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The Impact of Behavioral and Psychosocial Protective Factors on Health Outcomes in Heart
Failure Patients: A Structural Equation Model

by

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June 26, 2019

Title of Thesis: The Impact of Behavioral and Psychosocial Protective Factors on Health Outcomes in Heart Failure Patients: A Structural Equation Model

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Objective: Heart failure (HF) rates have continued to increase, despite decreases in the incidence of heart disease. In addition to health consequences of HF, it contributes a staggering financial cost to the individual, caregiver, and the broader health care. One significant component of the total cost and burden is frequent hospitalizations. HF research has suggested the importance of behavioral and psychological risk factors, but there has also been increased examination of protective factors that may reduce the progression of HF and improve overall prognosis. This study aims to determine if psychosocial or behavioral protective factors predict improved long-term health status and decreased hospitalizations in HF patients. The present study used a Structural Equation Model (SEM) approach to examine the impact of protective factors on outcomes in HF patients. **Method and Results:** This study is based on previously collected data from the Behavioral Triggers of Heart Failure (BETRHEART) study. One hundred and fifty participants were administered self-report measures on psychosocial (e.g., positive affect, optimism, self-efficacy, social support, coping styles), and behavioral variables (e.g., medication adherence, sleep quality, physical activity, adherence to a healthy diet), at the

baseline assessment and up to a total of 39 months. The Kansas City Cardiomyopathy Questionnaire (KCCQ) was also administered at the baseline and subsequent follow-up assessments to evaluate HF symptoms and health status. Data on hospitalizations were collected over the entire 39-month study period. SEM was conducted to determine whether the two theoretical factors “Psychosocial Protective Factor” and “Behavioral Protective Factor” predict hospitalizations and KCCQ health status at a 9-month and up to a 39-month follow-up. Results of a confirmatory factor analysis indicated some of the items/measures had low factor loadings and were removed based on model fit statistics. “Psychosocial Protective Factor” was comprised of significant items measuring positive affect, optimism, self-efficacy, acceptance-based coping, and coping through spirituality. Items for the “Behavioral Protective Factor” did not have adequate factor loadings, so Medication Adherence, Sleep Quality, and Adherence were retained as three separate behavioral factors. Next, the SEM results indicated that only the Psychosocial Protective Factor, but not the three behavioral factors, were predictive of short-term (9-month) KCCQ Clinical Summary scores. Neither the Psychosocial Protective Factor nor the three behavioral factors predicted longer-term (up to 39-months) effects. Additional analyses found that the POMS-Vigor-Activity subscale was the strongest predictor of short-term KCCQ Clinical Summary scores out of all of the psychosocial protective variables. **Discussion:** A construct representing psychosocial protective variables is predictive of relatively short-term self-reported health status, but neither health status nor hospitalizations at 39 months. In this study, behavioral factors were not a significant predictor of any of the measures of HF outcomes. This study suggests that fostering a combination of positive affect, optimism, self-efficacy, and adaptive coping styles may help reduce HF symptom burden and improve health status for at least up to 9 months.

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CHAPTER 1: INTRODUCTION

Heart disease typically describes a variety of conditions that impact the heart, to include myocardial infarction (i.e., heart attack) and heart failure (1). Although heart disease rates have decreased over the past several years, the disease is still highly associated with mortality and the development of additional conditions such as heart failure (2; 3). Heart failure (HF) is a “chronic, progressive condition in which the heart muscle is unable to pump enough blood through to meet the body's needs for blood and oxygen” (4), and its disease rates have only increased over the past several years (5). In addition to adverse consequences on health (e.g., increased fatigue), HF is also associated with high rates of mortality and hospitalizations (5). Additionally, the direct medical care cost of admissions and the indirect cost (e.g., loss of wages) place an economic burden on the individual, their caregiver, and the broader healthcare system (3). To improve prognosis and prevent individuals from ultimately developing HF, several common risk factors and protective factors have been identified.

The current study examined the interrelationship of various psychological, social, and behavioral protective factors and their influence on HF prognosis as determined by subsequent hospitalizations and self-reported health status. This introduction will first review the development of HF, the associated symptoms, and discuss identified risk factors. To gain a better understanding of potential factors that could prevent a diagnosis of HF or improve prognosis, aspects from positive psychology that focus on psychological, social and behavioral protective factors will also be reviewed. The study’s proposed Structural Equation Model (SEM), to further examine potential relationships between protective factors and HF outcomes, will then be presented and discussed.

HEART FAILURE ETIOLOGY AND SYMPTOMS

Cardiovascular disease (i.e., heart disease) is defined as a condition that impacts the heart and blood vessels and includes conditions such as coronary artery disease and heart failure (1). Although heart disease rates have seen a gradual decline, heart disease has remained the leading cause of death in the United States for the past 40 years (2; 3). The most common form of heart disease, coronary artery disease (CAD) or coronary heart disease (CHD), is caused by the gradual build-up of plaque in the arterial walls (6). The build-up of plaque (i.e., Atherosclerosis) within the arteries then contributes to either partial or complete blockage of blood to the heart and results in decreased oxygen flow (6). Atherosclerosis accounts for nearly all cases in the overall development of CHD (7).

Over time, the heart's inability to maintain sufficient oxygen due to complications from Atherosclerosis can cause the heart muscle to weaken or lead to the development of other cardiovascular conditions, such as heart failure (6). Due to the weakening of the heart, the heart muscle and surrounding vessels then attempt to compensate for the lack of sufficient oxygenated blood by either enlarging in size, increasing muscle mass, increasing heart rate, diverting blood from other organs, or by narrowing blood vessels (4).

HF can develop over time without the previous development of Atherosclerosis and CAD. While evaluating the development of HF, the disease is typically delineated into the categories of Ischemic or Non-Ischemic (8). Non-Ischemic describes HF that was developed due to factors such as an infection, immunological factors, hormonal factors or genetic factors (8; 9). The general prognosis of individuals diagnosed with Non-Ischemic HF tends to be better than those with Ischemic HF (9). Ischemic HF, which will be the focus of the current study, tends to

be caused by damage in the actual heart tissue after the development of CAD or myocardial infarctions (10).

Common identifying symptoms of HF include shortness of breath, persistent coughing, edema, daily fatigue during common everyday tasks, lack of appetite or nausea, impaired cognitive abilities, high blood pressure, and increased heart rate (11). To categorize HF severity and determine how much physical activity is being limited, HF patients are placed within one of four categories as defined by the New York Heart Association (12; 13). The least severe type, Class I, is characterized by individuals having no limitations in physical activity and no unexpected symptoms (e.g., shortness of breath) associated with physical activity (12). The most severe classification, Class IV, categorizes individuals by being unable to participate in physical activity without discomfort (12). Individuals within Class IV also experience symptoms of HF during rest, such as shortness of breath and increased heart rate, with an increase in symptoms after initiating physical activity (12).

Due to the etiology of the development of HF, the heart's ability to pump blood (i.e., ejection fraction) is also utilized to classify various types of heart disease (14). An ejection fraction percentage less than 40%, which indicates less than 40% of the blood within the left ventricle is being pumped out with each contraction, is considered to be consistent with a diagnosis of HF (14). HF can then be further classified by the side of the heart that is being impacted, with Systolic Heart Failure (i.e., reduced ejection fraction) and Diastolic Heart Failure most often being associated with the left ventricle (13). Right-sided HF can also occur but is often a result of damage due to left-sided HF or due to severe lung disease, and it subsequently causes edema from a reduced ability to pump blood that creates an overall buildup of fluid (15).

During Diastolic HF (most often associated with the left side of the heart and the left ventricle), the heart muscles are able to contract normally but have diminished ability to relax and fill with blood (14). During diastolic HF, the heart attempts to increase cardiac output by increasing in size but it then decreases the size of the ventricles (15). The heart is then prevented from having adequate blood flow due to impaired ability to relax the cardiac muscle and re-fill the chambers of the heart (15). The restrictive cardiomyopathy causes the heart muscle to become more stiff and unable to stretch to fill with as much blood (15). The decrease in blood in the heart then causes inflammation and edema throughout the body (15). Systolic HF refers to the heart muscle being unable to contract efficiently due to the death of cardiomyocytes (i.e., heart muscle) (14). Systolic HF is typically caused by chronic hypertension which causes increased arterial pressure and then weakened the heart muscle (14). The weakened heart muscle then causes weaker ventricular contractions and increases the demand of oxygen (14). Cardiomyocytes (i.e., cardiac muscle cells) can die following ischemia (i.e., inadequate blood supply) or myocardial infarctions (i.e., obstruction of blood supply to the heart which often leads to tissue death) (15). During Systolic HF, the heart subsequently increases in size to compensate and the heart muscle has a reduced ability contract (15). The following sections will describe more explicitly the greater financial and health impacts of HF on individuals and the overall healthcare system.

Heart Failure Prevalence and Costs

Although heart disease prevalence rates have begun to decrease, HF rates have shown a increase in the past several years (5). There are approximately 960,000 individuals with HF identified each year through hospitalizations and deaths, but this number does not account for individuals living with HF that have not been diagnosed yet (5). Additionally, approximately 13

million individuals within the United States have been diagnosed with the broader category of CHD (7). As stated previously, the development of CHD can lead to HF over time. Although survival rates for those diagnosed with HF have improved, mortality rates are still considered to be relatively high with as many as 50% of individuals dying within 5 years of receiving a diagnosis (5).

As briefly discussed previously, HF and CHD additionally place an economic burden on both the individual patients and caregivers. From 2011-2012, total costs associated with cardiovascular disease and stroke were estimated to be as high as \$316.6 billion and projected to increase further (5). By the year 2030, annual direct medical costs due to cardiovascular diseases are expected to be over \$818 billion (16). The majority of costs associated with cardiovascular diseases are categorized as direct costs, with hospitalization services and medications being a major component. Hospitalization costs for heart related procedures have only increased in the past decade, to include cardiac pacemaker insertion and heart valve repair (2). Indirect costs of HF, such as loss of productivity, are also expected to rise over \$275 billion annually within the United States by 2030 (16).

Furthermore, frequent hospitalizations increase the total cost associated with HF. From 2000 to 2010, there were an estimated one million hospitalizations for congestive HF, with the number of admissions for those under age 65 showing the most substantial increase (17). The odds of being re-hospitalized after an initial discharge have also remained high. As many as 61.3% of HF patients are re-admitted to the hospital within the first year after discharged, and as high as 66.5% of patients reported experiencing a cardiac-related event after being discharged (18). 61% of HF patients, in 2007-2009, were re-admitted to the hospital for a month within

fifteen days after initially being discharged (19). Hospitalization rates of HF patients are only expected to rise due to the increasing aging population and general improvements in healthcare over time (20). Recurrent hospitalizations not only further place an economic burden on the HF patient but also upon the healthcare system (18; 21).

Due to high admission and re-admission rates, causes for overall hospitalizations in HF patients have been explored. The majority of admissions reported by HF patients are due to the primary diagnosis of HF and associated cardiac concerns (22). Although hospitalization for a condition may seem like a beneficial outcome to enhance treatment, the high number of hospitalizations experienced by HF patients is also associated with worsening HF symptoms and mortality (23). Although hospitalizations due to HF have declined over time, hospitalizations due to a non-cardiac related co-occurring condition (e.g., renal failure, infection, injury, pulmonary disease, etc.) with a secondary diagnosis of HF have persisted (24). Furthermore, approximately half of patients with HF believe their hospitalization is due to treatment nonadherence (e.g., healthy eating behaviors, medication compliance, fluid restriction, etc.) and a lack of sufficient information about their condition (25; 26). This relatively large percentage of HF patients reporting their belief that their hospitalization is related to treatment nonadherence shows that interventions to improve these factors may improve overall prognosis.

ASSOCIATED RISK FACTORS FOR HEART DISEASE

To identify HF earlier and prevent an increase in severity, several different risk factors have been recognized for their potential contribution to the etiology of the disease. Extensive reviews have suggested that there are both modifiable and non-modifiable factors associated with the development of heart disease, and consequently HF (27). Non-modifiable risk factors, and

often categorized as standard risk factors, of developing heart disease have included: age, biological sex, and race (27; 28).

When considering potential risk factors for the development of heart disease, Low-density cholesterol (LDL), hypertension, diabetes, a history of smoking, and advanced age (i.e., post-menopausal for women, older than age 45 for men) are typically discussed as standard risk factors (29). Although factors such as perceived stress and low social support have also been considered as potential risk factors of developing heart disease (30; 31), standard risk factors will be further explored first.

Standard Risk Factors

Demographic Factors

There are a few demographic factors, such as age, sex, and race, which have been identified as standard risks for heart disease prevalence. Although heart disease and other heart conditions can occur at any age, heart disease is the most prevalent among adults over the age of 45 (2; 29). The risk for the development of heart disease is also higher overall among males, with the highest risk being seen while combined with other risk factors, such as diabetes and a history of smoking (2). The overall risk of developing heart disease only increases with age, with factors such as cholesterol, history of smoking, diagnosis of diabetes, and hypertension commonly being associated with an increased likelihood of diagnosis (32).

In comparison to Caucasians, African American (i.e., Black) males and females have had higher incidences of myocardial infarctions, elevated blood pressure, and hypertension (2). These higher rates are believed to be in part due to some physiological differences seen between Caucasians and Africans, such as; greater salt sensitivity and higher rates of left ventricular hypertrophy (33). The impact of cholesterol in individuals in regards to HF development and

prognosis has also been explored. There have been mixed findings regarding demographic differences and LDL cholesterol in the broader literature. In Caucasians, higher HDL cholesterol is considered a protective factor against the development of CHD in comparison to Blacks (34). LDL particle size has also been shown to be smaller in Black individuals and therefore is also less atherogenic (i.e., less likely to promote plaques within the arteries) (35). The impact of LDL on the development and prognosis of heart disease will be reviewed further under the physiological risk factor section. Allostatic load (i.e., physiological adaptations to stress which often leads to heart disease) is also higher in Blacks, in comparison to Caucasians, and is believed to be due to anger, experienced discrimination, and subsequent sleep impairment (36). The potential impact of anger upon the development of HF and prognosis will also be discussed further during the review of psychosocial risk factors.

