2013

ADHERENCE TO PHYSICAL ACTIVITY AMONG INDIVIDUALS WITH OR WITHOUT CARDIOVASCULAR DISEASE

Zyad T. Saleh
University of Kentucky, zyad.saleh@uky.edu

STUDENT AGREEMENT:

I represent that my thesis or dissertation and abstract are my original work. Proper attribution has been given to all outside sources. I understand that I am solely responsible for obtaining any needed copyright permissions. I have obtained and attached hereto needed written permission statements(s) from the owner(s) of each third-party copyrighted matter to be included in my work, allowing electronic distribution (if such use is not permitted by the fair use doctrine).

I hereby grant to The University of Kentucky and its agents the non-exclusive license to archive and make accessible my work in whole or in part in all forms of media, now or hereafter known. I agree that the document mentioned above may be made available immediately for worldwide access unless a preapproved embargo applies.

I retain all other ownership rights to the copyright of my work. I also retain the right to use in future works (such as articles or books) all or part of my work. I understand that I am free to register the copyright to my work.

REVIEW, APPROVAL AND ACCEPTANCE

The document mentioned above has been reviewed and accepted by the student's advisor, on behalf of the advisory committee, and by the Director of Graduate Studies (DGS), on behalf of the program; we verify that this is the final, approved version of the student's dissertation including all changes required by the advisory committee. The undersigned agree to abide by the statements above.

Zyad T. Saleh, Student

Dr. Terry Lennie, Major Professor

Dr. Terry Lennie, Director of Graduate Studies

ADHERENCE TO PHYSICAL ACTIVITY AMONG INDIVIDUALS WITH OR WITHOUT CARDIOVASCULAR DISEASE

DISSERTATION

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the College of Nursing at the University of Kentucky

By

Zyad Taher Saleh

Lexington, KY

Director: Dr. Terry A. Lennie, Professor of Nursing

Co-director: Dr. Debra K. Moser, Professor of Nursing

Lexington, KY

2013

ABSTRACT OF DISSERTATION

ADHERENCE TO PHYSICAL ACTIVITY AMONG INDIVIDUALS WITH OR WITHOUT CARDIOVASCULAR DISEASE

Cardiovascular disease (CVD) is a major public health problem and a primary cause of morbidity and mortality in the United States. Regular physical activity is recommended for prevention and management of CVD. Despite the cardiovascular health benefits of physical activity most adults are physically inactive. Therefore, the aim of this dissertation was to examine the factors associated with adherence to physical activity among individuals with or without CVD.

The first paper is a report of a study conducted to examine which baseline demographic (age, gender, marital status, socioeconomic status, and place of residency), psychosocial (social support, depression, anxiety, and fatalism), and clinical (past history of exercising, comorbidity, and health literacy) variables predicted successful adoption of the active lifestyle recommendation of increasing moderate-to-vigorous physical activity by an accumulated 15 minutes or more each day following a CVD risk reduction intervention and 2) to identify which of those same factors predicted dropout from the CVD risk reduction intervention among at-risk individuals in rural America. The study sample consisted of 399 rural Americans. The results revealed that a higher anxiety level was a predictor of active lifestyle modification following a CVD risk reduction intervention. In contrast, younger age and low health literacy were predictors of dropout from a CVD risk reduction intervention.

The second paper is a literature review of studies investigating the factors that affected enrollment in cardiac rehabilitation in patients with heart failure (HF). The aims of this review were to: (a) describe enrollment rates of patients with HF in cardiac rehabilitation programs, (b) review the literature on factors affecting enrollment of patients with HF, and (c) identify areas for future research. It is difficult to draw conclusion about enrollment rates because the period of time after hospital discharge that enrollment was measured varied across studies. A wide array of demographic, psychosocial, and clinical variables have been identified as potential barriers of enrollment in cardiac rehabilitation programs. Additional research including patients with HF is needed.

The third paper is a report of a cross-sectional study of 181 patients with HF. The aims were to determine 1) the amount of variance in the functional status predicted by depressive symptoms, perceived control, self-rated health, HF self-care maintenance behaviors, and serum N-terminal pro-B-type natriuretic peptide (NT-pro-BNP) biomarker of cardiac dysfunction in patients with HF and 2) whether NT-pro-BNP mediated the relationship between self-care maintenance behaviors and functional status. Depressive symptoms, poor self-rated health, non-adherence to physical activity, and greater serum NT-pro-BNP levels were independently associated with worse perceptions of functional status. Serum NT-pro-BNP levels partially mediated the association between adherence to physical activity and perception of functional status.

The findings from this dissertation provided further evidence of the importance of adherence to physical activity and identify key variables that promote participation in interventions to promote heart healthy lifestyles and adherence to physical activity.

Keywords: Active lifestyle modification, Barriers, Cardiovascular disease, Dropout, Functional status

Zyad T. Saleh

Student's Signature

April 23, 2013

Date

ADHERENCE TO PHYSICAL ACTIVITY AMONG INDIVIDUALS WITH OR WITHOUT CARDIOVASCULAR DISEASE

By

Zyad Taher Saleh

Dr. Terry A. Lennie

Director of Dissertation

Dr. Debra K. Moser

Co-director of Dissertation

Dr. Terry A. Lennie

Director of Graduate Studies

April 23, 2013

Date

ACKNOWLEDGMENTS

I would like to express my special gratitude to those individuals who without their support, guidance, and timely responsiveness, this dissertation would not have been possible. I would like to express the deepest appreciation to my dissertation chair, Dr. Terry A. Lennie and co-chair, Dr. Debra K. Moser. I can't say thank you enough for your tremendous support, exemplary guidance, monitoring, and constant encouragement throughout my doctoral program. I am grateful that Dr. Terry and Dr. Debra believed in me, provided me with opportunities, valued my input, and recognized my accomplishments. I would like to extend my special thanks to Dr. Elizabeth G. Tovar and Dr. Jody L. Clasey for serving in my committee and providing their insightful guidance and expertise. I would also like to thank Dr. James W. Yates to serve as outside examiner in my committee.

I would also like to acknowledge the faculty and staff of the RICH Heart Program at the University of Kentucky, College of Nursing for their support, love, and friendly work environment. I am particularly thankful for the director of the program, Dr. Misook L. Chung for giving me such attention and time. An additional thank you goes to all members in the RICH Heart Program who contributed to the projects and data sets that I used in my dissertation.

Last but not least I wish to avail myself of this opportunity, express a sense of gratitude and love to my father, Taher, mother, Shinarah, grandmother, brothers, and sisters for their support, strength, help, and prayers. My final and most heartfelt acknowledgment must go to my wife Hiba. Her support, encouragement, and companionship has turned my journey through graduate school into a pleasure. I am also

particularly thankful for my daughters, Leen and Zaina, and my son, Arwad, who are my joy.

Table of Contents

ACKNOWLEDGMENT iii

LIST OF TABLES viii

LIST OF FIGURES viii

CHAPTER ONE: Introduction 1

CHAPTER TWO: Factors Associated with Adoption of Active Lifestyle and Dropout from Cardiovascular Disease Preventive Intervention among Rural Americans 9

Introduction 9

Methods 12

Design 12

HeartHealth Intervention 12

Participants and Setting 13

Measurement of variables 14

Demographic characteristics 14

Psychosocial variables 14

Clinical variables 16

Dependent Variable 17

Successful adoption of activity lifestyle modification 17

Dropout 18

Procedure 18

Data Analysis 19

Results 20

Predictors of Active Lifestyle Modification 20

Predictors of Dropout from Heart Health Program 20

Discussion 21

CHAPTER THREE: Factors Associated with Enrollment in a Cardiac Rehabilitation Program in Patients with Heart Failure: a Review of the Literature 31

Introduction 31

Methodology 32

Definition of Enrollment 33
Rates of Enrollment in Rehabilitation Programs 33
Factors Associated with Participation in Cardiac Rehabilitation Program 35
Socio-demographic Factors 35
Age 35
Gender 38
Marital Status 39
Ethnicity 41
Employment Status 42
Household Income 43
Level of Education 44
Distance from Rehabilitation Program Site 45
Summary 45
Psychosocial Factors 46
Emotional Distress 46
Self-efficacy 47
Social Support 48
Perceptions of Cardiac Rehabilitation 49
Summary 49
Clinical Factors 50
Referral 50
Functional ability 50
Medical History 51
Other clinical-related factors 51
Summary 53
Discussion 53
Suggestions for Future Research 55
Implication 56
Conclusions 58

CHAPTER FOUR: Factors Associated with Perception of Functional Status in Patients with Heart Failure 61
Introduction 61
Conceptual Framework 63
Methods 66
Sample 67
Measures 67
Procedure 70
Data analysis 70
Results 72
Characteristics of the Patients 72
Predictors of Functional Status in Patients with HF 73
Mediation Serum NT-pro-BNP levels on the Link between Self-Care Maintenance Behaviors and Perception of Functional Status 73
Discussion 74
Implications and Conclusion 78
CHAPTER FIVE: Conclusions and Discussion 85
Implication 90
Summary 92
Refernces 95
VITA 131

LIST OF TABLES

Table 2.1. Baseline Sample Characteristics 26
Table 2.2. Predictors of Adoption of Active Lifestyle Post Intervention 29
Table 2.3. Predictors of Dropout from Heart Health Intervention 30
Table 3.1. Factors Influencing Enrollment in a Cardiac Rehabilitation Program 59
Table 4.1. Demographic, Psychosocial, and Clinical Characteristics of the Sample 81
Table 4.2. Factors Related to Perception of Functional Status in Patients with Heart Failure 83

LIST OF FIGURES

Figure 4.1. Conceptual Framework for the Factors Related to Functional Status in Patients with Heart Failure 80
Figure 4.2. Mediator Effect of Serum NT-pro-BNP Levels on The Association between Adherence to Physical Activity and Perception of Functional Status 84

CHAPTER ONE

Introduction

Cardiovascular disease (CVD) encompasses diseases that involve the heart or vascular system including coronary artery disease, angina, and hypertension.[1] CVD is a significant public health problem in the United States affecting one in three American adults and accounting for nearly 33% of all deaths.[2] Heart failure (HF) is the end stage of CVD and is the most expensive CVD-related condition with respect to health care costs of which the largest component is related to repeated hospitalizations. Consequently, prevention of CVD is essential to decreasing the incidence of HF and associated costs.

Sedentary lifestyle is a primary risk factor for CVD.[2] In a prospective case-control study with over 12,000 cases and 14,000 controls, sedentary lifestyle accounted for 12.2% of the risk of developing coronary heart disease after accounting for other CVD risk factors such as smoking, diabetes mellitus, hypertension, and lipid profile.[3] In two prospective studies with over 17000 individuals who were followed for more than 12 years, prolonged time spent sitting predicted CVD mortality rates independent of age, smoking, and body mass index (BMI).[4,5] A dose-response relationship has been observed between sedentary behaviors and mortality from CVD. Individuals who spent 3 to 5 hours per day in sitting activities were 20% more likely and those who spent 6 or more hours were 33% more likely to die from CVD during a 14-year follow up compared to individuals who spent less than 3 hours sitting.[5] Similarly, watching television for 4 or more hours per day over a 6-year follow up period was associated with an 80% increased risk of CVD mortality compared to watching television for less than 2 hours per day.[6]

Several factors may explain the association between sedentary lifestyle and increased risk of developing CVD. One of the demonstrated consequences of sedentary lifestyle is metabolic syndrome. Metabolic syndrome is a constellation of risk factors for CVD, including elevated plasma triglyceride, low high density lipoprotein (HDL) cholesterol, hyperglycemia, hypertension, and increased abdominal adiposity. Direct relationships have been noted between time spent in sedentary behaviors and metabolic risk factors, hypertension, and excessive adiposity.[7,8] A meta-analysis of data from 10 studies with over 21,000 individuals demonstrated that sedentary lifestyle was related to development of metabolic syndrome. Researchers estimated that prolonged time spent in sedentary behaviors was associated with a 73% increase in the risk of metabolic syndrome.[9] In addition, sedentary behaviors are associated with other unhealthy behaviors that may contribute to risk of CVD. A recent review by Rhodes[10] suggests that time spent in sedentary behaviors, especially watching television, might be related to smoking, increased food consumption, and poor food choices. Thus, sedentary behaviors and low physical activity can have negative impact on cardiovascular health.

There is abundant evidence that CVD and related mortality are preventable through active lifestyle change.[2,11,12] Two meta-analyses of the effects of physical activity on CVD showed a significant inverse dose-response relationship between physical activity levels and the incidence of CVD.[13,14] Other researchers estimated that a 2.3% increase in the individuals with a physically active lifestyle prevented approximately 5% of deaths attributable to the coronary heart disease between 1980 and 2000.[15]

Regular physical activity has been shown to improve cardiovascular health[2] by decreasing resting heart rate,[16] increasing diameter of the coronary artery, formation of collateral circulation,[17] decreased platelet adhesiveness, and enhancement of vascular endothelial function.[18,19] Regular physical activity is associate with a lower risk of developing components of metabolic syndrome including hypertension,[20] low HDL cholesterol, abdominal adiposity, and hyperglycemia.[21] Moreover, regular physical activity has been suggested to have positive effects on health behaviors such as quitting smoking and consuming a heart-healthy diet.[21,22] Thus, physical activity is one of the most important elements in cardiovascular health that may play a role in reducing the risk of CVD and death. Physical activity has been shown to attenuate inflammatory processes.[23] Inflammation is a key role in mediating the development of atherosclerosis and its ultimate endpoint, thrombotic complications leading to myocardial infarction.

Physical activity is also recommended in the management of HF. Results from previous studies of exercise training trials have detailed benefits that could be achieved with physical activity in patients with HF. These include improvement in the cardiac output, peripheral blood flow, and skeletal muscle aerobic metabolism.[24] Physical activity associated health benefits in patients with HF has been translated to decreased HF symptoms, increased activity tolerance, prolong survival, and lowers hospitalization rates.[24,25]

Despite cardiovascular health benefits of physical activity, more than 30% of American adults are physically inactive and nearly 50% of adults do not meet minimum recommendation of 150 minutes of moderate intensity aerobic activity each week. Adults

living in rural areas are more likely to be physical inactive compared with adults living in urban areas.[26] The factors associated with adoption to active lifestyle have been described.[27-32] However, there is a lack of research examining the impact of the factors on activity in rural Americans. Given the significant clinical consequences of physical inactivity and the greater burden of CVD in rural areas, it is imperative that researchers determine what factors affect active lifestyle in rural adults.

Non-adherence to physical activity recommendations is also common among patients with HF.[33-35] Enrollment in cardiac rehabilitation programs may be an important first step to promote physical activity behavior in patients with HF.[36] Cardiac rehabilitation programs are designed to facilitate initiation and maintenance of safe physical activity levels for patients with HF.[37] Researchers have noted that enrollment in a cardiac rehabilitation program can increase activity tolerance in patients with HF.[24] However, enrollment in cardiac rehabilitation programs has been estimated to be as low as 20% of all eligible HF patients.[34,35] Although researchers have described the problem of low enrollment rates among patients with HF, little is known about what factors affect their enrollment in a cardiac rehabilitation program. To assure enrollment in rehabilitation and maintenance to physical activity recommendations for patients with HF, it is also important to identify the predictors of as well as the barriers to utilization of rehabilitation.

Functional status may be an important determinant of participation in physical activity in patients with HF.[38-41] HF significantly compromises functional status by contributing to physiologic, physical, cognitive, and social functioning impairment as

well as increased psychological distress.[41,42] Patients' perception of lower functional status may limit their ability to participate in physical activity.[41] Although functional status in patients with HF has been used as an important outcome to detect effect of treatment plan, investigators have not examined what factors affect their perception of functional status. Therefore, it is also imperative to determine the factors that impact patients' perception of functional status.

The purpose of this dissertation was to examine the factors associated with adherence to physical activity among individuals with or without CVD. Each chapter of this dissertation demonstrates part of my inquiry to develop a preliminary program of research focused on improving active lifestyle in individuals with or without CVD.

In Chapter Two, results are presented from a study that was conducted to identify the predictors of adopting an active lifestyle following a CVD risk reduction intervention and the predictors of dropout from the intervention among individuals with CVD risk factors living in rural America. This was a longitudinal, prospective study of 399 rural Appalachians who participated in at the HeartHealth CVD risk reduction intervention. The HeartHealth intervention was a structured 3 month educational and skill building intervention aimed to promote cardiovascular health. Physical activity was recorded for 48 consecutive hours by Actiwatch at baseline and 3 months after the intervention. Data from a subsample of 202 participants with complete baseline and follow up physical activity data, defined as completers, were used to determine the predictors of active lifestyle modification. Participants were grouped into those who increased their moderate-to-vigorous level of activity by 15 minutes or more each day after the

intervention and those who did not. This classification was based on evidence that CVD risk can be decreased at lower amounts of moderate physical activity (i.e., 15 minutes of walking daily)[43] than the current recommendation of daily 30-minute of moderate activity.[44] Also, baseline data from a total of 128 participants defined as dropouts because they withdrew from the study before completing the final assessment and 271 participants defined as completers because they attended the intervention sessions and completed the final assessment were used to determine the predictors of dropout from the intervention. Backward binary logistic regression was conducted to identify which baseline demographic (age, gender, marital status, level of education, financial status, and place of residency), psychosocial (social support, fatalism, depression, and anxiety), and clinical (past history of exercising, health literacy, and comorbidity) variables predicted adoption to active lifestyle and dropout from the intervention study. All of these factors may impact rural Americans but to date this has not been demonstrated. We found that higher anxiety levels were associated with adoption of a more active lifestyle after the intervention. Regarding dropout, younger age and low health literacy were found to be predictors of dropout from CVD risk reduction intervention.

In Chapter Three, a systematic review of the literature is presented to examine the factors affecting enrollment of patients with HF in cardiac rehabilitation programs. Because there were no studies conducted in patients with HF, the review was expanded to include research studies across all cardiac-related conditions. An electronic literature search was conducted covering the period of 1995 to 2012. The keywords used were: cardiac rehabilitation, enrollment, participation, attendance, barriers, physical activity,

and exercise. A total of 22 studies were included in the systematic review that met the following criteria: quantitative studies included men and/or women discharged from a cardiac-related hospitalization and measured enrollment in a cardiac rehabilitation program. The factors affecting enrollment in a cardiac rehabilitation program were grouped into three dimensions (socio-demographic, psychosocial, or clinical factors).

Chapter Four presents findings from a secondary analysis of cross-sectional data collected on adults with HF. In this study, we tested two hypotheses derived from previous research findings: 1) emotional distress, perceived control, self-rated health, HF self-care maintenance behaviors, and N-terminal pro-brain natriuretic peptide (NT-pro-BNP) a biomarker of myocardial dysfunction will independently predict functional status in patients with HF after controlling for age, gender, socioeconomic status, and comorbidity and 2) NT-pro-BNP will mediate the influences of HF self-care maintenance behaviors on functional status. A sample of 279 patients with a documented diagnosis of HF was included in this study. Hierarchical multiple linear regression and mediation analysis were used for data analysis. The results revealed that depressive symptoms, HF self-care of adherence to physical activity, serum NT-pro-BNP levels, and self-rated health were independent predictors of patients' perception of functional status. The association between adherence to physical activity and patients' perceptions of functional status was mediated partially by serum NT-pro-BNP levels.

In Chapter Five, an integrated summary and conclusions from the findings of prior chapters are presented. Recommendations for practice and future research are outlined. The findings from each chapter contribute to the knowledge about the factors

that affect adherence to physical activity among individuals with or without cardiovascular disease. Results from this dissertation may translate into significant benefits for public health by targeting factors that could affect individuals' adoption to active lifestyle modification.

CHAPTER TWO

Factors Associated with Adoption of Active Lifestyle and Dropout from Cardiovascular Disease Preventive Intervention among Rural Americans

Introduction

Cardiovascular disease (CVD) is a set of disorders affecting the heart and the vascular system.[1] CVD is a major public health problem and a primary cause of morbidity and mortality in the United States.[2] It is estimated that one in three adults are affected by one or more types of CVD, including coronary artery disease, hypertension, angina, and heart failure. CVD accounts for approximately 33% of all underlying causes of death. Despite efforts to reduce CVD morbidity and mortality,[2] rural Appalachia continues to have a higher prevalence of CVD and associated risk factors including hypertension, obesity, diabetes mellitus, and dyslipidemia than urban areas.[2,45-47] Lifestyle modifications that decrease risk factors are essential for prevention and management of CVD.[2] There is growing evidence that interventions that effectively promote lifestyle modifications improve cardiovascular health.[48,49] However, there are barriers in rural Appalachia that may make interventions in this population less likely to produce lifestyle modifications.[50] Accordingly, designing an effective CVD primary, secondary, and tertiary preventive intervention requires understanding of the predictors of adoption and maintenance of healthy lifestyle modifications by residents of rural America.

Physical activity is considered an important means of reducing CVD morbidity and mortality.[51] Regular physical activity results in decreased heart rate[16] and lower

systolic blood pressure[20] leading to reduced myocardial oxygen demands and ultimately to lowered risk for myocardial ischemia.[37] Regular physical activity is accompanied by an increase in the interior diameter of the coronary artery, formulation of collateral circulation,[17] decrease in platelet adhesiveness, and an enhancement of vascular endothelial function.[18,19] The effects of regular physical activity on CVD risk factors include reduction in blood pressure of individuals with hypertension, increase in high-density lipoprotein cholesterol levels, decrease in cholesterol levels, control of or reduction in body weight, and reduced risk of developing type 2 diabetes mellitus.[2,21] Moreover, regular physical activity has been associated with adoption of other health behaviors such as quitting smoking and consuming a heart-healthy diet.[21,22]

The relationship between physical activity and cardiovascular health benefits can be achieved at levels of physical activity (e.g., 15 minutes of walking daily)[43] lower than currently recommended by the American Heart Association and the American College of Sports Medicine (30 minutes of moderate-to-vigorous intensity activity daily).[44] Repeated short bouts of activity, including all leisure, occupational, or household activities, when performed at moderate or vigorous intensity levels have cardiovascular health benefits similar to continuous long bouts of physical activity at the same intensity levels.[44,52,53] Thus, CVD risk can be reduced through daily 15-minute bouts of moderate intensity activity. These bouts may make physical activity more convenient, encouraging physically inactive individuals to adopt a more active lifestyle.

In contrast, sedentary behavior is considered among the top 5 risk factors for CVD.[2,4,5,21] Sedentary behavior involves low energy inactivity such as sitting and laying

down.[54] Time spent in sedentary behavior is positively associated with CVD risk factors of obesity and diabetes mellitus independent of physical activity levels.[54-56] This suggests that cardiovascular health benefits associated with regular bouts of daily physical activity may be negated in individuals who spend the remainder of time in sedentary behavior. Accordingly, successful CVD preventive interventions must target both planned physical activity and reduction in sedentary behavior. Addressing the factors that affect active lifestyle in rural Americans is important for designing effective CVD preventive interventions. The majority of studies to date have not addressed barriers that affect adoption of active lifestyles in rural Americans.[57,58]

Identifying the factors associated with dropout from CVD preventive interventions is equally important because completion of the intervention is the necessary first step in promoting adoption of a more active lifestyle.[59] Previous researchers have identified several factors associated with dropout from health promotion programs and barriers to adopting active lifestyle recommendations across a wide range of populations. These factors included demographic variables (age, gender, marital status, level of education, financial status, and place of residency), psychosocial variables (social support, fatalism, depression, and anxiety), and clinical variables (past history of exercising, health literacy, and comorbidities). [27-32] All of these factors may impact rural Americans, but have not been examined.

