than analysis of variance (ANOVA) because of the multiple dependent variables used to prevent Type I errors related to running multiple tests correlated to dependent variables (Tabachnick & Fidell, 2013). MANOVA can potentially reveal differences not exposed in an ANOVA (Tabachnick & Fidell, 2013). MANOVA has one or more independent variables and two or more dependent variables, with two or more levels for each topic within the different combinations of independent variables (Tabachnick & Fidell, 2013). An example might include evaluating patients diagnosed with CHF, other cardiac problems, and pre-CR EF as the dependent variables and HR, EF, and BP as the independent variables pre-CR and again post-CR. Running the MANOVA and MANCOVA analysis decreased any probability of error and gave the best results to the research questions.

The first objective when gathering the participants was to find individuals diagnosed with CHF. They could have experienced some form of acute myocardial infarction, multiple vessel disease, 50% vessel occlusion, or cardiac bypass. The second objective was the subjects were physically able to walk or jog. The third objective was subjects were over the age of 18. The fourth objective was subjects had participated in or were participating in a CR program. The objectives listed served to ensure the safety of the participants and the validity of the research. Appendix B includes further review of the facility consent letter that allowed me to gather archival data for research purposes. All the data were archival but it was still important to follow procedures so that the health care provider continued to ensure the safety of the participants. The guidelines also helped to narrow the large amount of data provided to ensure the participants selected for this research were correct.

Threats to Validity

Internal validity within a research study is important because it evaluates the dependent variable and the cause and effect of the independent variables (Creswell, 2014). An extraneous internal variable may compete with the independent variable also known as the confounding variable (Creswell, 2014). These variables systematically influence the independent and dependent variable (Creswell, 2014). For example, BP (independent variable) could change dramatically depending on medications, which can play a role on the HR (independent variable), time exercised (independent variable), and the EF (dependent variable) if prolonged treatment is indicated. A listing of the variables appears in Table 4.

Threats to internal validity compromise the relationship between independent and dependent variable. (Creswell, 2014). Another threat to internal validity consists of statistical regression, which occurs when the measurement of the dependent variable is not “perfectly reliable” (Creswell, 2014, p. 201). Selection is a major part of ensuring the validity of the internal variables because it motivations the influence of the outcomes.

Table 4

Variable Table

Variable title	Why this variable could affect cardiac function	Dependent or independent variable
Patient diagnosed with CHF	Comparison variable	Dependent variable
Patient diagnosed with other cardiac problems	Comparison variable	Dependent variable
Pre-cardiac-rehabilitation heart rate	Increased HR could affect blood flow throughout the body decreasing perfusion	Independent variable
Pre-cardiac-rehabilitation blood pressure	BP directly affects CHF by increasing BNP, which increases edema, etc.	Independent variable
Pre-cardiac-rehabilitation ejection fraction	EF is the measurement of cardiac function, and the lower the number, the worse the cardiac function	Dependent variable
Time participating in cardiac rehabilitation	Time participating in CR is important for evaluating the constancy of the heart function	Independent variable
Average time exercised	Time exercised is important to know if the patient could keep the HR elevated for a period of time	Independent variable
Type of exercise	Type of exercise is important to help identify which is best for improving cardiac function	Independent variable
Heart rate and blood pressure during exercise	Helped classify the patients into categories and determined if they correlated with cardiac function and improvement	Independent variable
Post-cardiac-rehabilitation heart rate	Determined if the time and type of exercise improved HR	Independent variable
Post-cardiac-rehabilitation blood pressure	Determined if the time and type of exercise improved BP	Independent variable
Post-cardiac-rehabilitation ejection fraction	Determined if the time and type of exercise improved EF	Dependent variable

Note. HR, heart rate; BP, blood pressure; BNP, B-type natriuretic peptide; EF, ejection fraction.

External validity refers to quantity of the results of a realistic investigation across individuals, populations, or times (Creswell, 2014). Population validity refers to how well the sample size represents the population (Creswell, 2014). For example, the population within this study consisted of patients diagnosed with CHF attending CR. Sample size needed to represent the population size within the community of individuals diagnosed with CHF to ensure internal validity. To ensure the sample size was adequately represented, a G*Power analysis took place. Threats to external validity consist of the interaction effect of testing, interaction effect of selection biases and the experimental treatments, reactive effects of experimental arrangements, multiple treatment interference, and reactive effects of experimental arrangements (Creswell, 2014).

Analysis

Data analysis involved correlating the data gathered from the chart review using MANOVA and MANCOVA to have a better understanding of the outcomes of the variables mentioned within the research questions and hypotheses. The research questions and hypotheses were as follows:

RQ1: Does less intensive exercise (HR < 120 bpm) produce greater improvement in BP, HR, and EF than more intensive exercise (HR ≥ 120 bpm)?

RQ2: Does CR improve HR, BP, and EF?

$H1_0$: Longer, slower daily walks do not provide increased cardiac output for a longer time, which increases cardiac function (EF%) at a faster rate than jogging in patients diagnosed cardiac problems including CHF.

H1: Longer, slower daily walks provide increased cardiac output for a longer time, which increases cardiac function (EF%) at a faster rate than jogging in patients diagnosed with cardiac problems including CHF.

H2$_0$: Jogging daily for a short amount of time does not increase cardiac output or increase cardiac function (EF%) at a faster rate than walking in patients diagnosed with cardiac problems including CHF.

H2: Jogging daily for a short amount of time increases cardiac output and increases cardiac function (EF%) at a faster rate than walking in patients diagnosed with cardiac problems, including CHF.

Ethical Considerations

Ethical procedures consist of institutional permissions, Institutional Review Board (IRB) and University Research Review approvals, the anonymity and confidentiality of participant and archival data, and participant roles**.** Patient and institutional names do not appear in any part of the research study to ensure confidentiality. The data will remain in a locked computer that only I can access. The data came from patients diagnosed with CHF and patients diagnosed with other cardiac problems and included pre-CR HR, BP and EF; time participating in CR; average time exercised; type of exercise patient participated in; HR and BP during exercise; and post-CR HR, BP, and EF. The time frame for this research was the amount of time needed to complete the study; once complete the data will remain in storage for 5 years past the completion of the research study in accordance with IRB's minimum requirement guidelines (Institutional Review Board, 2010). The policies and procedures for obtaining and handling records are different within every health care facility and were followed without reservation.