Additionally, there have been some differences seen by race in terms of reporting symptoms and conditions, accessing healthcare, and treatment adherence. A review found that Non-Hispanic white males were the most likely to report a prevalence of CHD (7.8%) with Non-Hispanic Black males being the second highest at 7% (28). The review also indicated that African Americans and Hispanics were less likely to report using medication to control cholesterol and African Americans had higher median levels, in comparison to Caucasians and Hispanics, of LDL cholesterol (28). The risk of having undiagnosed heart conditions that can ultimately lead to HF, such as angina, is higher among Blacks (37). The reasoning for this difference may be due to the underreporting of heart failure conditions, as described above, or it may be partially due to socioeconomic differences that will be explored further in the following section.

Socioeconomic Status

Socioeconomic status (SES) within psychological and epidemiological research often pertains to an individual's social class standing, as based on income, education, and occupation (38). In addition to factors such as race, SES is a factor that historically is related to increased risk for developing various diseases and conditions, such as depression, obesity, diabetes, and heart disease (39). Higher SES has generally been associated with better health outcomes and this is believed to be potentially from greater access to healthcare resources and education on adaptive health behaviors (38). In a study that examined predominately Caucasian individuals (85%), lower income was associated with increased risk for behavioral risk factors that are correlated with developing heart disease: smoking, high blood pressure, and high-density lipoprotein cholesterol (40). In a large study that examined individuals from ten different countries, men and women over the age of 39 had a higher mortality risk from Ischemic heart disease if they were also within a lower SES category (41). However, there have been some findings which argue that overall improvement in health education and health behaviors have helped decrease the association between heart disease and SES over time (42).

Diabetes

In 2015, an estimated 9.4% of the entire United States Population had diabetes (43). Individuals that are older in age, Asians, non-Hispanic Blacks, and Hispanics are all more likely to develop diabetes (43). Although both Type 1 and Type 2 diabetes are associated with heart disease, Type 2 will be focused on as a risk factor due to its prevalence within the overall population and its ability to develop at any age (44). Type 2 diabetes is defined as the body's inability to create or utilize insulin sufficiently (44). Diabetes is often associated with increased

risk for developing heart disease, especially after an individual has their first myocardial infarction (30; 45)

The American Heart Association (AHA) stated that diabetes not only acts as a risk factor for the development of cardiovascular disease (CVD) but is also associated with a poorer prognosis for individuals diagnosed with CVD (46). Diabetes is also associated with mortality risk from Ischemic Heart Disease, even while accounting for other potential heart disease risk factors, such as body mass index (47). Cardiovascular disease-related hospitalizations have remained relatively high for individuals with a co-occurring diagnosis of diabetes, with as many as 1.5 million being hospitalized in 2014 alone (43).

One possible explanation for why there is such a strong association between diabetes and heart disease is the overlapping features and risk factors between the two diseases. Similar to heart disease, individuals that are older in age, have a higher body-mass-index, hypertension, changes in Low-density Lipoprotein cholesterol, are all more likely to have Type 2 diabetes (45). High blood glucose, which is present in diabetes, is also associated with damage over time to blood vessels and nerves necessary for cardiovascular health (48).

Physiological and Biological Risk Factors

In addition to standard demographic risk factors for the development of heart disease and ultimately HF, several physiological and biological factors have been identified. Recognized physiological conditions, such as hypertension and high LDL cholesterol, and inflammation markers for heart disease will be reviewed further in the following sections. Although these risk factors will not be explored further in the current study design, due to a primary focus on protective components and health promotion in HF patients, these factors will still be reviewed due to their impact on the overall etiology of heart disease and association with prognosis.

Beta-natriuretic peptide (BNP)

BNP “is secreted by the heart and is involved in maintaining homeostasis of fluid and electrolytes” and is also utilized to decrease arterial pressure (49). In HF research, BNP is one of the most commonly examined biomarkers (50) and BNP levels are believed to increase due to increased pressure in cardiac ventricles (49). Beyond being used as a general biomarker for HF, BNP is known to be a predictor of mortality in HF patients, regardless of their current stage of heart disease (51). BNP levels have also been examined to evaluate mortality risk during and after hospitalization (52; 53). HF patients with a decrease of over 30% for BNP, within the first six months after hospitalization, are associated with lower mortality risk (53). Higher levels of BNP at hospital discharge are not only associated with increased mortality risk within the first six months but also increased heart congestion (52), which increases risk over time for continued cardiovascular related complications and disease.

Inflammation and Markers

In addition to BNP, there have been several different inflammatory cytokines (i.e., protein utilized to signal other cells) that are associated with increased risk for cardiovascular disease and HF. Higher levels of proinflammatory cytokine interleukin-6 (IL-6) are associated with inflammation (54). Additionally, higher levels of IL-6 are seen with depressive symptoms and higher Allostatic load in African Americans (55). Among women with CVD, age 65 years and older, higher levels of IL-6 is associated with significantly increased mortality risk (56). In healthy men, ages 40-84, higher levels of IL-6 have similarly been predictive of a subsequent myocardial infarction (57).

Cytokine tumor necrosis factor alpha (TNF- α) is another cytokine that is commonly seen during heart disease and particularly during HF (58). In HF patients, high levels of TNF- α

are circulated during the final stage of the disease or as prognosis worsens (58). Interleukin-1 beta ($\text{IL-1 } \beta$) is associated with increased inflammation in HF patients, and the increased development of atherosclerotic plaques (59). Increased atherosclerotic plaques are then predictive of worsening Atherosclerosis (59), which in turn leads to increased risk of HF. There have been mixed findings in the examination of anti-inflammatory interleukin-10 (IL-10) and heart disease. In adults aged 70-82 years, IL-10 was only associated with increased risk for CVD if the individual had no prior history of heart disease-related events (e.g., myocardial infarction; (60)). In renal disease patients, IL-10 increases as renal function decreases and is related to increased risk for subsequent cardiovascular-related events (61).

Hypertension

A widely recognized physiological risk factor for heart disease is Hypertension (i.e., high blood pressure). Hypertension is defined as the “the force of the blood flowing through your blood vessels” at a high level (62). Blood pressure is delineated into Systolic pressure (i.e., blood pumping out of the heart into the arteries and vessels) and Diastolic pressure (i.e., blood while the heart is in between heartbeats; (63), with Hypertension being defined as Systolic blood pressure of at least 130 mm Hg or Diastolic blood pressure of at least 80 mm Hg (64). Hypertension then places an individual at higher risk of having a myocardial infarction, developing heart disease, or experiencing HF due to sustained damage to the arteries and heart muscle (62).

Low-density Lipoprotein (LDL) cholesterol

LDL cholesterol (i.e., “bad cholesterol”) promotes the buildup of plaques within the arteries (i.e., Atherosclerosis) and ultimately can lead to adverse heart events, such as myocardial infarction and stroke (65). Higher levels of LDL cholesterol are not always indicative of

increased risk for heart disease. Patients with diabetes have been found to have lower levels of LDL cholesterol and high-density lipid (HDL) cholesterol (i.e., “good” cholesterol), and higher levels of triglycerides (i.e., the fat found within the blood; (66). As described previously, diabetes is a risk factor for the development of heart disease. In patients with co-occurring illnesses, such as diabetes, HDL cholesterol should then be examined in relation to LDL cholesterol to determine the increased risk of fat deposits within the blood.

Health Behavior Risk Factors

Smoking

Cigarette smoking has long been identified as a risk factor for the development of heart disease (67). Cigarette smoking induces inflammation, which over time can contribute to plaque rupture and cardiovascular events (e.g., myocardial infarction, stroke; (68; 69). Higher levels of IL-6, IL-1 β , and TNF- α also indicate inflammation from cigarette smoking (69-72). Smoking is also known to increase blood pressure, increase the risk of developing blood clots, decrease HDL cholesterol, and reduce the individual’s ability to exercise (67).

Although the prevalence of smoking has declined in the past fifty years, the adverse effects of smoking on the heart are still grounds for concern (68). Smoking is often correlated with psychological risk factors such as depression, anxiety, perceived stress, and overall negative affect (73; 74). Additionally, smoking is often viewed in the context of stress because it is frequently utilized as a coping mechanism for situations that the individual considers stressful or anxiety-inducing (73; 74). However, smoking induces stress upon the body by causing adverse physiological changes, such as inflammation and increased plaque rupture (68; 69). Cigarette smoking is also associated with demographic risk factors for heart disease and HF, such as lower SES as determined by less than a high school education (75).

Obesity

Another health behavior risk factor for heart disease that is often examined is obesity. Obesity is defined by a Body Mass Index (i.e., body weight in kilograms divided by height in meters squared) of 30 or higher (76). Several adverse consequences associated with obesity are also seen in patients with heart disease, such as hypertension, high LDL cholesterol, Type 2 Diabetes, and psychological risk factors such as depression and anxiety (77; 78). Obesity is also associated with other health conditions, such as sleep apnea (i.e., a condition which induces pauses in breathing while the individual is sleeping), which can contribute to increased inflammation and increased blood pressure (79). Over time, increased blood pressure and inflammation from sleep apnea then cause an increased risk of CHD and HF (77). Although obesity is often considered in congruence with other associated physiological risk factors of heart disease, obesity is also recognized as an independent factor for the development of heart disease (77).

Medication Nonadherence

Medication nonadherence is also a health behavior risk factor that is commonly associated with poorer prognosis in HF patients. In HF patients, medication nonadherence is associated with all-cause mortality but not necessarily cardiovascular-related deaths (80). In HF patients, the presence of depressive symptoms in conjunction with heart disease is further associated with medication nonadherence (80). Contributing causes to medication adherence in HF patients is lack of knowledge of their medication following discharge from the hospital (81), believing the medications disrupt their daily life, and difficulties associated with medical insurance (82). Medication nonadherence, for patients prescribed medication to control cholesterol and blood pressure, was predicted by various psychological and psychosocial risk

factors (e.g., smoking, depressive symptoms, eating “fast food” outside the home two or more times a week, being less educated, being over the age of 65; (83; 84).

Unhealthy Diet

One of the common factors examined for HF risk and prognosis is diet. General guidelines for individuals with CVD concerns include a variety of fruits and vegetables, whole grains, low-fat dairy and protein products (e.g., fish, poultry), limiting saturated and trans fat intake, reducing sugar intake, limiting alcohol consumption, and limiting sodium intake (85). Higher sodium intake is associated with an increased risk of stroke and heart disease (86). In women, higher intake of saturated fat is associated with an increased risk for coronary heart disease (87). Having psychological risk factors, such as depression or anxiety, can also make an individual more likely to engage in an unhealthy diet and, therefore, be at increased cardiovascular risk (88). Beyond risk factors for developing heart disease, an unhealthy diet is considered one of the contributing factors that leads to hospitalizations in HF patients (89).

Psychosocial Risk Factors

In the overall examination of psychosocial risk factors for heart disease and HF, there have been several different factors identified within the psychosocial domain. Anxiety and depression have long been recognized as psychological factors that are strongly associated with the development of heart disease, mortality, and adherence to adverse health behaviors (e.g., lower physical activity, cigarette smoking; (31). The well-known association between stress and heart disease is considered more complex, due to overlap with other risk factors, such as lack of social support, depression, anxiety, and hostility (31). Each of the previously mentioned psychosocial factors, particularly how each factor can be described as trait and state, will be discussed in more depth below.

Anxiety

Anxiety is characterized by “feelings of tension, worried thoughts, and physical changes like increased blood pressure” (38). Although anxiety is considered a typical experience for individuals as they adapt to various situations, the symptoms of anxiety, and increases in the severity of the anxiety can also promote increased cardiovascular risk (90-92). Additionally, there have been differences seen between “state” and “trait” anxiety. State anxiety is considered a temporary anxious “emotional status evoked by a condition,” which lasts for a period of minutes up to days (93). Trait anxiety is a “relatively enduring individual differences in anxiety proneness” that helps account for individual differences when someone is exposed to a stressor (93). In patients with identified cardiac risk, both state and trait anxiety are highly correlated with depressive symptoms, as measured by the Beck Depression Inventory (93).

There have been mixed findings within the literature on the potential impact of anxiety upon heart disease development and prognosis. An extensive review found that anxiety is the most predictive of increased CVD risk in an initially healthy patient population and does not necessarily increase risk with patients with known heart disease (94). A meta-analysis similarly found that anxiety is associated with a 26% increase risk in incident CHD (92). Symptoms of anxiety, such as increased heart rate, are also seen to increase cardiovascular risk (e.g., developing CHD, sudden cardiac death) in both men and women (90; 91).

Anxiety is associated with CHD risk and cardiovascular-related mortality, with anxiety promoting a 48% increased risk of cardiac-related death (92). The presence of anxiety has furthermore been correlated with other risk factors for the development of heart disease and promoting a poorer prognosis. Primary risk factors associated with anxiety and heart disease include history of diabetes, history of smoking, higher BMI, and hypertension (90). Both

depression and anxiety are also believed to increase cardiovascular risk by promoting physiological changes, such as increased sympathetic activity (e.g., increased heart rate, increased blood pressure), plaque rupture, etc. (95).

Depression

Based on DSM-5 diagnostic criteria, depression is identified by the presence of a combination of symptoms for at least a two-week period; such as a depressed or down mood, diminished ability to concentrate, changes in appetite or weight, decreased interest in activities previously enjoyed, impacts to sleeping (e.g., sleeping too much, insomnia), excessive feelings of guilt or worthlessness, and recurrent thoughts of death or suicide (96). However, studies of depression and cardiovascular disease often assess depressive symptoms utilizing self-report measures, with the Beck Depression Inventory being the most widely used and validated. A review and a meta-analysis of 36 studies found Major Depressive Disorder and/or depressive symptoms occur in approximately 20%-21.6% of patients with HF (97; 98). The same meta-analysis of 36 studies also found that depressive symptoms in HF patients increases their mortality risk by 2.1% (98).

Both depressive symptoms and Major Depressive Disorder are also significantly predictive of cardiac events (e.g., myocardial infarction) independently from anxiety symptoms (99). However, measuring depressive symptoms in patients with HF can be difficult due to symptoms overlapping with common symptoms of HF, such as fatigue, changes in body weight, difficulty sleeping or sleeping too much, difficulty concentrating, and reduced physical activity (100). Suls and Bunde (2005) found in their review of 24 studies of healthy populations and 52 studies on patients with known CHD, that the association between depression and cardiovascular risk overall has mixed findings (i.e., some studies citing an association between psychological

symptoms and heart disease and others not). However, the majority of studies have found depression is associated with disease progression and mortality (94).