Therefore, the purposes of this study were to determine predictors of 1) successful adoption of a CVD preventive lifestyle modification following an intervention and 2) dropout from the intervention in a group of individuals with CVD risk factors living in

rural Appalachia. The specific aims of the study were 1) to determine which baseline demographic (age, gender, marital status, socioeconomic status, and rurality), psychosocial (social support, depression, anxiety, and fatalism), and clinical (past history of exercising, health literacy, and comorbidity) variables predicted successful adoption of the lifestyle recommendation to increasing moderate-to-vigorous physical activity by an accumulated 15 minutes or more each day following a CVD risk reduction intervention and 2) to identify which of those same factors predicted dropout from the CVD risk reduction intervention among at-risk individuals living in rural Appalachia.

Methods

Design

We conducted a secondary analysis of data obtained from the HeartHealth intervention study conducted between 2009 and 2011. The HeartHealth intervention was designed to improve self-management of CVD risk factors and quality of life of adults living in rural Appalachian Kentucky.

HeartHealth Intervention

The HeartHealth intervention was a structured 3 month educational and skill building intervention program using a whole health approach to promote cardiovascular health in rural Appalachian Kentucky. The program focused on encouraging lifestyle modification with regard to eating habits, adherence to prescribed medication, physical activity, and self-management through a set of strategies based on the Theory of Planned Behavior (TPB). Individualized counseling was included to identify and address individuals' attitudes that facilitate or impede lifestyle change.

Participants and Setting

Participants were residents of three counties located in southeastern Kentucky that are among a cluster of counties with the highest rates of CVD mortality and CVD risk factors in the United States.[60-62] Participants were mainly recruited from primary care clinics. Other recruitment methods were self-referral, participant referrals, interested party referrals, and flyers posted at various community locations. Inclusion criteria were adults with CVD or having two or more of the following CVD risk factors: 1) age > 44 years in men or > 55 years in women, 2) family history of CVD, 3) history of hypertension, abnormal lipids, or diabetes, 3) current smoker, 4) overweight or obesity, 5) diet high in total fat or low in fruit and vegetable intake, or 6) sedentary lifestyle. Exclusion criteria were: 1) cognitive impairment, 2) non-English speaking, 3) chronic drug abuse, 4) end-stage renal, liver, or pulmonary disease; 5) undergoing active treatment for cancer, 6) gastrointestinal disease that required special diets; or 7) condition that prohibited engagement in physical activity.

A total of 399 participants were eligible for this study. Out of 271 participants, defined as completers, 202 participants with complete baseline and follow up physical activity data were used to determine the predictors of active lifestyle modification. For the remaining 69 participants, Actigraph data were missing, either at baseline or follow up, due to technical issues including errors in saving or uploading the data and the battery becoming dislodged. Baseline data from a total of 128 participants defined as dropouts and 271 participants defined as completers were used in determining the predictors of dropout from the intervention.

Measurement of variables

Demographic characteristics. Demographic characteristics including age, gender, marital status, socioeconomic status, and place of residence were collected via simple self-administered form. Participants were divided into 3 socioeconomic status groups based on level of education, employment status, and financial status. Level of educational was categorized as having high school or less or more than high school. Participants' employment status was categorized as employed or unemployed. Financial status was assessed using one item that asked participants to rate their income as 1 = "have more than enough to make ends meet," 2 = "have enough to make ends meet," and 3 = "do not have enough to make ends meet." Participants in categories 2 and 3 were combined. We adopted this classification system under the assumption not having enough money to make ends meet would potentially have a financial impact on attending health promotion programs and accessing local recreational physical activity facilities. Place of residency was classified as rural vs. urban groups using county of residence based on rural-urban commuting area (RUCA) codes.[63] The RUCA codes classify each county into one of nine categories along the rural-urban continuum based on population density, urbanization, and adjacency to an urban area. RUCA codes from 1 to 3 represent urban areas and from 4 and higher denote rural areas. Within the six rural categories, higher numbered categories indicate small population density and more isolated rural areas.

Psychosocial variables. Depressive symptoms were measured by the 9-item Patient Health Questionnaire (PHQ). The PHQ uses four-point semantic differential statement scales, including 0 = "not at all," 1 = "several days," 2 = "more than half the

days," and 3 = "nearly every day." The items that precede the statements are related to how frequently depressive symptoms interfere with aspects of daily life. The nine item scores were totaled to obtain depressive symptoms severity. A higher total score indicates more depressive symptom severity. The cutoff point of 10 has been used to define major depressive disorder which has a specificity and sensitivity of 88%. The reliability of the PHQ was previously reported as 0.89.[64]

Anxiety was measured using the 6-item anxiety subscale of the Brief Symptom Inventory (BSI). The items are related to different feelings of anxiety. Each feeling is scored on a 5-point Likert scale ranging from 0 = "not at all," 1 = "a little bit," 2 = "moderately," 3 = "quite a bit," and 4 = "extremely." The scores were summed and averaged with higher scores indicating more severe anxiety. A score above > 0.35 was used to indicate the presence of mild to moderate anxiety and 1.7 or higher to indicate clinically significant anxiety.[65] The reported reliability of the BSI anxiety subscale ranged between .81 and .85[66-68] and its construct validity has been supported by factorial analysis.[65]

Social support was defined as perceived instrumental and emotional support. Instrumental support includes the provision of tangible aids. Emotional support involves the expressions of empathy, love, and trust.[69] Social support was measured by the Perceived Social Support Scale (PSSS). The PSSS contains 12 items rated on a Likert scale that is scored from 1 (very strongly disagree) to 6 (very strongly agree). The PSSS item ratings were added for a total score that could range between 7 and 84; higher scores indicated a greater perception of social support. The PSSS is reliable with reported

Cronbach's alpha of 0.93 to 0.94[70,71] and its construct validity has been supported by factor analysis.[71]

Fatalism was defined as the belief that illness is unavoidable and that death related serious illnesses are inevitable regardless of the individual's actions.[72] Fatalism was measured with the 20-item Fatalism Scale. The scale measures individuals' beliefs about health-seeking behaviors and fatalistic beliefs when CVD is present. Each item is scored on a 5-point Likert scale from 1 "strongly disagree" to 5 "strongly agree." An example of an item is: "If someone gets heart disease, that's the way they were meant to die." The scores of the items were added, with a lower total score indicating lower negative fatalistic beliefs. The Fatalism Scale reliability was 0.88, and its construct validity has been supported by factorial analysis.[72]

Clinical variables. Past exercise participation before attending the HeartHealth program was assessed using a single item to which participants indicated the statement that best described their past exercising level before participating in the program: (0) "none of the time," (1) "a little bit of the time," (2) "some of the time," (3) "a good bit of the time," (4) "most of the time," and (5) "all of the time." Concurrent validity for exercise level was supported by a significant positive correlation with quality of life, exercise capacity, and survival rates.[24]

Health literacy was assessed using the Short form of the Test of Functional Health Literacy for Adults (S-TOFHLA). The S-TOFHLA assesses individuals' ability to comprehend health related material. The S-TOFHLA instrument starts by giving participants simple general information on nutrition followed by a 6-item test about how

they would interpret and act in response to the information that they are given. The correct responses were summed to produce a health literacy score ranging from 0 to 6, with higher scores indicating better literacy. Content validity of the S-TOFHLA has been demonstrated. Internal consistency Cronbach's alpha was 0.68.[73]

Comorbidity burden was measured using the Charlson Comorbidity Index. The scores can range from 1 to 34 with higher scores, indicating greater comorbidity burden. Validity for this instrument has been demonstrated by its ability to predict mortality, complications, health care resource use, length of hospital stay, and cost.[74,75]

Dependent Variables

Successful adoption of activity lifestyle modification. Activity levels were defined as total time per 24-hours at sedentary, moderate, and vigorous intensity levels. Activity was measured using an Actiwatch accelerometer (Actical®, Respironics Inc.). The Actiwatch was worn on the non-dominant arm for 48 hours. The Actiwatch contains an accelerometer that can capture body movement (activity counts). Movements were summed over each minute epoch and converted into energy unit (metabolic equivalents [METs]). According to the manufacturer's default setting, the ranges in METs that defined each activity level were a) < 3 METs for light activity, b) 3 to < 6 for moderate activity, and c) 6 ≥ for vigorous activity. Activity levels were totaled to determine minute per hour spent at each activity level. The Actiwatch has been shown to be a valid measurement of daily activity intensity.[76,77] Successful activity lifestyle modification after participation in the HeartHealth intervention program was defined as an increase of 15 minutes or more per day of moderate-to-vigorous physical activity.

Dropout. Participants' attendance to the program sessions were recorded by a research assistant. Participants were instructed to notify program instructors if circumstances prevented them from attending scheduled sessions. Participants who were absent without explanations were called by research assistants and encouraged to resume attendance. If a participant reported that he or she wanted to withdraw from the study, the research assistant coded the participant as a dropout. Participants who attended program sessions and completed final program assessment were considered completers.

Procedure

Data on demographic variables, psychosocial variables, past history of exercise, and comorbidity were collected at baseline. Physical activity was recorded for 48 consecutive hours by Actiwatch at baseline and 3 months after the intervention.

Approval for the study was obtained from the University of Kentucky Institutional Review Board. For eligible participants, study requirements were explained and signed informed consent was obtained. After baseline assessment, the 3 month intervention was delivered by trained nurses who were hired from the local community. The intervention consisted of 6 to 12 sessions lasting 1 to 1.5 hours each. The sessions were conducted in the participant's home, the primary care clinic, or another place preferred by the participant. Fidelity of intervention implementation was continuously monitored throughout all sessions by primary study co-investigators and expertise in self-management interventions. After completing the intervention, the trained nurses scheduled a visit for follow up assessment.

Data Analysis

Data analyses were done using SPSS version 17.0 (SPSS Inc., Chicago, Illinois). Data were examined, verified, and cleaned prior to starting analysis. Analyses began with a descriptive examination of demographic, psychosocial, and clinical characteristics and physical activity levels. Frequencies and percentages or means and standard deviations as appropriate to the level of measurement were used to characterize the sample.

Predictors of active lifestyle modification. The 202 participants with complete baseline and follow up physical activity data were divided into two groups based on their physical activity levels post intervention: Adopters: participants who increased moderate-to-vigorous physical activity by an accumulated 15 minutes or more per day following the intervention and non-adopters participants who did not increase moderate to vigorous activity levels post-intervention. Because there is no existing predictive model, we used backward binary logistic regression to determine the most parsimonious model that best predicted active lifestyle modification after the intervention. The first step included all baseline demographic, psychosocial, and clinical variables. Variables were sequentially removed from the model based upon the criterion of $p \geq .10$ for removal.

Predictors of dropout. The 399 participants with complete baseline data were included in the analysis. Participants were assigned to the dropout group if they withdrew from the study before completing the final assessment and in the completion group if they continued attendance to the intervention sessions and completed the final assessment. Backward binary logistic regression was conducted to identify which baseline demographic, psychosocial, and clinical variables predicted dropout from the intervention

study. Variables were sequentially removed from the full model at each step using a $p \geq .10$ as criterion for removal.

Results

Baseline demographic, psychosocial, and clinical characteristics of participants are presented in Table 2.1. Overall the sample was middle aged, Caucasian, female, married or cohabitating, and had enough or less to meet ends need. Nearly half of the sample had more than a high school education and were employed. Less than a fifth of the sample had at least moderate depressive symptoms (PHQ score > 9) while twice as many had anxiety (BSI score ≥ 0.35). CVD was presented in a third of the sample. The most common risk factors were abnormal waist circumference and dyslipidemia. More than half were obese and one third had hypertension.

Participants who adopted the activity recommendation (increased their moderate-to-vigorous physical activity levels by 15 minutes or more per day) had higher anxiety scores and lower baseline physical activity levels than those who did not adopt the activity recommendation ($P < .01$). HeartHealth program Dropouts had lower health literacy levels, and higher fatalism and comorbidity scores than Completers ($P < .05$).

Predictors of Active Lifestyle Modification

Approximately 42% of the 202 Completers (N = 84) achieved an increase of 15 minutes or more per day of moderate-to-vigorous physical activity at 3 months after the intervention (Adopters). Anxiety was the only independent predictor of active lifestyle increase (model $X^2 = 17.1$, $df = 1$, $p = 0.001$). The model correctly classified 60% of cases. Age, gender, marital status, employment status, level of education, financial status,

rurality, social support, depressive symptoms, fatalism, past history of exercising, health literacy, and comorbidity were not significant predictors (Table 2.2). Every 1-point increase in baseline anxiety scores was associated with 3.3 times greater odds of adoption of active lifestyle post intervention.

Predictors of Dropout from Heart Health Program

Age and health literacy were independent predictors of dropout from HeartHealth intervention (model $X^2 = 30.45$, df = 6, $p < 0.001$). The model correctly classified 70.4% of cases (Table 2.3). For every 1-year increase in age, participants were 2 % less likely to drop out from the intervention. Every 1-unit increase in participant's baseline health literacy score was associated with a 22% decrease in likelihood of dropping out of the intervention. Gender, marital status, employment status, level of education, place of residency, financial status, depression, anxiety, social support, fatalism, past history of exercising, and comorbidity were not significant predictors of dropout.

Discussion

We found that higher baseline anxiety levels were associated with a higher probability of adopting an increase in physical activity following the intervention. This result contradicts previous studies that reported anxiety had a negative impact on physical activity behavior.[78] However, there is evidence to support our finding that anxiety may increase activity in response to an intervention. Anxiety about health has been suggested to be formulated based on past experiences or to be triggered when anxious individuals are provided with information about health.[79,80] It has been hypothesized that while anxiety is associated with excessive worries about health and greater awareness of body

sensations, mild to moderate anxiety may be related to improved health behaviors, such as physical activity. [81,82] The results from our study support this hypothesis by showing an association between nonspecific anxiety and improved physical activity behavior following participation in CVD prevention intervention.

Regarding dropout, we found that age and health literacy were significant independent predictors. Younger participants were at higher risk of dropout than older participants. As shown in previous research in an urban population,[83-87] younger people were more likely to dropout from CVD risk reduction intervention. The results from a recent twelve-year longitudinal study of 1,142 women showed that older women were more likely to use CVD preventive measures such as checking blood pressure and cholesterol level, following healthy diet, quitting using tobacco, trying to manage stress, and keeping making medical appointments.[88] In this study, older women were more likely to adopt CVD preventive measures because they were more informed about CVD prevention and had more CVD symptoms. In a study of 189 patients with CVD recruited from cardiac rehabilitation program, the researchers suggested that younger age patients were more likely to drop out because they might have lower expectations of the benefits of participation.[84]

Baseline low health literacy scores were associated with a greater likelihood of dropout. This finding corresponds with the findings from previous studies that showed low health literacy was associated with lack of motivation to improve health and engage in disease preventive measures such as quitting smoking, mammography screening, and influenza immunization.[89-91] In a recent literature review, Sorensen and colleagues[89]

suggested that low health literacy was associated with four main factors which in turn have an impact on using preventive measures. These factors include inability to acquire information, understand this information, analyze and appraise it, and to make appropriate health decisions to improve health. This suggests that low health literacy participants were less likely to understand their risk of CVD and therefore may perceive no benefits to continue attendance to the CVD risk reduction intervention. Other researchers have suggested that individuals with low health literacy were less likely to participate in disease prevention measures because they had greater comorbidity and worse health status.[92,93] Individuals with comorbidities are more likely to experience poor mental health.[94,95] Accumulating evidence shows that mental health partially explains the high rate of non-adherence to healthy behaviors such as medication, diet, and physical activity recommendations among individuals with comorbidities.[96] Individuals with poor mental health are frequently less likely to learn or to act upon new information about lifestyle change.[96] This may undermine individuals' motivation to adhere to CVD risk reduction intervention. Our result corresponds with this explanation by showing that low health literacy was associated with greater comorbidity.

Several limitations must be considered in interpreting the results of this study. First, we used upper arm Actiwatch to assess physical activity intensity levels. Wrist-worn Actiwatch mainly captures activity concentrated in the upper body. This method of physical activity measurement can overestimate the prevalence of physical activity in participants with occupational activities such as washing dishes but who do not perform planned regular physical activity. However, this limitation did not have an effect on

outcomes because participants did not change occupational activities during the study period. Second, data on physical activity were measured for 48 consecutive hours because the Actiwatch that we used in this study has nearly 3 days maximum physical activity data storage. Physical activity data from 48 hours may not be sufficient to estimate habitual daily physical activity levels. Research has suggested that a minimum of 4 days of Actiwatch data are needed for reliable estimates of individuals who met activity level recommendations.[97] However, given that Actiwatch is considered one of the standards in assessing physical activity, using activity data from this instrument was a scientifically sound approach to meet our aims. Third, we were not able to follow dropout participants to probe their reasons for dropping out from HeartHealth intervention. Therefore, we could not identify other important predictors that might be associated with dropout from CVD risk reduction intervention. Fourth, this study was conducted on a relatively small sample size, which may limit the power to detect a statistically significant effect of some predictors on outcomes. In addition, the sample was predominantly female and White, more educated, and from one region in Appalachia, making it difficult to draw inferences for all rural Americans.

Implication and Conclusion

To date, investigators have primarily studied anxiety as a barrier to health behaviors. However, this study provides insight to the positive potential effect of anxiety on adoption to the health behaviors in response to the CVD risk reduction intervention. We found that higher anxiety levels were associated with adoption of a more active

lifestyle. Although a psychological mechanism is unclear, further studies could help clarify this finding.

Regarding dropout, we found that younger age was a predictor of dropout from CVD risk reduction intervention. There may be unique barriers to participation in CVD risk reduction interventions among younger participants; however it may also be that younger participants perceive less immediate threat to health necessitating behavior change. A better understanding of factors may inform interventions to promote cardiovascular health among this population. Finally, we found that low health literacy was a predictor of dropout from CVD risk reduction intervention. This finding suggests that health educators need to use simple health-related information that fits their participants with low health literacy levels.

Table 2.1. Baseline Sample Characteristics

	Whole sample (n = 399)	Adopters (n = 84)	Non-adopters (n = 118)	Completers HeartHealth intervention (n = 271)	Dropouts (n = 128)
Age (years)	57.5 ± 16.5	57.9 ± 14.0	57.6 ± 15.1	57.0 ± 15.6	57.9 ± 18.1
Gender (female)	305 (75.7%)	65 (77.4%)	87 (73.7%)	201 (74.2%)	101 (78.9%)
Ethnicity (Caucasian)	393 (97.5%)	84 (100%)	117 (99.2%)	267 (98.5%)	122 (95.3%)
Married or cohabitated	237 (58.8%)	56 (66.7%)	76 (64.4%)	172 (63.5%)	63 (49.2%)
Employed full or part time	226 (56.1%)	49 (58.3%)	74 (62.7%)	163 (60.1%)	63 (49.2%)
Education more than high school	221 (54.8%)	52 (61.9%)	71 (60.2%)	151 (55.7%)	68 (53.1%)
Financial status (have enough or less to make ends meet)	267 (67.2%)	51 (60.7%)	81 (68.6%)	182 (67.2%)	88 (62.7%)
Charlson comorbidity score	0.8 ± 1.3	0.7 ± 1.4	0.7 ± 1.2	0.7 ± 1.2*	0.9 ± 1.4*

Table 2.1. (Continued)

Comorbidities					
Heart catheterization	83 (20.6%)	19 (22.6%)	18 (15.3%)	48 (17.7%)	33 (25.8%)
Heart attack	26 (6.5%)	4 (4.8%)	7 (5.9%)	14 (5.2%)	11 (8.6%)
Stroke	22 (5.5%)	5 (6.0%)	5 (4.2%)	13 (4.8%)	8 (6.3%)
Health literacy	5.0 ± 1.6	5.3 ± 1.3	5.4 ± 1.0	5.3 ± 1.2**	4.6 ± 2.1**
Fatalism score	2.2 ± 0.6	2.2 ± 0.7	2.2 ± 0.61	2.2 ± 0.6*	2.3 ± 0.6*
Social support score	73 ± 14.8	72.7 ± 15.7	74.6 ± 13.6	73.0 ± 14.5	72.9 ± 15.5
Anxiety symptoms (BSI score)	0.5 ± 0.6	0.63 ± 0.8**	0.35 ± 0.5**	0.4 ± 0.6	0.6 ± 0.7
Mild to moderate	131 (32.6%)	28 (33.3%)	28 (23.7%)	77 (28.4%)	54 (42.2)
Severe	21 (5.2%)	10 (11.9%)	4 (3.4%)	15 (5.5)	6 (4.7%)
Depressive symptoms (PHQ 9 score)	4.8 ± 4.4	4.8 ± 4.2	4.7 ± 4.7	4.7 ± 4.5	5.1 ± 4.4
Moderate to severe	66 (16.4%)	13 (15.5%)	19 (16.1%)	44 (16.2%)	22 (17.2%)
Baseline moderate to vigorous activity levels (minute/hour)	.	4.1 ± 2.9**	5.7 ± 3.7**	.	.

Data are presented as Mean (SD) or n (%).

*: $P < .05$

**: $P < .01$

Table 2.1. (Continued)

Adopters increased moderate to vigorous activity by ≥ 15min per day post intervention, non-adopters did not increase activity.

Completers finished the HeartHealth interventions. Dropouts stopped participation early.

BSI: Brief Symptom Inventory-Anxiety subscale. Mild to moderate anxiety = 0.35 ≤ BSI score ≤ 1.7. Severe anxiety = BSI score ≥ 1.7.

PHQ9: Patient Health Questionnaire 9. Moderate to severe depression = PHQ score > 9.

Table 2.2. Predictors of Adoption of Active Lifestyle Post Intervention

	B	Wald	df	*p*	Odds Ratio	95% CI	
Financial status (have enough or less to make ends meet)	-.57	3.22	1	.073	.57	.31	1.05
Anxiety	1.2	12.98	1	< .001	3.31	1.73	6.35
Depression	-.08	3.73	1	.053	.92	.85	1.0

B: Unstandardized coefficient. Beta: Standardized coefficients. df: Degree of freedom. *P*: Significant.

Table 2.3. Predictors of Dropout from Heart Health Intervention

	B	Wald	df	*p*	Odds Ratio		95% CI
Age	-.021	5.33	1	.021	.98	.96	1.0
Marital status (being unmarried)	.40	3.06	1	.080	1.50	.95	2.36
Employment status (being unemployed)	.498	3.002	1	.083	1.65	.94	2.90
Health literacy	-.25	11.79	1	.001	.78	.68	.90
Past exercise participation	.13	3.32	1	.068	1.14	.99	1.31
Comorbidity	.17	3.51	1	.061	1.19	.99	1.42

B: Unstandardized coefficient. Beta: Standardized coefficients. df: Degree of freedom. *P*: Significant.