Summary

This chapter included a description of the data collection and evaluation processes. The purpose of this research was to determine what form of exercise is most beneficial in CR for patients diagnosed with cardiac problems including CHF. The chapter indicated the type of archival data collected and its source. A G*Power analysis determined the sample size and the amount of data needed to ensure internal and external validity. Chapter 4 includes the findings from the statistical analysis.

Chapter 4: Data Collection

Introduction

The purpose of this research was to determine what form of exercise is most beneficial in CR for patients diagnosed with cardiac problems including CHF. The first research question was as follows: Does less intensive exercise (HR < 120 bpm) produce greater improvement in BP, HR, and EF than more intensive exercise (HR ≥ 120 bpm). The HR was the foundation of defining the walking and jogging pace. The second research question was as follows: Does CR improve HR, BP, and EF? This question helped to determine whether CR has a positive or negative effect on basic vital signs and EF. The focus of the hypotheses and null hypotheses of this research study was on the intensity of the CR and cardiac function. Chapter 4 includes a discussion of the data collection and the results of the study. The results are organized by the research questions that emerged from the analysis, and the chapter ends with a brief summary.

Data Collection

The data collection process for this retrospective research study required approvals from multiple hospital departments. With the help of the director of research and the head of cardiac department, the data collection process was a smooth process. After approval from the hospital IRB and Walden University's IRB, it took approximately 3 days for the head of the CR department to provide the medical record numbers (MRNs) of the patients who fit the qualifications of this research study. After receiving the MRNs, it took approximately 5 working days and 5 to 8 hours each day to gather the data. There were no discrepancies from the data needed from Chapter 3. The headers in Table 5 show the categories used to separate the data collected to evaluate each research question properly. Of the 282 MRNs provided for the research study, 228 were used because 54 patients were still actively participating in CR or the patients self-discontinued CR after one session. The sample consisted of patients who resided in Hawaii, but the ethnicity or demographics of the patients were not obtained.

Table 5

Spreadsheet Headers of the Retrospective Data Obtained

Dependent variables and independent variables
Patients diagnosed with other cardiac problems
Patients diagnosed with CHF
Pre-CR resting BP
Pre-CR resting HR
Pre-CR EF
Time in CR (number of sessions)
Time exercising initial (treadmill)
Time exercising post (treadmill)
Time exercising (min)
Number of days per week exercising
BP during exercise (initial)
BP during exercise (post)
HR during exercise (initial)
HR during exercise (post)
Post-CR resting BP
Post-resting HR
Post-CR EF%
Did not complete the program

Note. CHF, congestive heart failure; CR, cardiac rehabilitation; BP, blood pressure; HR, heart rate; EF, ejection fraction.

Cardiac Rehabilitation Treatment Plan

Each patient received an individualized treatment plan prescription during the initial CR appointment. This treatment plan could be altered during the sessions to ensure the patient's health was improving. Appendix A includes an example of a long-term outpatient program daily exercise record. The greatest challenge that the treatment team encountered was the patients not cooperating with the treatment plan. In many cases, CR is a lifestyle change, but many of the patients had multiple reasons for not completing the sessions prescribed. One of the reasons found in the data was insurance not paying for CR or the patient did not have transportation to the CR facility. No one followed up with the patients who did not complete the CR treatment plan. After discussion with the CR health care team, the team members indicated that they do everything they can to help each patient understand the importance of CR and of completing all their sessions, which aligns with the health belief model and community readiness model discussed in Chapter 2. The health belief and community readiness model are important and helped to ensure the patient and patient's environment met the four principles of the Levine conservation model: conservation of energy, conservation of structural integrity, conservation of personal integrity, and conservation of social integrity (Fawcett, 2014).

Results

Research Question 1

RQ1 was as follows: Does less intensive exercise (HR < 120 bpm) produce greater improvement in BP, HR, and EF than more intensive exercise (HR ≥ 120 bpm)? The first step was to divide the data into two groups based on the spreadsheet variable HR during exercise (post). The groups consisted of those with less intensive exercise (HR < 120 bpm; $N = 166$) and those with more intensive exercise (HR ≥ 120 bpm; $N = 62$). Table 6 includes a description of all participants' mean scores and standard deviations.

Table 6

Description of Sample

No. with CHF	No. other cardiac	Number completing program	CR sessions		Treadmill time (min) initial		Treadmill time (min) (post)		Time exercising (min)		No. days per week exercising	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
113	228	138	13.6	8.74	14.1	11.43	27.8	6.04	30.2	2.25	3.3	0.79

Note. N = 228. CR, cardiac rehabilitation.

Table 7 and Figure 3 show a comparison of means for each of the four dependent variables by group. Each of the four variables showed an advantage for lower intensity exercise, but not all of those differences were significant, as described below.

Table 7

Comparison of Post-Cardiac Rehabilitation Means by Dependent Variable and Group

	HR < 120 bpm			HR ≥ 120 bpm			Total		
	M	*N*	*SD*	*M*	*N*	*SD*	*M*	*N*	*SD*
Post-CR resting systolic BP	118.63	166	18.671	119.27	62	14.125	118.80	228	17.524
Post-CR resting diastolic BP	64.38	166	9.630	665.40	62	8.838	64.66	228	9.413
Postresting HR	72.34	166	10.906	82.87	62	12.337	75.21	228	12.223
Post-CR EF	37.33	39	13.560	36.25	8	13.296	37.14	47	13.378

Note. HR, heart rate; CR, cardiac rehabilitation; BP, blood pressure; EF, ejection fraction.

Rather than perform four separate *t* tests (one for each dependent variable), which would increase the probability of Type-I error, a problem called experimentwise error or per-comparison error, the best approach was to perform a MANOVA to examine differences across the two groups for all four dependent variables simultaneously, thereby holding Type I error constant (Tabachnick & Fidell, 2013).