An extensive review reported that depression not only promotes physiological changes (e.g., plaque rupture, increased blood pressure) but also impacts health behavior changes, such as medication adherence (101). Both physiological and health behavioral changes can further increase the risk of developing heart disease and adversely impact prognosis. Other physiological changes that are often linked to depression are increased inflammation processes (97). Although depression is not associated directly with changes in commonly measured inflammation markers, such as IL-6 and TNF-alpha, it has been associated with increased perceived stress due to a significant life event, such as the loss of loved one or coping with disease (102). One study of 164 patients, measured at two weeks and six months post-Acute Coronary Syndrome, found depressive symptoms were associated with increased inflammation (i.e., interleukin-17), endothelial dysfunction (i.e., endothelin -1), and myocardial difficulties (*N*-terminal pro-B-type natriuretic peptide) (103).

Depression is also correlated with other psychological risk factors for heart disease, such as anxiety (99) and anger (104). Depression has additionally been linked with adverse health behaviors that contribute to poorer HF prognosis, such as medication nonadherence (105). Reasons identified for medication nonadherence in HF patients with co-occurring depression include: forgetting to take medications and consciously choosing not to take medication (105). Difficulties with maintaining these potentially protective health behaviors then theoretically could impact overall prognosis in HF patients and increase their risk for adverse HF outcomes (105).

Anger and Hostility

Another psychological risk factor of HF that has been thoroughly examined over the past few decades is anger. Similar to difficulties created by overlapping symptoms in depression and HF, determining if anger causes the most significant impact on the etiology of CVD is convoluted due to overlapping symptomology of depression and anxiety (94). Smith (as cited in Smith and Traupman, 2012) defines anger as “an unpleasant emotion ranging in intensity from irritation or annoyance to fury or rage.”

Similar to anxiety, anger can also be categorized as either state or trait. In HF patients, trait (i.e., chronic, longer lasting) anger was predictive of hospitalizations, even after controlling for demographic factors (107). In HF patients, the presence of anger is also predictive of the length of hospital stay after initial admission (104). In men, higher levels of trait anger also occur with an elevated hazard ratio for incident HF events (108). Difficulties coping with anger and the way anger is expressed can also cause adverse health consequences. In men, 45 years of age and older, decreases in the usage of constructive anger expression (i.e., problem-solving) and increases in the usage of destructive anger justification (i.e., externalizing blame) is predictive of a CHD related incident within a ten year follow-up period (109).

Often anger, particularly within the health literature, is examined with the concept of hostility. Hostility is defined by Smith (as cited in Smith, Glazer, Ruiz, and Gallo, 2004) as a “negative attitude toward others, consisting of enmity, denigration, and ill will.” In women, 50-79 years of age, higher levels of hostility are associated with increased risk for CHD and higher mortality rates (111). In older men with a diagnosed cardiovascular-related disease, reported hostility is highest post-myocardial infarction and after a coronary artery bypass graft surgery (112). Both anger and hostility are predictive of cardiac and non-cardiac hospitalizations in HF

patients (107). Considering the high rates of hospital re-admissions of HF patients, increased hostility after a procedure or condition that causes a hospitalization (e.g., a physical injury, illness, etc.) may only increase their risk for poorer HF prognosis and subsequent future hospitalizations.

Perceived Stress

Lazarus (as cited in Cohen, Kessler, & Gordon, 1995) described the “Stress-Appraisal model” as an individual evaluating if a particular situation induces stress and then determining if they can cope with the specific stressful situation. Stress is most often defined as a significant event or situation (i.e., stressor), such as loss of a job or a divorce, which an individual identifies as causing a substantial cognitive or emotional demand (113). Stress is also described as an individual evaluating a stressor (e.g., loss of a job) and determining if they can cope (113). For the purpose of this review and the present study, stress will be considered as a construct underneath both domains.

There are several mechanisms by which stress is thought to increase cardiovascular risk. One mechanism is based on the notion that stress is associated with increased sympathetic cardiovascular and neuroendocrine responses, such as increased heart rate and blood pressure, and release of catecholamines (114). Stress also can lead to increased inflammatory response, such as increased levels of inflammatory cytokines such as IL-6 (54).

In addition to physiological symptoms, stress is known to contribute to adverse health behaviors that further increase cardiovascular risk (e.g., smoking, obesity, poor diet, lack of physical activity; (54; 73; 113; 115). Stress has also been associated with other medical conditions that commonly co-occur with heart disease. Stress is linked to the development of

Type 2 diabetes, which, as described previously, is associated with risk for heart disease and poorer prognosis (46; 116).

POTENTIAL PSYCHOSOCIAL AND BEHAVIORAL PROTECTIVE FACTORS

In addition to risk factors for the development of heart disease and HF, several psychosocial or behavioral protective factors have been identified as well. In the following sections, this review will first discuss known health protective behaviors, such as physical activity medication adherence, adherence to a healthy diet, and sleep quality. This review will then address potential psychosocial protective factors for HF patients, such as social support and social networks, optimism, self-efficacy, positive affect, and coping through the usage of spirituality and religion.

Health Behavior Protective Factors

Physical Activity

Overall, physical activity is frequently considered a protective factor against the development of heart disease. An extensive review found an inverse relationship between CHD risk factors and physical activity, across ethnicities and sex, with the presence of physical activity being associated with reduced risk for CHD (117). There have been mixed findings in regards to the impact of physical activity on cardiovascular risk in men. One study found both extremely high levels of physical activity and low levels of physical activity are associated with increased risk of HF in men (118). Another study had conflicting results by finding only total physical activity conducted and vigorous activities related to a reduction in CHD risk in men (119). Among women, any type of physical activity (e.g., walking) is associated with a 20-50% reduced risk of developing heart disease (120).

In consideration of prognosis and mortality risk, physical activity has also been examined for potential protective effects. Overall, physical activity is considered to help increase longevity of life in healthy individuals (121). The most substantial increase in survival of life is seen in individuals that participate in “high physical activity” (i.e., intense physical activity for over 4 hours per week or competitive sports several times per week), by promoting an increase in approximately 5.5 years of life (121). Additionally, an increase in physical activity is associated with decreased heart disease-related mortality risk in healthy individuals (121) and individuals with stable CHD (122).

Medication Adherence

Medication adherence refers to the patient’s ability to adhere to treatment guidelines as prescribed by their medical provider, in terms of dosage and duration of time (123). Medication adherence differs from medication compliance because it incorporates the patient’s understanding of the prescribed medication plan, as determined by their medical provider (84). Hypertensive patients who were adherent with hypertensive medication guidelines were 38% less likely to experience cardiovascular-related events in comparison to patients that were not highly adherent (124), and they were better able to control their blood pressure (123). The risk for hospitalization and mortality is also decreased while the patient stays adherent to medications (125).

Non-adherence to medication guidelines is associated with adverse outcomes in HF patients, such as increased risk for hospitalizations and a 50-80% increased mortality risk (123). As described previously, medication non-adherence is sometimes due to a lack of understanding of the importance of the medication (81). A couple general factors have been identified in HF patients to increase medication adherence: 1) A firmly held belief in the importance of one’s

medication for heart disease is associated with better medication adherence (126). 2) The presence of additional protective factors, such as social support, are also associated with increased medication adherence (84).

Adhering to a Healthy Diet

In addition to a focus on smoking cessation research to reduce cardiovascular risk, the AHA within the past few years has also emphasized the importance of maintaining a healthier body weight and eating a healthy diet (5). A recommended diet to promote cardiovascular health includes: vegetables, fruits, protein (e.g., seafood, legumes) whole grains, decreased sugar, decreased intake of red meat, decreased processed food, and alcohol in moderation (5; 85). In the past decade, greater adherence to recommended health behaviors, to include a healthier diet, was associated with a lower lifetime risk of developing HF (5; 127). Additionally, adhering to healthy lifestyle changes (e.g., eating a healthy diet) is associated with decreased risk of experiencing cardiovascular disease-related events (128).

Adherence to healthy lifestyle changes also has been associated overall with better prognosis and decreased risk for CVD and stroke (129). In consideration of various potential protective factors for individuals with HF (e.g., restricting fluids, physical activity, maintaining a healthy body weight), eating a healthy diet is one of the areas that patients show a higher compliance rate in HF patients (130). In an examination of 501 HF patients, ages 23-93 years of age, approximately 83% reported compliance with a healthy diet (130).

Sleep

Although sleep has both physiological and behavioral components, it will be discussed as a health behavior in this review due to its modifiable components (e.g., sleep hygiene, sleep duration). While considering sleep, both quality and quantity are commonly utilized to describe

overall sleep architecture. Insomnia can be defined as having difficulty falling asleep, staying asleep, and/or waking up before the intended wake-up time (131). Often with insomnia, there is also a subsequent complaint of a lack of sleep quality. A study that examined 772 insomnia patients found that approximately 21.9% also had heart disease (132).

Additionally, it is relatively common for individuals with stable HF to also experience symptoms of insomnia such as daytime fatigue, waking up too early, difficulty falling asleep, trouble staying asleep, and depressive symptoms (133). In an examination of adults over the age of 40, less than six hours of sleep was associated with increased risk of CHD (134). Poor sleep quality, as defined as difficulty falling asleep or requiring sleep aid medication, is also associated with increased risk of developing CHD (134). Several other risk factors associated with heart disease (e.g., increasing age, anxiety, depression) also impact sleep quantity and quality (135).

Psychosocial Protective Factors

Positive psychology has been increasingly examined in both research and interventions within the past several years. Positive psychology has been defined as “a science of positive subjective experience, positive individual traits, and positive institutions...to improve quality of life and prevent pathologies” (136). Positive psychology also includes an emphasis on individual features (e.g., hope, spirituality, etc.) that promote overall well being (136). Psychosocial factors, such as the presence of social support, social networks, optimism, positive affect, spirituality, and self-efficacy, are all factors that can be considered under the overarching field of positive psychology. Each of these psychosocial factors will then be reviewed in more detail for their potential impact upon health, heart disease, and among HF patients. In cardiac patients, an eight-week positive psychology focused intervention (e.g., exercises to increase optimism and gratitude) was associated with decreased depressive symptoms, reduced anxiety, increased

happiness, and improved quality of life (137). It is important to note that, similar to anxiety, some of the potential positive psychosocial protective factors in HF patients (e.g., positive affect) can also have different state and trait effects (138).

Social Support

Social support is typically defined as “the social resources that [people] perceive to be available or that are actually provided to them by nonprofessionals in the context of both formal support groups and informal helping relationships” (139). On a broader level, social support is considered structural (i.e., social network number, types of relationships, frequency of contact) and functional (i.e., tangible aid, emotional support; (140). Cohen et al. (1985) further categorized forms of social support as appraisal (e.g., advice, guidance), belonging (e.g., empathy, acceptance, concern), and tangible (e.g., help, assistance, financial support, etc.).

Low social support is associated with poor outcomes for patients with persistent diseases or ailments. In the examination of other chronic health concerns, such as pain, decreases in social support are associated with increased anger by the pain patient (141). Lower levels of social support (i.e., social isolation) are also related to physiological health risk factors (e.g., increased blood pressure, increased heart rate, atherosclerosis) and adverse psychological factors (e.g., depression, PTSD; (142). Overall, social support has been proposed to act as a buffer against adverse health effects (143), and has been associated with decreased risk for mortality in individuals with heart disease (144).

The presence of social support is associated with other protective factors, such as decreased blood pressure, reduced hypertension rates, smoking cessation, adherence to a healthy diet (144) and medication adherence (84). HF patients with reported higher levels of social support also report feeling they would be more likely to engage in positive health behaviors, such

as limiting fluid intake, consulting with a medical provider regarding weight gain, exercising, and preventive health measures (e.g., flu shot; (145).

Higher levels of social support are inversely related to mortality and poorer prognosis in CHD patients (146; 147), but there have been mixed findings while examining the potential impact of social support upon HF patients. In a review of 17 studies, Luttik et al. (2005) found a few studies showed low social support was a significant predictor of hospitalization readmission, but one conflicting study reported no meaningful relationship between social support and HF hospitalizations. The one conflicting study, however; was focused on elderly HF patients and found low social support is associated with re-hospitalizations (148). Determining the exact relationship social support has upon outcomes in HF patients is more complicated due to some studies, including the concept of social networks within the definition (149). Luttik et al. (2005) also reported finding low social support was a significant predictor of hospitalizations, but a portion of these studies were also including social networks (i.e., looking at the types if individuals someone has for social support and the size of these social networks).

Optimism

Another positive psychology concept that has been examined with heart disease literature is the concept of optimism. Optimism is defined as an “inclination to hope” (150). Often optimism is discussed using the term “dispositional optimism” and refers to a trait that predicts how an individual copes with stress (138). Optimism is suggested to impact both mental health and overall physical health (150) by helping an individual attain goals through influencing cognitions and behaviors (151). In patients with Acute Coronary Syndrome, higher levels of optimism were associated with positive health behaviors such as physical activity (152).

In a review of fifteen studies focused on optimism and cardiovascular diseases, dispositional optimism is associated with improved cardiovascular health, decreased mortality risk, and better well-being (151). For example, in premenopausal women, slower progression of carotid disease (i.e., disease of the two large blood vessels in the neck) is related to higher levels in reported optimism (153). In a large community-based study, 1,306 men 21-80 years of age, higher levels of optimism were associated with decreased risk for developing cardiovascular-related diseases and experiencing cardiovascular events, such as myocardial infarctions (154). In the examination of women and optimism, similar results have been found. A study that examined women initially without cardiovascular disease found women with higher levels of optimism were less likely to develop CHD and had lower mortality rates (111). A longitudinal study, which evaluated individuals over a 15-year timespan, found that those with higher levels of dispositional optimism had lower incidences of cardiovascular-related death (155). In a study of 309 patients after coronary artery bypass graft surgery, higher levels of optimism were associated with lower all-cause hospitalization rates (156).

There is less known about the potential impact of dispositional optimism in HF patients. In a large study that examined approximately 6,000 healthy individuals over a four years, individuals who had higher rates of optimism were 48% less likely to develop HF (157). A smaller study of 189 HF patients found dispositional optimism was not significantly predictive of mortality, and instead marital quality (Risk Ratio of 2.01) and self-efficacy (Risk Ratio of 1.23) predicted 8-year survival (158). In a study of 125 patients with HF, optimism was related to several better HF outcomes: fewer reported symptoms, better functional status, and less HF-related hospitalizations at a one-year follow-up (159). Whittaker (2013) also found that optimism

was predictive of fewer HF-related hospitalizations and increased survival rate, while controlling for affect, depressive symptoms, and coping styles.