CHAPTER THREE

Factors Associated with Enrollment in a Cardiac Rehabilitation Program in Patients with Heart Failure: a Review of the Literature

Introduction

Heart failure (HF) is the end stage of cardiovascular disease.[24] In the United States, more than five million individuals have HF with an approximate 11% annual increase in people newly diagnosed.[98] HF is a leading contributor to healthcare services costs.[98,99] Dyspnea and fatigue are the two most common symptoms experienced by patients with HF and are often the reasons for seeking medical care.[100] Despite advances in medical therapy, the number of patients with marked symptoms of HF at rest or upon minimal physical exertion continues to increase.[99,101,102] The pathological changes associated with HF are used to explain symptom progression that results in activity intolerance.[24] Clinical trials show that physical activity decreases HF symptoms, increases activity tolerance, prolongs survival, and lowers hospitalization rates.[24,25] In order to achieve these outcomes, patients' long-term adherence to physical activity is necessary.[24,103] Accordingly, cardiac rehabilitation programs are designed to facilitate initiation and maintenance of safe physical activity levels for patients with HF.[37]

Unfortunately, enrollment in a cardiac rehabilitation program is not common in patients with HF. Enrollment in cardiac rehabilitation programs has been estimated to be as low as 20% of all eligible HF patients.[34,35] These findings demonstrate the importance of improving cardiac rehabilitation enrollment by patients who have HF. An important first step is to gain a better understanding of the factors that promote patients' enrollment

in rehabilitation programs. Therefore, the aims of this review paper were to: (a) describe enrollment rates of patients with HF in cardiac rehabilitation programs, (b) review the literature on factors affecting enrollment of patients with HF, and (c) identify areas for future research.

Methodology

An electronic literature search covering the years of 1995 to 2012 was conducted using the Cumulative Index of Nursing and Allied Health (CINAHL) and US National Library of Medicine National Institutes of Health (PubMed). This time period was chosen because cardiac rehabilitation programs became more comprehensive after 1995 by including education and counseling to promote adoption of an active lifestyle.[104] The keywords used were: cardiac rehabilitation, enrollment, participation, attendance, barriers, physical activity, and exercise. The focus of this review was quantitative studies in which factors associated with cardiac rehabilitation program enrollment were investigated. Because HF is the end stage of cardiovascular disease and no investigators have specifically examined patients with HF, published studies of all patients discharged from any cardiac-related hospitalization were included in this review.

The titles and abstracts of 1047 studies identified that were written in English and included adult patients with heart disease were reviewed for inclusion. The references of the selected articles were also examined to identify additional relevant studies. Studies that were included in this review had to meet the following criteria: (1) samples included men and/or women discharged from a cardiac-related hospitalization, (2) measured enrollment in a cardiac rehabilitation program, and (3) examined the impact of socio-

demographic, psychosocial, or clinical factors on enrollment in a cardiac rehabilitation program. A total of 1017 studies were excluded. Reasons for exclusion were classification as literature review articles (N = 34), using qualitative research methods (N = 23), inclusion of patients enrolled in interventions to promote enrollment in a cardiac rehabilitation program (N = 27), and failure to provide information about the predictors of enrollment (N = 933). Another 8 studies were later excluded. Of these, 3 studies were excluded because they focused on reporting the frequencies of enrollment barriers rather than testing the effect of the barriers on enrollment in a cardiac rehabilitation program.[105-107] Another 4 studies were excluded because of failure to classify patients who did not attend rehabilitation after hospital discharge from patients who dropped out after their attendance to rehabilitation sessions.[108-111] One additional study was excluded because enrollment in a cardiac rehabilitation program was measured retrospectively.[112] Overall 22 studies were deemed relevant and were included in this review (Table 3.1).

Definition of Enrollment

In this review, we defined enrollment in a rehabilitation program as the initial patient enrollment in a cardiac rehabilitation program rather than adherence to attendance at rehabilitation sessions.

Rates of Enrollment in Rehabilitation Programs

It is difficult to draw definitive conclusions about rates of enrollment in cardiac rehabilitation programs because the period of time after hospital discharge that enrollment was measured varied across studies from 1 to 9 months resulting in widely varying reports of enrollment rates.

In 5 studies, enrollment rates in a cardiac rehabilitation program of all patients discharged following a cardiac-related hospitalization measured at 1 month were reported to be between 22% and 68%.[113-117] The wide range in the enrollment rates among these studies may be related to sample size. In studies with sample sizes less than 200, enrollment rates had the widest range between 23% and 68%.[113,114 115] In studies with sample sizes of more than 400 patients, enrolment rates were reported to be 29% to 36% .[116,117] Thus, it appears that greater sample size reduced the variability, resulting in more stable estimates of enrollment rates. Studies in which enrollment in rehabilitation programs was measured at 2 to 3 months after hospital discharge yielded similar rates of 28% to 34%.[118-120] In the 2 studies that included only women, enrollment rates were reported to be 34% in a sample of 77 patients[120] and 29% in a larger sample of 183 patients.[118] However, in a study of 254 rural patients, the enrollment rate was reported to only be 28% of all patients discharged from the hospital.[119]

Enrollment in cardiac rehabilitation programs was measured between 6 to 9 months after hospital discharge in 9 studies.[117,121-128] Among these, enrollment rates were reported to be somewhat higher ranging from 36% to 56%. Enrolment rates varied based on population characteristics. In 4 studies with more than 1,200 patients discharged with coronary heart disease, enrollment rates were reported to be between 36% and 43%.[125-128] In 5 other studies of patients discharged following acute myocardial infarction, enrolment rates ranged from 40% to 56%.[117,121-124] In contrast to studies of enrollment at 1 month, these studies at 6 to 9 months with sample sizes of 500 or more yielded higher enrollment rates (e.g., 56%) [117,121,122] than studies with samples of less of than 200 (e.g., 40%).[123,124]

Thus, it appears that measuring enrollment in rehabilitation programs after a longer period following hospital discharge results in higher enrollment rates. This suggests that patients may take time after discharge to decide to enroll in a cardiac rehabilitation program.

In summary, enrollment rates in rehabilitation programs vary from 22% to 68%, depending upon when enrollment was measured, sample size, and population characteristics. Knowing reliable information about enrollment rates is important for researchers and clinicians to set a goal to improve enrollment in a rehabilitation program. Because a patient's decision to enroll in a program may increase over time, it is necessary for future investigators to determine the time period after hospital discharge that patients need to make a decision to enroll in a cardiac rehabilitation program. This will help to determine the factors associated with enrollment and identify the patients who are less likely to enroll in rehabilitation.

Factors Associated with Participation in Cardiac Rehabilitation Program

Socio-demographic Factors

Age. The effect of age on enrollment in a rehabilitation program was examined in 16 studies.[113-125,127,129,130] The results were inconsistent. In 6 studies, younger patients were more likely to enroll in a rehabilitation program than older patients.[115,117,121,124,125,127] Among these studies, mean age of the samples ranged from 60 to 68 years. In another 4 studies, patients younger than 70 years were more likely to enroll in a rehabilitation program than older patients.[118,122,123,129] In 4 of the previous studies, the relationship between age and enrollment in a rehabilitation program was only

tested in t-test and chi square analyses in samples of patients with acute MI, CABG surgery, and coronary heart disease.[121,123,124,127] In 6 other studies[115,117,118,122,125,129] in which logistic regression models were tested, age was consistently a predictor of enrollment in patients following acute MI or CABG surgery[115,117,122,129] but not in patients with coronary heart disease.[118,125] Two groups of investigators tested the relationship between age and enrollment in a rehabilitation program in patients with coronary heart disease and in logistic regression models. In one study (N = 183), age was a predictor of enrollment after controlling for employment status, type of heart disease diagnosis, personal stressful event, and perceived control.[118] In the other study including a larger sample size (N = 1,268), age was related to enrollment in a rehabilitation program in a t-test analysis but not a predictor in a logistic regression model that controlled for 16 variables.[125] In this study, the controlled variables of being married, short distance from rehabilitation program site, healthcare provider recommendation for enrollment, and fewer total enrollment barriers were significant predictors of enrollment. Based on results of previous studies with large samples using multivariate analyses, younger age patients with more life-threatening heart disease such as acute MI or CABG surgery were more likely to enroll in a rehabilitation program. In contrast, younger age was associated with enrollment in a rehabilitation program in simple bivariate analyses but not in multivariate analyses in patients with less life threatening heart disease. This suggests that the relationship between age and enrollment in this population is actually due to other important factors that are age related. These factors include marital status, distance from

rehabilitation program site, healthcare provider recommendation for enrollment, and total enrollment barriers.

Contrasting findings were reported in a study of rural patients (N = 254) with a mean age of 64 years.[119] In this study, enrollment in a rehabilitation program increased with older age. This contradictory finding may be related to demographic differences across rural and non-rural population. Rural areas tend to have large number of elderly, poorer, and more often uninsured people.[131] In another 4 studies, age was unrelated to enrollment in a rehabilitation program.[113,114,116,120] In 3 of these, sample sizes were less than 100.[113,114,120,130] In the other study, the sample was younger (mean age = 57 years) than previous studies that reported age was a predictor.[116] Thus, the preponderance of evidence suggests that younger age patients are more likely to enroll in rehabilitation programs.

There are many reasons why older patients may be less likely to enroll in a rehabilitation program. First, practitioners have been less likely to refer older patients to a rehabilitation program.[115,125,127,130] Second, older patients report more enrollment barriers than younger patients. [127] These include preference to exercise at home, perception of exercise as painful, high self-confidence in ability to manage heart condition, lack of knowledge about rehabilitation, no physician recommendation, more comorbidities, and belief of limited health benefits of enrollment. Younger patients reported work responsibilities and time constraints. These findings suggest that older patients face a number of modifiable barriers to enrollment in a rehabilitation program.

Gender. In 13 studies, investigators examined the difference in the rates of enrollment in rehabilitation programs between genders.[113-117,121-126,129,132] In 11 of these, percent of women in the samples ranged from 15% to 35%.[113-117,121,123-125,129,132] In another 2 studies in which investigators specifically examined the effect of enrollment barriers among gender on enrollment in a rehabilitation program, women accounted for only 29% and 43% of their sample.[122,126] In 6 studies in which chi square analysis was used, more men were reported to enroll in a rehabilitation program than women.[115,117,121-123,126] Contrary findings were reported in 5 other studies in which chi square analysis was used.[113,114,116,124,125,129] The researchers found no difference in the rates of enrollment between gender.

In 4 studies, gender was tested in logistic regression models and the results revealed that gender was not a predictor of enrollment in a rehabilitation program.[115,117,129,132] In one of these models, investigators controlled for 31 variables and found that younger age, higher level of education, White ethnicity, non-smoking, and no prior percutaneous coronary intervention were significant predictors of enrollment.[117] In a second model in which 18 variables were controlled, younger age, residents in urban areas, lower body mass index, and higher self-efficacy were significant predictors of enrollment.[129] In a third model, investigators tested the predictive ability of gender after controlling for 13 variables and found that referral to rehabilitation program, treated with reperfusion therapy, and perceived rehabilitation benefits were significant predictors of enrollment.[115] In the remaining model, gender was tested in a model that included 6 variables in which higher income, self-efficacy, and anxiety were significant predictors of

enrollment.[132] Based on previous studies, it is difficult to draw conclusions about the relationship between gender and enrollment in a rehabilitation program because the results from those studies were on samples with a small proportion of women.

Despite the results that the relationship between gender and enrollment in a rehabilitation program is unclear, investigators noted many important enrollment barriers among women which may make women patients less likely to enroll than men. The primary reason that women were less likely to enroll is lack of referral.[115,120,132,133] Other reasons reported by women were low functional ability,[126,134] lack of rehabilitation awarness,[120,126,135] perception of exercise as pain,[126] comorbidities,[126,136] low annual income,[135] and family responsibilities.[126] Reasons from men included work responsibilities, already exercising, and self-confidence in ability to self-manage heart condition as the main barriers.[126] Common to both genders were older age, being unmarried, and transportation problems.[113,121,122,126,133,136] Factors that increase enrollment included spouse's emotional and tangible support.[137,138] Perceived emotional support has been demonstrated to attenuate the negative effects of stressful events and enhance physical and emotional well-being. Tangible support helps in decreasing personal barriers to enroll in a rehabilitation program such as transportation problem, financial burden, and household and job responsibilities. In conclusion, gender differences in annual income, functional ability, referral, and perceptions about cardiac rehabilitation might be reasons men are more likely to be enrolled in a rehabilitation program.

Marital Status. Five groups of investigators examined the role of marital status in enrollment in a rehabilitation program.[115,117,120,121,125] Three groups showed being married

increased enrollment in a rehabilitation program in a chi square analysis.[117,121,125] In previous studies, sample sizes were large with more than 900 patients. However, the results from 2 other studies in which chi square analysis was used revealed a non-significant difference in the enrollment rates between married and unmarried patients.[115,120] Among these studies, the relationship between marital status and enrollment was tested in smaller sample sizes of 100 and 179 patients.

In studies in which the relationship of marital status was tested in logistic regression models, the results were inconsistent. One group included a sample of patients with coronary heart disease and found that being married was an independent predictor of enrollment in a rehabilitation program after controlling for 16 variables.[125] In another study including post CABG patients, being married was more likely to enroll in a rehabilitation program in an unadjusted model, but this association was insignificant after controlling for demographic, clinical, and perceived social support factors.[121] In another study, being married was unrelated to enrollment in samples of patients with acute MI.[117] In this study, the model controlled for 31 variables in which younger age, higher level of education, White ethnicity, non-smoking, and no prior percutaneous coronary intervention were significant predictors of enrollment. Based on results from studies in which sample sizes were large and multivariate analyses were used, it appears that being married is an important predictor of enrollment in a rehabilitation program in patients with less life-threatening heart disease conditions. On the other hand, in patients with more life-threatening heart disease, being married was associated with enrollment in a rehabilitation program in simple bivariate analyses but not in multivariate analyses

because this relationship in this population is due to other factors that are related to marital status. These factors include age, level of education, ethnicity, smoking status, and previous history of cardiac disease.

Ethnicity. Most of the studies reviewed described the ethnicity of the sample, but only 4 groups of investigators examined the association between ethnicity and enrollment in a rehabilitation program.[117,120,125,135] In one study in which chi square analysis was used, more White women patients with coronary heart disease (N = 253; minority = 43%) were reported to enroll in a rehabilitation program than minorities.[135] The results from another group used larger sample size of patients with MI (N = 1347; minority = 16%) and a logistic regression model revealed that White patients were more likely to enroll in a rehabilitation program than minority patients.[117] Lack of a physician's recommendation, lack of awareness about rehabilitation, and financial burden were reported as the most influential barriers affecting minority enrollment in a rehabilitation program.[105,135,139,140] Other barriers were reported including: language barriers, job demands, inflexible program time, long distance to program site, transportation problem, comorbidities, and lack of support from family.[105,116,139,140]

Conversely, 2 other groups reported that ethnicity was unrelated to enrollment in a rehabilitation program in a chi square analysis.[120,125] In one study, this relationship was tested in small sample size of minorities (N = 77; minority = 30%),[120] while in another study, the sample size was large including patients with coronary heart disease (N = 1268; minorities = 14%).[125] In another study reported above, ethnicity was not a predictor of enrollment in a logistic regression model controlling for age, annual income, level of

education, severity of angina pain, and comorbidity.[135] Thus, it is difficult to draw a conclusion about the relationship between ethnicity and enrollment in a rehabilitation program because the results from previous studies were based on samples of a small proportion of minorities.

Employment Status. The results from the 8 studies in which employment status was examined produced inconsistent results.[113,114,117,118,120,121,124,125] In 3 studies of patients with coronary heart disease, acute MI, and CABG, using chi square analysis, enrollment rates in a rehabilitation program were greater among employed patients than those who were unemployed.[114,121,124] In another study, employment status was found to be an independent predictor of enrollment in a logistic regression model (N = 183).[118] In 2 other studies, employment status was related to enrollment in a chi square analysis, but not in logistic regression models.[117,125] Both studies had larger sample sizes (N > 1200) of patients with coronary heart disease and acute MI than the previous study.[118] In one of the previous models, investigators controlled for 31 variables and found that younger age, higher level of education, White ethnicity, non-smoking, and no prior percutaneous coronary intervention were significant predictors of enrollment.[117] In a second model in which 16 variables were controlled, being married, short distance from rehabilitation program site, healthcare provider recommendation for enrollment, and fewer total enrollment barriers were significant predictors of enrollment.[125]

In 2 other studies with smaller sample sizes of less than 100 patients, employment status was unrelated to enrollment in a rehabilitation program in a chi square analysis.[113,120] In conclusion, being employed was associated with enrollment in a

rehabilitation program in simple bivariate analyses but not in multivariate analyses controlling for other factors. This suggests that employment status did not directly affected patients' enrollment in a rehabilitation program. Thus, based on studies with large sample sizes in which employment status was included in a multivariate model the results were inconsistent making it difficult to draw conclusions about employment status as a predictor of enrollment in a rehabilitation program.

Household Income. Five groups of investigators have examined the relationship between income and enrollment in a rehabilitation program.[116,120,125,132,135] Household income was analyzed as a continuous or a dichotomous variable. In one study in which income was analyzed as a continuous variable, higher income was an independent predictor of enrollment.[132] In contrast, in 4 other studies in which income was analyzed as a categorical variable, the results are inconsistent.[116,120,125,135] In 3 of these, the relationship was tested in a chi square analysis.[116,120,125] In one study, more patients with higher income levels were reported to enroll in a rehabilitation program than those with lower income levels.[125] However, in 2 other studies, income levels made no difference in enrollment rates.[116,120] Income was also tested in a logistic regression model in 2 studies.[125,135] In one of these, higher income levels were a predictor of enrollment in a rehabilitation program after controlling for age, ethnicity, level of education, severity of angina pain, and comorbidity.[135] In another study, income was not a predictor of enrollment in a model controlling for 16 variables in which being married, short distance from rehabilitation program site, healthcare provider recommendation for enrollment, and fewer total enrollment barriers were significant predictors of enrollment.[125] The

inconsistencies in the results in previous studies are related to how household income groups were defined. The investigators used an arbitrary cutoff point that is different in each study. Thus, based on one study in which household income was analyzed as continuous variable, it appears that higher income was related to enrollment in a rehabilitation program.

Level of Education. The relationship between level of education and enrollment in rehabilitation program was examined in 7 studies.[114,115,117,120,121,125,135] In 4 studies, higher level of education was related to enrollment in a rehabilitation program.[115,117,121,125] In one of these studies, the relationship was tested in a chi square analysis and in a sample of patients with CABG surgery.[121] In another 2 studies, higher level of education was a predictor of enrollment in logistic regression models and in samples of patients with acute MI.[115,117] In the remaining study of patients with coronary heart disease, although level of education was related to enrollment in a rehabilitation program in a chi square analysis, it was unrelated in a multivariate model.[125] In this study, the model controlled for 16 variables in which being married, short distance from rehabilitation program site, healthcare provider recommendation for enrollment, and fewer total enrollment barriers were significant predictors of enrollment. In 3 of the previous studies, sample sizes were large with more than 900 patients.[117,121,125]

However, in 3 studies, education was not a significant factor in patients with coronary heart disease.[114,120,135] In 2 of these, the relationship was tested in a chi square analysis and in smaller sample sizes (N < 80 patients).[114,120] In the other study (N = 253), education was tested in a logistic regression model controlling for 5 variables in which

higher income was a significant predictor of enrollment.[135] Thus, based on the studies in which sample sizes were large and multivariate analyses were used, higher level of education was positively related to enrollment in a rehabilitation program in patients with more life-threatening heart disease such as acute MI. In patients with less life-threatening heart disease, educational level was directly related to enrollment in simple bivariate analyses but not in multivariate analyses suggesting this relationship in this population is affected by other important factors. These factors include marital status, household income, distance from rehabilitation program site, healthcare provider recommendation for enrollment, and total enrollment barriers.

Distance from Rehabilitation Program Site. A positive relationship between distance from rehabilitation program and enrollment was consistently reported in 5 studies.[116,119,125,128,141] Short distance to rehabilitation program site was associated with more likelihood to enroll in a rehabilitation program. The result from one study showed that patients were significantly less likely to enroll in a rehabilitation program if they have to drive 60 minutes or more to the nearest program.[128] Overall, distance from rehabilitation program site was the strongest factor among socio-demographic characteristics.

Summary. Although the findings for other demographic characteristics are inconsistent, the majority of evidence suggests that younger age, married, higher income, and higher level of education are associated with enrollment in a rehabilitation program. The findings regarding the relationship of gender, ethnicity, and employment status to enrollment are inconsistent.

Psychosocial Factors

Emotional Distress. Inconsistent results have been reported in the studies examining the relationship between emotional distress and enrollment in a rehabilitation program. In 2 studies, the results of t-test analyses showed that non-enrollment patients had greater depressive symptom levels than those who enrolled in a rehabilitation program.[114,125] Contrary findings were reported in 3 other studies in which t-test analysis was used.[113,115,120] The investigators did not find difference in depressive symptom levels between enrollment and non-enrollment patients. In 4 studies in which the relationship was tested in logistic regression models, depressive symptoms did not predict enrollment.[117,125,129,132] In one of these studies, depressive symptoms were included in a model controlling for 31 variables in which younger age, higher level of education, White ethnicity, non-smoking, and no prior percutaneous coronary intervention were significant predictors of enrollment.[117] In a second study in which 18 controlled variables were included, younger age, residents in urban areas, lower body mass index, and higher self-efficacy were significant predictors of enrollment.[129] In a third study, depressive symptoms were tested in a model that controlled for 16 variables in which being married, short distance from rehabilitation program site, healthcare provider recommendation for enrollment, and fewer total enrollment barriers were significant predictors of enrollment. [125] In the remaining study, the model controlled for 6 variables in which higher income, self-efficacy, and anxiety were significant predictors of enrollment.[132]

The relationship between anxiety and enrollment in a rehabilitation program was examined in 2 studies.[113,132] One group of investigators found a positive relationship

between anxiety levels after hospital discharge and enrollment in a logistic regression model that controlled for gender, annual income, self-efficacy, social support, and a number of negative life events.[132] The other group found no difference in anxiety symptoms levels between enrollment and non-enrollment patients in a t-test analysis.[113] The limited evidence makes it difficult to draw conclusions about the effect of emotional distress on enrollment in a rehabilitation program.

Lack of evidence of the relationship between emotional distress and enrollment in a rehabilitation program may be because emotional distress in previous studies was assessed at or shortly after hospital discharge. Research has shown that emotional distress rises in patients with CVD at hospital discharge.[142,143] Emotional distress has been shown to remit over the following weeks however, about one a quarter of patients may remain distress at one year.[142-144] Research has suggested that follow up assessment of emotional distress is more predictive of health behaviors and patients outcomes than emotional distress assessed at or shortly after hospital discharge.[145,146] Thus, it becomes difficult to make inferences that emotional distress in patients with CVD has no negative effects on enrollment in a rehabilitation program.

Self-efficacy. Four studies examined the relationship between self-efficacy to perform health behaviors and daily functional tasks with enrollment in a rehabilitation program.[115,123,129,132] In one study, patients with coronary heart disease who had higher self-efficacy were more likely to enroll in a rehabilitation program in a logistic regression model that controlled for gender, annual income, anxiety levels, social support, and number of negative life events.[132] The results from 3 other studies in which samples were

patients with acute MI and post CABG surgery produced inconsistent results.[115,123,129] In one study in which t-test analysis was used, enrollment patients had greater self-efficacy levels than those who did not enroll in a rehabilitation program.[123] Insignificant findings were reported in 2 other studies.[115,129] In one of these, self-efficacy was tested in a logistic regression model that controlled for 13 variables in which referral to rehabilitation program, treated with reperfusion therapy, and perceived benefits of rehabilitation were significant predictors of enrollment.[115] Research has shown that self-efficacy is low in patients who experienced acute cardiac symptoms.[147,148] It has been noted that the beliefs that are held by those patients regarding the effectiveness of cardiac disease managements had more powerful effects on health behaviors than self-efficacy.[148] Thus, it seems that self-efficacy is an important predictor of enrollment in a rehabilitation program in patients with coronary heart disease but not important in patients with more life-threatening heart disease of acute MI or CABG surgery.