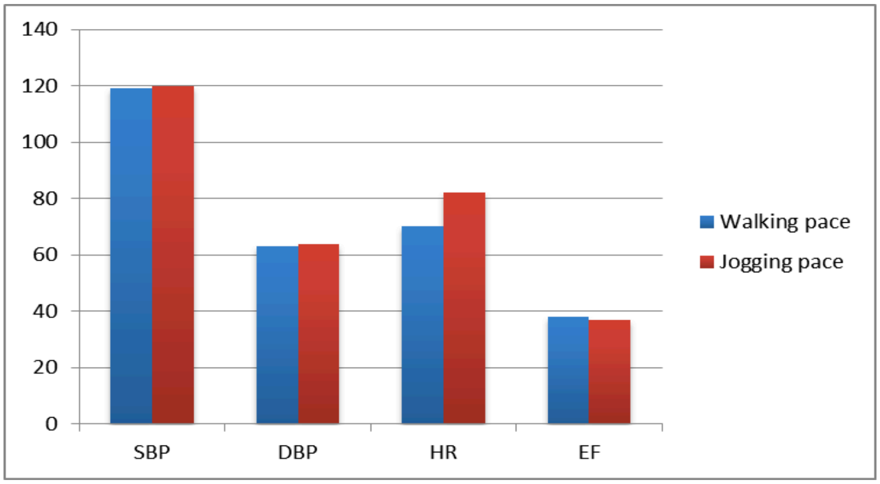

Figure 3. Comparison of postexercise means for systolic blood pressure, diastolic blood pressure, and heart rate by level of exercise intensity. Walking pace (low) = less than 120 bpm; jogging pace (high) = greater than or equal to 120 bpm. As shown, heart rate shows the greatest benefit at low relative to high intensity.

Table 8 shows results of the MANOVA that involved comparing the difference between the two groups (low versus high intensity) across the four dependent variables. The overall model was significant for group ($p < .01$) as indicated across all four tests (Pillai's trace, Wilks' lambda, etc.), with all four converging on the same *F* ratio.

Table 8

Multivariate Results—Comparison of Systolic Blood Pressure, Diastolic Blood Pressure, Heart Rate, and Ejection Function by Group

Effect	Value	*F*	Hypothesis *df*	Error *df*	Sig.
Intercept					
Pillai's trace	.991	1162.017	4.000	42.000	.000
Wilks' lambda	.009	1162.017	4.000	42.000	.000
Hotelling's trace	110.668	1162.017	4.000	42.000	.000
Roy's largest root	110.668	1162.017	4.000	42.000	.000
Group					
Pillai's trace	.322	4.986	4.000	42.000	.002
Wilks' lambda	.678	4.986	4.000	42.000	.002
Hotelling's trace	.475	4.986	4.000	42.000	.002
Roy's largest root	.475	4.986	4.000	42.000	.002

Table 9 shows the results of group comparisons for each of the four dependent variables. As shown, the results for group were significant ($p < .05$) for two of the four dependent variables: diastolic blood pressure (DBP) and HR. Thus, the mean DBP and HR values for the low-intensity group were significantly lower than those for the high-intensity group, as indicated by the mean values shown in Table 2. The *R*-squared values for these two significant effects were .073 and .211, respectively. Thus, the effect of exercise on HR was greater than that of DBP. A summary of the results is as follows:

Systolic blood pressure (SBP): $F(1, 45) = 3.31$, $p > .05$; $R^2 = .048$

DBP: $F(1, 45) = 4.60$, $p < .05$; $R^2 = .073$

HR: $F(1, 45) = 13.33$, $p < .01$; $R^2 = .211$

EF: $F(1, 45) = 0.04$, $p > .05$; $R^2 = .001$

Research Question 2

RQ2 was as follows: Does CR improve HR, BP, and EF? Solving this research question involved assessing the benefits of CR on three variables: BP (SBP, DBP), HR, and EF. The general analytic approach was to compare baseline levels of each variable (pre-CR) with levels derived after CR (post-CR) using MANCOVA (Tabachnick & Fidell, 2013). For each of the variables entered into the model (BP, HR and EF), the dependent variable was the post-CR value for each, and the pre-CR was a covariate. Thus, any change in the dependent variable beyond that of the pre-CR levels would show up as a significant effect of group.

Table 9

Tests of Between-Subjects Effects

Source and dependent variable	Type III sum of squares	*df*	Mean square	*F*	Sig.
Corrected model					
Post-CR resting SBP	733.213[a]	1	733.213	3.313	.075
Post-CR resting DBP	337.604[b]	1	337.604	4.603	.037
Post-resting HR	1412.411[c]	1	1412.411	13.334	.001
Post-CR EF	7.717[d]	1	7.717	.042	.838
Intercept					
Post-CR resting SBP	381539.171	1	381539.171	1723.803	.000
Post-CR resting DBP	113257.434	1	113257.434	1544.274	.000
Post-resting HR	177811.645	1	177811.645	1678.676	.000
Post-CR EF	35938.100	1	35938.100	196.628	.000
Group					
Post-CR resting SBP	733.213	1	733.213	3.313	.075
Post-CR resting DBP	337.604	1	337.604	4.603	.037
Post-resting HR	1412.411	1	1412.411	13.334	.001
Post-CR EF	7.717	1	7.717	.042	.838
Error					
Post-CR resting SBP	9960.106	45	221.336		
Post-CR resting DBP	3300.311	45	73.340		
Post-resting HR	4766.567	45	105.924		
Post-CR EF	8224.739	45	182.772		
Total					
Post-CR resting SBP	647541.000	47			
Post-CR resting DBP	189929.000	47			
Post-resting HR	284996.000	47			
Post-CR EF	73079.640	47			
Corrected total					
Post-CR resting SBP	10693.319	46			
Post-CR resting DBP	3637.915	46			
Post-resting HR	6178.979	46			
Post-CR EF	8232.456	46			

[a]*R*-squared = .069 (adjusted *R*-squared = .048). [b]*R*-squared = .093 (adjusted *R*-squared = .073). [c]*R*-squared = .229 (adjusted *R*-squared = .211. [d]*R*-squared = .001 (adjusted *R*-squared = -.021).

Table 10 shows means from pre- to post-CR phases for each of the four dependent variables. SBP, DBP and EF showed favorable change, whereas HR showed an increase.

A discussion on the statistical significance of these changes appears below. Information about how the exercise intervention affected the dependent variables pre- and post-CR appears in Figure 4.