Self-Efficacy

Bandura (1993) defined self-efficacy as “people’s beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives.” Self-efficacy has been proposed as a necessary tool to aid behavioral change and promote better health prognosis (161). In older women with heart disease, self-efficacy was associated with greater adherence to protective health behaviors (e.g., medication adherence, maintaining a healthy diet, physical activity, and coping with perceived stress (162). Self-efficacy in HF patients is considered to be a factor that contributes to self-care behaviors, such as limiting sodium intake and consulting with medical providers (163). Self-efficacy also promotes increased adherence to other positive health behaviors (e.g., physical activity) in HF patients (164).

A study of 1,024 patients with stable CHD found low self-efficacy scores predicted hospitalizations and mortality, but that the association may be best explained by the degree of cardiac function at the baseline (161). Similar to difficulties described previously regarding barriers to medication adherence, programs specifically designed to better educate HF patients not only help improve their adherence to self-care behaviors (e.g., medication adherence, maintaining a healthy diet, etc.) but also enhance their perceived self-efficacy (165). It can be suggested that improved self-efficacy and adherence to positive health behaviors should promote a better HF prognosis and decrease hospitalization rates.

Positive Affect

Positive and negative affect are defined as “two mood factors...[that are] distinctive dimensions (166). Positive affect (PA) is a concept that has generally seen some overlap with emotion, mood, and both psychological and psychosocial constructs, such as optimism. In the past few years, PA has been increasingly examined for its potential impacts upon health. In healthy individuals, PA (i.e., happiness) is associated with less reported psychological distress and lower physiological stress indicators (167). An extensive review suggested PA predicts better health outcomes, to include participation in positive health behaviors, such as physical activity and smoking cessation (168).

In HF patients specifically, higher PA is significantly correlated with lower average levels of inflammatory markers: Soluble Tumour necrosis factor 2, TNF- α , and IL-6 (169). In addition to physiological benefits, the presence of PA is associated with various psychological and psychosocial protective factors (e.g., optimism, positive coping skills, perceived emotional and tangible social support) (170). Improvement in self-care behaviors, while the individual has higher PA has, also been seen in heart disease (171) and HF patients (172). In men with heart disease, PA is also positively correlated with physical (e.g., pain, physical functioning, physical health) related quality of life (173).

In HF patients, higher levels of “trait like” (i.e., stable, chronic) PA significantly predicted better health status [per the Kansas City Cardiomyopathy Questionnaire (KCCQ) Overall Summary scores] at a three-month follow-up period, even while accounting for an individual’s reported quality of life and social support components (174). However, in the same study on patients with HF; higher perceived stress levels partially mediated the predictive relationship between PA and self-reported health status (174). The lack of significant predictive

ability after controlling for the partial mediating effect of perceived stress suggests that other psychosocial factors, such as social support, may predict health better than PA in HF patients. State-like PA (i.e., fluctuating) in HF patients was predictive of higher reported health status, after controlling for the partial mediating effect of perceived stress and excluding the potential confounding psychosocial variables from the KCCQ Overall Summary scores (174). State PA has also been associated with a slower overall progression of disease and illnesses (175).

PA also has an impact on prognosis in heart disease patients. In a study that examined 121 patients with heart disease risk of subsequent hospital admissions was increased by overall physical health, “personal adjustment” to the diagnosis, and happiness (176). Extensive reviews and meta-analyses have found mixed results regarding the impact of PA upon mortality, but the majority of studies have found higher PA is related to increased longevity of life (177; 178).

Coping through Spirituality

Although spirituality often encompasses religion, the broader definition of spirituality involves: “an individual’s belief developed through the lifespan that influences a person’s interpretation of morals, faith, love, trust, suffering, and God. It guides a person’s view of the world and self, providing structure, purpose, and meaning to everyday activities” (179). The impact of spirituality upon health is an area that has continued to be examined, with some focus directly on the effects on individuals with heart disease. Selman, Beynon, Higginson, and Harding (2007) reported in their review that there is a clear need to address spirituality with HF patients but there is little to no research evaluating spiritual needs in HF patients.

In pain and cancer patients, spirituality and religion are also useful methods to cope with disease-related symptoms (180). A study examining Alzheimer’s disease patients found that despite experiencing cognitive difficulties due to the disease, patients still reported feeling

positive and attributed their positive emotions to spirituality and familial support (179). As described previously, HF can often occur with other potential psychological risk factors (e.g., depressive symptoms). Spirituality in HF patients may also partially protect individuals from symptom burden (i.e., HF symptom frequency and intensity) while they are also experiencing depressive symptoms simultaneously (181). In a study examining sixty HF patients, 60 years of age and older, higher rated “spiritual well-being” had a strong association with decreased depression (182). Spirituality and religious social support are also associated with protective factors, such as adhering to a healthy diet, physical activity (183), and improved health behaviors (e.g., scheduling medical appointments, maintaining healthy body weight, etc.; (184). In HF patients specifically, spirituality is associated with higher adherence to medication (184; 185).

In addition to coping with disease-related symptoms, spirituality is also associated with decreased mortality risk and better prognosis (186). Reduced mortality risk may be through the usage of spirituality to cope with stress, and subsequently promote an increase in IL-6 (187). A small sample of 48 patients with CHD found that those within the experimental condition, which incorporated meditation, reported higher spirituality and a decrease in coronary obstruction within a four-year follow-up period (188).

Acceptance Based Coping

Along with coping with religion or spirituality, acceptance-based coping has more recently been explored for its potential benefits in patients with a chronic illness. In the disease literature, acceptance has been considered a coping response in which the patient accepts the particular situation they are in and attempts to identify methods of coping (189). Primarily, acceptance-based coping has been examined for its potential benefits on diabetes, chronic pain, and psychological concerns. In patients with a diabetes diagnosis, utilizing mindfulness and

acceptance based coping has been associated with improved self-management (e.g., medication adherence, adherence to a healthy diet, physical activity, monitoring blood glucose levels) (190). There have been a few qualitative studies that have explored the benefits of acceptance-based coping during early stage cancer diagnosis (191; 192).

In patients with cardiovascular disease and heart failure, there is less known about the potential impact of acceptance-based coping on prognosis and promoting other protective factors. Although the presence of acceptance-based coping is associated with fewer depressive symptoms in HF patients, there have also been findings that suggested there is no association between acceptance-based coping and improved subjective well-being or lower depressive symptoms (193). Acceptance-based coping is associated with an increased quality of life in patients with congestive heart failure (184). Teaching patients acceptance-based behavior therapy has also been associated with improved protective factors in HF patients, such as improved diet and physical activity (194). Acceptances based coping may then have a positive impact upon prognosis in HF patients.

CHAPTER 2: Rationale and Specific Aims

Although there have been several factors identified for the potential influence of protective psychosocial factors in the etiology of heart disease and HF, the exact mechanisms are still not well understood. For example, DuBois et al. (2015) reviewed 30 studies of positive psychological constructs (e.g., optimism, PA, well-being) and health outcomes in CVD patients and concluded that there have been mixed findings in the potential impact upon cardiovascular events and mortality. Therefore, further research is needed to determine the constructs that were most important in impacting prognosis.

PA has increasingly been found to have a potential impact on health and disease. A master's thesis conducted by Garza (2018) found that both state-like and trait-like PA were associated with potentially beneficial predictive effects on the health status of HF patients at a three-month follow-up. The potential influence of factors such as self-efficacy and social support, and the partial mediating effects of perceived stress, made it difficult to determine a direct predictive relationship between PA and health status per the KCCQ Summary scores (174). Additionally, the previously mentioned study only focused on one form of outcome data (self-reported HF symptom burden on the KCCQ) and did not explore the potential impact of other positive psychosocial factors on hospitalizations or mortality rates.

The present study used structural equation modeling (SEM) to examine the possible influence of protective factors on heart failure outcomes. SEM enables the examination of latent as well as observed psychological variables and has been used in the past decade as a method of further examining both cross-sectional and longitudinal data (196). Few studies have examined cardiovascular-related endpoints using SEM analysis. In 398 cardiovascular disease (CVD) patients, an SEM approach found that spiritual intelligence was the strongest indicator of a

Protective Factor (Standardized factor loading of 0.58) (197). In the same study, Optimism (Standardized factor loading of 0.47), Problem-Oriented Coping (Standardized factor loading of 0.30), and Self-Efficacy (Standardized factor loading of 0.55) were weaker indicators of a Protective Factor to potentially improve quality of life in CVD patients (197). A similar study of 130 CAD patients found Self-Efficacy accounted for 70.0% of the variance in self-care behaviors (e.g., exercise, smoking cessation, healthy diet), and that this produced an indirect effect on quality of life (198). Using SEM, another study of 400 hospitalized HF patients found that “Self-Management Ability” (i.e., treatment adherence, symptom monitoring, confidence in ability to manage symptoms), as measured by the Self-Care of Heart Failure Index measure, had a direct effect on health status and severity of illness only had an indirect impact on health status (199).

The purpose of the proposed study is to use a SEM approach to better understand the role of protective psychological, social, and behavioral factors on overall health in HF patients. The proposed study will include multiple potential protective factors within the overall study model (i.e., optimism, self-efficacy, social support, medication adherence, etc.), and will examine HF outcome measures including perceived health status and hospitalizations. This study differs from previously conducted SEM approaches because it is looking at multiple protective variables (e.g., self-efficacy, perceived social support, etc.), instead of associated risk factors. Prior studies have also predominately focused on the impact of protective factors on other psychological and behavioral constructs, such as self-efficacy impacting self-care behaviors (164).

The current study will also examine the relationship between two overall theoretical factors (Psychosocial Protective Factor and Behavioral Protective Factor), comprised of psychosocial and behavioral variables for each factor respectively, on HF outcomes (e.g., hospitalizations and reported HF symptom burden and health status). It is expected that

protective factors would be more predictive at a shorter-term follow-up, in comparison to a longer-term follow-up, due to findings within previous research. One particular study found that after being discharged from the hospital, the most significant improvement in the participants' health, as measured by the KCCQ, was seen within the first week after discharge and only up to 24 weeks after (230). The previous study conducted by Garza (2018) found that PA was significantly associated with better health and lower symptom burden in HF patients at a short-term (3-month) follow-up but did not examine any outcomes afterward. The current study aims to see if a similar finding would be seen for a longer duration of time and with additional protective factors included in the model.

The specific aims and hypotheses are presented below:

Aim One

To determine whether in patients with heart failure (HF), items for measures of Positive Affect, Social Support, Optimism, Coping through Spirituality/Religion, Acceptance-Based Coping, and Self-Efficacy accurately depict the factors they are designed to measure.

Hypothesis 1a

In HF patients, positive affect items (“Vigor-Activity”) from both the Profile of Mood States (POMS) and positive affect items from Mood & Health Practices Questionnaire (MHPQ) measures will be significantly correlated with each other and accurately measure Positive Affect.

Hypothesis 1b

In HF patients, social support items on the Interpersonal Support Evaluation List-12 (ISEL-12) will be significantly correlated with each other and accurately measure Social

Support.

Hypothesis 1c

In HF patients, optimism items from the sum of the Life Orientation Test (LOT) will be significantly correlated with each other and accurately measure Optimism.

Hypothesis 1d

In HF patients, spirituality items from the COPE inventory “Spirituality and Religion” subscales will be significantly correlated with each other and accurately measure Coping through Spirituality.

Hypothesis 1e

In HF patients, items from the COPE inventory “Acceptance” subscale will be significantly correlated with each other and accurately measure the Acceptance based Coping.

Hypothesis 1f

In HF patients, items from the Self-Efficacy subscale of the Kansas City Cardiomyopathy Questionnaire (KCCQ) and Ad Hoc Self Efficacy scale will be significantly correlated with each other and accurately measure Self-Efficacy.

Aim Two

To determine whether in patients with HF measures of Sleep Quality, Physical Activity, Medication Adherence, and Adherence to a Healthy Diet accurately depict the factors they are designed to measure.

Hypothesis 2a

In HF patients, sleep quality items from the Mood and Health Practices questionnaire will

be significantly correlated with each other and accurately measure Sleep Quality.

Hypothesis 2b

In HF patients, medication adherence items from the Morisky Adherence Scale will be significantly correlated with each other and accurately measure Medication Adherence.

Hypothesis 2c

In HF patients, the sum of healthy diet adherence items from the Dietary Compliance Survey will be significantly correlated with each other and accurately measure Adherence to a Healthy Diet.

Aim Three

To determine whether in HF patients various psychosocial measure items (e.g., items from the POMS, positive affect items from the MHPQ, LOT, ISEL, COPE, KCCQ Self-Efficacy scale, items from the Ad Hoc Self-Efficacy) are significantly associated with each other and comprise an overall factor called “Psychosocial Protective Factor.”

Hypothesis 3a

Items from the POMS, positive affect items from the MHPQ, items from the LOT, ISEL, COPE, KCCQ Self-Efficacy scale, and Ad Hoc Self-Efficacy will accurately measure “Psychosocial Protective Factor.”

Aim Four

To determine whether in patients sleep items from the MHPQ, the physical activity item from the MHPQ, items from the Dietary Compliance Survey, and medication adherence items from the Morisky Adherence Scale are significantly associated with each other and represent a

overall factor: “Behavioral Protective Factor.”

Hypothesis 4a

Sleep and physical activity items from the Mood & Health Practices Questionnaire, Dietary Compliance Survey, medication adherence items from the Morisky Adherence Scale will accurately measure “Behavioral Protective Factor” within the HF population.

Aim Five

To determine if there is a relationship between both “Psychosocial Protective Factor” and “Behavioral Protective Factor” on the outcome variables of hospitalizations (HF-related, cardiovascular-related, and all-cause) and self-reported HF symptom burden and health status at both short-term follow-up (9 months after baseline) and up to a 3-year (39-months after baseline) follow-up period.

Hypothesis 5a

There will be a significant relationship between “Psychosocial Protective Factor” and self-reported HF health status and symptom burden, and hospitalizations (HF-related, cardiac-related, and all-cause) in HF patients at both a short-term and longer-term follow-up period.