Social Support. Inconsistent results have been reported in studies examining the relationship between structural, instrumental, and emotional types of social support to enrollment in a rehabilitation program.[115,117,119,121,123,125,129,132] In one study, emotional and instrumental social support were related to enrollment in a rehabilitation program in a rural population using a multivariate model.[119] Social support in rural populations could address such rural-specific enrollment barriers of long distance from program site and transportation problems, which may make enrollment in rehabilitation program easier. In another study, patients who perceived greater emotional support were more likely to enroll in a rehabilitation program in an unadjusted logistic regression analysis, but this

association was insignificant after controlling for gender, socioeconomic status, and comorbidity factors.[121] In 2 other studies, the relationship between emotional and instrumental social support and enrollment in a rehabilitation program was insignificant in t-test and multivariate analyses.[117,125] In another 4 studies, the investigators found insignificant effect of structural social support on enrollment in a rehabilitation program in logistic regression models.[123,125,129,132] Thus, the majority of investigators found non-significant relationships between social support and enrollment in a rehabilitation program. Perceived social support appears to have no effect on enrollment.

Perceptions of Cardiac Rehabilitation. Aspects of patients' perceptions have been considered to be influential factors in determining enrollment in a rehabilitation program.[115,124,125,149] In reviewing 4 studies reported for this factor, it would appear that enrollment in a rehabilitation program was better when patients had the following perceptions that: 1) cardiac illness will last a long time,[125,149] 2) cardiac disease is controllable,[124,125] and 3) exercise or cardiac rehabilitation is important or necessary.[115,124,125] On the contrary, misconceptions held by patients about the causes of cardiac illness and that rehabilitation is suitable for younger age were associated with non-enrollment in a rehabilitation program.[124] Moreover, greater perceived barriers of enrollment than benefits were negatively related to enrollment in a rehabilitation program.[125]

Summary. Patients' beliefs about rehabilitation and disease have a strong effect on enrollment in a rehabilitation program. Self-efficacy may be an important predictor of

enrollment in patients with coronary heart disease. Emotional distress and social support appear to have no effect on enrollment in a rehabilitation program.

Clinical Factors

Referral. Healthcare providers' referral in general has been found to be a significant predictor of enrollment in a rehabilitation program.[115,125,128,150,151] Factors associated with referral to rehabilitation were: younger age,[86,115,127,130] male gender,[86,115,132,133] White ethnicity,[139] higher annual income,[135] having commercial insurance,[133] short driving time,[128] no history of cardiac disease, follow up appointment with cardiologist or cardiac surgeon,[115,130] and discharged following acute MI or CABG surgery.[115,130]

Functional ability. The impact of functional ability on enrollment in a rehabilitation program was reported in 4 studies and the results are inconsistent.[117,121,125,128] In 2 studies, greater functional ability was associated with enrollment in a rehabilitation program.[117,128] In these studies, the relationship was tested using a t-test analysis[117] and in a logistic regression model[128] among samples of patients with acute MI and coronary heart disease, respectively. In 2 other studies, the investigators did not find a relationship between functional ability and enrollment in a rehabilitation program in a t-test analysis[121] and in a logistic regression model[125] among samples of patients with CABG surgery and coronary heart disease, respectively. Thus, functional ability might not be an important internal cue to enroll in a rehabilitation program.

Medical History. The relationship between patients' medical history and enrollment in a rehabilitation program was examined in 9 studies. In 4 studies in which chi square analysis was used, more patients without previous medical history of cardiac disease were reported to enroll in a rehabilitation program than those with such previous cardiac disease.[115-117,121] Hospital admissions subsequent to a diagnosis of a more severe forms of MI were associated with enrollment in a rehabilitation program in logistic regression models.[115,118] In another study in which a logistic regression model was used, patients who received reperfusion therapy were more likely to enroll in a rehabilitation program than those who did not.[115] In contrast, in 3 other studies in which chi square analysis was used, investigators did not note differences in the medical history of cardiac disease or comorbidity between enrollment and non-enrollment patients.[113,120,124] Among these studies, this relationship was tested in smaller sample sizes (N < 140 patients) than those previous studies that reported opposite results.[115-118,121] Thus, it appears that previous history of cardiac disease has a negative impact on their enrollment in a rehabilitation program.

Other clinical-related factors. Several investigators examined the relationships of left ventricular ejection fraction (LVEF), active lifestyle, body mass index (BMI), and smoking status to enrollment in a rehabilitation program. LVEF is an important clinical indicator of myocardial contractility and of the severity and prognosis of heart disease.[152,153] In one study, patients who enrolled in a rehabilitation program had greater LVEF than those who did not enroll.[121] This relationship was tested in a t-test analysis, LVEF was analyzed as continuous variable (mean = 50%), and sample size of patients

with CABG surgery was large (N = 944). However, in 2 other studies, LVEF was unrelated to enrollment in a rehabilitation program.[114,117] In one study, the relationship was tested in a t-test analysis and LVEF was analyzed as a continuous variable, but mean LVEF was greater than the previous study (mean = 56%) and the sample was smaller of less than 80 patients with coronary heart disease.[114] In another study, the relationship was tested in a logistic regression analysis and in a large sample of patients with acute MI (N = 1347), but LVEF was analyzed as a categorical variable using an arbitrary cutoff point of 40%.[117] Based on one study in which the sample size was large and LVEF was analyzed as a continuous variable, LVEF is suggested as a factor that may be related to enrollment in a rehabilitation program.

In one study, a positive relationship was noted between sedentary lifestyle and enrollment in a rehabilitation program.[113] Another group of investigators found patients with more active lifestyle were more likely to enroll.[116] The relationship between active lifestyle and enrollment was non-significant in 4 other studies.[113,117,120,124] Using self-report measurements to assess physical activity was a major limitation common to all of these studies that may contribute to inconsistences in findings. The self-report measures are often encountered with issues of recall and response bias and the inability to capture the actual level of physical activity.[154]

In 2 studies, higher BMI was reported to be associated with enrollment in a rehabilitation program.[113,121] In these studies, BMI was analyzed as a continuous (mean = 29.9 kg/m^2) and categorical variable. However, in 7 other studies, BMI was unrelated to enrollment.[114,117,120,124,125,128,129] In 5 of these, BMI was analyzed as a continuous variable

in which mean BMI in one study[117] was 29.5 kg/m^2 and in others[114,124,125,128] was smaller of less than 28 kg/m^2.

Being a smoker was negatively related to enrollment in a rehabilitation program in several studies,[114,121] while other groups could not find a relationship.[113,116,120,124,125,129] In 3 of the previous studies, [113,114,120] the results were based on small sample sizes of less than 90 patients and in others were based on samples of a small proportion of smokers (smoker < 25%).[116,121,124,125,129] Based on the findings from previous studies, the relationships between BMI and smoking status and enrollment in a rehabilitation program are not clear.

Summary. Patients who had no cardiac disease history and who received referral to the rehabilitation program are more likely to enroll in a rehabilitation program. LVEF is suggested to be a factor that could affect enrollment in a rehabilitation program. The relationships between functional ability, active lifestyle, BMI, and smoking status and enrollment in a rehabilitation program are not clear.

Discussion

It appears that younger patients with more life-threatening heart conditions such as acute MI or CABG surgery were more likely to enroll in a cardiac rehabilitation program than patients with less severe heart conditions. A higher level of education was an important predictor of enrollment in patients post-acute MI or CABG surgery, whereas being married appeared to be an important factor for patients with coronary heart disease. The factors of age and level of education among patients with coronary heart disease, marital status among patients following a MI or CABG, and employment status in

general cardiac patients did not appear to be directly related to enrollment in a rehabilitation program. In addition, there was no consistent evidence of gender differences in enrollment in a rehabilitation program. This may be because studies in which enrollment rate was compared between genders included a small proportion of women. Similarly, the relationship between ethnicity and enrollment in a rehabilitation program is not clear because only a few studies have been conducted and those had small sample sizes of minorities. As expected, a short distance from cardiac rehabilitation program site and higher income were consistently related to enrollment in a rehabilitation program.

Among psychosocial factors, patients who believed their cardiac condition was chronic but controllable and perceived rehabilitation as beneficial were more likely to enroll in a rehabilitation program. In contrast, patients with misconceptions about the causes of cardiac disease and who perceived greater barriers to participating were less likely to enroll in a cardiac rehabilitation program. Self-efficacy was positively associated with enrollment in a rehabilitation program among patients with coronary heart disease. Depression, anxiety, and social support did not appear to have an effect on enrollment.

Among clinical factors, referral to rehabilitation was consistently found to be a strong predictor of enrollment in a rehabilitation program. Enrollment rates were greater in patients without heart disease history than those with a previous heart-related condition. In addition, patients with more severe acute MI and who received reperfusion therapy were more likely to enroll. Greater LVEF levels were suggested as a factor that may be related to enrollment in a rehabilitation program. The results of relationships

between functional ability, smoking status, and BMI and enrollment in a cardiac rehabilitation program are limited because of inconsistent findings from the available literature.

Suggestions for Future Research

A limitation in current research is the variation in period of time for which enrollment after hospital discharge was measured. Enrollment in rehabilitation programs was determined at 1 to 9 months after hospital discharge, resulting in a wide range in enrollment rates. It appears that investigators who measured enrollment at 6 to 9 months found higher enrollment rates than investigators who measured enrollment at shorter follow up times of 1 to 3 months. It is possible that a patients' decision to enroll in a rehabilitation program and their enrollment barriers change over time.[117] Therefore, it is necessary for future studies to determine the time period after hospital discharge that patients need to make a decision to enroll in a cardiac rehabilitation program. Knowing the process by which patients make the decision to enroll in a rehabilitation program may be a vital component in identifying the optimal time period after hospital discharge to encourage patients to enroll.

Smaller sample sizes also produce wider ranges in enrollment rates in rehabilitation programs and preclude the use of multivariate statistical techniques. This makes it difficult to draw any definitive conclusions regarding enrollment.

Last limitation is the lack of using theoretical frameworks to guide the study design and methods. This approach results in oversimplification and potential misinterpretation of these phenomena that influence enrollment in a rehabilitation

program. Therefore, it will be important to conduct theoretically guided research studies of enrollment in a cardiac rehabilitation program. Using a theoretical framework has the following benefits: 1) specifies key variables that influence enrollment in a rehabilitation program, 2) explains how those key variables interact to affect enrollment, 3) can provide more consistent information about enrollment, and 4) provides guidance in interpreting results and regarding mechanisms through which these factors can be better understood. The Transtheoretical Model may be one of the best models that can guide future investigations to identify determinants of enrollment in a rehabilitation program after hospital discharge.[155] The model is based on theories of motivation and behavioral change. It is an integrated model of current behavioral status and behavioral intention of changing a problem behavior or acquiring a positive behavior. Using this model to guide the future studies has one advantage over other models. The Transtheoretical Model conceptualizes behavior change as a process occurring over time, as opposed to alternative theories of change. By breaking the change process into stages, this model will help in investigating which factors contribute to progress through the stages of making the decision to enrollment in a rehabilitation program and physical activity behavior change.[156-159] This can help identify important strategies for developing an intervention, which may move patients forward to maintenance stage of physical activity behavior after rehabilitation.[160]

Implications

Although age, gender, ethnicity, medical history, and LVEF are not modifiable, they can help identify those needing attention to increase the likelihood of enrollment.

Factors can be modified to have positive impacts. Investigators consistently found that patients with lower income and who drove long distances to a rehabilitation program site were less likely to enroll in a rehabilitation program. Patients who are less educated or have no spouse were less likely to enroll. The lower income factor may indicate patients who cannot afford the cost of rehabilitation. Even with Medicare or Medicaid, many patients are unable to afford other expenses that are not strictly related to rehabilitation program cost, for instance transportation and parking. As part of clinical practice, health care providers should act as a supporter for the patients. Providers should ascertain the information needs of patients and their family members about heart disease and the benefits of rehabilitation. Providers need to afford patients with the available resources to lower enrollment costs and to overcome impediments of accessing rehabilitation programs.

The results from this review suggest that patients' perceptions of cardiac disease and management are important to enrollment in a rehabilitation program. Health care providers can have a strong, positive impact on patients' perceptions of these two factors. For example, health care providers can promote patients' awareness about their condition and the benefits of rehabilitation. Providers should encourage patients to raise their concerns and to develop an understanding and response to them. Providers should routinely assess patients' awareness of the benefits of rehabilitation, while emphasizing the importance of continuous attendance.

Within the category of clinical factors, the investigators consistently found that referral is essential to enrollment in a rehabilitation program. Health care providers are

responsible for identifying and referring all eligible patients to a rehabilitation program. Educating providers about eligibility may improve the rate of referral. Rehabilitation programs may also establish policies and procedures for automatic referral for patients who meet the pre-specified requirements of enrollment.

Conclusions

Physical activity is recommended in the management of HF. Several studies have documented that adherence to physical activity improves many indices associated with activity tolerance. Increased activity tolerance is associated with enrollment in a cardiac rehabilitation program. Therefore, it is essential that motivators as well as barriers to rehabilitation enrollment be considered. It is interesting to note that research on factors related to enrollment has not been conducted specifically on patients with HF. This may be that increasing physical activity behavior in patients with HF is not considered as important as adherence to medication and diet. Accordingly, more studies with HF populations are needed to investigate the many other factors that appear to influence utilization of rehabilitation and adherence to physical activity.

Table 3.1. Factors Increasing Enrollment in a Cardiac Rehabilitation Program	
Variables	Findings of higher rates of enrollment
Socio-demographic factors:	
Age	Younger age with more life-threatening heart disease such as acute MI or CABG surgery.[115,117,121-123,129]
Gender	No consistent results.[113-117,121-126,129,132]
Marital status	Being married with less life-threatening heart disease.[125]
Ethnicity	No consistent results.[117,120,125,135]
Employment status	No consistent results.[113,114,117,118,120,121,124,125]
Household income	Higher household income.[132]
Level of education	Higher level of education with more life-threatening heart disease such as acute MI or CABG surgery.[115,117,121]
Distance from rehabilitation program site	Short distance from rehabilitation program site.[116,119,125,128,141]
Psychosocial factors:	
Emotional distress	No consistent results.[114,125113,115,117,120,125,129,132]
Self-efficacy	Greater perception of self-efficacy with less life-threatening heart disease.[132]
Social support	No consistent results.[115,117,119,121,123,125,129,132]
Perceptions of cardiac rehabilitation	Perceived benefits of rehabilitation and perceived fewer enrollment barriers.[115,124,125,149]

Table 3.1. (Continued)	
Clinical factors:	
Referral to rehabilitation	Received referral to rehabilitation program.[115,125,128,150,151]
Functional ability	No consistent results.[117,121,125,128]
Medical history	No history of cardiac disease and diagnosis of acute myocardial infarction.[115-118,121]
Left ventricular ejection fraction	No consistent results.[114,117,121]
Physical activity level	No consistent results.[113,116,117,120,124]
Body mass index	No consistent results.[113,121114,117,120,124,125,128,129]
Smoking status	No consistent results.[113,114,116,120,121,124,125,129]

CHAPTER FOUR

Factors Associated with Perception of Functional Status in Patients with Heart Failure

Introduction

Heart failure (HF) is a chronic, progressive condition in which the heart does not provide enough blood to meet metabolic needs. This leads to compensatory mechanisms that contribute to impaired functional status.[38,39] Functional status includes physiological, physical, cognitive, and social functions[161-165] and is viewed as two dimensions functional capacity and functional performance. These dimensions respectively refer to highest level of functioning and present level of function.[166-168] Most investigators have considered physical function as an important indicator of functional status in patients with HF because it decreases with the onset of HF symptoms.[39] Accordingly, for the purpose of this study, functional status was defined as the patient's functional ability to perform activities of daily living.

The assessment of functional ability in the HF population is fundamental for planning treatment and evaluating treatment effectiveness.[169,170] Clinicians and researchers have used functional ability to determine severity of HF and to track changes in patients overtime.[170,171] The underlying assumptions have been based on a relationship between indices of abnormal cardiac function and HF symptoms, and functional ability.[172]

A growing body of research has demonstrated that decreased functional ability in patients with HF is strongly associated with hospitalization and mortality.[170,173-175] By focusing on functional ability as a medical outcome, clinical indicators associated with

patients' improvement have been identified. Several clinical trials of HF management have confirmed that intervention strategies such as myocardial revascularization intervention, pharmacological therapy, exercise, nutritional supplementation, and improvement in self-care can prevent or delay the onset of disabling HF symptoms and consequently, decrease HF-related events.[170,175-181] In contrast, the physiological, psychosocial, and behavior factors that affect functional ability in HF patients have not been specifically targeted. Identification of such factors may have important implications for identifying the most desirable plan of care.

The factors having a potential impact on patients' functional ability include: HF self-care maintenance behaviors, myocardial dysfunction, emotional distress, perceived control, and self-rated health. Elevated N-terminal pro-B type natriuretic peptide (NT-pro-BNP) has been identified as a sensitive biomarker of myocardial dysfunction in the general population[182] and a strong predictor of worsening functional ability, hospitalization, and mortality in patients with HF.[183-185] Engagement in HF self-care behaviors has been shown to be an essential aspect of HF management optimizing health outcomes including a decreased number and duration of hospitalizations.[186-188] Patients with the most successful outcomes have been found to have less emotional distress and better perceived control and self-rated health.[189-191] This suggests that emotional distress, perceived control, and self-rated health may be key factors in successful HF self-care behaviors, which in turn may improve myocardial function and patients' perceptions of their functional ability.

The purpose of this study was to determine the factors associated with functional ability in patients with HF. The specific aims were: (1) to determine the amount of variance in the functional ability scores of patients with HF as measured by the Duke Activity Status Index (DASI) predicted by emotional distress, perceived control, self-rated health, HF self-care maintenance behaviors, and serum NT-pro-BNP biomarker of myocardial dysfunction after controlling for age, gender, socioeconomic status, and comorbidities and (2) to determine whether NT-pro-BNP mediated the influence of HF self-care maintenance behaviors on functional ability. The following hypotheses were tested: (1) emotional distress, perceived control, self-rated health, HF self-care maintenance behaviors, and NT-pro-BNP biomarker of myocardial dysfunction will independently predict functional ability in patients with HF after controlling for age, gender, socioeconomic status, and comorbidity and (2) NT-pro-BNP will mediate the influences of HF self-care maintenance behaviors on functional ability.

Conceptual Framework

Figure 4.1 is the conceptual framework guiding this study in identifying the determinants of functional ability perception among patients with HF. The relationships in the framework are based on two propositions derived from research findings. These propositions are: (1) emotional distress, perceived control, and self-rated health are the key variables in determining HF self-care maintenance behaviors and (2) serum NT-pro-BNP biomarker of myocardial dysfunction mediates the relationship between HF self-care maintenance behaviors on functional ability.

NT-pro-BNP. NT-pro-BNP is mainly released into the blood from left atrial and left ventricular myocytes in response to volume overload and increased filling pressure that occur with myocardial dysfunction.[192] NT-pro-BNP is considered to be the best marker of prognosis in patients with HF. Elevated NT-pro-BNP is associated with HF severity, mortality, and poor perception of functional ability. A low serum NT-pro-BNP level is an indicator of successful HF management.[192,193]

HF Self-care. Self-care is fundamental to attaining optimal functional ability in patients with HF.[186,194] Self-care includes the necessary tasks that patients undertake to manage their HF condition in order to maintain health and prevent further functional ability impairment.[194] Self-care in patients with HF involves maintenance and management activities.[195,196] HF self-care maintenance requires patients to engage in recommended behaviors that maintain optimal functional ability including sodium and fluid restriction, regular exercise, and daily weighing. HF self-care maintenance behaviors maintain physiological stability and are indicated by serum NT-pro-BNP levels.[188,192] HF self-care management requires recognizing symptoms of worsening HF, taking appropriate actions to treat symptoms, and evaluating the effectiveness of those actions. Poor engagement in recommended HF self-care contributes to the exacerbation of HF symptoms and the perception of impaired functional ability.[186,194,197,198] Therefore, for the purpose of this study, HF self-care was defined in terms of HF self-care maintenance behaviors (sodium and fluid restriction, regular exercise, and daily weighing).

Depression. Depression arises when patients feel they are unable to manage or control the stressors related to their HF condition.[199] Depression is more common in patients with cardiovascular disease than healthy individuals.[200-203] Depression is associated with multiple negative health behaviors (non-adherence with medication, diet, exercise, and smoking cessation).[204-208] Depression has an adverse effect on the ability to engage in HF self-care activities.[199,209-213] Depression also impacts the ability to learn or carry out necessary HF self-care behaviors.[209,214]

Perceived control. Perceived control is the cognitive perception of the HF condition as a threat or challenge.[215] Perceived control occurs when patients believe in their ability to control their HF condition in a way that positively affects their symptoms and subsequent functional ability impairment.[190,216,217] Perceived control is related to HF self-care.[194] Low sense of control adversely affects HF self-care by contributing to a lack of curiosity about learning or seeking more information about HF and its management.[197,218-220] Patients with a low sense of control are the least likely to make healthy behavioral changes.[221] Lower levels of perceived control are also associated with the inability to make emotional adaptation to HF, leading to greater emotional distress.[222,223]

Self-rated health. Self-rated health reflects patients' perceptions of their own physical, emotional, and behavioral health.[224-228] Poor self-rated health is an independent predictor of physical illness,[224,228] which could be a strong predictor of patients' perceptions of impaired functional ability.[229-231] Given that emotional distress amplifies physical illness symptoms,[199,209-213,232] self-rated health also has been demonstrated to be

a strong predictor of underlying emotional distress.[226,227] The association between lower self-rated health and chronic illnesses and mortality suggests that self-rated health is a predictor of behavioral risk factors and poor engagement in HF self-care.[225]

***Demographic and clinical characteristics*.** Age, gender, socioeconomic status, and comorbidity are variables contributing to differences in emotional distress, perceived control, and self-rated health in patients with HF. Younger patients are more likely to retire early,[233,234] to perceive greater symptom intensity,[235,236] and to experience unhealthy behavior restrictions[234], all of which increase emotional distress[233,237] and decrease self-rated health.[238,239] Older patients are more likely to have low perceived control related to decreasing sensory, cognitive, and physical abilities[194] and lower socioeconomic status.[234,240,241] Compared to men with HF, women have lower socioeconomic status,[240,242] poorer emotional adaptation to HF,[243,244] more severe HF symptoms, and greater limitations in physical ability.[244-247] All of these can lead to increased emotional distress[243] and can reduce their perceived control[234,240] and self-rated health.[242,248] Low socioeconomic status is associated with greater emotional distress[249] and poor perceived control[234,240] and self-rated health.[241,248] Comorbidities in patients with HF can compound HF symptoms[194] and increase self-care demands which result in emotional distress, poor perceived control, and lower self-rated health.

Methods

This was a secondary data analysis to determine predictors of functional ability among patients with HF. The data were collected in six studies with the same inclusion and exclusion criteria from patients with HF attending cardiology clinics in the East

South Central region. Data about demographic and clinical characteristics, functional ability, serum NT-pro-BNP levels, HF self-care maintenance behaviors, perceived control, self-rated health, and depressive symptoms were collected during a five year period between 2004 and 2009.