Table 10

Pre-Cardiac Rehabilitation and Post-Cardiac Rehabilitation for All Four Dependent Variables

	Pre-CR		Post-CR	
Variable	*M*	*SD*	*M*	*SD*
Systolic blood pressure (SBP)	122.8	19.78	118.8	17.52
Diastolic blood pressure (DBP)	66.2	10.41	64.7	9.41
Heart rate (HR)	72.9	13.12	75.2	12.22
Efficiency function (EF)	33.8	10.40	37.5	13.68

Note. N = 228.

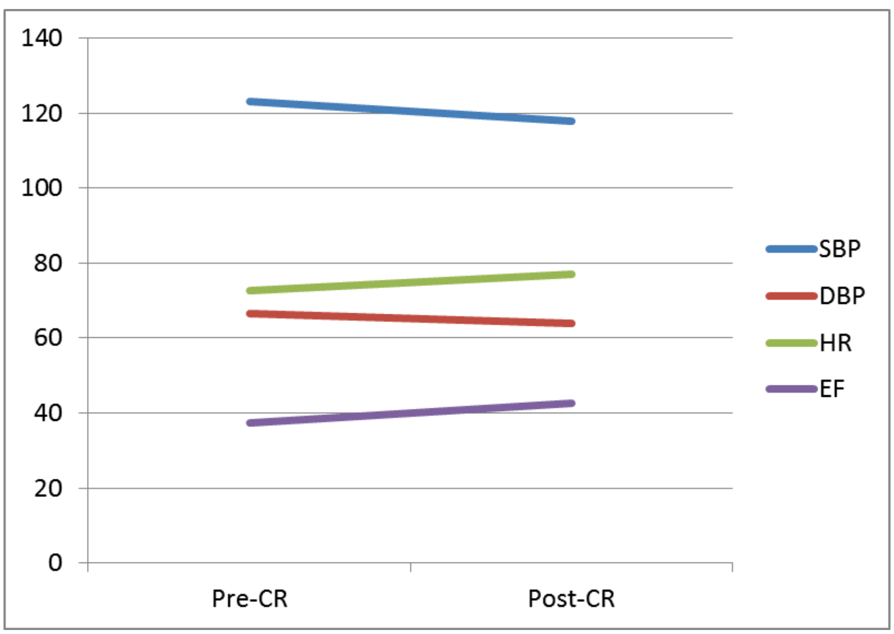

Figure 4. All data combined (*N* = 228). Changes in systolic blood pressure, diastolic blood pressure, heart rate, and cardiac efficiency function before the exercise intervention and then following.

Multivariate results (see Table 11) indicated significance ($p < .05$) for all variables except DBP. The results of pre-CR and post-CR comparisons appear in Table 12. Again, all but DBP indicated significant and favorable change, with HR showing significant increase, which does not seem favorable.

Table 11

Multivariate Results for Pre- Versus Post-Cardiac Rehabilitation Comparison on Systolic Blood Pressure, Diastolic Blood Pressure, Heart Rate, and Efficiency Function

Effect	Value	*F*	Hypothesis *df*	Error *df*	Sig.
Intercept					
Pillai's trace	.375	5.251	4.000	35.000	.002
Wilks' lambda	.625	5.251	4.000	35.000	.002
Hotelling's trace	.600	5.251	4.000	35.000	.002
Roy's largest root	.600	5.251	4.000	35.000	.002
PreCRRestingSBP					
Pillai's trace	.430	6.606	4.000	35.000	.000
Wilks' lambda	.570	6.606	4.000	35.000	.000
Hotelling's trace	.755	6.606	4.000	35.000	.000
Roy's largest root	.755	6.606	4.000	35.000	.000
PreCRRestingDBP					
Pillai's trace	.217	2.425	4.000	35.000	.066
Wilks' lambda	.783	2.425	4.000	35.000	.066
Hotelling's trace	.277	2.425	4.000	35.000	.066
Roy's largest root	.277	2.425	4.000	35.000	.066
PreCRRestingHR					
Pillai's trace	.550	10.697	4.000	35.000	.000
Wilks' lambda	.450	10.697	4.000	35.000	.000
Hotelling's trace	1.222	10.697	4.000	35.000	.000
Roy's largest root	1.222	10.697	4.000	35.000	.000
PreCREF					
Pillai's trace	.310	3.935	4.000	35.000	.010
Wilks' lambda	.690	3.935	4.000	35.000	.010
Hotelling's trace	.450	3.935	4.000	35.000	.010
Roy's largest root	.450	3.935	4.000	35.000	.010

R-squared values (effect sizes) indicated that EF and HR showed larger effects, with HR largest. Summaries of these data were as follows:

SBP: $F(1, 38) = 6.83, p < .05; R^2 = .075$

DBP: $F(1, 38) = 2.65, p > .05; R^2 = .023$

HR: $F(1, 38) = 44.59, p < .01; R^2 = .540$

EF: $F(1, 38) = 13.93, p < .01; R^2 = .325$

Table 12

Results of Pre- and Post-Cardiac Rehabilitation Comparisons

Source	Dependent variable	Type III sum of squares	*df*	Mean square	*F*	Sig.
Corrected model	Post-CR resting SBP	1395.519[a]	4	348.880	1.849	.140
	Post-CR resting DBP	378.238[b]	4	94.560	1.243	.309
	Post-resting HR	3456.961[c]	4	864.240	13.312	.000
	Post-CR EF	3062.869[d]	4	765.717	6.061	.001
Intercept	Post-CR resting SBP	3705.011	1	3705.011	19.631	.000
	Post-CR resting DBP	948.876	1	948.876	12.470	.001
	Post-resting HR	294.459	1	294.459	4.535	.040
	Post-CR EF	48.785	1	48.785	.386	.538
PreCR resting SBP	Post-CR resting SBP	1289.239	1	1289.239	6.831	.013
PreCR resting DBP	Post-CR resting DBP	201.977	1	201.977	2.654	.112
PreCR resting HR	Post-resting HR	2895.144	1	2895.144	44.593	.000
PreCR EF	Post-CR EF	1759.722	1	1759.722	13.930	.001
Error	Post-CR resting SBP	7171.922	38	188.735		
	Post-CR resting DBP	2891.529	38	76.093		
	Post-resting HR	2467.086	38	64.923		
	Post-CR EF	4800.454	38	126.328		
Total	Post-CR resting SBP	583932.000	43			
	Post-CR resting DBP	172052.000	43			
	Post-resting HR	265046.000	43			
	Post-CR EF	68204.640	43			
Corrected total	Post-CR resting SBP	8567.442	42			
	Post-CR resting DBP	3269.767	42			
	Post-resting HR	5924.047	42			
	Post-CR EF	7863.323	42			

[a]*R*-squared = .163 (adjusted *R*-squared = .075). [b]*R*-squared = .116 (adjusted *R* squared = .023). [c]*R*-squared = .584 (adjusted *R*-squared = .540). [d]*R*-squared = .390 (adjusted *R*-squared = .325).