Hypothesis 5b

There will be a significant relationship between the construct of “Behavioral Protective Factor”, and HF health status, and hospitalizations (HF-related, cardiac-related, and all-cause) in HF patients at both a short-term and long-term follow-up period.

CHAPTER 3: Study Methods

PARTICIPANTS AND RECRUITMENT

This study will be a continuation of the previous research study conducted by Garza (2018) and will utilize previously collected data from the longitudinal study, Behavioral Triggers of Heart Failure (BETRHEART). The BETRHEART study was held at the Heart Failure Clinic at the University of Maryland Hospital in Baltimore, Maryland. The BETRHEART study has received IRB approval through the Uniformed Services University of the Health Sciences (USUHS), the Baltimore Veterans Affairs (VA) Medical Center, and the University of Maryland (UMD). The sample for the current study is 150 patients from the Heart Failure clinic during the original BETRHEART study recruitment. Participants were considered eligible for the BETRHEART study if they met diagnostic criteria for HF (left ventricular ejection fraction of less than or equal to 40%) and were classified by the New York Heart Association HF class as II-IV for at least three months. A classification of II-IV by the New York Heart Association (NYHA) indicates that an individual has mild to severe limitations on physical activity (12).

All patients in the BETRHEART study during recruitment were considered to be in a stable condition, verified by a board-certified physician, and were at least 21 years of age. Exclusionary criteria from the original BETRHEART study included: documented myocarditis for less than 6 months, mitral valve disease, thyroid dysfunction, alcohol abuse currently or within the past six months, significant cognitive impairment, left ventricular assistance device implanted, prior heart transplantation, current cancer treatment, living in a nursing home, or currently pregnant.

PROCEDURE

During a routine HF clinic visit at the University of Maryland Medical Center (UMMC) HF clinic patients were determined to be eligible per inclusionary criteria, and informed consent was obtained. Self-report measures to assess psychosocial protective factors (e.g., affect, coping styles, optimism, social support, etc.) and behavioral protective factors (e.g., sleep, medication adherence, physical activity, etc.) were collected at the baseline and during subsequent telephone interview assessment time points. Patients were re-evaluated during a 3-month follow-up at the HF clinic after the baseline. Telephone interviews and associated assessment measurements were conducted every two weeks, between the baseline and 3-month follow-up assessments. After the 3-month follow-up assessment, patients were contacted by phone every six months for a total of (up to 39 months after the original baseline assessment) to continue to assess for psychosocial changes and any changes to their reported health status (i.e., hospitalizations, death). Figure 2 and Table 2 provides an outline of when participants received particular measures, which are being utilized within the current study, throughout the original BETREHART study. The Institutional Review Board of UMMC and Uniformed Services University of the Health Sciences both approved the protocol for the BETRHEART study.

MEASURES

The following sections will describe in detail the measures and items being utilized in the current study. Table 1 depicts how each of the below measures and associated items will be utilized to observe latent general factors. The proposed latent factor “Psychosocial Protective Factor” will be determined by items measuring Positive Affect, Optimism, Social Support, Coping through Spirituality, Acceptance based Coping, and Self-Efficacy. Items measuring Sleep Quality, Medication Adherence, Adherence to a Healthy Diet, and Physical Activity will

determine the proposed latent factor of “Behavioral Protective Factor.” Each of these general factors is then comprised of observed variables, such items from the Mood and Health Practices Questionnaire, which are obtained from the various measures described below.

Psychosocial Variables

Positive Affect

Mood and Health Practices Questionnaire (MHPQ). Patients were given the “Mood and Health Practices Questionnaire” at the baseline assessment to assess for PA. The MHPQ is a 23-item set of self-report items, which is comprised of several scales and measures to examine health behaviors during the past 24 hours. Eighteen of the items on the MHPQ directly measure affect, with nine of the items specifically related to PA. Affect items on the MHPQ were adapted from an affect scale utilized by Cohen et al. (2003). The widely utilized Positive and Negative Affect Schedule (PANAS) by Watson, Clark, & Tellegen (1988) was not used in the previous study by Garza (2018) and is not included in the current proposed study due to the PANAS lacking adjectives to measure varying PA states that range from “calm” to “happy” (175). The PANAS has also been noted to consist of adjectives, such as “strong”, that are not considered to be consistent with measuring either mood or emotional states (175). The eighteen affect items adopted from Cohen et al. (2003) included in the MHPQ questionnaire are considered both valid and reliable, with Cronbach's alpha ranging from 0.89- 0.93 for the PA scale (200).

Profile of Mood States (POMS). The POMS measure has been utilized within the health literature through the examination of cancer patients to assess affective states (201; 202). The original POMS scale is comprised of 65 items with the shortened version consisting of 37 items, and there is a 0.95 correlation between the two measures (202). The POMS is categorized

into separate subscales with the Vigor-Activity subscale being comprised of the following items: “lively, active, energetic, cheerful, full of pep, and vigorous” (203). In the evaluation of various subscales within the shortened form of the POMS, the internal consistency was 0.76 across six different samples (e.g., breast cancer patients, healthy sample, bone marrow transplant survivors, renal transplant survivors, etc.) and the reliability was at least 0.84 (204).

Perceived Social Support

The Interpersonal Support Evaluation List (ISEL). The ISEL is a measure which is comprised of 48 statements to evaluate an individual’s access to social support by utilizing a 4-point Likert Scale that ranges from “definitely false to definitely true” (205). A shortened 12-item version was used in the BETRHEART study to reduce potential patient burden. The ISEL-12 is comprised of three separate subscales that examine various forms of perceived social support: appraisal, belonging, and tangible (206). “Appraisal” as a form of social support is determined by the availability of someone for the individual to talk to about their concerns and “tangible” is the individual’s perceived access to material aid (206). “Belonging” measures the person’s perceived ability to have other individuals that they can do activities with and “self-esteem” measures the individual’s ability to compare themselves positively with others (206). The ISEL-12 is considered to be both a valid measure among different demographic groups (140) and reliable (i.e., Cronbach alpha of approximately .77) (206). Additionally, analyzing both the total ISEL score and individual subscales has been recommended by previous studies to determine differences seen in forms of social support and to help control for correlations between subscales (207).

Optimism

Life Orientation Test (LOT). Optimism was measured utilizing the Life Orientation Test, a 16-item measure which uses a 5-point Likert scale that ranges from “strongly disagree” to “strongly agree” (208). An example of an item on the LOT is: “I’m always optimistic about my future” (208). The LOT is reliable with a Cronbach alpha of 0.76 and test-retest reliability of 0.79 (208). In more recent studies, the LOT has been utilized to look at the two separate dimensions of optimism and pessimism. To examine the effects of optimism specifically without the potential effects of pessimism, a previous study analyzing CVD risk analyzed optimism as a separate subscale from pessimism (209). The proposed study will utilize a similar approach while evaluating patients with HF.

Coping through Spirituality and Acceptance Based Coping

The COPE. The COPE is a sixty item self-report measure that utilizes a 4 –point Likert scale, ranging from a 1 to notate “I usually don’t do this at all” to a 4 to notate “I usually do this a lot”, to determine how individuals respond to stressful situations. The COPE includes such statements as: “I concentrate my efforts on doing something about it” and “I seek God’s help” (189). The brief COPE is comprised of 16 items from the original COPE measure but was minimized to reduce patient burden (210). The Brief COPE, similar to the original measure, is further comprised of separate subscales to evaluate various methods of coping with two items measuring the usage of religion or spirituality and two items measuring acceptance based coping (210). The Brief COPE has been found to have good internal reliability with religion items and acceptance items forming distinct factors separate from other subscales (210).

The BETRHEART study utilized the Brief COPE for the majority of patients to help reduce the burden of filling out self-report measures. Only approximately 21.7% of participants

that completed the COPE measure completed the original longer COPE during the BETRHEART study. A T-test comparing the means for participants from each measure (i.e., the COPE and Brief COPE) was conducted to determine if there was a significant difference in the two measures for this particular sample. There was not a significant difference in the scores for acceptance on the Brief COPE ($M=2.99$, $SD=0.86$) and COPE ($M=3.11$, $SD=0.82$); $t(135)=0.72$, $p = 0.94$. There was also not a significant difference in the scores for religion on the Brief COPE ($M=2.90$, $SD=1.12$) and COPE ($M=2.77$, $SD=1.21$) conditions; $t(135)=-0.57$, $p = 0.42$. Therefore, collapsing similar items was considered sufficient for measuring coping through religion and spirituality and acceptance-based coping.

Although there are several other subscales that could have been utilized from the COPE, such as “Behavioral Disengagement”, “Emotional Social Support”, or “Denial”, the current study chose these two particular subscales (i.e., coping through spirituality/Religious coping and Acceptance) due to them representing distinct components that were not expected to overlap with other psychosocial measures in HF patients (189). Additionally, both spirituality/religion and acceptance have been explored within the disease literature as potential protective factors in regards to mortality and morbidity and this study aimed to see if this relationship was similar in HF patients (186; 191; 192). The current study is also focusing on protective factors in HF patients and therefore subscales that are described as “less useful” or negative coping styles, such as “Behavioral Disengagement” and “Denial” were not included as they would be anticipated to be risk factors instead (211).

Self-Efficacy

Kansas City Cardiomyopathy Questionnaire (KCCQ). The KCCQ is a well-validated 23-item self-report measure utilized to examine health-related quality of life in HF

patients (212). The measure is further comprised of separate sub-scales that assess for various domains related to quality of life and health, such as physical limitation, symptoms, quality of life, social interference, and self-efficacy (212). In the examination of KCCQ domains, all subscales were found to be reliable with self-efficacy having a Cronbach's alpha of 0.62 (212). Self-efficacy scores have been seen to improve over time in HF patients, and this may be due to patients gaining a better understanding of their disease after hospitalization (212). The KCCQ self-efficacy subscale is calculated from two items on the overall KCCQ measure (212). Items measuring self-efficacy ask the patient to rank on a Likert scale "how well do you understand what things you are able to do to keep your heart failure symptoms from getting worse? (For example, weighing yourself, eating a low salt diet, etc.)" (212).

Ad Hoc Self-Efficacy Scale. A fourteen-item ad hoc self-efficacy measure previously utilized by Keith (2017) and the BETRHEART study was also used in the current study. The measure asks the individual to rate on a five-point Likert scale how "certain" they feel they are able to do a range of tasks, such as "take medications at the right time" or "take time to relax." This ad hoc scale is similar to ones created to measure self-efficacy in populations with cardiac related concerns, such as the Cardiac Self-Efficacy Scale (213). Keith (2017) found the ad hoc self-efficacy scale to have adequate internal reliability (Cronbach's alpha of 0.90). The average score of the fourteen items from the ad hoc measure was used for the current study to reflect the participant's perceived self-efficacy.

Behavioral Variables

Sleep Quality

MHPQ. The previously described MHPQ was also utilized to examine sleep quality. As reviewed earlier, an individual reporting difficulty falling back asleep or waking up too early

often indicates insomnia and poor sleep quality. The MHPQ assesses for poor sleep quality by asking the participant “How many minutes of sleep did you lose last night because you had difficulty falling asleep or woke up and couldn’t go back to sleep?” The measure also asks the participant to indicate if they feel rested when they woke up in the morning.

Since these items were not part of a standardized questionnaire, the items were correlated with a more widely used sleep questionnaire, the Pittsburgh Sleep Quality Index or PSQI. The PSQI is a ten-item validated sleep questionnaire that evaluates an individual’s sleep efficiency (i.e., actual duration in comparison to total time in bed) and quality of sleep (214). The PSQI asks individuals questions regarding the time they go to bed and approximately how long it takes for them to fall asleep within the past month (214). The item on the PSQI utilized to assess quality of sleep asks the participant to rate on a four-point Likert scale (i.e., “1-Very Good to 4-Very Bad”, “How would you rate your sleep quality overall?” (214).

Since the PSQI was only administered at baseline assessment to a minority of patients in the BETRHEART study, it could not be utilized in the data analyses in the present study because of missing data. To validate the MHPQ sleep items, available sleep quality data from the PSQI was correlated with the two above items from the MHPQ utilizing SPSS (Version 25). The first sleep item from the MHPQ was significantly correlated ($r = 0.55, p < 0.05$) with the sleep quality index on the PSQI, with individuals reporting poorer sleep quality if they were experiencing a loss of sleep (e.g., over 30 minutes to fall back asleep). The second sleep item from the MHPQ, which asked the participant to respond if they felt rested or not, was also significantly correlated with the sleep quality index from the PSQI ($r = -0.61, p < 0.01$). Therefore, we utilized the 2 sleep items on the MHPQ as a measure of sleep quality.

Medication Adherence

Morisky Adherence Scale. The Morisky Adherence Scale consists of 19 statements and questions that ask about medication adherence. Questions inquire if the individual forgets to take their medication, if they understand their medication regimen, and if they are aware of any potential side effects (215). Adherence scores on the scale are considered to have predictive validity of blood pressure control (215). Sensitivity of the measure is found to be 93% and specificity has been found to be 53%, which indicates the Morisky Adherence Scale accurately classifies individuals who have difficulty with medication adherence (i.e., low adherence) (216). The present study will utilize the measure to determine if the participant has been adherent to their medication regimen as a component of the overall “Behavioral Protective Factor”.

Adherence to a Healthy Diet

Dietary Compliance Survey. The dietary compliance survey is a brief self-report measured utilized in the BETRHEART study. The survey asks patients to rate on a 5-point Likert scale, which ranges from “1-Always “ to “5-None of the time”, how frequently in the previous week they have engaged in healthy eating behaviors (e.g., “avoid salty food, read food labels for sodium content when buying or eating food?”). The survey also asks patients to notate the frequency of eating particular foods within the past three days, such as bacon, smoked salmon, soy sauce, and etc. Items for the dietary compliance survey were adapted from a previous study of HF patients that evaluated their readiness to change through the Transtheoretical Model to adjust health behaviors (217) and will be evaluated using a Confirmatory Factor Analysis initially to determine if the items adequately are correlated with each other to measure adherence to a healthy diet.