Sample

Patients recruited had a documented diagnosis of HF with either an impaired left ventricular ejection fraction (LVEF ≤ 45%) or preserved systolic function confirmed by a cardiologist. Patients were excluded if they had been referred for heart transplantation, had a history of cerebral vascular accident or acute myocardial infarction within the previous three months, physical disability, psychiatric illness, cognitive impairment, or terminal illness such as cancer.

A sample of 279 HF patients with complete data on depressive symptoms, self-care maintenance behaviors, perceived control, self-rated health, NT-pro-BNP, and functional ability were included in this study.

Measures

***Functional ability*.** The DASI was used to measure functional ability. It is a 12-item self-report scale measuring patients' ability to perform activities of daily living. Patients rate ability to engage in specific behaviors on four-point semantic differential statement scales of 1 = "yes, with no difficulty," 2 = "yes, with some difficulty," 3 = "no, I can't do this," and 4 = "don't do this for other reasons." Examples of items are: "run a short distance" and "walk a block or two on level ground." The item scores were summed. A higher score indicates greater difficulty to perform activities of daily living

and lower functional ability. The reliability for the DASI is 0.90 and criterion validity against peak oxygen consumption is 0.58.[250]

Self-care maintenance. HF self-care maintenance behaviors were measured using the maintenance subscale of the Self-care of Heart Failure Index (SCHFI). The subscale assesses self-care maintenance behaviors for patients with HF including adherence to a low sodium diet, fluid restriction, regular physical activity, and daily weighing. The items are rated on a 4-point scale using semantic statements of 1 = "never," 2 = "sometimes," 3 = "frequently," and 4 = "always." A higher score for each self-care maintenance behavior demonstrates better adherence. SCHFI maintenance subscale construct-related validity is supported by confirmatory factor analysis and with significant differences in self-care scores between patients with HF and those newly diagnosed.[196] The internal consistency reliability of the SCHFI maintenance subscale was .71.[251]

Depression. Symptoms of depression were measured using the 6-item depression subscale of the Brief Symptom Inventory (BSI). The degree to which they were bothered by depressive symptoms such as depressed mood, loss of interest, vulnerability to criticism, loneliness, worthlessness, hopelessness, and thoughts of suicide are rated on a 5-point Likert scale ranging from 0 = "not at all," 1 = "a little bit," 2 = "moderately," 3 = "quite a bit," and 4 = "extremely." The scores were summed and averaged, the higher the score, the more severe the depression. The cut point of .28 was used to indicate the presence of depression.[65] The reliability of BSI depression subscale was .85 and its construct validity was supported by factorial analysis.[65]

Perceived control. Eight items from the Cardiac Attitudes Scale-Revised (CAS-R) were used to measure perceived control. The CAS-R measures patients' perception of control related to their heart condition. Each item is scored on a 5-point Likert scale from 1 "totally disagree" to 5 "totally agree." An example of an item is: "regarding heart problems, how much control do you feel?" The scores of the items were summed, with a higher total score indicating greater perceived control. The CAS-R reliability was 0.70, and its construct validity was supported in a variety of cardiac patients by factorial analysis.[252]

Self-rated health. A single item from the Medical Outcomes Survey Short-Form 36 was used to measure self-rated health. The patient's perceptions of their health was rated from 1 = "excellent," 2 = "very good," 3 = "good," 4 = "fair" to 5 = "poor." Concurrent validity for self-rated health was supported by significant association with hospitalization and mortality among patients with HF.[189]

NT-pro-BNP levels. Serum samples were collected to determine NT-pro-BNP concentrations. Serum NT-pro-BNP levels were measured using enzyme immunoassay kits (ALPCO Diagnostics, Salem NH). The analytic performance of the enzyme immunoassay was previously reported in detail. [253] The analytical range extended from 5 to 1000 fmol/ml.

Demographic and clinical characteristics. Age, gender, living status, socioeconomic status, ethnicity, and comorbidities were collected by patient interview and medical record review. Socioeconomic status was assessed based on educational level and financial status. Educational level was assessed by one question, "what is the

highest grade acheived." Educational level was categorized as less than high school, high school, or more than high school education. Financial status was assessed using one item that asked patients to rate their income from 1 = "have more than enough to make ends meet," 2 = "have enough to make ends needs," and 3 = "do not have enough to make ends meet." Comorbidity burden was measured using the Charlson Comorbidity Index. The scores can range from 1 to 34 with higher scores, indicating greater comorbidity burden. Validity for this instrument has been demonstrated by its ability to predict mortality, complications, health care resource use, length of hospital stay, and cost. [74,75]

Procedure

Appropriate institutional review board approval was obtained from all study sites. All patients were referred to the studies by nurses or physicians. Patient eligibility was confirmed from the medical record by trained research nurses. Eligible patients were contacted at their regular clinic visit and gave written informed consent to participate. Participating eligible patients completed all study questionnaires and provided a blood sample in an EDTA tube for the NT-pro-BNP test. Research nurses read the questionnaire to patients who had difficulty reading. Demographic and clinical characteristics were collected by patient interview and medical record review using a structured questionnaire.

Data analysis

The data were analyzed using SPSS software for Windows 17.0 (SPSS Inc, Chicago, Illinois). Data were examined, verified, and cleaned prior to starting analysis. Log transformation was performed for non-normally distributed data for a better

approximation of normal distribution. Appropriate descriptive statistics (frequencies and percentages, means and standard deviations) were used to characterize the sample. A multiple linear regression was conducted to determine which factors accounted for the greatest variance in the DASI score of patients with HF. Variables were entered using the following procedure. In the first block, control variables of age, gender, economical status, educational level, and comorbidities were entered into the model. In the second block, the psychosocial variables of depressive symptoms, perceived control, and self-rated health were entered into the model. In the third and fourth block, HF-self-care maintenance behaviors of sodium and fluid restriction, adherence to physical activity, and daily weighing and serum NT-pro-BNP levels were entered, respectively. The magnitude of change in the R-squared was used to determine the contribution of these factors and to identify the best predictors of functional ability.

A separate mediation analysis was conducted in three steps for each HF self-care maintenance behavior (sodium and fluid restriction, adherence to physical activity, and daily weighing) to test the mediation effects of serum NT-pro-BNP levels. All analyses were performed with a hierarchical multiple linear regression in which all variables that were significantly associated with functional ability in the first regression analysis were included in the first block as control variables. These variables included age, gender, educational levels, economical status, comorbidity, depression symptoms, perceived control, and self-rated health. In the first regression, the mediator (NT-pro-BNP) was regressed on each HF-self-care maintenance behaviors. In the second regression, the dependent variable (functional ability) was regressed on each HF self-care maintenance

behavior. In the third step, functional ability was regressed on both the mediator (NT-pro-BNP) and each HF self-care maintenance behavior.

For each of the self-care behaviors, the following criteria needed to be met for serum levels NT-pro-BNP to mediate the relationship between the behavior and functional ability. In the first regression, the HF self-care behavior had to predict a significant amount of the variance in NT-pro-BNP levels. In the second regression the HF self-care behavior had to predict a significant amount of variance in functional ability. In the third regression, the amount of variance in functional ability explained by the HF self-care behavior must be significantly less than that in the second regression.

Results

Evaluation of linearity led to the log transformation of serum NT-pro-BNP levels. Due to low frequencies in some self-rated health categories, patients with self-rated health as excellent were combined with those rated as very good and patients with self-rated health as fair were combined with those rated as poor.

Characteristics of the Patients

Demographic, psychosocial, and clinical characteristics of the patients are summarized in Table 4.1. The average age of patients was 61 years with a range of 32 to 89 years. Patients were predominantly male and Caucasian. Most patients had more than high school education and most had enough income to make ends meet. The patients were distributed evenly between NYHA class I/II and class III/IV. Nearly half of the patients had ischemic heart disease as the underlying etiology of HF. The most frequent comorbidities were hypertension and diabetes. Approximately 57% had a moderate to

severe depressive symptoms. Only 14% of patients rated their health as excellent or very good, while greater half of the patients rated their health as fair or quite poor. Overall, self-care maintenance behaviors were low. Slightly more than half of the patients (54.8%) reported never or only sometimes weighing themselves daily, less than half were never or rarely following a low sodium diet (41.2%), and only 38.7% were frequently or always engaging in regular exercise.

Predictors of Functional Ability in Patients with HF

The predictors of functional ability are presented in (Table 4.2). The model explained 40.2% of the variance in functional ability. Higher depressive symptoms, fair or poor self-rated health, non-adherence to physical activity, and greater serum NT-pro-BNP levels were independent predictors of worse functional ability in patients with HF. Perceived control and HF self-care maintenance behaviors of daily weighing and sodium restriction were not significant predictors. The factors with the highest proportion of explained variance in functional ability were depressive symptoms and self-rated health. Adherence to physical activity and NT-pro-BNP explained the least amount of variance.

Mediation Serum NT-pro-BNP levels on the Link between Self-Care Maintenance Behaviors and Perception of Functional Ability

The first model NT-pro-BNP regressed on each HF self-care maintenance behavior after controlling for variables that were significant predictors of functional ability in previous regression analysis. These variables included age, gender, economical status, comorbidity, depressive symptoms, and self-rated health. Regression results indicated that adherence to physical activity was the only predictor of serum NT-pro-

BNP levels, with non-adherent patients having higher serum NT-pro-BNP levels (β = .1; *P* = .042). Adherence to physical activity accounted for 1.3% of the variance in serum NT-pro-BNP levels.

The second model functional ability regressed on adherence to physical activity after controlling for the same variables. Regression results revealed that adherence to physical activity was a significant predictor of patients' perceptions of functional ability, with non-adherent patients having a poor perception of functional ability. Adherence to physical activity explained 1.2% of the variance in functional ability. When serum NT-pro-BNP levels were entered in the third model, the relationships between serum NT-pro-BNP levels and adherence to physical activity and functional ability was significant. The percentage of variance in functional ability explained by adherence to physical activity decreased and the p value increased in the final model (Figure 4.2).

Discussion

The ability to perform daily physical activities with minimal symptoms is an important goal of HF treatment.[38,39] Good functional ability is associated with fewer hospitalizations and better survival rates, [12,15-17] making functional ability an essential outcome for HF management.[11,12] Achieving an optimal functional ability for patients with HF requires an understanding of what factors are associated with potential changes in functional ability. The mediation analysis in our study revealed that serum NT-pro-BNP levels partially mediated the relationship between adherence to physical activity and functional ability in patients with HF. The overall proportion mediated by serum NT-pro-BNP levels, however, was small suggesting additional mediating mechanisms.

The partial mediation of serum NT-pro-BNP levels in the association between adherence to physical activity and perception of functional ability corroborates previous studies of physical activity training programs in patients with HF. Physical activity was observed to reverse some physiological changes responsible for HF symptoms, leading to improvement in patients' physical functional ability.[24] Although physical activity training initially produces an elevation in serum NT-pro-BNP levels in patients with HF, serum NT-pro-BNP levels have been observed to decrease with long-term training.[254,255] Other investigators have observed associations between decreased serum NT-pro-BNP levels and improved perception of functional ability after physical activity training.[255] Previous mediation analysis revealed that serum NT-pro-BNP levels explained a small part of the relationship of adherence to physical activity to perception of functional ability confirming our suggestion of additional mediating mechanisms.

In our study, depending on patients' own subjective estimations of their health, self-rated health was a predictor of functional ability. Fair or poor self-rated health was associated with poor perception of functional ability in patients with HF. This finding is consistent with those previously reported for the healthy older adults as well as for elderly people with ischemic heart disease.[229-231] Several hypotheses have been proposed to explain this finding. First, poor self-rated health may have been secondary to intolerance of performing daily activities as a result of HF.[224,228] Second, poor self-rated health may be related to depressive symptoms,[226,227] which were shown to be a major predictor of poor functional ability in our study. Last, the association we observed may have been mediated by unhealthy behaviors such as non-adherence to medication, diet,

and physical activity.[225] In our data, poor self-rated health was significantly associated with non-adherence to physical activity. Therefore, it was likely that previous factors play a major role in the association between poor self-rated health and poor perception of functional ability in patients with HF.

Our finding that depressive symptoms were an independent predictor of patients' perceptions of functional ability corresponds with the results from previous studies that investigated the relationship between depressive symptoms and functional ability.[38,256] Depression has been found to be associated with multiple adverse health behaviors (non-adherence to medication, diet, exercise, and smoking cessation recommendations)[204,205,257] that can exacerbate HF symptoms,[204-208] leading to poor perception of physical function.[38] In our data, depressive symptoms were associated with non-adherence to physical activity recommendations. Depressive symptoms are associated with feelings of fatigue, low energy, perceived exertion, and greater HF severity, which in turn can negatively affect patients' physical function and the ability to perform daily activities.[210-213] Patients with depressive symptoms may also have low self confidence in the ability to overcome HF symptoms and to attain the desired physical function needed to perform their daily activities.[258]

The present study showed that non-adherence to regular physical activity contributed to poor perception of functional ability in patients with HF, which supports the findings from previous studies.[259-261] HF resulted in the symptoms of fatigue and dyspnea that develop with minimal exertion.[24] These symptoms are associated with increased HF severity, worsening prognosis, and significantly impaired physical function.

Non-adherence to physical activity in patients with HF contributed to further physiological impairments, increased intensity of fatigue and dyspnea symptoms, and progressive decrease in physical function as indicated by decreased peak oxygen consumption and exercise capacity.[24]

Consistent with previous studies,[192,193] the current findings suggest that higher serum NT-pro-BNP levels are associated with poorer perception of functional ability. This finding corroborated the observations that higher serum NT-pro-BNP levels were associated with progressive myocardial dysfunction and worsening HF.[34,35] This progression in HF has been documented by the presence of fluid overload and increased cardiac wall tension. These result in more severe fatigue and dyspnea symptoms[192] that compromise physical function in the performance of daily activities.[24]

A number of limitations must be considered in interpreting the results of this study. First, the study is cross-sectional which limits the ability to make inferences about causality. In further studies, researchers might employ repeated measurement and, ultimately, interventional studies to further clarify their respective roles in long-term outcomes. Second, data on HF self-care maintenance behaviors were measured by using a single item. Single item measures may not capture the multidimensional nature of actual adherence to a health behavior. Future studies might investigate the effects of these variables on functional ability using a multidimensional measure. Third, most patients in our sample were Caucasian males and, therefore, the results may not be generalizable to other patient populations. Lastly, our study is a secondary analysis of data collected throughout multiple clinical studies. However, the samples in all of the studies had

similar inclusion and exclusion criteria. In addition, our analyses were restricted to the available variables in our data set. Therefore, we could not identify other important factors that might be associated with patients' perception of functional ability such as physical activity self-efficacy.

Implications and Conclusion

Evaluation of functional ability at the time of initial diagnosis of HF provides information that can predict outcomes and may be useful for HF management. In the current study, we found that depressive symptoms and self-rated health were predictors of patients' perceptions of functional ability. This indicates that clinicians should pay attention to depressive symptoms and perceived health in patients with HF in which improving functional ability is a goal.

Our data showed that self-reported HF self-care maintenance behaviors were poor in patients with HF. Adherence to physical activity and serum NT-pro-BNP levels were associated with patients' perceptions of functional ability. Specifically, the association between adherence to physical activity and patients' perceptions of functional ability was mediated partially by serum NT-pro-BNP levels. This indicates that adherence to physical activity may reduce serum NT-pro-BNP levels that is likely a function of decreased cardiac wall tension and improved myocardial function, which, in turn, improves patients perception of functional ability. Alternatively, this result suggests that high levels of NT-pro-BNP may be an indicator of inability to engage in regular physical activity because of activity intolerance symptoms resulting in reluctance to engage in regular physical activity. Either way, patients with elevated levels of serum NT-pro-BNP

are a group primed for interventions aiming at improving daily physical activity levels. In conclusion, our results suggest that any intervention to maintain a high level of functional status in patients with HF should address depression, perceived health, HF self-care behavior of adherence to physical activity, and NT-Pro-BNP.

Figure 4.1. Conceptual Framework for the Factors Related to Functional Ability in Patients with Heart Failure

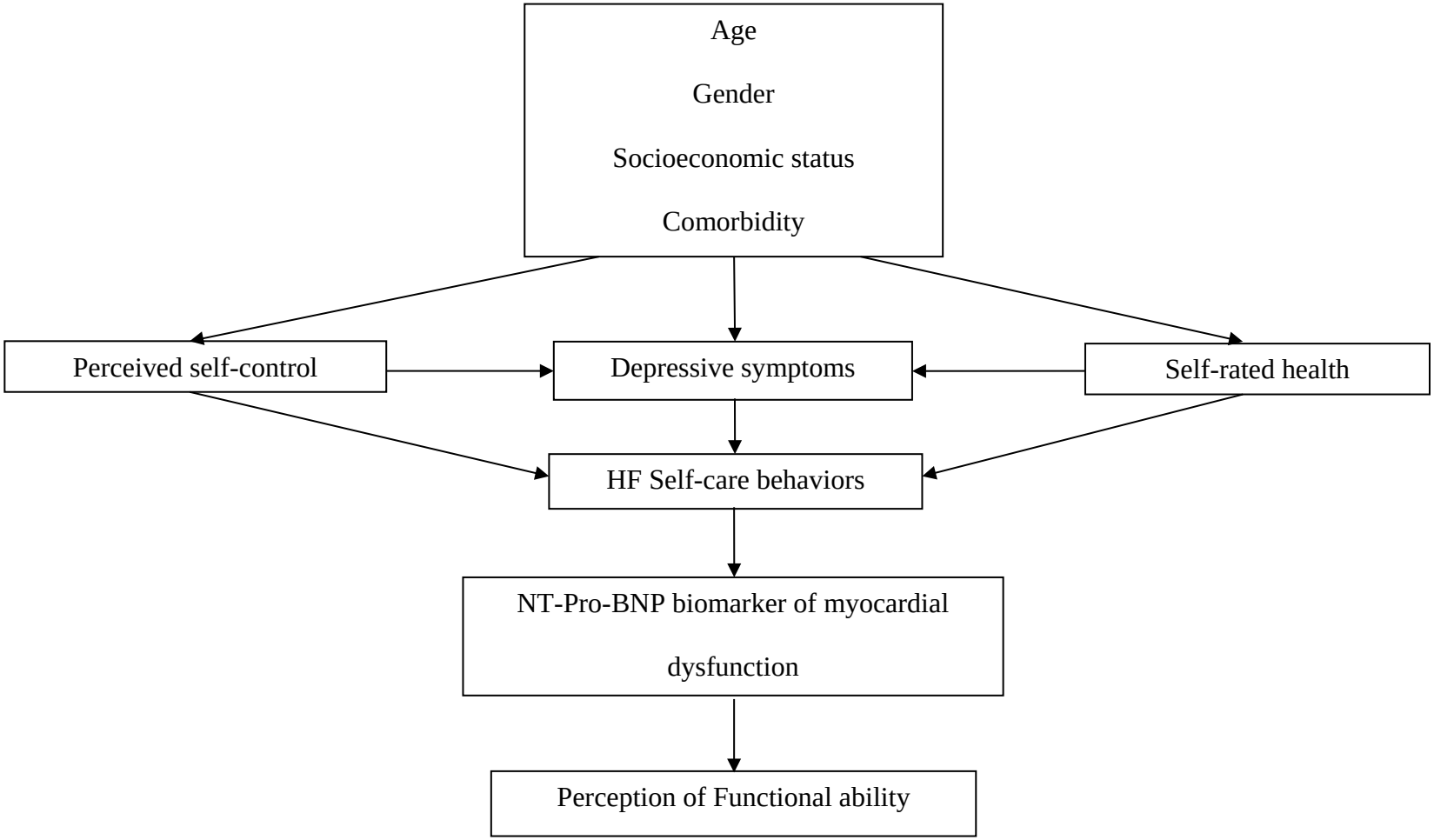


Table 4.1. Demographic, psychosocial, and clinical characteristics of the sample (n = 279)	
Age	60.9 ± 11.5
Gender	
Male	190 (68.1)
Ethnicity	
Caucasian	221 (79.2)
Minorities	58 (20.8)
Educational levels	
Less than high school	54 (19.4)
High school	79 (28.3)
More than high school	146 (52.3)
Economic status	
Have more than enough to make ends meet	83 (29.7)
Have enough to make ends need	130 (46.6)
Do not have enough to make ends meet	66 (23.7)
NYHA	
I/II	130 (46.6)
III/IV	149 (53.4)
Comorbidities	
Hypertension	193 (69.2)
Diabetes	123 (44.1)
Depressive symptoms	
BSI $\geq$ 0.28	162 (57.2)
Self-rated health	
Excellent or Very good	39 (14.0)
Good	96 (34.4)
Fair or Poor	144 (51.6)
Self-care management	
Weigh daily	
Never or rarely	77 (27.6)

Table 4.1. (Continued)

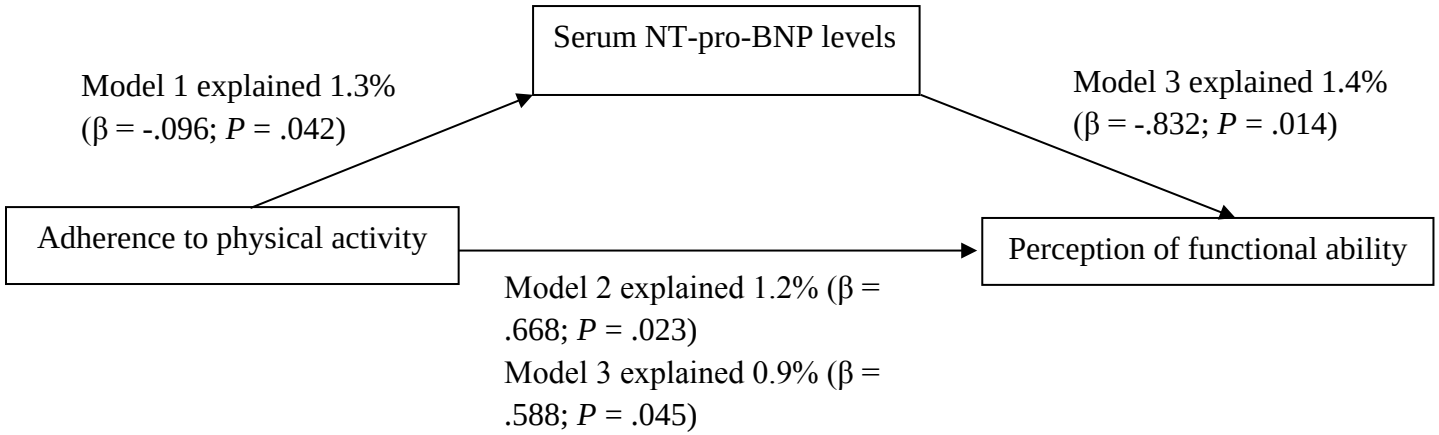
Sometimes	76 (27.2)
Frequently	49 (17.6)
always	77 (27.6)
Eat a low salt diet	
Never or rarely	38 (13.6)
Sometimes	77 (27.6)
Frequently	84 (30.1)
always	80 (28.7)
Engage in regular physical activity	
Never or rarely	75 (26.9)
Sometimes	96 (34.4)
Frequently	63 (22.6)
Always	45 (16.1)

Data are presented as Mean (SD) or n (%).