Summary

Cardiac health is complex and lifestyles can greatly influence how the heart functions. This chapter showed how CR affects the health of the heart by giving more understanding if CR improves HR, BP, and EF (RQ2) and if less-intensive exercise (walking pace; HR < 120 bpm) produces greater improvement on BP, HR, and EF than more intensive exercise (jogging pace; HR ≥ 120 bpm; RQ1). This chapter included an in-depth discussion of the data collection process and the results. Although 282 MRNs were received, the multivariate analysis included data from 228 MRNs. RQ1 and RQ2 were evaluated in analytical detail. The process of answering RQ1 included a comparison of postexercise means for SBP, DBP, and HR by level of exercise intensity (walking pace [low] < 120 bpm; jogging pace (high) = ≥ 120 bpm)**.** HR showed the greatest benefit at low-intensity exercise (walking pace). RQ2 indicated that CR, except for DBP, significantly affected all variables. The next chapter includes the interpretation of the research findings and insight into recommendations for furthering this research study.

Chapter 5: Summary, Conclusions, and Recommendations

Introduction

The purpose of this research was to determine what form of exercise is most beneficial in CR for patients diagnosed with cardiac problems including CHF. The study originated from the lack of knowledge of different types of exercises that provide the best cardiac function improvement. Chapter 4 included detailed analytical information; this chapter includes the interpretation of the findings, comparison of the findings with the literature review, limitations of the study, recommendations for future research studies, and implications of the possible social change generated from this research study.

Interpretation of the Findings

The findings of this research study provided insight to CR and improving cardiac function. In the attempt to answer RQ2, the multivariate analysis revealed that CR does improve HR, BP, and EF%. The greatest effect that CR had was improving the resting HR. Ulbrich et al. (2016) noted that they based their exercise intensity on HR acquired by the ergometric test, which aligned well with the findings of this research study.

The attempt to answer RQ1 revealed that aerobic exercising for approximately 30 min three times a week kept the HR < 120 bpm, which provided greater improvement in cardiac function than keeping the HR at ≥ 120 bpm. The theory behind this finding was that maintaining the cardiac output at a moderate rate improves cardiac perfusion, which improves cardiac muscle function. Improved cardiac muscle function will increase cardiac output into the body so patients generate and conserve energy for maintaining the aerobic exercise and the time needed for completion. The analysis led to the conclusion that walking leads to greater improvement in cardiac function. In a similar research study, Ulbrich et al. (2016) revealed that high-intensity exercises are an option for patients diagnosed with CHF and that there are still loopholes regarding the protocol for which exercises are optimal. Ulbrich et al. revealed three components of quality of life as having the most influence on CR: performing physical and social activities, maintaining happiness, and engaging in fulfilling relationships.

Comparison of Previous Literature Review

New research published in 2017 revealed high-interval training improves aerobic capacity more effectively than moderate continuous training within cardiac patients (Xie, Yan, Cai, & Li, 2017). This interventional research study included 736 participants broken up into 21 groups. Each group participated in either interval or continuous training for a period that ranged from 4 to 24 weeks with the participants exercising 2 to 5 days a week (Xie et al., 2017). Xie et al. (2017) supported that high-interval aerobic exercise is best for cardiac patients, which contradicts the findings of my research study, in which the findings indicated that maintaining HR with a walking pace (aerobic exercise) led patients diagnosed with cardiac problems including CHF to greater cardiac function improvement. Xie et al. (2017) did not mention whether their poll of participants included CHF patients, which leads to the question whether that could be the difference in results. When patients participate in CR, health care providers have used intermittent high-intensity aerobic training in patients with CHF for the past decade. During this form of training, the goal is to achieve 95% of the peak HR, but researchers have not completed an adequate investigation of this form of CR (AACVPR, 2013).

As discussed in Chapter 2, both aerobic and anaerobic exercising at any level provides a positive effect by strengthening the heart if the participant maintains the CR regime. Further research is necessary to gain more knowledge on how gradually increasing exercise intensity affects the heart. Also discussed in Chapter 2, the initial exercise intensity for a patient with CVD is about 2-4 METs and then increases to about 4-7 METs for approximately 30 min (AACVPR, 2013; Williams, 2001). A gradual increase is the key factor for maintaining safety for patients, including their physiological responses and fatigue at each workload level (ACSM, 2014). Understanding patients' exercise limitations (stratification of risk) is key to the success of maintaining health but increasing compliance among patients (AACVPR, 2013). This research study did reveal a correlation between patient cooperation and health care providers starting the CR regime at a very low intensity. Many of the physician and physical therapy notes indicated that the health care providers' main concern was patient safety and ensuring patients could handle CR and its gradual increase in intensity.

Compliance and cooperation of the patients makes a CR program a success in improving cardiac function. The health belief model (individual based), community readiness model (community based), and Levine conservation model (individual/provider based) are all greatly affected by the willingness of patients, community members, and providers to adapt to change. Lifestyle changes can greatly affect a person's life both negatively or positively, but the individuals must make the change with the support of their surrounding environment, community, and health care providers. The hope of health care providers in CR programs is to affect patients' lives in a positive manner to help increase the overall health of patients and their lifestyle (Shiraev & Barclay, 2012). This research study indicated that there are many different aspects affected by multiple factors, from exercise compliance to monitoring patients during exercising. There is no one reason that a patient remains compliant, and it is important that all health care providers understand that they need to look at patients holistically.