Physical Activity

Information on the patient's physical activity was obtained from an item on the MHPQ during the original BETRHEART study, which asks, "did you exercise long enough to work up a sweat or get your heart pumping in the past 24 hours?" and if so, to indicate the duration of the exercise. Although this item lacked both reliability and validity data, it was still included due to the relevance of physical activity as a factor promoting better outcomes in HF patients (121; 129) and because it is going to be comprising the "Behavioral Protective Factor."

Outcome Variables

Health Status

Kansas City Cardiomyopathy Questionnaire (KCCQ)-Clinical Summary.

As described previously, the KCCQ is a 23-item self-report measure utilized to examine health related quality of life in HF patients and is comprised of separate domains (212). The clinical summary has high internal consistency with a Cronbach's alpha of 0.95 (212). The clinical summary score is highly correlated with a HF patient's NYHA class and survival outcomes, such as hospitalizations and mortality (212). The KCCQ Clinical Summary score is calculated by combining the physical limitation score (measured by six items) and HF total symptom scores (seven items measuring symptom frequency and perceived burden) (212). The overall summary score is not being utilized for data analysis due to the inclusion of quality of life and social limitations as a portion of the overall score, which are anticipated to overlap with psychosocial variables.

Hospitalizations

Information regarding hospitalizations was recorded both during the baseline until the 9-month follow-up period, and up to a 39-month follow-up period (during phone follow-ups every

six months). Refer to Figure 2 for the original BETRHEART study timeline and assessment time points. Hospitalization information was obtained from both the study participant and verified by UMMC HF clinic staff within the participant's medical record. Hospitalizations were then further delineated into three separate categories: (1) HF-related (i.e., pump related or fluid), (2) cardiovascular-related (i.e., angina, MI, Ischemia, and procedures such as a coronary bypass), and (3) all-cause hospitalizations (i.e., cardiovascular-related, HF-related, and non-cardiovascular related). A clinical research specialist at the UMMC HF Clinic confirmed categorization for each hospitalization type. For the purpose of the current study, hospitalizations will be evaluated as they pertain to HF-related, cardiovascular-related, and all cause.

DATA ANALYTIC PLAN

Overview of Structural Equation Modeling

Structural equation modeling (SEM) using MPlus statistical software (Version 8) by Muthén and Muthén (1998-2017) was used for the primary data analyses in the study. An advantage of SEM is that it will allow us to look at potential effects of both measured variables (i.e., items on the POMS) and non-observed (latent) variables, such as the proposed factor the "Psychosocial Protective Factor" (218). Refer to Table 2 for a more detailed description of the observed variables being utilized in the current study and latent factors being explored through the SEM model.

SEM is comprised of several smaller steps that create both a measurement model and a structural model: (1) SEM utilizes Confirmatory Factor Analysis (CFA) first as a measurement model, to determine if observed variables (i.e., measure items) accurately depict the factor they are designed to measure, such as positive affect, or if they should be removed from the proposed model. CFA is considered a more effective method of testing item and instrument reliability than the standard Pearson's correlation values because of its ability to examine items on multiple

types of scales, such as interval, nominal, and ordinal (219). (2) A CFA is conducted for each factor being included within the study analysis for the potential model. A CFA also estimates correlations and measurement error for each observed variables to compare against model fit indices. (3) Items are removed from the potential model, after the CFA, by utilizing several model-fit-indices, such as the Tucker-Lewis Index and Comparative Fit Index. (4) Measurement models are considered to have adequate fit and the latent factors (e.g., “Psychosocial Protective Factor” or “Behavioral Protective Factor”) are then evaluated as two separate variables instead of as multiple items from various scales (e.g., POMS and MHPQ). (5) Then the next step was to evaluate the created structural model to determine potential relationships between latent factors and dependent variables.

Fit for each measure through the CFA will be determined by utilizing four goodness-of-fit indices that are widely used within the literature: Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and the Root-mean-square error of approximation (RMSEA). The RMSEA Index is the “difference between the observed covariance per degree of freedom and the hypothesized covariance” (220). The model is considered to be a good fit when the RMSEA is less than 0.08, and the TLI is 0.90-0.97 (220). CFI is an index used to determine the goodness of fit for the model and centrality of the index, with an acceptable fit determined by a value greater than 0.95 (220). The Chi Square Test of Model Fit was considered when examining CFA and SEM analyses. The Chi Square Test of Model Fit value assumes normality within the sample distribution but is sensitive to sample size (220), therefore a nonsignificant Chi Square Test of Model Fit value was used as one of the additional measures of adequate model fit. Additionally, any variables in the SEM analyses that are considered categorical or binary utilized the weighted least squares means and variance (WLSMV) estimator (221).

Following an SEM approach, protective variables were examined in additional regression analyses utilizing SPSS: Version 25 to determine which variable is causing the most significant impact on HF outcomes (e.g., examining the relationship between Positive Affect items and hospitalizations). Finally, cohabitation and marital status were examined through regression analyses to determine if they should be included as potential covariates (in addition to the demographic related covariates discussed below).

Covariates in the SEM analyses included: age, sex, race, household income/SES, Body Mass Index (BMI), and time in study. Covariates were chosen due to demographic differences found in previous studies (i.e., higher hospitalization rates for Blacks, men, and older adults) of HF patients (222; 223) and to replicate covariates selected from a previous study with the current study's sample (149). There have been mixed findings within the literature regarding BMI and household income/SES. Some studies have claimed that higher BMI is associated with increased mortality and hospitalization rates in HF patients, and others have suggested that higher BMI is inversely related to hospitalization and mortality rates (54; 224; 225). Lower income HF patients are also seen to be more at risk of hospitalization readmission, due to suspected lower access to care, and this factor as a potential covariate was included to account for any differences that may be seen in the current study's sample (40; 226). Time in study (TIS) was added to account for variations in measure administration times and due to participants dropping out of the study before 39-months.

Aim One Analyses

Aim One was first explored through Confirmatory Factor Analysis (CFA) to determine if items from each of the psychosocial measures utilized in the current study accurately depict the scales they are designed to measure. For example, the CFA determined if

each of the items on the LOT subscale accurately measured the proposed variable of optimism. Items from each measure that were determined to reflect the psychosocial domain accurately that they are designed to measure (e.g., items from the LOT being significantly associated with optimism) were included in the structural model for the “Psychosocial Protective Factor.” Model fit criteria for the theoretical model was determined by the previously described model fit indices (CFI, TLI, Chi Square Test of Model Fit, and RMSEA) during the CFA. Factor loading estimates were also evaluated, and any indicators with a low magnitude (less than 0.50) were removed from further analysis to ensure the model is a strong representation of the proposed general factor.

Aim Two Analyses

The process of conducting a CFA, as described previously, was repeated to determine if items from each of the health behavior scales utilized for the current study accurately measured their particular latent variables, such as sleep quality. The same goodness-of-fit indexes (CFI, TLI, Chi Square Test of Model Fit, and RMSEA) were utilized to determine if the observed variables obtained from various measurement items are going to be included in the structural model for the “Behavioral Protective Factor” in subsequent aims. Model fit criteria, based on the indices previously described, and factor loading estimates determined which measures were retained for the overall theoretical model for “Protective Behavioral Factor.”

Any scales that contained less than three items were not able to undergo a CFA, and instead, reliability measures from previous studies were utilized. Factor analyses consisting of less than three variables (i.e., items) cannot be conducted in a CFA (227). In this particular study, sleep quality was only measured by the sum of two items and therefore could not be analyzed through a CFA. However, as mentioned previously, the two items measuring sleep quality for this study were significantly correlated with the widely utilized and reliable PSQI. Similarly,

physical activity was only measured by one item but was still included within the model for Aim Two analyses due to its correlation with outcomes in HF patients from prior research (121; 122).

Aim Three and Aim Four Analyses

To investigate Aim Three, a CFA was utilized again to determine if the “Psychosocial Protective Factor” is accurately measured by various robust psychosocial indicators, to include: items from the POMS, positive affect items from the MHPQ, items from the LOT, ISEL, COPE, KCCQ Self-Efficacy scale, and the Ad Hoc Self-Efficacy scale. Similar to before, goodness-of-fit for the model was determined by various indices: CFI, TLI, Chi Square Test of Model Fit, and RMSEA. The magnitude for factor loading estimates was also considered for the “Psychosocial Protective Factor.”

Aim Four was investigated through a CFA to determine if the “Behavioral Protective Factor” was accurately measured by various behavioral indicators, to include: sleep items and the physical activity item from the MHPQ, items from the Dietary Compliance Survey, and medication adherence items from the Morisky Adherence Scale. Goodness-of-fit for the model was again determined by CFI, TLI, the Chi Square Test of Model Fit, and RMSEA. Factor loading estimates for the “Behavioral Protective Factor” were also evaluated by examining magnitudes (≥ 0.50).

Aim Five Analyses

Aim Five utilized the final step of the SEM, similar to a regression analysis, by running separate analyses to determine the influence of “Psychosocial Protective Factor” and “Behavioral Protective Factor” on hospitalizations and health status in HF patients. The analyses were analyzed as eight separate models (one analysis per hospitalization type and for the KCCQ Clinical Summary scores at both 9-month follow-up and up to 39-months). For example,

“Psychosocial Protective Factor” was examined to determine how it is associated with short-term KCCQ Clinical Summary Scores (9 months after baseline). As discussed previously, the KCCQ Clinical Summary score is the one that most closely corresponds with NYHA classifications for HF and evaluates the individuals total HF symptom score (seven items measuring symptom frequency and perceived burden), and physical limitations (measured by six items).

ACCOUNTING FOR MISSING DATA

Another advantage of SEM in comparison to other regression models is it compensates for any potential missing data through Full-Information Maximum Likelihood (FIML). FIML utilizes “observed responses” (i.e., items that were filled out on a measure) to account for any missing information that is assumed to have been missed at random, such as forgetting to fill out a few items on a measure (228). During an SEM analysis, FIML utilizes any information from data in a measure to create an algorithm to determine what the model would be if it wasn’t missing data. Other methods to impute or account for missing data, such as mean substitution or listwise deletion, are not recommended (228).

POWER

There is conflict within the general literature in regards to the best way to do a power analysis for SEM analyses with some arguing that calculating power based on a MANOVA is sufficient. (229). One recommendation for determining sufficient sample size for an SEM is utilizing the Monte Carlo Method, which requires multiple simulations to be run by generating “data from hypothesized parameter values” (230) but the resulting required sample size is not conclusive and can range from 30-460 participants (231).

Other recommendations for determining appropriate sample size and adequate power for SEM are having at least ten cases per variable and a minimum sample size of at least 100

participants (231). For simplicity, based on the criterion of 10 cases per observed variable or at least 100 participants, the present study will include 147 participants with 14 variables being examined (see Table 2).

REGRESSION ANALYSES

Additionally, to further determine how each psychosocial variable impacts HF outcome variables, regression analyses for each measure were conducted (e.g., examining the impact of optimism as measured by the LOT on HF health status on the KCCQ). The potential impact of additional covariates, such as marital status and cohabitation, were also examined through separate regression analyses to determine if they impact the relationship between the proposed “Psychosocial Protective Factor” and “Behavioral Protective Factor” on HF outcomes.

CHAPTER 4: Results

SAMPLE CHARACTERISTICS

Physiological and Demographic Characteristics

The overall sample consisted of 147 participants from the BETRHEART study. The sample was predominately male (75.9%) and had an average age of 57.41 years. The sample was predominately African American (70.1%), had 29.3% individuals that identified as Caucasian, and only 0.68% of individuals that identified their race as being either “Asian/Native American” or “Other.” The Average BMI for the sample was 30.81, which the National Institute of Health (NIH) categorizes as an individual having obesity (228). The majority of the overall sample was classified as having non-ischemic heart failure (54.6%), with 45.4% of individuals being diagnosed with ischemic HF. The average ejection fraction percentage for the sample was 23.14 (SD = 7.48), which is very poor and indicates the severity of HF in this particular sample. The majority of participants also reported they had a history of smoking. Table 3 includes more detailed information on the physiological/biological demographics for the overall sample.

Covariates were examined to determine their correlation with each other and proposed protective variables that were going to be included within the study. Although there were a few significant correlations seen between covariates, it speaks more to the skewness within the demographics for the current study sample (see Table 3). There was a significant small to medium correlation seen between BMI and SES, $r=0.28, p \leq .01$. There was also a significant small to medium correlation seen between BMI and time in study, $r=0.25, p \leq .05$. Collinearity between covariates was then not considered a concern due to the relatively smaller correlation sizes therefore each covariate was determined to have adequate discriminate validity. Table 21 shows the full correlation matrix between psychosocial variables for the study and the covariates.

Follow-Up and Hospitalization Characteristics

Although time in the study was controlled for in the final SEM, there were differences in the amount of time that the patients were available for follow-up. Participants on average were followed up for 26 months (SD = 13.89), but the length of follow-up ranged up to 39-months. Of the 147 participants, 21.8% (N = 32) died during the 39-month entirety of the original BETRHEART study.

In addition to deaths, hospitalizations and their causes were examined. On average, participants reported 3.65 (SD = 9.36) all-cause hospitalizations throughout the entire study. 18.2% (N=53) of participants had no hospitalizations, 8% (N=24) of participants had at least one admission, while 38.1% had between two and ten hospitalizations (N = 56), and 9.5% (N=14) with more than ten hospitalizations. There was one individual with a reported 103 all-cause hospitalizations due to factors, such as not being able to afford to pay for heating in their home and as a result choosing not to be medication adherent to increase their chance of being hospitalized. The majority of reported hospitalizations for participants were cardiovascular-related (53.6%, N = 78), and of the cardiovascular-related hospitalizations, 52 were directly related to HF (35.37%). The number of cardiovascular-related admissions ranged from 1-22, with HF-specific hospitalizations counts ranging from 1-18. Non-cardiovascular related hospitalizations had a multitude of causes, including back pain and gastrointestinal distress. Actual counts for each admission type were truncated into smaller categorical variables due to the skewness of the data. Aim Five below discusses the categorical and binary categories that were utilized (see Figures 3-5 for the skewness of the hospitalization data with the means and standard deviations for each hospitalization cause type).

Psychosocial and Behavioral Characteristics

Psychological, social, and behavioral variables were also measured to determine the characteristics of the overall sample. Mean scores and standard deviations, after being re-scaled, were fairly similar across measures despite sample size differences. Measures were re-scaled due

to the variety in scales (i.e., scales ranging from 0-5 or from 1-4, etc.). Table 4 depicts the overall sample characteristics for the psychological, social, and behavioral measures. Means for each variable and standard deviation represent unadjusted scale scores within Table 4.