Abbreviations: NYHA, New York Heart Association; BSI, Brief Symptom Inventory-Depression subscale. Moderate to severe depression = BSI score ≥ 0.28.

Table 4.2. Factors related to perception of functional ability in patients with heart failure (n = 279)					
Model	R square change	B	Beta	t	Sig.
Controlled variables	.238				
Age		.081	.16	2.94	.004
Gender (female)		2.83	.23	4.57	< .001
Financial status (Do not have enough to make ends meet)		1.69	.21	3.99	< .001
Educational level (more than high school)		.55	.07	1.45	.148
Comorbidity		.31	.18	3.29	.001
Psychosocial factors	.137				
Depressive symptoms		1.01	.146	2.76	.006
Perceived control		-.091	-.053	-1.08	.280
Self-rated health (fair or poor)		2.56	.32	5.74	< .001
HF self-care maintenance behaviors	.017				
Adherence to physical activity		-.71	-.13	-2.18	.03
Weigh yourself daily		-.023	-.01	-.089	.929
Eat a low salt diet		.32	.06	1.05	.297
Myocardial dysfunction	.01				
NT-pro-BNP		.818	.112	2.150	.032
Abbreviations: B, unstandardized coefficient; Beta, standardized coefficients; Sig., significant; NT-pro-BNP N-terminal pro-brain natriuretic peptide.					

Figure 4.2. Mediator Effect of Serum NT-pro-BNP Levels on The Association between Adherence to Physical Activity and Perception of Functional Ability



CHAPTER FIVE

Conclusions and Discussion

Approximately one in three American adults have one or more types of cardiovascular disease (CVD) including coronary artery disease, angina, and hypertension.[2] This makes CVD the primary cause of death and the most expensive condition treated in United States hospitals. Despite advances in medical care reducing CVD mortality, the burden of CVD is expected to increase with an increase in the number of patients with heart failure (HF) by more than 600 thousand cases each year.[2] HF places an enormous burden on individuals and the healthcare system; burden that is mostly related to frequent hospitalization. Given that HF is the result of CVD and both share similar risk factors,[24] lifestyle changes are a key component to address and greatly reduce the burden of CVD.

The CVD is more common among individuals who live a sedentary lifestyle.[3] The risk for CVD is higher among those who spend more than 3 hours per day in sedentary activities such as sitting and lying down.[5,6] The more time spent in sedentary activities, the higher risk of CVD. Sedentary lifestyle increases the risk for CVD independent of other CVD risk factors such as age, smoking, and body mass index (BMI).[4,5] Sedentary lifestyle contributes to other CVD risk factors, including elevated plasma triglyceride, low high density lipoprotein (HDL) cholesterol, hyperglycemia, hypertension, and increased abdominal adiposity.[7-9] Sedentary lifestyle is also associated with unhealthy behavioral risk factors such as smoking and unhealthy diet.[10]

Scientific evidence indicates that regular physical activity is effective in preventing the development of CVD and reducing symptoms in patients with established CVD.[2,11,1213-15] Physical activity prevents atherosclerosis by boosting HDL cholesterol and enhancing vascular endothelial function.[18,19] Physical activity reduces other risk factors for atherosclerosis including high blood pressure, diabetes, and obesity.[20,21] In addition, physical activity has been shown to decrease the risk of myocardial infarction by decreasing resting heart rate, increasing diameter of coronary arteries, promoting formation of collateral circulation, and decreasing formation of thrombus.[16-19] In patients with CVD, research has shown that physical activity can improve inflammatory markers and enhance physical ability by improving cardiac output, peripheral blood flow, and skeletal muscle aerobic metabolism.[23-25]

Despite cardiovascular health benefits of physical activity, approximately 80% of American adults are physically inactive or do not meet the minimum recommendation of 150 minutes of moderate intensity aerobic activity each week. Adults living in rural areas are more likely to be physically inactive compared with adults living in urban areas.[26] Addressing the factors that affect active lifestyle in rural Americans is important for designing effective CVD preventive interventions. The majority of studies to date have not addressed barriers that affect adoption of active lifestyles in rural Americans.[57,58] Chapter Two of this dissertation was a report of a longitudinal prospective study examining the demographic, psychosocial, and clinical factors that affected successful adoption of the lifestyle recommendation to increasing moderate-to-vigorous physical activity by an accumulated 15 minutes or more each day following a CVD risk reduction

intervention among at-risk individuals living in rural Appalachia. We found that anxiety was the only independent predictor of active lifestyle increase. Every 1-unit increase in baseline anxiety symptoms levels was associated with 3.3 times greater odds of adoption to active lifestyle post intervention. This finding suggests that anxious individuals in CVD risk reduction intervention are more responsive to increase their physical activity levels post intervention.

Because completion of the CVD preventive interventions is the necessary first step in promoting adoption of a more active lifestyle,[59] the factors associated with dropout from the HeartHealth intervention were also examined in Chapter Two. The results showed that age and health literacy were independent predictors of dropout from the HeartHealth intervention. For every 1-year increase in age, participants were 2 % less likely to drop out from the intervention. Every 1-unit increase in participant's baseline health literacy score was associated with a 22% decrease in likelihood of dropping out of the intervention. These findings suggest that younger participants may perceive less immediate threat to health necessitating participation in CVD risk reduction intervention and behavior change. Also our findings suggest that low health literacy participants may be unable to understand their risk of CVD and therefore may perceive no benefits to continue attendance to CVD risk reduction intervention.

There is growing evidence that cardiac rehabilitation programs can promote active lifestyle and improve cardiovascular health.[24] A cardiac rehabilitation program facilitates initiation of safe physical activity and helps achieve physical activity level recommendations.[37] However, enrollment in such a program remains low; particularly in

patients with HF. Only 20% of all eligible HF patients are enrolled in cardiac rehabilitation programs.[34,35] Although researchers have examined the benefits of enrollment in cardiac rehabilitation programs among patients with HF,[24] none have examined factors affecting their enrollment. Increasing cardiac rehabilitation utilization requires gaining a better understanding of the predictors of enrollment by patients with HF.

Chapter Three of this dissertation was a review of the literature to identify any investigations that have examined the factors associated with enrollment in cardiac rehabilitation programs among patients with HF. Because HF is the end stage of cardiovascular disease and no investigators have specifically examined patients with HF, published studies of all patients discharged from cardiac-related hospitalization were included in this review. The findings from this review suggest that patients do not enroll in a rehabilitation program because of a wide range of factors. Factors such as age, gender, ethnicity, and medical history cannot be modified, but they help identify those needing attention to increase the likelihood of enrollment. Demographic factors that had a positive impact on enrollment included level of education, being married, short distance from cardiac rehabilitation program site, and higher income. Patients who believed their cardiac condition was chronic but controllable and perceived rehabilitation was beneficial were more likely to enroll in a rehabilitation program. In contrast, patients with misconceptions about the causes of cardiac disease and who perceive greater barriers to participating were less likely to enroll in a cardiac rehabilitation program. Self-efficacy was positively associated with enrollment in a rehabilitation program among patients

with coronary heart disease. Among clinical factors, referral to rehabilitation was consistently found to be a strong predictor of enrollment in a rehabilitation program.

Functional status may have an important effect on engagement in physical activity in patients with HF.[38-41] Although previous studies have used functional status as an indicator of HF progression and as an important outcome to detect effect of treatment plan,[169-171] predictors of functional status have not been examined before. Chapter Four of this dissertation was a cross-sectional study on the predictors of functional status among patients with HF. The result from hierarchical multiple linear regression showed that depressive symptoms, HF self-care of adherence to physical activity, serum NT-pro-BNP levels, and self-rated health were independent predictors of patients' perception of functional status after controlling for age, gender, educational levels, financial status, and comorbidity. The other aim of this study was to examine the mechanism by which physical activity affected perception of functional status. The result from mediation analysis revealed that serum NT-pro-BNP levels partially mediated the relationship between adherence to physical activity and functional status in patients with HF. This result suggests that adherence to physical activity reduces serum NT-pro-BNP levels that is likely a marker of decreased cardiac wall tension and improved myocardial function, which, in turn, improves patients' perceptions of functional status. Alternatively, this result suggests that high levels of NT-pro-BNP may be an indicator of inability to engage in regular physical activity because of activity intolerance symptoms resulting in reluctance to engage in regular physical activity.

Implication

Physical activity is associated with many cardiovascular health benefits. Yet despite the efforts to improve physical activity levels, many Americans do not meet physical activity recommendations, and this remains an important public health problem. Awareness of the factors that affect physical activity behavior is the first step to design and administer intervention to promote physical activity. The studies in this dissertation described several factors in populations at greater risk of physical inactivity.

We found that higher baseline anxiety levels were associated with a higher probability of adopting an increase in physical activity following the CVD risk reduction intervention among rural Appalachians. Although a psychological mechanism is unclear, further studies will help clarify the motivators that influence anxious individuals to adopt active lifestyle after the CVD risk reduction intervention. Younger age was a predictor of dropout from the CVD risk reduction interventions. This finding indicates that younger participants may have unique barriers to participation in CVD risk reduction interventions. A better understanding of factors may inform interventions to promote cardiovascular health among this population. In addition, health literacy was noted as to be an important factor for encouraging rural Americans to adopt CVD risk reduction interventions. This suggests that any future intervention needs to take into account participants' health literacy levels. Health educators need to use simple health-related information to fit their participants with low health literacy levels. The education materials have to be developed at an appropriate reading level for participants with low health literacy levels.

The review of literature revealed a wide array of socio-demographic, psychosocial, and clinical variables as potential barriers to enrollment in cardiac rehabilitation programs. The factors most consistently associated with non-enrollment are long distance from rehabilitation program site, low income, perceived greater barriers and fewer benefits, and non-referral to rehabilitation. As part of clinical practice, health care providers should recognize these barriers and act as a supporter encouraging enrollment for all eligible patients.

We noted a large variation in the enrollment rates in cardiac rehabilitation programs. The reason for this variation was mainly related to the studies that have not yet identified an optimal time point to measure enrollment after hospital discharge. Knowing reliable information about enrollment rates is important for researchers and clinicians to set a goal to improve enrollment in a rehabilitation program. Thus, it is necessary for future investigators to determine the best time period after hospital discharge that patients will make a decision to enroll in a cardiac rehabilitation program. This will help to determine the factors associated with enrollment and identify the patients who are less likely to enroll in rehabilitation.

There is general lack of attention to using theoretical frameworks in examining the factors that affect enrollment in a cardiac rehabilitation program. Using a theoretical framework has the advantage facilitating the understanding of how those key variables interact to affect enrollment and interventions appropriately targeted. Moreover, it is interesting to note that research on factors related to enrollment has not been conducted specifically on patients with HF. Accordingly; more studies with HF populations are

needed to investigate the many other factors that appear to influence utilization of rehabilitation and adherence to physical activity.

Having high levels of NT-pro-BNP biomarker of cardiac dysfunction may be an indicator of failure to adherence to HF self-care behavior of physical activity or an indicator of inability to engage in regular physical activity as a consequence of greater myocardial dysfunction. Either way, patients with elevated levels of serum NT-pro-BNP are prime targets for interventions aiming at improving daily physical activity levels.

One of the purposes of Chapter Four was to examine whether HF self-care maintenance behaviors predict perception of functional status in patients with HF. The current HF self-care maintenance behaviors instrument (Self-care of Heart Failure Index [SCHFI]) used may not fulfill this purpose. The multidimensional nature of actual adherence to HF self-care maintenance behaviors are not addressed in the instrument. Despite the significant association between adherence to physical activity behavior and functional status, adherence to low sodium diet and daily weighing were not predictors. These findings differ from one study that noted that patients with severely impaired functional status commonly reported poor adherence to these behaviors.[262] Thus, it is necessary for future investigations to use proper ways of addressing self-reported adherence to self-care behaviors among patients with HF.

Summary

Adherence to physical activity in individuals with or without CVD is important because sedentary lifestyle has serious consequences on cardiovascular health. Participation in cardiovascular health promotion interventions is equally important

because completion of the intervention is the necessary first step in promoting adoption of a more active lifestyle. This dissertation has fulfilled an important gap in the knowledge about the factors that affect adherence to physical activity and participation in CVD risk reduction interventions in populations at greater risk of physical inactivity. Findings from this dissertation may contribute to further advancement of the state of science in promoting public health by identifying components that are necessary for the design of an effective CVD primary, secondary, and tertiary preventive intervention.

We found that higher anxiety levels were associated with adoption of a more active lifestyle among rural Americans. Older age and higher health literacy levels were predictors of participation in and completion of a CVD risk reduction intervention among rural Americans. The review of literature revealed that short distance from rehabilitation program site, higher income, perceived fewer barriers and greater benefits, and received referral to rehabilitation were the most consistent factors associated with HF patients' enrollment in cardiac rehabilitation programs. Functional status in patients with HF is crucially important to their engagement in regular physical activity. Our results revealed that lower depressive symptoms, HF self-care of adherence to physical activity, lower serum NT-pro-BNP levels, and better self-rated health were independent predictors of better perception of functional status. Serum NT-pro-BNP biomarker of myocardial dysfunction partially mediated the relationship between adherence to physical activity and functional status. This result provides further evidence of the benefits of adherence to physical activity in patients with HF. Also, it suggests that high levels of NT-pro-BNP

biomarker of cardiac dysfunction may be an indicator of non-adherence to regular physical activity or an indicator of inability to engage in regular physical activity.

References

1. Ades PA, Waldmann ML, McCann WJ, Weaver SO. Predictors of cardiac rehabilitation participation in older coronary patients. *Arch Intern Med.* May 1992;152(5):1033-1035.

2. Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics--2012 update: a report from the American Heart Association. *Circulation.* Jan 3 2012;125(1):e2-e220.

3. Yusuf S, Hawken S, Ôunpuu S, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *The Lancet.*364(9438):937-952.

4. Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting Time and Mortality from All Causes, Cardiovascular Disease, and Cancer. *Medicine and science in sports and exercise.* May 2009;41(5):998-1005.

5. Patel AV, Bernstein L, Deka A, et al. Leisure Time Spent Sitting in Relation to Total Mortality in a Prospective Cohort of US Adults. *Am J Epidemiol.* Aug 15 2010;172(4):419-429.

6. Dunstan DW, Barr EL, Healy GN, et al. Television viewing time and mortality: the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Circulation.* Jan 26 2010;121(3):384-391.

7. Hoedjes M, Berks D, Vogel I, et al. Motivators and Barriers to a Healthy Postpartum Lifestyle in Women at Increased Cardiovascular and Metabolic Risk: A Focus-Group Study. *Hypertension in Pregnancy.* 2012;31(1):147-155.

8. Amiri P, Ghofranipour F, Ahmadi F, et al. Barriers to a healthy lifestyle among obese adolescents: a qualitative study from Iran. *International journal of public health.* Apr 2011;56(2):181-189.

9. Edwardson CL, Gorely T, Davies MJ, et al. Association of Sedentary Behaviour with Metabolic Syndrome: A Meta-Analysis. *Plos One.* Apr 13 2012;7(4).

10. Tripp EV, Weissberg-Benchell J, Brickman WJ. Barriers to lifestyle change in children at risk for type 2 diabetes. *Diabetes.* 2005;54:A667-A667.

11. O'Connor GT, Buring JE, Yusuf S, et al. An overview of randomized trials of rehabilitation with exercise after myocardial infarction. *Circulation.* Aug 1989;80(2):234-244.

12. Lawler PR, Filion KB, Eisenberg MJ. Efficacy of exercise-based cardiac rehabilitation post-myocardial infarction: a systematic review and meta-analysis of randomized controlled trials. *American heart journal.* Oct 2011;162(4):571-584 e572.

13. Mosca L, McGillen C, Rubenfire M. Gender differences in barriers to lifestyle change for cardiovascular disease prevention. *J Womens Health.* Aug 1998;7(6):711-715.

14. Matsuzawa R, Matsunaga A, Wang G, et al. Habitual Physical Activity Measured by Accelerometer and Survival in Maintenance Hemodialysis Patients. *Clinical journal of the American Society of Nephrology : CJASN.* Sep 13 2012.

15. Ford ES, Ajani UA, Croft JB, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980-2000. *The New England journal of medicine.* Jun 7 2007;356(23):2388-2398.

16. Rimmele U, Zellweger BC, Marti B, et al. Trained men show lower cortisol, heart rate and psychological responses to psychosocial stress compared with untrained men. *Psychoneuroendocrino.* Jul 2007;32(6):627-635.

17. Franklin BA, Kahn JK. Delayed progression or regression of coronary atherosclerosis with intensive risk factor modification. Effects of diet, drugs, and exercise. *Sports medicine.* Nov 1996;22(5):306-320.

18. Billman GE. Aerobic exercise conditioning: a nonpharmacological antiarrhythmic intervention. *Journal of applied physiology.* Feb 2002;92(2):446-454.

19. Hambrecht R, Wolf A, Gielen S, et al. Effect of exercise on coronary endothelial function in patients with coronary artery disease. *The New England journal of medicine.* Feb 17 2000;342(7):454-460.

20. Sales AR, Silva BM, Neves FJ, et al. Diet and exercise training reduce blood pressure and improve autonomic modulation in women with prehypertension. *European journal of applied physiology.* Jan 24 2012.

21. Myers J. Cardiology patient pages. Exercise and cardiovascular health. *Circulation.* Jan 7 2003;107(1):e2-5.

22. Giannuzzi P, Mezzani A, Saner H, et al. Physical activity for primary and secondary prevention. Position paper of the Working Group on Cardiac Rehabilitation and Exercise Physiology of the European Society of Cardiology. *European journal of cardiovascular prevention and rehabilitation : official journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology.* Oct 2003;10(5):319-327.

23. Scrutinio D, Bellotto F, Lagioia R, Passantino A. Physical activity for coronary heart disease: cardioprotective mechanisms and effects on prognosis. *Monaldi archives for chest disease = Archivio Monaldi per le malattie del torace / Fondazione clinica del lavoro, IRCCS [and] Istituto di clinica tisiologica e malattie apparato respiratorio, Universita di Napoli, Secondo ateneo.* Jun 2005;64(2):77-87.

24. Pina IL, Apstein CS, Balady GJ, et al. Exercise and heart failure: A statement from the American Heart Association Committee on exercise, rehabilitation, and prevention. *Circulation.* Mar 4 2003;107(8):1210-1225.

25. Belardinelli R, Georgiou D, Cianci G, Purcaro A. Randomized, controlled trial of long-term moderate exercise training in chronic heart failure: effects on functional capacity, quality of life, and clinical outcome. *Circulation.* Mar 9 1999;99(9):1173-1182.

26. Schiller JS, Lucas JW, Ward BW, Peregoy JA. Summary health statistics for U.S. adults: National Health Interview Survey, 2010. *Vital and health statistics. Series 10, Data from the National Health Survey.* Jan 2012(252):1-207.

27. White JL, Ransdell LB, Vener J, Flohr JA. Factors related to physical activity adherence in women: Review and suggestions for future research. *Women Health.* 2005;41(4):123-148.

28. Conraads VM, Deaton C, Piotrowicz E, et al. Adherence of heart failure patients to exercise: barriers and possible solutions: a position statement of the Study Group on Exercise Training in Heart Failure of the Heart Failure Association of

the European Society of Cardiology. *European journal of heart failure.* May 2012;14(5):451-458.

29. Taylor GH, Wilson SL, Sharp J. Medical, psychological, and sociodemographic factors associated with adherence to cardiac rehabilitation programs: a systematic review. *The Journal of cardiovascular nursing.* May-Jun 2011;26(3):202-209.

30. Groeneveld IF, Proper KI, van der Beek AJ, Hildebrandt VH, van Mechelen W. Factors associated with non-participation and drop-out in a lifestyle intervention for workers with an elevated risk of cardiovascular disease. *Int J Behav Nutr Phy.* Dec 1 2009;6.

31. Rhodes RE, Martin AD, Taunton JE, Rhodes EC, Donnelly M, Elliot J. Factors associated with exercise adherence among older adults - An individual perspective. *Sports medicine.* Dec 1999;28(6):397-411.

32. Boyette LW, Lloyd A, Boyette JE, et al. Personal characteristics that influence exercise behavior of older adults. *J Rehabil Res Dev.* Jan-Feb 2002;39(1):95-103.

33. O'Connor CM, Whellan DJ, Lee KL, et al. Efficacy and safety of exercise training in patients with chronic heart failure: HF-ACTION randomized controlled trial. *JAMA.* Apr 8 2009;301(14):1439-1450.

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

35. Bjarnason-Wehrens B, McGee H, Zwisler AD, et al. Cardiac rehabilitation in Europe: results from the European Cardiac Rehabilitation Inventory Survey. *Eur J Cardiovasc Prev Rehabil.* Aug 2010;17(4):410-418.

36. Wise FM. Exercise based cardiac rehabilitation in chronic heart failure. *Aust Fam Physician.* 2007;36(12):1019-1024.

37. Fletcher GF, Balady GJ, Amsterdam EA, et al. Exercise standards for testing and training: a statement for healthcare professionals from the American Heart Association. *Circulation.* Oct 2 2001;104(14):1694-1740.

38. Song EK, Moser DK, Lennie TA. Relationship of Depressive Symptoms to the Impact of Physical Symptoms on Functional Status in Women with Heart Failure. *American Journal of Critical Care.* Jul 1 2009;18(4):348-356.

39. Zannad F, Stough WG, Pitt B, et al. Heart failure as an endpoint in heart failure and non-heart failure cardiovascular clinical trials: the need for a consensus definition. *Eur Heart J.* Feb 2008;29(3):413-421.

40. Boone-Heinonen J, Evenson KR, Taber DR, Gordon-Larsen P. Walking for prevention of cardiovascular disease in men and women: a systematic review of observational studies. *Obesity reviews : an official journal of the International Association for the Study of Obesity.* Mar 2009;10(2):204-217.

41. Holland R, Rechel B, Stepien K, Harvey I, Brooksby I. Patients' self-assessed functional status in heart failure by New York Heart Association class: a prognostic predictor of hospitalizations, quality of life and death. *Journal of cardiac failure.* Feb 2010;16(2):150-156.

42. Marwick TH, Zuchowski C, Lauer MS, Secknus MA, Williams MJ, Lytle BW. Functional status and quality of life in patients with heart failure undergoing coronary bypass surgery after assessment of myocardial viability. *J Am Coll Cardiol.* Mar 1 1999;33(3):750-758.

43. Hill JO, Wyatt HR, Reed GW, Peters JC. Obesity and the environment: Where do we go from here? *Science.* Feb 7 2003;299(5608):853-855.

44. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation.* Aug 28 2007;116(9):1081-1093.

45. Robeson S. *The Kentucky Behavioral Risk Factor Surveillance System.* Frankfort: Kentucky Department for Public Health; February 2001.

46. Hacker WD. *Kentucky Behavioral Risk Factor Surveillance System, 2003-2004 Report.* Frankfort: Kentucky Department for Public Health;2008.

47. Barnett E, Halverson J. Disparities in premature coronary heart disease mortality by region and urbanicity among black and white adults ages 35-64, 1985-1995. *Public health reports.* Jan-Feb 2000;115(1):52-64.

48. Carleton RA, Lasater TM, Assaf AR, Feldman HA, McKinlay S. The Pawtucket Heart Health Program: community changes in cardiovascular risk factors and projected disease risk. *American journal of public health.* Jun 1995;85(6):777-785.