Limitations of the Study

The limitations to CR are patient participation and following the treatment plan. The lifestyle changes can be dramatic, depending on how the patient is currently living life. Another limitation is the medications that patients take and patients' ability to maintain a moderate HR level during exercise. Many of the medications given to decrease BP also decrease HR as a side effect. As discussed in Chapter 4, another major limitation is patients are not able to complete CR because insurance does not pay for the sessions or the patients do not have transportation to the CR facility. These few limitations affect patients' progression in improving their cardiac health; therefore, health care providers should consider increasing education and giving an outpatient self-treatment plan for patients to complete on their own.

Recommendations

Recommendations for furthering this research study are to gather the same data for more patients in different CR facilities. It would be interesting to see if a difference exists in environmental factors and lifestyles from different environments or if demographic environments would affect the results of this research study. Another recommendation is to obtain the age of the patients and determine if age plays a role in how CR improves cardiac function. It was helpful during the data analysis to separate and compare patients diagnosed with CHF and patients diagnosed with other cardiac problems to determine if the treatment would be the same or different for the two groups.

Implications

The plan for this research study is to give health care teams who care for patients with CHF or other cardiac problems guidance for educating patients on CR. I will present this research to the leaders of the Cardiac Rehabilitation Facility at Queen's Medical Center and to the University of Hawaii at Manoa Nursing Department. Initiating a quality CR improvement treatment plan for patients diagnosed with CHF or other cardiac problems will be discussed, but it is not yet known if it will be implemented. Implementation of this treatment plan could help decrease hospital admissions and help patients who do not have insurance that pays for CR. Increasing CR education among all health care teams could help improve the quality of life in many patients. The autonomy and empowerment given to the patients may increase their cooperation with the treatment plan. Monitoring HR is becoming easier because of new technology available in smart watches, and being able to participate in moderate exercise to keep the exercising HR >120 bpm will ensure energy conservation is being expressed and that patients can exercise for longer periods. Plans to publish this research study have already been initiated in discussions with different cardiologists and the Queen's Medical Center CR head physical therapist. The social change of this research study could be impactful to the staff at many CR facilities if shared appropriately.

Conclusion

In summary, keeping the HR <120 bpm (walking pace) during exercise will give the greatest improvement in patients diagnosed with CHF or other cardiac problems. HR emerged as the best method for defining the intensity of exercise. CR is important for improving cardiac function, as shown in many research studies. One of the major complications in CR is ensuring patient compliance. With the use of the Levine conservation model, patient compliance could increase because it will help patients actively participate while maintaining their dignity. The Levine conservation model is designed to promote adaptation and maintain wholeness by involving four principles of conservation: conservation of energy, conservation of structural integrity, conservation of personal integrity, and conservation of social integrity (Fawcett, 2014). This research study concludes with the knowledge that walking while keeping the HR <120 bpm gives greater improvement to overall cardiac function in patients diagnosed with cardiac problems, including CHF. This research study also included discussions on the importance of patient compliance and cooperation and on the meaning of exercising for improving and maintaining cardiac health.

References

American Association of Cardiovascular and Pulmonary Rehabilitation. (2013). *Guidelines for cardiac rehabilitation and secondary prevention programs* (5th ed.). Champaign, IL: Human Kinetics.

American College of Sports Medicine. (2014). *ACSM's guidelines for exercise testing and prescription* (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

American Heart Association. (2014a). *Circulation*. Retrieved from http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.108.191261

American Heart Association. (2014b). *Ejection fraction heart failure measurement*. Retrieved from http://www.heart.org/HEARTORG/Conditions/HeartFailure /SymptomsDiagnosisofHeartFailure/Ejection-Fraction-Heart-Failure-Measurement_UCM_306339_Article.jsp

American Heart Association. (2014c). *Heart disease and stroke continue to threaten U.S. health*. Retrieved from http://newsroom.heart.org/news/heartdisease-and-stroke-continue-to-threaten-u-s-health doi:10.1056/NEJMhpr1405667

American Heart Association. (2014d). *What is cardiac rehabilitation.* Retrieved from http://www.heart.org/HEARTORG/Conditions/More/CardiacRehab/What-isCardiacRehabilitation_UCM_307049_Article.jsp

Blumenthal, D., Collins, S. (2014). Health care coverage under the affordable care act- a progress report. *The New England Journal of Medicine, 371(3) 275-281.* doi:10.1056/NEJMhpr1405667

Buchner, A., Faul, F., & Erdfelder, E. (n.d.). *G*Power*. Retrieved from http://www.psycho.uni-duesseldorf.de/aap/projects/gpower/

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports*, *100*, 126-131. Retrieved from http://journals.sagepub.com/home/phr

Centers for Disease Control and Prevention. (2014a). *Heart failure fact sheet*. Retrieved from http://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_heart_failure.htm

Centers for Disease Control and Prevention. (2014b). *Mortality from congestive heart failure United States*. Retrieved from http://www.cdc.gov/nchs/fastats/map_page.htm

Centers for Medicare and Medicaid Services. (2014). *Decision memo for cardiac rehabilitation programs: Chronic heart failure* (CAG-00437N). Retrieved from https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=270

Chan, C., Tang, D., Jones, A. (2008). Clinical outcomes of cardiac rehabilitation and maintenance program for Chinese patients with congestive heart failure. *Disability Rehabilitation, 30(17)*, 1245-1253. doi:10.1080/09638280701580226

Cornelissen, V., Verheyden, B., Aubert, A., & Fagard, R. (2010). Effects of aerobic trading intensity on resting, exercise and post-exercise blood pressure, heart rate and heart-rate variability. *Journal of Human Hypertension, 24*(3), 175-182. doi:10.1038/jhh.2009.51

Creswell, J. (2014). *Qualitative, quantitative, and mixed methods approaches* (4th ed.) Thousand Oaks, CA: Sage.

de Groote, P., Soudan, B., Lamblin, N., Rouaix-Emery, N., Mc Fadden, E., Meurice, T., & Bauters, C. (2004). Is hormonal activation during exercise useful for risk stratification in patients with moderate congestive heart failure? *American Heart Journal, 148*, 349-355. doi:10.1016/j.ahj.2004.03.044

Fawcett, J. (2014). Thoughts about conceptual models, theories and quality improvement projects. *Nursing Science Quarterly, 27*, 336-339. doi:101177/0894318414546511

Ford, C. M., Pruitt, R., Parker, V., & Reimels, E. (2004). CHF: Effects of cardiac rehabilitation and brain natriuretic peptide. *Nurse Practitioner, 29*(3), 36-39. doi:10.1097/00006205-200403000-00005

Foster, B., & Porcari, J. (2001). The risks of exercise training. *Cardiopulmonary Rehabilitation, 21*, 347-352. doi:10.1097/00008483-200111000-00002

Fox, N., Hunn, A., & Mathers, N. (2009). *Sampling and sample size calculation*. Nottingham, England: National Institute for Health Research.