Given the possible range of scale scores, participants reported experiencing relatively high positive affect, based on the average baseline total PA score of 22.73 ($SD = 11.46$). Participants also reported relatively high average levels of optimism 11.81 ($SD = 3.19$). Participants generally reported high percentages of perceived average social support on the ISEL's total score ($M = 38.08$, $SD = 6.76$). Self-efficacy, as measured by the Ad Hoc Scale ($M = 53.19$, $SD = 10.7$) and Self-Efficacy subscale from the KCCQ ($M = 87.4$, $SD = 15.1$), was also generally high for participants at the baseline assessment. Engagement in acceptance-based coping was seen to be relatively high in participants ($M = 3.02$, $SD = 0.85$), while participation in religion or spirituality-based coping was relatively low ($M = 0.87$, $SD = 1.14$).

The overall sample reported at baseline that they experienced on average 80 minutes of sleep loss due to difficulty falling asleep or awakening either too early or throughout the previous night ($SD = 109.17$), but the actual amount of sleep loss that was reported between participants was highly variable. Despite a significant amount of time reported sleep loss due to awakenings during the night or taking a while to fall asleep, 65.1% of participants reported that they felt rested. The majority of participants said they did not engage in physical activity or exercise within the past 24 hours at their baseline assessment, with only 37.7% indicating they had exercised. Based on their possible scores on the Dietary Compliance Scale and the Morisky Medication Adherence Scale, on average, participants reported low adherence to a healthy diet at their baseline assessment ($M = 7.70$, $SD = 2.78$) but relatively high rates of medication adherence ($M = 1.78$, $SD = 1.82$).

AIM ONE

The purpose of Aim One was to determine if items from each scale were associated with each other and represented their particular construct best (i.e., latent variable). Any items that did

not retain high enough factor loadings were removed from further analysis to ensure the most robust items were utilized to measure the theoretical “Psychosocial Factor” for Aim Three. The following sections show the initial CFA results for each of the observed variables.

Positive Affect

The final sample size for this measure, utilizing the PA items from the Mood and Health Practices Questionnaire, was 147. Due to a CFA with categorical variables, particularly with low frequencies in any one category, variables were collapsed into a 2-point binary scale instead of the original 5-point Likert scale (e.g., values either less than or equal to one, or greater than 1). Model fit indices from the CFA were mixed ($\chi^2 = 64.17$, $p = 0.00$; CFI = 0.95, TLI = 0.94, and RMSEA = 0.10). After removing three of the items (“full of pep,” “lively” and “energetic”) in the overall model, due to lower factor loadings, the remaining items obtained an adequate fit for the model ($\chi^2 = 9.24$, $p = 0.42$, CFI = 0.99, TLI = 0.99, and RMSEA = 0.01). Refer to Table 5 for more details on the CFA results for PA.

The final sample size, for PA items from the POMS, was 144. Initial CFA analyses indicated that item six (“vigorous”) had a relatively lower unstandardized factor-loading estimate (Unstandardized factor-loading estimate: 0.82; Standardized factor-loading: 0.67), in comparison to the other five items. After item six was removed, the CFA found that the remaining five items adequately measured PA ($\chi^2 = 7.12$, $p = 0.21$, CFI = 0.99, and RMSEA = 0.05). The TLI was adequate (0.99), so the remaining five items were still retained due to adequate goodness-of-fit with the majority of indices (see Table 6). The remaining items for PA on the POMS “Vigor-Activity” subscale were still included within the model for the “Psychosocial Protective Factor.”

Optimism

The final sample size for this measure was 126 due to missing data. The CFA found that Optimism overall had adequate model fit ($\chi^2 = 0.45$, $p = 0.78$; CFI = 1.0, TLI = 1.03, and RMSEA = 0.00) and all of the four items from the LOT had adequate magnitude (at least 0.50). All items overall showed adequate factor loading estimates for Optimism and had unstandardized

values estimated over 0.90 (see Table 7). Overall, participants reported moderate Optimism (indicating that they felt either “neutral” or agreed to statements examining Optimism).

Social Support

The final sample size was 133 for social support items, as measured by the ISEL. The CFA found that after removing six of the items with weaker factor loadings, the model was determined to have adequate fit ($X^2 = 10.95$, $p = 0.28$; CFI = 0.99, TLI = 0.98, and RMSEA = 0.04). All items overall showed adequate factor loadings for social Support (see Table 8).

Acceptance based Coping and Coping through Spirituality

As stated previously, both acceptance-based coping and coping through spirituality/religion were measured from two similar items from the Brief COPE and COPE measures. One such similar item for religion/spirituality was the original COPE stated “I try to find comfort in my religion” and the Brief COPE stated “I’ve been trying to find comfort in my religion or spiritual beliefs.” Direct correlation analyses couldn’t be conducted to compare the two versions of the measure, due to participants not filling out two different versions, but the measures were still retained for the current study due to the phrasing being nearly identical and ample reliability testing in the larger literature. Additionally, a minimum of three items is necessary to conduct a CFA on a measure, therefore; a CFA could not be completed on these particular measures.

Previous reliability testing for the COPE found a Cronbach’s alpha of 0.92 for religion (i.e., spirituality) items and 0.65 for acceptance items (187). The Brief COPE had a Cronbach’s alpha of 0.82 for coping utilizing religion items and 0.57 for acceptance-based coping (208). Despite the slightly weaker reliability ratings found for the original Brief COPE, the similar items from both measures will still be utilized in the current study for the general “Psychosocial Protective Factor” in the model. Items from the COPE and Brief COPE were most similar in

magnitude with other scales as a sum instead of an average, partially due to the scale only being comprised of two items, and as a result, the sum was used instead.

Self-Efficacy

The KCCQ self-efficacy scale only consists of two items and is insufficient to conduct a CFA on the exact measure. As stated previously, the KCCQ Self-Efficacy scale has an adequate Cronbach's alpha of 0.62 (209) and was still included within the model for the "Psychosocial Protective Factor." As described previously in the measures section, the ad-hoc self-efficacy scale has not been heavily validated but is comprised of items similar to those used in the Cardiac Self-Efficacy scale (210), which is why it was considered important to additionally examine self-efficacy in HF patients.

When these items were utilized within the CFA, the overall model was determined to not be an adequate fit due to items potentially measuring more than one factor. Removing items with relatively low factor loadings from the CFA also did not yield results within sufficient "goodness-of-fit" ranges, despite reliability testing finding a Cronbach's alpha of 0.88. Differences seen may be due to the measure examining self-efficacy in a general sense (i.e., "...able to relax") and disease-specific (i.e., "...understand your illness"). The current study will only be examining average total scores for self-efficacy, and due to the limited items from the KCCQ subscale and high Cronbach's alpha of the ad hoc scale; all fourteen items were still included as an average within the theoretical model to represent Self-Efficacy.

AIM TWO

The purpose of Aim Two, similar to the first aim, was to determine if each of the items for the observed behavioral variables represents the construct they are designed to measure adequately for inclusion within the proposed "Behavioral Protective Factor." A CFA was

conducted for each latent variable by evaluating items on each behavioral measure and any items without adequate significant factor loadings was subsequently removed from the model. The following sections depict the findings from the initial CFA analysis for each observed variable from their respective original measures (Sleep Quality, Physical Activity, Medication Adherence, and Adherence to a Healthy Diet).

Sleep Quality and Physical Activity

One of the limitations of the measure for Sleep Quality in the current study is that only two items were available to be utilized. As discussed previously, both of these items were correlated with the sleep quality item from the PSQI and were then considered robust enough for inclusion in the current study. Due to the nature of a CFA, further analysis could not be conducted for Aim Two in regards to “Sleep Quality.” Instead, these two items were included within the analysis for Aim Four to determine if they fit within the theoretical model for “Behavioral Protective Factor.” As reviewed previously, physical activity is associated with the prevention of heart disease and better prognosis in individuals already diagnosed with heart disease or HF (119; 121). Physical activity was similarly only measured by one item but was considered necessary for inclusion within the model due to prior research on heart disease and HF.

Medication Adherence

All eight items analyzed during the CFA on the Morisky Adherence scale adequately fit for Medication Adherence ($\chi^2 = 25.25$, $p = 0.19$; CFI = 0.96, TLI = .95, and RMSEA = .04) and were considered to be adequate indicators for Medication Adherence. Possible skewness was also evaluated and determined to be within normal limits, but participants predominately reported being adherent to medication on observed variables. Table 9 depicts the unstandardized

factor loadings for the different measure items with “Medication Adherence” being considered the overall single factor in the CFA.

Adherence to a Healthy Diet

A correlation analysis was conducted to determine if the three items being utilized to measure dietary compliance were associated with each other. One item, that measured if the participant ingested the recommended amount of water, was not correlated with the other two items and was subsequently removed ($r = -0.00$, $p = 0.96$). The remaining two items, “How often in the past week did you avoid salty foods?” and “How often in the past week did you read food labels for sodium content when buying or eating food?” had a significant medium correlation ($r = 0.40$, $p = 0.00$). A CFA was unable to be conducted due to there only being two items remaining and the Cronbach’s alpha for the two items was relatively low ($\alpha = 0.55$), but these items were retained due to the emphasis on maintaining a healthy diet in HF patients within the larger literature (5; 127).

AIM THREE

The purpose of Aim Three was to examine if the remaining adequate items, representing psychological and social protective latent variables, (e.g., PA items from the Mood and Health Practices Questionnaire, etc.) are associated and then comprise an overall factor (i.e., “Psychosocial Protective Factor”). Similar to Aim One, only observed variables with sufficient factor loading estimates were retained and model-fit-indices were utilized to determine if the remaining variables represented the proposed factor adequately.

Psychosocial Protective Factor

A CFA was conducted with all eight potential observed variables included that examine positive affect, optimism, self-efficacy, social support, coping through spirituality, and

acceptance based coping items. For each scale, an average or sum of all of the scale items was utilized for observed variables and values were rescaled to stay consistent with a 0-5 range. The CFA determined that self-efficacy and social support, as measured by the KCCQ Self-Efficacy subscale and ISEL respectively, had low factor loadings. Table 10 reflects the factor loading estimates of the complete proposed factor for Aim Three, and model-fit-indices, prior to the items from these two measures being removed from the ultimate model.

The CFA was then conducted again, without the KCCQ self-efficacy subscale and the ISEL, to determine if the remaining variables sufficiently measure the proposed “Psychosocial Protective Factor.” Despite adequate factor loadings (magnitude of at least 0.50), the overall theoretical model still was inadequate (as determined by poor model fit indices). Both the CFI and TLI estimates were below 0.95, and the estimated Chi-Square value was significant ($\chi^2 = 31.89, p \leq 0.01$). The RMSEA estimate was the only value that indicated potentially an adequate fit and was found to be 0.00.

Modification indices were utilized in the CFA to determine if there were parameters that could be adjusted to make the model fit better. Modification indices operate by freeing constrained parameters (i.e., the observed variables/items) and if the suggested freed parameters to the model improve the significance of model fit indices, then the modified model is utilized (232). Additionally, correlated measurement errors not included within a model can impact both the overall power for the analysis and mask potentially significant effects between variables (232). The modification indices determined that four of the subscales were highly correlated with each other, and suggested correlated measurement errors between these particular subscales should be controlled for in the CFA.

Due to factor loadings with adequate magnitude, yet poor model fit indices, the CFA was conducted a final time while controlling for potential correlated measurement errors between the observed variables that were highly correlated. The correlated measurement error between coping through religion/spirituality and acceptance-based coping was added due to the items being highly correlated and the fact that items were coming from the same measure (Brief COPE and COPE). The correlated measurement error between the average POMS subscale score and the PA average score from the MHPQ were also added since both variables measure items consistent with positive affect.

After accounting for the correlated measurement errors of the variables, the remaining 6 variables had adequate model-fit-indices and factor loadings and were included for the “Psychosocial Protective Factor” ($\chi^2 = 4.09$, $p = 0.77$, CFI = 1.00, TLI = 1.00, RMSEA = 0.00). Since all the goodness of fit indices were acceptable, the remaining 6 variables were still included for the final factor model of “Psychosocial Protective Factor.” The final observed variables for the “Psychosocial Protective Factor” are then the averages of PA items from the Mood & Health Practices Questionnaire and POMS, the average of optimism items from the LOT, the average of self-efficacy items from the Ad Hoc scale, the sum of the acceptance-based coping items from the COPE scales, and the sum of the coping through spirituality items from the COPE scales.

AIM FOUR

Similar to Aim Three, the purpose of Aim Four was to examine if the remaining adequate items from each behavioral measure are associated and represent an overall latent factor (i.e., “Behavioral Protective Factor”). Similar to the previous aims, only observed variables with sufficient significant factor loadings were retained and model-fit-indices will be utilized to

determine if the remaining variables represent the proposed “Behavioral Protective Factor” adequately.

Behavioral Protective Factor

An additional CFA was conducted with all eight potential observed variables/items included that examine sleep quality, physical activity, medication adherence, and dietary compliance. In preparation for the CFA, values were re-coded to binary (yes/no). Values coded as “yes,” indicate an individual reported; being adherent to their medication, had a good quality of sleep, was physically active, and compliant with a healthy diet. For the dietary compliance items, values were recorded into three separate categories (“always,” “most of the time,” and “some of the time to none.” After running a correlation of the new re-coded values, item 8 of the Morisky Adherence Scale was negatively correlated with the rest of the scale ($r = -0.40$, $p \leq .001$) and was subsequently removed from further analysis since the item was not adequately measuring medication adherence in this sample. Table 11a depicts the factor loadings for the Morisky Adherence Scale items after being recoded as binary values, and shows adequate magnitude for each item (with the lowest unstandardized factor loading estimate being 0.78).

The initial CFA conducted yielded poor model-fit-indices due to an overall low association between observed variables; therefore suggesting the variables did not comprise a latent factor and that they might be better examined in HF patients as four separate factors (Dietary Compliance, Medication Adherence, Physical Activity. and Sleep Quality). However; due to its low correlation with all other potential variables and because a CFA cannot be conducted with only one item, physical activity was removed from further analysis for the model as well. Instead, the CFA was conducted again as a three-factor model (Dietary Compliance, Medication Adherence, and Sleep Quality) to determine if each of the observed variables (i.e.,

measure items) adequately represented their own proposed factors. Overall, the respective remaining items had adequate factor loading estimates as a three-factor model ($X^2 = 35.83$, $p > 0.5$, CFI and TLI were > 0.95 , and RMSEA estimate below 0.05). See Table 11a for the overall model (Aim Three and Aim Four) with corresponding factor loadings and overall model-fit-indices.