49. Maruthur NM, Wang NY, Appel LJ. Lifestyle interventions reduce coronary heart disease risk: results from the PREMIER Trial. *Circulation.* Apr 21 2009;119(15):2026-2031.

50. Buchan DS, Ollis S, Thomas NE, Baker JS. Physical Activity Behaviour: An Overview of Current and Emergent Theoretical Practices. *Journal of Obesity.* 2012;2012:11.

51. Artinian NT, Fletcher GF, Mozaffarian D, et al. Interventions to promote physical activity and dietary lifestyle changes for cardiovascular risk factor reduction in adults: a scientific statement from the American Heart Association. *Circulation.* Jul 27 2010;122(4):406-441.

52. Murphy MH, Blair SN, Murtagh EM. Accumulated versus continuous exercise for health benefit: a review of empirical studies. *Sports medicine.* 2009;39(1):29-43.

53. Pate RR, Pratt M, Blair SN, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA : the journal of the American Medical Association.* Feb 1 1995;273(5):402-407.

54. Healy GN, Matthews CE, Dunstan DW, Winkler EAH, Owen N. Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003-06. *Eur Heart J.* Mar 2011;32(5):590-597.

55. Hu FB, Li TY, Colditz GA, Willett WC, Manson JE. Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. *JAMA : the journal of the American Medical Association.* Apr 9 2003;289(14):1785-1791.

56. Dunstan DW, Salmon J, Healy GN, et al. Association of television viewing with fasting and 2-h postchallenge plasma glucose levels in adults without diagnosed diabetes. *Diabetes care.* Mar 2007;30(3):516-522.

57. Pearson TA, Lewis C. Rural epidemiology: Insights from a rural population laboratory. *Am J Epidemiol.* Nov 15 1998;148(10):949-957.

58. Lewis C, Gadomski A, Nafziger A, et al. Insights from a Large Rural Population Laboratory: Health census '89 and '99. *Annals of Epidemiology.* Vol 102000:454 - 455.

59. Yates BC, Braklow-Whitton JL, Agrawal S. Outcomes of cardiac rehabilitation participants and nonparticipants in a rural area. *Rehabilitation nursing : the official journal of the Association of Rehabilitation Nurses.* Mar-Apr 2003;28(2):57-63.

60. The health of Kentucky. A county assessment. http://www.kyiom.org/assessment.html. Accessed July 7, 2009.

61. Department of Health and Human Services. *Chronic diseases: The leading causes of death in Kentucky.* Atlanta: Centers for Disease Control and Prevention;2004.

62. *Healthy People 2010.* Atlanta: Centers for Disease Control and Prevention;2000.

63. United States Department of Agriculture. Rural-Urban Commuting Area Codes. http://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx. Accessed July 7, 2012.

64. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* Sep 2001;16(9):606-613.

65. Derogatis LR, Melisaratos N. The Brief Symptom Inventory: an introductory report. *Psychol Med.* Aug 1983;13(3):595-605.

66. Moser DK, Dracup K. Is anxiety early after myocardial infarction associated with subsequent ischemic and arrhythmic events? *Psychosom Med.* Sep-Oct 1996;58(5):395-401.

67. Kim KA, Moser DK, Garvin BJ, et al. Differences between men and women in anxiety early after acute myocardial infarction. *Am J Crit Care.* Jul 2000;9(4):245-253.

68. Moser DK, Dracup K, McKinley S, et al. An international perspective on gender differences in anxiety early after acute myocardial infarction. *Psychosom. Med.* Jul-Aug 2003;65(4):511-516.

69. Gibson CH. A revised conceptualization of social support. *J Clin Nurs.* 1992;1(3):147-152.

70. Evangelista LS, Berg J, Dracup K. Relationship between psychosocial variables and compliance in patients with heart failure. *Heart Lung.* Jul-Aug 2001;30(4):294-301.

71. Canty-Mitchell J, Zimet GD. Psychometric properties of the Multidimensional Scale of Perceived Social Support in urban adolescents. *American journal of community psychology.* Jun 2000;28(3):391-400.

72. Shen L, Condit CM, Wright L. The psychometric property and validation of a fatalism scale. *Psychology & health.* Jun 2009;24(5):597-613.

73. Baker DW, Williams MV, Parker RM, Gazmararian JA, Nurss J. Development of a brief test to measure functional health literacy. *Patient education and counseling.* Sep 1999;38(1):33-42.

74. Katz JN, Chang LC, Sangha O, Fossel AH, Bates DW. Can comorbidity be measured by questionnaire rather than medical record review? *Med Care.* Jan 1996;34(1):73-84.

75. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J. Chronic Dis.* 1987;40(5):373-383.

76. Patterson SM, Krantz DS, Montgomery LC, Deuster PA, Hedges SM, Nebel LE. Automated physical activity monitoring: validation and comparison with physiological and self-report measures. *Psychophysiology.* May 1993;30(3):296-305.

77. Puyau MR, Adolph AL, Vohra FA, Butte NF. Validation and calibration of physical activity monitors in children. *Obesity research.* Mar 2002;10(3):150-157.

78. Zvolensky MJ, Smits JA. *Anxiety in health behaviors and physical illness*. New York: Springer; 2008.

79. Thompson DR, Lewin RJ. Coronary disease. Management of the post-myocardial infarction patient: rehabilitation and cardiac neurosis. *Heart.* Jul 2000;84(1):101-105.

80. Hadjistavropoulos H, Lawrence B. Does anxiety about health influence eating patterns and shape-related body checking among females? *Personality and Individual Differences.* Jul 2007;43(2):319-328.

81. Longley SL, Watson D, Noyes Jr R. Assessment of the hypochondriasis domain: the multidimensional inventory of hypochondriacal traits (MIHT). *Psychol Assess.* Mar 2005;17(1):3-14.

82. Olatunji BO, Deacon BJ, Abramowitz JS. Is hypochondriasis an anxiety disorder? *The British Journal of Psychiatry.* June 1, 2009 2009;194(6):481-482.

83. Emmons KM, Linnan LA, Shadel WG, Marcus B, Abrams DB. The Working Healthy Project: a worksite health-promotion trial targeting physical activity, diet, and smoking. *J Occup Environ Med.* Jul 1999;41(7):545-555.

84. Yohannes AM, Yalfani A, Doherty P, Bundy C. Predictors of drop-out from an outpatient cardiac rehabilitation programme. *Clinical Rehabilitation.* Mar 2007;21(3):222-229.

85. Casey E, Hughes JW, Waechter D, Josephson R, Rosneck J. Depression predicts failure to complete phase-II cardiac rehabilitation. *Journal of Behavioral Medicine.* Oct 2008;31(5):421-431.

86. Doolan-Noble F, Broad J, Riddell T, North D. Cardiac rehabilitation services in New Zealand: access and utilisation. *N Z Med J.* Jul 9 2004;117(1197):U955.

87. Groeneveld IF, Proper KI, van der Beek AJ, Hildebrandt VH, van Mechelen W. Factors associated with non-participation and drop-out in a lifestyle intervention for workers with an elevated risk of cardiovascular disease. *The international journal of behavioral nutrition and physical activity.* 2009;6:80.

88. Mosca L, Mochari-Greenberger H, Dolor RJ, Newby LK, Robb KJ. Twelve-year follow-up of American women's awareness of cardiovascular disease risk and barriers to heart health. *Circ Cardiovasc Qual Outcomes.* Mar 2010;3(2):120-127.

89. Sorensen K, Van den Broucke S, Fullam J, et al. Health literacy and public health: a systematic review and integration of definitions and models. *BMC Public Health.* 2012;12:80.

90. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med.* Jul 19 2011;155(2):97-107.

91. Mausbach BT, Patterson TL, von Kanel R, et al. The moderating effect of personal mastery on the relations between stress and plasminogen activator inhibitor-1 (PAI-1) antigen. *Health Psychology.* Mar 2008;27(2):S172-S179.

92. Paasche-Orlow MK, Wolf MS. The causal pathways linking health literacy to health outcomes. *Am J Health Behav.* Sep-Oct 2007;31 Suppl 1:S19-26.

93. Howard DH, Gazmararian J, Parker RM. The impact of low health literacy on the medical costs of Medicare managed care enrollees. *Am J Med.* Apr 2005;118(4):371-377.

94. Wells KB, Golding JM, Burnam MA. Psychiatric-Disorder in a Sample of the General-Population with and without Chronic Medical Conditions. *Am J Psychiat.* Aug 1988;145(8):976-981.

95. Moser DK, Dracup K, Evangelista LS, et al. Comparison of prevalence of symptoms of depression, anxiety, and hostility in elderly patients with heart failure, myocardial infarction, and a coronary artery bypass graft. *Heart Lung.* Sep-Oct 2010;39(5):378-385.

96. Walters-Salas T. The Challenge of Patient Adherence. *Bariat Nurs Surg Pat.* Dec 2012;7(4):186-186.

97. Berlin JE, Storti KL, Brach JS. Using activity monitors to measure physical activity in free-living conditions. *Phys Ther.* Aug 2006;86(8):1137-1145.

98. Lloyd-Jones D, Adams RJ, Brown TM, et al. Heart disease and stroke statistics--2010 update: a report from the American Heart Association. *Circulation.* Feb 23 2010;121(7):e46-e215.

99. Hunt SA, Abraham WT, Chin MH, et al. ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure): developed in collaboration with the American College of Chest Physicians and the International Society for Heart and Lung Transplantation: endorsed by the Heart Rhythm Society. *Circulation.* Sep 20 2005;112(12):e154-235.

100. Evangelista LS, Dracup K, Doering LV. Treatment-seeking delays in heart failure patients. *J. Heart Lung Transplant.* Oct 2000;19(10):932-938.

101. Avery CL, Mills KT, Chambless LE, et al. Long-term association between self-reported signs and symptoms and heart failure hospitalizations: the Atherosclerosis Risk In Communities (ARIC) Study. *Eur J Heart Fail.* Mar 2010;12(3):232-238.

102. Burns RB, McCarthy EP, Moskowitz MA, Ash A, Kane RL, Finch M. Outcomes for older men and women with congestive heart failure. *J. Am. Geriatr. Soc.* Mar 1997;45(3):276-280.

103. Taylor A. Physiological response to a short period of exercise training in patients with chronic heart failure. *Physiother Res Int.* 1999;4(4):237-249.

104. Leon AS, Franklin BA, Costa F, et al. Cardiac rehabilitation and secondary prevention of coronary heart disease: an American Heart Association scientific statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity), in collaboration with the American association of Cardiovascular and Pulmonary Rehabilitation. *Circulation.* Jan 25 2005;111(3):369-376.

105. Tod AM, Wadsworth E, Asif S, Gerrish K. Cardiac rehabilitation: the needs of South Asian cardiac patients. *Br J Nurs.* Sep 13-26 2001;10(16):1028-1033.

106. De Vos C, Li X, Van Vlaenderen I, et al. Participating or not in a cardiac rehabilitation programme: factors influencing a patient's decision. *European Journal of Preventive Cardiology.* Jan 20 2012.

107. Evenson KR, Fleury J. Barriers to outpatient cardiac rehabilitation participation and adherence. *J Cardiopulm Rehabil.* Jul-Aug 2000;20(4):241-246.

108. De Angelis C, Bunker S, Schoo A. Exploring the barriers and enablers to attendance at rural cardiac rehabilitation programs. *Australian Journal of Rural Health.* Jun 2008;16(3):137-142.

109. Sarrafzadegan N, Rabiei K, Shirani S, Kabir A, Mohammadifard N, Roohafza H. Drop-out predictors in cardiac rehabilitation programmes and the impact of sex differences among coronary heart disease patients in an Iranian sample: a cohort study. *Clinical Rehabilitation.* Apr 2007;21(4):362-372.

110. Lane D, Carroll D, Ring C, Beevers DG, Lip GYH. Predictors of attendance at cardiac rehabilitation after myocardial infarction. *Journal of psychosomatic research.* Sep 2001;51(3):497-501.

111. Ramm C, Robinson S, Sharpe N. Factors determining non-attendance at a cardiac rehabilitation programme following myocardial infarction. *New Zealand Medical Journal.* May 25 2001;114(1132):227-229.

112. Cooper AF, Weinman J, Hankins M, Jackson G, Horne R. Assessing patients' beliefs about cardiac rehabilitation as a basis for predicting attendance after acute myocardial infarction. *Heart.* Jan 2007;93(1):53-58.

113. Farley RL, Wade TD, Birchmore L. Factors Influencing Attendance at Cardiac Rehabilitation among Coronary Heart Disease Patients. *European Journal of Cardiovascular Nursing.* September 1, 2003 2003;2(3):205-212.

114. Deskur-Smielecka E, Borowicz-Bienkowska S, Brychcy A, Wilk M, Przywarska I, Dylewicz P. Why patients after acute coronary syndromes do not participate in an early outpatient rehabilitation programme? *Kardiologia Polska.* Jun 2009;67(6):632-638.

115. Dunlay SM, Witt BJ, Allison TG, et al. Barriers to participation in cardiac rehabilitation. *Am Heart J.* Nov 2009;158(5):852-859.

116. Ali M, Qadir F, Javed S, Khan ZN, Asad S, Hanif B. Factors affecting outpatient cardiac rehabilitation attendance after acute myocardial infarction and coronary revascularization--a local experience. *J Pak Med Assoc.* Apr 2012;62(4):347-351.

117. Parashar S, Spertus JA, Tang F, et al. Predictors of Early and Late Enrollment in Cardiac Rehabilitation, Among Those Referred, After Acute Myocardial

Infarction / Clinical Perspective. *Circulation.* September 25, 2012 2012;126(13):1587-1595.

118. Gallagher R, McKinley S, Dracup K. Predictors of women's attendance at cardiac rehabilitation programs. *Prog Cardiovasc Nurs.* 2003;18(3):121-126.

119. Johnson JE, Weinert C, Richardson JK. Rural residents' use of cardiac rehabilitation programs. *Public Health Nursing.* Aug 1998;15(4):288-296.

120. Sanderson BK, Shewchulk RM, Bittner V. Cardiac Rehabilitation and Women WHAT KEEPS THEM AWAY? *J Cardiopulm Rehabil Prev.* Jan-Feb 2010;30(1):12-21.

121. Husak LN, Lin ZQ, Mattera J, Roumanis S, Krumholz HM, Vaccarino V. Social support as a predictor of participation in cardiac rehabilitation after coronary artery bypass graft. *Journal of the American College of Cardiology.* Mar 19 2003;41(6):522a-522a.

122. Worcester MU, Murphy BM, Mee VK, Roberts SB, Goble AJ. Cardiac rehabilitation programmes: predictors of non-attendance and drop-out. *Eur J Cardiovasc Prev Rehabil.* Aug 2004;11(4):328-335.

123. King KM, Humen DP, Smith HL, Phan CL, Teo KK. Psychosocial components of cardiac recovery and rehabilitation attendance. *Heart.* Mar 2001;85(3):290-294.

124. Cooper A, Lloyd G, Weinman J, Jackson G. Why patients do not attend cardiac rehabilitation: role of intentions and illness beliefs. *Heart.* August 1, 1999 1999;82(2):234-236.

125. Grace SL, Gravely-Witte S, Brual J, et al. Contribution of patient and physician factors to cardiac rehabilitation enrollment: a prospective multilevel study.

European Journal of Cardiovascular Prevention & Rehabilitation. Oct 2008;15(5):548-556.

126. Grace SL, Gravely-Witte S, Kayaniyil S, Brual J, Suskin N, Stewart DE. A multisite examination of sex differences in cardiac rehabilitation barriers by participation status. *J Womens Health (Larchmt).* Feb 2009;18(2):209-216.

127. Grace SL, Shanmugasegaram S, Gravely-Witte S, Brual J, Suskin N, Stewart DE. Barriers to cardiac rehabilitation: DOES AGE MAKE A DIFFERENCE? *J Cardiopulm Rehabil Prev.* May-Jun 2009;29(3):183-187.

128. Brual J, Gravely-Witte S, Suskin N, Stewart DE, Macpherson A, Grace SL. Drive time to cardiac rehabilitation: at what point does it affect utilization? *International Journal of Health Geographics.* Jun 4 2010;9.

129. King KM, Humen DP, Smith HL, Phan CL, Teo KK. Predicting and explaining cardiac rehabilitation attendance. *Canadian Journal of Cardiology.* Mar 2001;17(3):291-296.

130. Melville MR, Packham C, Brown N, Weston C, Gray D. Cardiac rehabilitation: socially deprived patients are less likely to attend but patients ineligible for thrombolysis are less likely to be invited. *Heart.* September 1, 1999 1999;82(3):373-377.

131. Eberhardt MS, Pamuk ER. The importance of place of residence: examining health in rural and nonrural areas. *Am J Public Health.* Oct 2004;94(10):1682-1686.

132. Grace SL, Abbey SE, Shnek ZM, Irvine J, Franche RL, Stewart DE. Cardiac rehabilitation II: referral and participation. *General Hospital Psychiatry.* May-Jun 2002;24(3):127-134.

133. Missik E. Women and cardiac rehabilitation: accessibility issues and policy recommendations. *Rehabil Nurs.* Jul-Aug 2001;26(4):141-147.

134. Harlan WR, 3rd, Sandler SA, Lee KL, Lam LC, Mark DB. Importance of baseline functional and socioeconomic factors for participation in cardiac rehabilitation. *Am J Cardiol.* Jul 1 1995;76(1):36-39.

135. Allen JK, Scott LB, Stewart KJ, Young DR. Disparities in women's referral to and enrollment in outpatient cardiac rehabilitation. *J Gen Intern Med.* Jul 2004;19(7):747-753.

136. Lieberman L, Meana M, Stewart D. Cardiac rehabilitation: gender differences in factors influencing participation. *J Womens Health.* Aug 1998;7(6):717-723.

137. DiMatteo MR. Social support and patient adherence to medical treatment: a meta-analysis. *Health Psychology.* Mar 2004;23(2):207-218.

138. Woods NF, Yates BC, Primomo J. Supporting families during chronic illness. *Image J Nurs Sch.* Spring 1989;21(1):46-50.

139. Mochari H, Lee JR, Kligfield P, Mosca L. Ethnic differences in barriers and referral to cardiac rehabilitation among women hospitalized with coronary heart disease. *Prev Cardiol.* Winter 2006;9(1):8-13.

140. Banerjee AT, Grace SL, Thomas SG, Faulkner G. Cultural factors facilitating cardiac rehabilitation participation among Canadian South Asians: A qualitative study. *Heart Lung.* Nov-Dec 2010;39(6):494-503.

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

142. Schoner P, Horstkotte D, Piper C. [Are Psychological Symptoms in Patients with Heart Failure Influenced by Improvement of Cardiological Treatment?]. *Psychotherapie, Psychosomatik, medizinische Psychologie.* Mar 8 2013.

143. Thompson DR, Lewin RJP. Management of the post-myocardial infarction patient: rehabilitation and cardiac neurosis. *Heart.* July 1, 2000 2000;84(1):101-105.

144. CARNEY RM, FREEDLAND KE. Depression and heart rate variability in patients with coronary heart disease. *Cleveland Clinic journal of medicine.* April 1, 2009 2009;76(Suppl 2):S13-S17.

145. Allan JL, Johnston DW, Johnston M, Mant D. Depression and perceived behavioral control are independent predictors of future activity and fitness after coronary syndrome events. *Journal of psychosomatic research.* Nov 2007;63(5):501-508.

146. Lane D, Carroll D, Ring C, Beevers DG, Lip GYH. In-hospital symptoms of depression do not predict mortality 3 years after myocardial infarction. *International Journal of Epidemiology.* December 1, 2002 2002;31(6):1179-1182.

147. Lau-Walker M. Importance of illness beliefs and self-efficacy for patients with coronary heart disease. *J Adv Nurs.* Oct 2007;60(2):187-198.

148. Lau-Walker M. Predicting self-efficacy using illness perception components: A patient survey. *British Journal of Health Psychology.* Nov 2006;11:643-661.

149. Stenstrom U, Nilsson AK, Stridh C, et al. Denial in patients with a first-time myocardial infarction: relations to pre-hospital delay and attendance to a cardiac rehabilitation programme. *Eur J Cardiovasc Prev Rehabil.* Dec 2005;12(6):568-571.

150. Smith KM, Harkness K, Arthur HM. Predicting cardiac rehabilitation enrollment: the role of automatic physician referral. *Eur J Cardiovasc Prev Rehabil.* 2006;13(1):60-66.

151. Parker K, Stone JA, Arena R, et al. An Early Cardiac Access Clinic Significantly Improves Cardiac Rehabilitation Participation and Completion Rates in Low-Risk ST-Elevation Myocardial Infarction Patients. *Canadian Journal of Cardiology.* Sep-Oct 2011;27(5):619-627.

152. Supino PG, Borer JS, Herrold EM, Hochreiter C. Prognostication in 3-vessel coronary artery disease based on left ventricular ejection fraction during exercise : influence of coronary artery bypass grafting. *Circulation.* Aug 31 1999;100(9):924-932.

153. Curtis JP, Sokol SI, Wang Y, et al. The association of left ventricular ejection fraction, mortality, and cause of death in stable outpatients with heart failure. *Journal of the American College of Cardiology.* Aug 20 2003;42(4):736-742.

154. Sallis JF, Saelens BE. Assessment of physical activity by self-report: status, limitations, and future directions. *Res Q Exerc Sport.* Jun 2000;71(2 Suppl):S1-14.

155. Marcus BH, Simkin LR, Rossi JS, Pinto BM. Longitudinal shifts in employees' stages and processes of exercise behavior change. *Am J Health Promot.* Jan-Feb 1996;10(3):195-200.

156. Prochaska JO, DiClemente CC. Self change processes, self efficacy and decisional balance across five stages of smoking cessation. *Progress in clinical and biological research.* 1984;156:131-140.

157. Marcus BH, Selby VC, Niaura RS, Rossi JS. Self-efficacy and the stages of exercise behavior change. *Res Q Exerc Sport.* Mar 1992;63(1):60-66.

158. Marcus BH, Simkin LR. The transtheoretical model: applications to exercise behavior. *Med Sci Sports Exerc.* Nov 1994;26(11):1400-1404.

159. Kim YH. Korean adolescents' exercise behavior and its relationship with psychological variables based on stages of change model. *J Adolesc Health.* Jun 2004;34(6):523-530.

160. Spencer L, Adams TB, Malone S, Roy L, Yost E. Applying the transtheoretical model to exercise: a systematic and comprehensive review of the literature. *Health promotion practice.* Oct 2006;7(4):428-443.

161. Zambroski CH, Moser DK, Bhat G, Ziegler C. Impact of symptom prevalence and symptom burden on quality of life in patients with heart failure. *Eur J Cardiovasc Nurs.* Sep 2005;4(3):198-206.

162. Sokos GG, Nikolaidis LA, Mankad S, Elahi D, Shannon RP. Glucagon-like peptide-1 infusion improves left ventricular ejection fraction and functional status in patients with chronic heart failure. *J Card Fail.* Dec 2006;12(9):694-699.

163. Paraskevaidis IA, Tsiapras DP, Adamopoulos S, Kremastinos DT. Assessment of the functional status of heart failure in non ischemic dilated cardiomyopathy: an echo-dobutamine study. *Cardiovasc Res.* Jul 1999;43(1):58-66.