Frankfort-Nachmias, C., & Nachmias, D. (2008). *Research methods in the social sciences* (7th ed.). New York, NY: Worth.

Gibbons, R. J., Balady, G. J., Bricker, J. T., Chaitman, B. R., Fletcher, G. F., Froelicher, V. F., . . . Smith, S. C. (2002). ACC/AHA 2002 guideline update for exercise testing: Summary article. *Journal of the American College of Cardiology, 40*, 1531-1540. doi:10.1016/S0735-1097(02)02164-2

Go, A., Mozaffarian, D., Roger, V., Benjamin, E., Berry, J., Borden, W., & Turner, M. (2013). Heart disease and stroke statistics—2013 update: A report from the American Heart Association. *Circulation*, *127*, e6-e245. doi:10.1161/CIR.0b013e31828124ad

Healthy People 2020. (2014). *Health disparities*. Retrieved from www.healthypeople.gov

Hughes, J., Bon-Wilson, A., Eichenauer, K., & Feltz, G. (2010). Behavioral medicine for patients with heart disease the case of depression and cardiac rehabilitation. *US Cardiology, 7*, 55-60. Retrieved from https://www.uscjournal.com/taxonomy/term/983/0?page=1

Hunt, S. A., Abraham, W. T., Chin, M. H., Feldman, A. M., Francis, G. S., Ganiats, T. G., & Yancy, C. W. (2009). 2009 focused update incorporated into the ACC/AHA 2005 guidelines for the diagnosis and management of heart failure in adults. *Journal of the American College of Cardiology, 53*(15), e1-e90. doi:10.1016/j.jacc.2008.11.013

Institutional Review Board. (2010). *Research ethics review application*. Minneapolis, MN: Walden University.

Joint Commision (2014b). Advanced certification in heart failure: standardized performance measures. Retrieved from https://www.jointcommission.org/adv_certification_heart_failure_standardized_performance_measures/

Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design*. Upper Saddle River, N.J: Prentice Hall.

Izawa, K. P., Watanabe, S., Hiraki, K., Morio, Y., Kasahara, Y., Takeichi, N., & Omiya, K. (2012). Determination of the effectiveness of accelerometer use in the promotion of physical activity in cardiac patients: A randomized controlled trial. *Archives of Physical Medicine & Rehabilitation, 93*, 1896-1902. doi:10.1016/j.apmr.2012.06.015

Katzmarzyk, P., Church, T., & Craig, C. (2009). Sitting time and mortality from all causes, cardiovascular disease and cancer. *Medicine & Science in Sports & Exercise, 41,* 998-1005. doi:10.1249/MSS.0b013e3181930355

Lavie, C. J., Thomas, R. J., Squires, R. W., Allison, T. G., & Milani, R. V. (2009). Exercise training and cardiac rehabilitation in primary and secondary prevention of coronary heart disease. *Mayo Clinic Proceedings, 84*, 373-383. doi:10.1016/S0025-6196(11)60548-X

Lewis, S. (2014). *Medical-surgical nursing: Assessment and management of clinical problems* (9th ed.). Maryland Heights, MO: Elsevier/Mosby.

Milani, R., & Lavie, C. (2003). Prevelence and profile of metabolic syndrome in patients following acute coronary events and effects of therapeutic lifestyle change with cardiac rehabilitation. *American Journal of Cardiology, 92*, 50-54. doi:10.1016/S0002-9149(03)00464-8

Mock, V., St. Ours, C., Hall, S., Bositis, A., Tillery, M., Belcher, A., . . . McCorkle, R. (2007). Using a conceptual model in nursing research: Mitigating fatigue in cancer patients. *Journal of Advanced Nursing*, *58*, 503-512. doi:10.1111/j.1365-2648.2007.04293.x

National Heart, Lung, and Blood Institute. (2014). *Morbidity and mortality: 1998 chart-book on cardiovascular, lung, and blood diseases*. Bethesda, MD: Public Health Service.

Nilsson, B. B., Hellesnes, B., Westheim, A., & Risberg, M. A. (2008). Group-based aerobic interval training in patients with chronic heart failure: Norwegian ullevaal model. *Physical Therapy, 88*, 523-535. doi:10.2522/ptj.20060374

Okun, M. A., & Karoly, P. (2007). Perceived goal ownership, regulatory goal cognition, and health behavior change. *American Journal of Health Behavior, 31*, 98-109. doi:10.5993/AJHB.31.1.10

Oldridge, N., & Pashkow, F. (1993). Compliance and motivation in cardiac rehabilitation. In F. J. Pashkow & W. A. Dafoe (Eds.), *Clinical rehabilitation: A cardiologist's guide* (pp. 335-348). Baltimore, MD: Williams and Wilkins.

Papademetriou, V., Gradman, A., Egan, B., Nesbitt, S., Vidt, D., & Julius, S. (2002). P240: Utility of load pressure during submaximal exercise in the risk stratification of patients with high normal blood pressure. *American Journal of Hypertension, 15*, 1. doi:10.1016/S0895-7061(02)02591-8

PASW Statistics. (2015). *Graduate pack* (Version 19) [Computer software]. San Ramon, CA: PASW, Inc.

Physical Therapy Association. (2014). *CMS cardiac rehab policy expands, leaves physical therapy coverage unchanged*. Retrieved from http://www.apta.org/PTinMotion/NewsNow/2014/2/21/CMSHeartFailurePolicy/

Pigozzi, F., Alabiso, A., Parisi, A., Di Salvo, V., Di Luigi, L., Spataro, A., & Iellamo, F. (2001). Effects of aerobic exercise training on 24 hr profile of heart rate variability in female athletes. *Journal of Sports Medicine and Physical Fitness, 41*, 101-107. Retrieved from http://www.minervamedica.it/en/journals/sports-med-physical-fitness/

Plested, B. A., Edwards, R. W., & Jumper-Thurman, P. (2006, April). *Community readiness: A handbook for successful change.* Fort Collins, CO: Tri-Ethnic Center for Prevention Research.