164. Vandenbroek SAJ, Vanveldhuisen DJ, Degraeff PA, Landsman MLJ, Hillege H, Lie KI. Comparison between New-York Heart Association Classification and Peak Oxygen-Consumption in the Assessment of Functional Status and Prognosis in Patients with Mild to Moderate Chronic Congestive-Heart-Failure Secondary to Either Ischemic or Idiopathic Dilated Cardiomyopathy. *American Journal of Cardiology.* Aug 1 1992;70(3):359-363.

165. Radauceanu A, Ducki C, Virion JM, et al. Extracellular matrix turnover and inflammatory markers independently predict functional status and outcome in chronic heart failure. *J Card Fail.* Aug 2008;14(6):467-474.

166. Rao A, Asadi-Lari M, Walsh J, Wilcox R, Gray D. Quality of life in patients with signs and symptoms of heart failure - Does systolic function matter? *J Card Fail.* Dec 2006;12(9):677-683.

167. Riedinger MS, Dracup KA, Brecht ML, et al. Quality of life in patients with heart failure: Do gender differences exist? *Heart & Lung.* Mar-Apr 2001;30(2):105-116.

168. Miller-Davis C, Marden S, Leidy NK. The New York Heart Association Classes and functional status: What are we really measuring? *Heart & Lung.* Jul-Aug 2006;35(4):217-224.

169. Bierman AS. Functional status: the six vital sign. *J Gen Intern Med.* Nov 2001;16(11):785-786.

170. Fonarow GC, Stevenson LW, Walden JA, et al. Impact of a comprehensive heart failure management program on hospital readmission and functional status of patients with advanced heart failure. *J Am Coll Cardiol.* Sep 1997;30(3):725-732.

171. Hogenhuis J, Jaarsma T, Voors AA, van Veldhuisen DJ. BNP and functional status in heart failure. *Cardiovasc Drugs Ther.* Nov 2004;18(6):507; author reply 509.

172. Xie GY, Berk MR, Smith MD, DeMaria AN. Relation of Doppler transmitral flow patterns to functional status in congestive heart failure. *Am Heart J.* Apr 1996;131(4):766-771.

173. Llorens P, Perello R, Martin-Sanchez FJ, Herrero P. Functional status as risk factor for mortality in patients with acute heart failure at the emergency department. *Med Clin-Barcelona.* Oct 17 2009;133(14):566-567.

174. Correia J, Silva FF, Roque C, Vieira H, Providencia LA. Impact of a specialized outpatient heart failure follow-up program on hospitalization frequency and functional status of patients with advanced heart failure. *Rev Port Cardiol.* Apr 2007;26(4):335-343.

175. Corvera-Tindel T, Doering LV, Woo MA, Khan S, Dracup K. Effects of a home walking exercise program on functional status and symptoms in heart failure. *American heart journal.* Feb 2004;147(2):339-346.

176. Marwick TH, Zuchowski C, Lauer MS, Secknus MA, Williams J, Lytle BW. Functional status and quality of life in patients with heart failure undergoing coronary bypass surgery after assessment of myocardial viability. *J Am Coll Cardiol.* Mar 1999;33(3):750-758.

177. Paraskevaidis IA, Dodouras T, Adamopoulos S, Kremastinos DT. Effects of dobutamine on left ventricular shape and geometry: an easy way to detect the functional status of chronic heart failure in patients with dilated cardiomyopathy. *J Am Soc Echocardiogr.* Feb 2003;16(2):132-139.

178. Chinaglia A, Gaschino G, Asteggiano R, et al. [Impact of a nurse-based heart failure management program on hospitalization rate, functional status, quality of life, and medical costs]. *Ital Heart J Suppl.* May 2002;3(5):532-538.

179. Kostis JB, Rosen RC, Cosgrove NM, Shindler DM, Wilson AC. Nonpharmacologic therapy improves functional and emotional status in congestive heart failure. *Chest.* Oct 1994;106(4):996-1001.

180. Evangelista LS, Heber D, Li Z, Bowerman S, Hamilton MA, Fonarow GC. Reduced body weight and adiposity with a high-protein diet improves functional status, lipid profiles, glycemic control, and quality of life in patients with heart failure: a feasibility study. *J Cardiovasc Nurs.* May-Jun 2009;24(3):207-215.

181. Yeh GY, Wood MJ, Lorell BH, et al. Effects of tai chi mind-body movement therapy on functional status and exercise capacity in patients with chronic heart failure: a randomized controlled trial. *Am J Med.* Oct 15 2004;117(8):541-548.

182. Maisel AS, Koon J, Krishnaswamy P, et al. Utility of B-natriuretic peptide as a rapid, point-of-care test for screening patients undergoing echocardiography to determine left ventricular dysfunction. *Am Heart J.* Mar 2001;141(3):367-374.

183. Cheng V, Kazanagra R, Garcia A, et al. A rapid bedside test for B-type peptide predicts treatment outcomes in patients admitted for decompensated heart failure: a pilot study. *J Am Coll Cardiol.* Feb 2001;37(2):386-391.

184. Koglin J, Pehlivanli S, Schwaiblmair M, Vogeser M, Cremer P, vonScheidt W. Role of brain natriuretic peptide in risk stratification of patients with congestive heart failure. *J Am Coll Cardiol.* Dec 2001;38(7):1934-1941.

185. Yu CM, Sanderson JE. Plasma brain natriuretic peptide--an independent predictor of cardiovascular mortality in acute heart failure. *Eur J Heart Fail.* Mar 1999;1(1):59-65.

186. Jovicic A, Holroyd-Leduc JM, Straus SE. Effects of self-management intervention on health outcomes of patients with heart failure: a systematic review of randomized controlled trials. *BMC Cardiovasc Disord.* 2006;6:43.

187. Riegel B, Lee CS, Dickson VV. Self care in patients with chronic heart failure. *Nature reviews. Cardiology.* Nov 2011;8(11):644-654.

188. Riegel B, Dickson VV. A situation-specific theory of heart failure self-care. *J Cardiovasc Nurs.* May-Jun 2008;23(3):190-196.

189. Farkas J, Nabb S, Zaletel-Kragelj L, Cleland JG, Lainscak M. Self-rated health and mortality in patients with chronic heart failure. *Eur J Heart Fail.* May 2009;11(5):518-524.

190. Moser DK, Riegel B, McKinley S, Doering LV, An K, Sheahan S. Impact of anxiety and perceived control on in-hospital complications after acute myocardial infarction. *Psychosom Med.* Jan 2007;69(1):10-16.

191. Albert NM, Fonarow GC, Abraham WT, et al. Depression and clinical outcomes in heart failure: an OPTIMIZE-HF analysis. *Am J Med.* Apr 2009;122(4):366-373.

192. Weber M, Hamm C. Role of B-type natriuretic peptide (BNP) and NT-proBNP in clinical routine. *Heart.* Jun 2006;92(6):843-849.

193. Wang AY, Lam CW, Yu CM, et al. N-terminal pro-brain natriuretic peptide: an independent risk predictor of cardiovascular congestion, mortality, and adverse cardiovascular outcomes in chronic peritoneal dialysis patients. *J Am Soc Nephrol.* Jan 2007;18(1):321-330.

194. Moser DK, Watkins JF. Conceptualizing self-care in heart failure: a life course model of patient characteristics. *J Cardiovasc Nurs.* May-Jun 2008;23(3):205-218; quiz 219-220.

195. Riegel B, Carlson B. Facilitators and barriers to heart failure self-care. *Patient Educ Couns.* Apr 2002;46(4):287-295.

196. Riegel B, Carlson B, Moser DK, Sebern M, Hicks FD, Roland V. Psychometric testing of the self-care of heart failure index. *J Card Fail.* Aug 2004;10(4):350-360.

197. Carlson B, Riegel B, Moser DK. Self-care abilities of patients with heart failure. *Heart Lung.* Sep-Oct 2001;30(5):351-359.

198. Lee CS, Moser DK, Lennie TA, Riegel B. Event-free survival in adults with heart failure who engage in self-care management. *Heart Lung.* Jan-Feb 2011;40(1):12-20.

199. Torpy JM, Burke AE, Glass RM. JAMA patient page. Acute emotional stress and the heart. *Jama.* Jul 18 2007;298(3):360.

200. Penninx BW, Beekman AT, Honig A, et al. Depression and cardiac mortality: results from a community-based longitudinal study. *Arch Gen Psychiatry.* Mar 2001;58(3):221-227.

201. Havranek EP, Ware MG, Lowes BD. Prevalence of depression in congestive heart failure. *Am J Cardiol.* Aug 1 1999;84(3):348-350, A349.

202. Freedland KE, Rich MW, Skala JA, Carney RM, Davila-Roman VG, Jaffe AS. Prevalence of depression in hospitalized patients with congestive heart failure. *Psychosomatic medicine.* Jan-Feb 2003;65(1):119-128.

203. Rutledge T, Reis VA, Linke SE, Greenberg BH, Mills PJ. Depression in heart failure a meta-analytic review of prevalence, intervention effects, and associations with clinical outcomes. *J Am Coll Cardiol.* Oct 17 2006;48(8):1527-1537.

204. Gehi A, Haas D, Pipkin S, Whooley MA. Depression and medication adherence in outpatients with coronary heart disease: findings from the Heart and Soul Study. *Arch Intern Med.* Nov 28 2005;165(21):2508-2513.

205. Brummett BH, Babyak MA, Siegler IC, Mark DB, Williams RB, Barefoot JC. Effect of smoking and sedentary behavior on the association between depressive symptoms and mortality from coronary heart disease. *American Journal of Cardiology.* Sep 1 2003;92(5):529-532.

206. Luyster FS, Hughes JW, Gunstad J. Depression and Anxiety Symptoms Are Associated With Reduced Dietary Adherence in Heart Failure Patients Treated With an Implantable Cardioverter Defibrillator. *Journal of Cardiovascular Nursing.* Jan-Feb 2009;24(1):10-17.

207. Hunt SA. ACC/AHA 2005 guideline update for the diagnosis and management of chronic heart failure in the adult: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure). *Journal of the American College of Cardiology.* Sep 20 2005;46(6):e1-82.

208. van der Wal MH, Jaarsma T. Adherence in heart failure in the elderly: problem and possible solutions. *Int J Cardiol.* Apr 10 2008;125(2):203-208.

209. Falk K, Patel H, Swedberg K, Ekman I. Fatigue in patients with chronic heart failure - a burden associated with emotional and symptom distress. *Eur J Cardiovasc Nurs.* Jun 2009;8(2):91-96.

210. van der Wal MH, Jaarsma T, Moser DK, Veeger NJ, van Gilst WH, van Veldhuisen DJ. Compliance in heart failure patients: the importance of knowledge and beliefs. *Eur Heart J.* Feb 2006;27(4):434-440.

211. Allan JL, Johnston DW, Johnston M, Mant D. Depression and perceived behavioral control are independent predictors of future activity and fitness after coronary syndrome events. *Journal of Psychosomatic Research.* Nov 2007;63(5):501-508.

212. Whooley MA, de Jonge P, Vittinghoff E, et al. Depressive symptoms, health behaviors, and risk of cardiovascular events in patients with coronary heart disease. *JAMA : the journal of the American Medical Association.* Nov 26 2008;300(20):2379-2388.

213. Gottlieb SS, Kop WJ, Ellis SJ, et al. Relation of depression to severity of illness in heart failure (from Heart Failure And a Controlled Trial Investigating Outcomes of Exercise Training [HF-ACTION]). *Am J Cardiol.* May 1 2009;103(9):1285-1289.

214. Rose SK, Conn VS, Rodeman BJ. Anxiety and self-care following myocardial infarction. *Issues Ment Health Nurs.* Jul-Aug 1994;15(4):433-444.

215. Litt MD. Cognitive Mediators of Stressful Experience - Self-Efficacy and Perceived Control. *Cognitive Ther Res.* Jun 1988;12(3):241-260.

216. McKinley S, Fien M, Riegel B, et al. Complications after acute coronary syndrome are reduced by perceived control of cardiac illness. *J Adv Nurs.* Jan 11 2012.

217. Evangelista LS, Moser D, Dracup K, Doering L, Kobashigawa J. Functional status and perceived control influence quality of life in female heart transplant recipients. *J Heart Lung Transplant.* Mar 2004;23(3):360-367.

218. Heo S, Moser DK, Lennie TA, Riegel B, Chung ML. Gender differences in and factors related to self-care behaviors: a cross-sectional, correlational study of patients with heart failure. *Int J Nurs Stud.* Dec 2008;45(12):1807-1815.

219. Wallston KA, Wallston BS, Smith S, Dobbins CJ. Perceived Control and Health. *Curr Psychol Res Rev.* Spr 1987;6(1):5-25.

220. Smith-McLallen A, Fishbein M, Hornik RC. Psychosocial Determinants of Cancer-Related Information Seeking Among Cancer Patients. *J Health Commun.* 2011;16(2):212-225.

221. Johnson JL, Morse JM. Regaining control: the process of adjustment after myocardial infarction. *Heart Lung.* Mar 1990;19(2):126-135.

222. Dracup K, Westlake C, Erickson VS, Moser DK, Caldwell ML, Hamilton MA. Perceived control reduces emotional stress in patients with heart failure. *J Heart Lung Transplant.* Jan 2003;22(1):90-93.

223. Moser DK, Dracup K. Psychosocial recovery from a cardiac event: the influence of perceived control. *Heart Lung.* Jul-Aug 1995;24(4):273-280.

224. Idler EL, Kasl SV. Self-Ratings of Health - Do They Also Predict Change in Functional Ability. *J Gerontol B-Psychol.* Nov 1995;50(6):S344-S353.

225. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav.* Mar 1997;38(1):21-37.

226. Greenwood JLJ, Joy EA, Stanford JB. The Physical Activity Vital Sign: A Primary Care Tool to Guide Counseling for Obesity. *J Phys Act Health.* Sep 2010;7(5):571-576.

227. Olfson M, Gilbert T, Weissman M, Blacklow RS, Broadhead WE. Recognition of Emotional Distress in Physically Healthy Primary-Care Patients Who Perceive Poor Physical Health. *Gen Hosp Psychiat.* May 1995;17(3):173-180.

228. Wilcox VL, Kasl SV, Idler EL. Self-rated health and physical disability in elderly survivors of a major medical event. *J Gerontol B Psychol Sci Soc Sci.* Mar 1996;51(2):S96-104.

229. Tobiasz-Adamczyk B, Brzyski P. Gender-related differences in self-rating of health and functional status of elderly people with ischaemic heart disease.

Comparative study in 12-year period. *Central European journal of public health.* Dec 2002;10(4):163-168.

230. Herman DR, Solomons NW, Mendoza I, Qureshi AK. Self-rated health and its relationship to functional status and well-being in a group of elderly Guatemalan subjects. *Asia Pacific journal of clinical nutrition.* 2001;10(3):176-182.

231. Hoeymans N, Feskens EJM, Kromhout D, VandenBos GAM. Ageing and the relationship between functional status and self-rated health in elderly men. *Social Science & Medicine.* Nov 1997;45(10):1527-1536.

232. Corvera-Tindel T, Doering LV, Gomez T, Dracup K. Predictors of noncompliance to exercise training in heart failure. *J Cardiovasc Nurs.* Jul-Aug 2004;19(4):269-277; quiz 278-269.

233. Hinz A, Kittel J, Karoff M, Schwarz R. Age and sex dependencies of anxiety and depression in cardiologic patients compared with the general population. *Psychosoc Med.* 2004;1:Doc09.

234. Slagsvold B, Sorensen A. Age, education, and the gender gap in the sense of control. *Int J Aging Hum Dev.* 2008;67(1):25-42.

235. Mahler DA, Fierro-Carrion G, Baird JC. Evaluation of dyspnea in the elderly. *Clin Geriatr Med.* Feb 2003;19(1):19-+.

236. Cook AJ, Chastain DC. The classification of patients with chronic pain: age and sex differences. *Pain Res Manag.* Fall 2001;6(3):142-151.

237. Moser DK, Dracup K, Evangelista LS, et al. Comparison of prevalence of symptoms of depression, anxiety, and hostility in elderly patients with heart

failure, myocardial infarction, and a coronary artery bypass graft. *Heart Lung.* Sep-Oct 2010;39(5):378-385.

238. Yu ESH, Kean YM, Slymen DJ, Liu WT, Zhang MY, Katzman R. Self-perceived health and 5-year mortality risks among the elderly in Shanghai, China. *Am J Epidemiol.* May 1 1998;147(9):880-890.

239. Giron P. Determinants of self-rated health in Spain: differences by age groups for adults. *Eur J Public Health.* Feb 2012;22(1):36-40.

240. Ross CE, Mirowsky J. Households, Employment, and the Sense of Control. *Soc Psychol Quart.* Sep 1992;55(3):217-235.

241. Foraker RE, Rose KM, Chang PP, et al. Socioeconomic status and the trajectory of self-rated health. *Age Ageing.* Nov 2011;40(6):706-711.

242. Jun HJ, Subramanian SV, Gortmaker S, Kawachi I. A multilevel analysis of women's status and self-rated health in the United States. *J Am Med Womens Assoc.* Summer 2004;59(3):172-180.

243. Gottlieb SS, Khatta M, Friedmann E, et al. The influence of age, gender, and race on the prevalence of depression in heart failure patients. *J Am Coll Cardiol.* May 5 2004;43(9):1542-1549.

244. Song EK, Moser DK, Lennie TA. Relationship of depressive symptoms to the impact of physical symptoms on functional status in women with heart failure. *Am J Crit Care.* Jul 2009;18(4):348-356.

245. Fini A, de Almeida Lopes Monteiro da Cruz D. Characteristics of fatigue in heart failure patients: a literature review. *Rev Lat Am Enfermagem.* Jul-Aug 2009;17(4):557-565.

246. Plach SK, Heidrich SM, Jeske L. Fatigue representations in women with heart failure. *Res Nurs Health.* Oct 2006;29(5):452-464.

247. Sjoland H, Caidahl K, Karlson BW, Karlsson T, Herlitz J. Limitation of physical activity, dyspnea and chest pain before and two years after coronary artery bypass grafting in relation to sex. *Int J Cardiol.* Sep 19 1997;61(2):123-133.

248. Lim WY, Ma S, Heng D, Bhalla V, Chew SK. Gender, ethnicity, health behaviour & self-rated health in Singapore. *BMC Public Health.* 2007;7:184.

249. Thurston RC, Kubzansky LD, Kawachi I, Berkman LF. Do depression and anxiety mediate the link between educational attainment and CHD? *Psychosom Med.* Jan-Feb 2006;68(1):25-32.

250. Hlatky MA, Boineau RE, Higginbotham MB, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). *Am J Cardiol.* Sep 15 1989;64(10):651-654.

251. Heo S, Moser DK, Lennie TA, Riegel B, Chung ML. Gender differences in and factors related to self-care behaviors: a cross-sectional, correlational study of patients with heart failure. *Int J Nurs Stud.* Dec 2008;45(12):1807-1815.

252. Moser DK, Riegel B, McKinley S, et al. The Control Attitudes Scale-Revised: psychometric evaluation in three groups of patients with cardiac illness. *Nurs Res.* Jan-Feb 2009;58(1):42-51.

253. BNP FRAGMENT EIA. Enzyme Immunoassay for The Quantitative Determination of BNP Fragment in Human Serum, Citrate Plasma, Edta Plasma or Heparin Plasma. http://alpco.com/pdfs/04/04-BI-20852W.pdf. Accessed February 7, 2013.

254. Grachtrup S, Brugel M, Pankau H, Halank M, Wirtz H, Seyfarth HJ. Exercise Dependence of N-Terminal Pro-Brain Natriuretic Peptide in Patients with Precapillary Pulmonary Hypertension. *Respiration; international review of thoracic diseases.* Feb 11 2012.

255. Conraads VM, Beckers P, Vaes J, et al. Combined endurance/resistance training reduces NT-proBNP levels in patients with chronic heart failure. *Eur Heart J.* Oct 2004;25(20):1797-1805.

256. Vaccarino V, Kasl SV, Abramson J, Krumholz HM. Depressive symptoms and risk of functional decline and death in patients with heart failure. *J Am Coll Cardiol.* Jul 2001;38(1):199-205.

257. Luyster FS, Hughes JW, Gunstad J. Depression and anxiety symptoms are associated with reduced dietary adherence in heart failure patients treated with an implantable cardioverter defibrillator. *The Journal of cardiovascular nursing.* Jan-Feb 2009;24(1):10-17.

258. Craft LL, Perna FM. The Benefits of Exercise for the Clinically Depressed. *Prim Care Companion J Clin Psychiatry.* 2004;6(3):104-111.

259. Clark DO. The effect of walking on lower body disability among older blacks and whites. *American Journal of Public Health.* Jan 1996;86(1):57-61.

260. Corvera-Tindel T, Doering LV, Woo MA, Khan S, Dracup K. Effects of a home walking exercise program on functional status and symptoms in heart failure. *Am Heart J.* Feb 2004;147(2):339-346.

261. Tung HH, Jan MS, Lin CY, Chen SC, Huang HC. Mediating role of daily physical activity on quality of life in patients with heart failure. *J Cardiovasc Nurs.* Jan-Feb 2012;27(1):16-23.

262. Moser DK, Doering LV, Chung ML. Vulnerabilities of patients recovering from an exacerbation of chronic heart failure. *American heart journal.* Nov 2005;150(5):984

VITA

Education

2006	Master of Clinical Nursing University of Jordan Amman, JO
2001	Bachelor of Science in Nursing University of Jordan Amman, Jo

Professional Experience

2009 – Present	Research Assistant, University of Kentucky, College of Nursing, RICH Heart Program, Lexington, KY
2006 -2008	Teaching Assistant, University of Jordan, College of Nursing Amman, JO
2004 - 2006	Staff/Charge Nurse, University of Jordan Hospital, Medical Intensive Care Unit, Amman, JO
2002 - 2004	Staff Nurse, University of Jordan Hospital, Medical Intensive Care Unit, Amman, JO

Presentation

Saleh, Z. T., Lennie, T. A., Chung, M. L., Connell, A. R., Moser, D. K. (2012, February). *Self-rated Health Perception Predicts Coronary Heart Disease Risk Factors in Prison Inmates.* Poster presentation at the 26th Annual Southern Nursing Research Society Conference, New Orleans, LA.

Saleh, Z. T., Lennie, T. A., Chung, M. L., Connell, A. R., Moser, D. K. (2012, March). *Self-rated Health Perception Predicts Coronary Heart Disease Risk Factors in Prison Inmates.* Poster presentation at the 8th Annual College of Nursing Student Scholarship Showcase, Lexington, KY.

Saleh, Z. T., Lennie, T. A., Chung, M. L., Connell, A. R., Moser, D. K. (2012, March). *Self-rated Health Perception Predicts Coronary Heart Disease Risk Factors in Prison Inmates.* Poster presentation at the University of Kentucky Center for Clinical and Translational Science the 7th Annual Spring Conference, Lexington, KY.

Saleh, Z. T., Lennie, T. A., Chung, M. L, Connell, A., Moser, D. K. (2012, August). Self-Rated Health Perception Predicts Coronary Heart Disease Risk Factors in Prison Inmates. Poster presentation at the European Society of Cardiology Congress 2012, Germany, Munich.

Saleh, Z. T., Lennie, T. A., Moser, D. K, Chung, M. L., Novak, M. J. (2013, March). A Daily 15-minute of Moderate Intensity Activity Level Decreases Cardiovascular Disease Risk among Rural Appalachian. Oral presentation at the 9th Annual College of Nursing Student Scholarship Showcase, Lexington, KY.

Zyad Taher Saleh