Riley, D., Stewart, D., & Grace, S. (2007). Continuity of cardiac care: Cardiac rehabilitation participation and other correlates. *International Journal Cardiology, 119,* 326-333. doi:10.1016/j.ijcard.2006.07.158

Rincón, M., Rojas, M. X., Romero, V. A. R., Tamayo, D. C., Franco, C., Castro, H., . . . Dennis, R. (2016). Economic evaluation of exercise-based cardiac rehabilitation programs for chronic heart failure patients in Colombia. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *36*, 12-19. doi:10.1097/HCR.0000000000000150

Sandri, M., Schuler, G., Mangner, N., & Kirsch, K. (2016). Effects of age and exercise training on ventilatory efficiency in chronic heart failure. *Journal of the American College of Cardiology*, *67*, 1935-1935. doi:10.1016/S0735-1097(16)31936-2

Savage, P. D., Banzer, J. A., Balady, G. J., & Ades, P. A. (2005). Prevalence of metabolic syndrome in cardiac rehabilitation/secondary prevention programs. *American Heart Journal, 149*, 627-631. doi:10.1016/j.ahj.2004.07.037

Shiraev, T., & Barclay, G. (2012). Evidence based exercise: Clinical benefits of high intensity interval training. *Australian Family Physician, 41*(12), 960-962. Retrieved from http://www.racgp.org.au/afp

Simon M. (2011). *Assumptions, limitations, and delimitations*. Retrieved from http://www.dissertationrecipes.com

Sloan, R. P., Shapiro, P. A., DeMeersman, R. E., Bagiella, E., Brondolo, E. N., McKinley, P. S., . . . Myers, M. M. (2009). The effect of aerobic training and cardiac autonomic regulation in young adults. *American Journal of Public Health, 99*, 921-928. doi:10.2105/AJPH.2007.133165

Smith, S. C., Allen, J., Blair, S. N., Bonow, R. O., Brass, L. M., Fonarow, G. C., & Taubert, K. A. (2006). AHA/ACC guidelines for secondary prevention for patients with coronary and other atherosclerotic vascular disease: 2006 update. *Journal of the American College of Cardiology, 47*, 2130-2139. doi:10.1016/j.jacc.2006.04.026

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.

Ulbrich, A. Z., Angarten, V. G., Netto, A. S., Sties, S. W., Bündchen, D. C., de Mara, L. S., . . . de Carvalho, T. (2016). Comparative effects of high intensity interval training versus moderate intensity continuous training on quality of life in patients with heart failure: Study protocol for a randomized controlled trial. *Clinical Trials and Regulatory Science in Cardiology*, *13*, 21-28. doi:10.1016/j.ctrsc.2015.11.005

Wang, S., Lin, L., Lee, C., & Wu, S. (2011). Effectiveness of a self-care program in improving symptom distress and quality of life in congestive heart failure patients: A preliminary study. *Journal of Nursing Research*, *19*, 257-266. doi:10.1097/JNR.0b013e318237f08d

Wannamethee S., Shaper A., & Walker, M. (2000). Physical activity and mortality in older men with diagnosed coronary heart disease. *Circulation, 102*, 1358-1363. doi:10.1161/01.CIR.102.12.1358

Whitehurst, M. (2012). High intensity interval training an alternative for older adults. *American Journal of Lifestyle Medicine, 6*, 382-386. doi:10.1177/1559827612450262

Williams, M. (2001). Exercise testing in cardiac rehabilitation: Exercise prescription and beyond. *Cardiology Clinical, 19*, 415-431. doi:10.1016/S0733-8651(05)70226-5

Wise F., & Patrick, J. (2012). Cardiac rehabilitation for women with heart failure. *Journal of Cardiopulmonary Rehabilitation and Prevention, 392,* 78-84. doi:10.1097/HCR.0b013e3182460c4b

World Health Organization. (2013). *Cardiovascular diseases*. Retrieved from http://www.who.int/mediacentre/factsheets/fs317/e

Xie, B., Yan, X., Cai, X., & Li, J. (2017). Effects of high-intensity interval training on aerobic capacity in cardiac patients: A systematic review with meta-analysis. *BioMed Research International,* doi:10.1155/2017/5420840

Appendix A: Example of Long-Term Outpatient Program Daily Exercise Record

Name: ____

Target HR: ____

Exercise prescription: ____

	Adjustment					**Ex**	**Ex**	**Ex**		

From *Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs, Fifth Edition,* by American Association of Cardiovascular and Pulmonary Rehabilitation, 2013, Human Kinetics, Champaign, IL.

Appendix B: Request for Permission to Conduct Research in a Facility

WALDEN UNIVERSITY

A higher degree. A higher purpose.

- 100 Washington Avenue South, Suite 900, Minneapolis, Minnesota 55401

March 16, 2015

Rosalie Garcia Ph.D. (c), MSN, RN

Walden University Graduate Student

[redacted]

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN YOUR FACILITY

Dear To Whom It May Concern,

My name is Rosalie Garcia, and I am a Health Sciences –Self Design Study student at Walden University. The research I wish to conduct for my Doctoral Dissertation involves obtaining archival data regarding patient's diagnosis with congestive heart failure (CHF) who have participated in cardiac rehabilitation. The purpose of this study is not to only bring further awareness and understand of CHF but is to give patients diagnosed with

CHF a method for maintaining their cardiac health by determining which exercises provide the most benefit for improving cardiac function in these patients. This research study will be conducted with full awareness of HIPPA and the facility and patients' names will not be utilized within any way.

I am hereby seeking your consent to access your archival data for sole purpose of this research study.

I have provided you with a copy of my dissertation proposal which includes copies of the assent forms to be used in the research process, as well as a copy of the approval letter which I received from the URR and IRB.

Upon completion of the study, I undertake to provide your facility with a bound copy of the full research report. If you require any further information, please do not hesitate to contact me. Thank you for your time and consideration in this matter.

Yours Sincerely,

Rosalie Garcia