Potential correlations between factors were also examined, and there were some distinct differences seen when utilizing standardized and unstandardized estimates. Overall, Sleep Quality and Psychosocial Protective Factor were significantly correlated with each other (Unstandardized Estimate: $r = 0.19$, $p = 0.01$; Standardized Estimate: $r = 0.42$, $p = 0.00$). There were no significant correlations seen between other factors when examining the values in an unstandardized format. Standardized values showed a significant correlation between Dietary Compliance and Medication Adherence ($r = 0.32$, $p = 0.02$), and Dietary Compliance and Psychosocial Protective Factor ($r = 0.30$, $p = 0.013$). Table 11b shows both the standardized and unstandardized correlation estimates and standard errors between factors.

Further examination of correlations between specific items for both the Sleep Quality Factor and Psychosocial Protective Factor, using a bivariate correlation analysis, showed that average Positive Affect scores were significantly correlated with the Sleep Loss item ($r = 0.32$, $p = 0.00$). Additionally, average scores on the POMS were significantly correlated with the “Feeling Rested” item for the Sleep Quality Factor ($r = 0.23$, $p = 0.02$). A couple of the behavioral variables also had significant correlations between factors when standardized values were examined (Dietary Compliance and Medication Adherence: $r = 0.32$, $p = 0.02$; Psychosocial Protective Factor and Dietary Compliance $r = 0.29$, $p = 0.01$) and these are represented in Table 11b. However; further examination of correlations between individual

items showed only one of the Medication Adherence items (MA7) was significantly correlated with average Ad Hoc Self-Efficacy scores ($r = 0.23, p = 0.02$).

AIM FIVE

The purpose of the final aim was to determine if the proposed protective factors predicted better health outcomes (i.e., less reported symptom burden, fewer hospitalizations) in HF patients at both a short-term (9 months) and longer-term (between 9 -39 months) follow-up. Additionally, in the current study, the overall sample N was smaller for the KCCQ at the shorter-term follow-up (N=95) because the longer-term (N=111) follow-up (i.e., last KCCQ collected) allowed for a more extended period of time for data to be collected. Similarly, long-term hospitalization counts allowed for more potential hospitalizations (due to the amount of time that the participant was potentially in the study increased from 9 months to 39 months).

In the following sections, results for Aim 5 for both KCCQ and hospitalizations will first be presented for short-term outcomes (9 months after baseline), and second for long-term follow-up (up to 39 months). Figure 6 depicts the overall theoretical model for the four-factor SEM analyses, with short-term KCCQ Clinical Summary scores as the example outcome variable.

Short-Term Outcomes (9 months after baseline)

KCCQ. As discussed previously, KCCQ Clinical Summary Scores for short-term KCCQ analyses, model fit and how the four determined latent factors (“Dietary Compliance”, “Medication Adherence”, “Sleep Quality”, and “Psychosocial Protective Factor”) predicted short-term KCCQ scores was first examined without including covariates in the model. After finding the covariates were not significantly associated, the original regression coefficients and model-fit-indices were kept (see Table 12b). “Psychosocial Protective Factor” significantly predicted short-term KCCQ scores [$X^2(124) = 119.18, p = 0.61, CFI = 1.00, TFI = 1.00, RMSEA = 0.00, B = 11.62, p = 0.02$; see Figure 6]. This significant finding means that for

every one unit increase a participant has in the theoretical “Psychosocial Protective Factor”, KCCQ Clinical Summary scores increase by 11.62 on a 100-point scale. In other words, people with a higher Psychosocial Protective Factor are predicted to have lower HF symptom burden and better health status up to 9 months after their initial baseline assessment. The other three factors were all nonsignificant predictors of short-term KCCQ Clinical Summary scores. Regression coefficients for all four factors and the model fit-indices for Aim 5 for the dependent variable of short-term KCCQ Clinical Summary scores) are further reflected in Table 12a.

Hospitalizations. The relationship between the four protective factors (“Dietary Compliance”, “Medication Adherence”, “Sleep Quality”, and “Psychosocial Protective Factor”) was examined for their potential relationship with all cause, cardiovascular, and HF-related hospitalizations. All cause hospitalizations included hospitalizations for any reason including HF-related, cardiovascular-related, and those not associated with cardiovascular disease. The skewness of admissions, as described previously in the section on demographic outcomes, is further shown in Figures 3-5. Due to the skewness of the hospitalization counts (See hospitalization information, pgs. 57-58), hospitalization counts for short-term outcomes were re-coded into binary yes/no variables (0 = no hospitalizations and 1 = 1 or more hospitalizations) for all short-term hospitalization analyses. Categorical values were utilized instead of a log-transformation due to the risk of increasing the skewness of the hospitalization data. Criticisms of log-transformations have suggested that the method can decrease the natural variability of the data and increase skewness (233). Additionally, study aims were designed to evaluate if protective factors were related to hospitalizations in HF patients (not necessarily the number of hospitalizations). There were also a large proportion of individuals that indicated they were never

hospitalized (see Table 3) and therefore logistic transformation likely would not have reduced the skewedness of the data.

None of the covariates were significantly associated with short-term hospitalization outcomes (see Tables 13b, 14b, and 15b) and were then not included in the model. In these SEM approaches, despite maintaining adequate model-fit-indices, the four proposed predictive protective factors (Dietary Compliance, Medication Adherence, Sleep Quality, and “Psychosocial Protective Factor”), were not significantly associated with short-term hospitalizations (see Tables 13a, 14a, and 15a).

Long-Term Outcomes (Between 9-39 months after baseline)

KCCQ. An SEM was conducted with the four factors (Dietary Compliance, Medication Adherence, Sleep Quality, and “Psychosocial Protective Factor”) included as independent variables, and while using the last KCCQ score collected for participants as the outcome (maximum follow-up period of 39 months). Based on the model fit indices, all four factors maintained a good fit for the overall model but none of the four factors (Dietary Compliance, Medication Adherence, Sleep Quality, and Psychosocial Protective Factor) were significant predictors for long-term KCCQ Clinical Summary scale scores (CFI= 1.00, TFI = 1.00. RMSEA = 0.00, $X^2(158) = 116.54$, $p = .067$; see Table 16a). Therefore, for KCCQ scores, “Psychosocial Protective Factor” is only predictive of shorter-term outcomes in HF patients and not predictive of the same outcomes at longer follow-up. Covariates were then examined to determine their relationship with longer-term KCCQ Clinical Summary scale scores. All of the covariates had a nonsignificant association with long-term KCCQ Clinical Summary scale scores (see Table 16b); therefore, the original model-fit-indices and regression coefficients for factors were retained.

Hospitalizations. The four protective factors (“Dietary Compliance,” “Medication Adherence,” “Sleep Quality,” and “Psychosocial Protective Factor”) were also examined for their potential relationships with longer-term (up to 39 months) all-cause, cardiovascular, and HF-related hospitalizations. For long-term analyses, the larger number of all-cause hospitalizations and CV related hospitalizations enabled us to reduce the skewness of the data and utilize a three-level categorical variable for all-cause and CV hospitalizations (0 = no hospitalizations, 1 = one hospitalization, and 2 = 2 or more hospitalizations). Hospitalization cut-off points for categories were chosen due to the smaller number of participants with hospitalization counts above two and to reduce the skewness of the data. HF-related hospitalizations had a smaller number of counts, 52 total hospitalizations (35.37%, $M = 1.14$, $SD = 2.4$), and were analyzed as a binary (yes/no) variable.

Overall, the four protective factors (“Dietary Compliance”, “Medication Adherence”, “Sleep Quality”, and “Psychosocial Protective Factor”) still retained adequate model-fit-indices (see Tables 17a, 18a, and 19a) but they were not significantly associated with any of the long-term hospitalization types (all-cause, CV-related, and HF-related). When the impact of potential covariates was further examined (see Tables 17ab 18b, and 19b), only time in study (TIS) and age were significant covariates for long-term all-cause hospitalizations [TIS: $B = 0.03$ (0.01), $p = 0.00$; Age: $B = 0.02$ (0.01), $p = 0.02$;] and CV related hospitalizations [TIS: $B = 0.42$ (0.11), $p = 0.00$; Age: $B = 0.23$ (0.09), $p = 0.01$]. Even after controlling for the time in study and age, the four protective factors were still not significant predictors of long-term hospitalizations.

FURTHER REGRESSION ANALYSES OF COVARIATES AND PREDICTORS

Multiple Regression Analyses of Psychosocial Protective Factor on Study Outcomes

Short-Term Outcomes. Multiple regression analyses were used to determine which of the components of “Psychosocial Protective Factor” predicted better short-term outcomes in the study. The regression model was examined both with and without covariates included. Results with covariates included indicated that “Psychosocial Protective Factor” was a significant predictor of short-term KCCQ Clinical Summary scores, $F(2,26) = 3.32, p = .001$. While controlling for covariates, the only significant component scale for the Psychosocial Protective Factors that significantly predicted short-term Clinical Summary KCCQ scores was the POMS Vigor-Activity subscale score (Unstandardized Estimate = 7.84, Standardized Estimate = 0.35, $p = .007$). Not controlling for covariates, the POMS Vigor-Activity subscale was an even stronger significant predictor (Unstandardized Estimate = 9.42, Standardized Estimate = 0.42, $p = .001$), but “coping through religion and spirituality” (Unstandardized Estimate = -4.69, Standardized Estimate = -0.24, $p = .04$) was also a significant predictor of short-term KCCQ Clinical Summary scores. Short-term hospitalizations were analyzed using logistic regression for binary (yes/no) hospitalization outcomes. As in the overall analyses, none of the components of the “Psychosocial Protective Factor” were significant predictors of any of the hospitalization types.

Long-Term Outcomes. Using multiple regression analyses with covariates included, the “Psychosocial Protective Factor” utilized to examine short-term outcomes was also examined in relation to longer-term outcomes. “Psychosocial Protective Factor” was a significant predictor of longer-term KCCQ Clinical Summary scores, $F(12,91) = 2.27, p = .01$. While controlling for covariates, only the POMS Vigor-Activity subscale score was a significant predictor of long-

term KCCQ Clinical Summary scores (Unstandardized Estimate = 7.70, Standardized Estimate = 0.36, $p = .006$). Other components of the “Psychosocial Protective Factor” were not significant predictors of long-term KCCQ Clinical Summary scores (even while not including covariates within the model).

The regression was analyzed again without the LOT and PA scales due to significant correlations and collinearity between scales/variables, and the POMS was still a significant predictor of longer-term KCCQ scores. Although the POMS-Vigor Activity subscale was significantly correlated with other scales (measuring Optimism, Self-Efficacy, and PA; see Table 20) and helped comprise a robust larger model in the SEM, it also was the strongest predictor of KCCQ scores out of each of the variables. Similar to shorter-term outcomes for hospitalizations, due to the skewness of the data, a binary logistic regression (“yes”/“no”) was utilized. The exploratory analyses replicated the lack of significant findings for a predictive relationship between components of the “Psychosocial Protective Factor” and longer-term hospitalizations.

Marital Status and Cohabitation as a Potential Covariate

Because analyses in this study could not be conducted for the social support measure (due to it not being associated with the general Psychosocial Protective Factor), an additional analysis of cohabitation and marital status for their potential impact on both hospitalizations and KCCQ scores within the SEM model was conducted. Cohabitation and marital status were coded as a binary dummy variables with 0 = “single”/ “living alone” and 1 = “partnered”/ “cohabitating.” The sample was overall skewed, with approximately 72% indicating they were single and 71.4% reporting they were cohabitating. Marital status was not significantly associated with shorter-term KCCQ Clinical Summary Scores (Unstandardized Estimate = 2.13, $p > .05$, Standardized Estimate = 0.41, $p > .05$). Similarly, marital status was not significantly associated with longer-

term KCCQ Clinical Summary Scores (Unstandardized Estimate = 5.23, $p > .05$, Standardized Estimate = 0.11, $p > .05$). Cohabitation was also not significantly associated with short-term KCCQ Clinical Summary Scores (Unstandardized Estimate = 2.85, $p > .05$, Standardized Estimate = 0.05, $p > .05$) and long-term KCCQ Clinical Summary Scores (Unstandardized Estimate = 1.48, $p > .05$, Standardized Estimate = 0.03, $p > .05$). The impact on hospitalizations was not further examined due to the original predictive variables not having a significant relationship with any of the hospitalization type outcomes.

CHAPTER 5: Discussion

SUMMARY OF RESULTS

The results from the present study are briefly reviewed in this section; followed by a fuller discussion of the present findings, study limitations, and a consideration of research and clinical implications.

Study Aim One and Aim Two CFA Analyses of Measures

Results for Aims One and Two (the CFAs for all the measures) indicated that not all items within the scales presumed to measure protective factors yielded high factor loading estimates. This result was somewhat surprising since the majority of these individual measures (e.g., the Vigor-Activity POMS subscale, ISEL) had been validated and utilized in many prior studies (202; 206). Differences between the factor structure of the scales seen in the current study and in previous research may have been due to the unique characteristics of the present sample (a majority were African American, lower socioeconomic status, greater severity of HF symptoms, and predominately male).

The majority of the items for PA were significantly associated with one another and had adequate factor loading estimates on the POMS - “Vigor-Activity” subscale. The observed items from the LOT Optimism similarly were retained for the overall model after a CFA was conducted. Some measures (e.g., the Ad Hoc Self-Efficacy subscale or positive affect items included in the “Mood and Health Practices” questionnaire), also were kept in the model because these measures had a high Cronbach alpha or were included in the analyses of the current sample by Keith et al. (2017). Similarly, measures that contained less than three items (e.g., KCCQ Self-Efficacy subscale, both subscales from the Brief COPE and COPE) were also included in

subsequent analyses because of their high reliability (e.g., Cronbach's alpha), even though they could not be analyzed in a CFA. It should be noted that as described within Chapter 2, factors consisting of less than three variables cannot be used in a CFA and have increased risk for estimation errors (232).

Similar to Aim One, Aim Two evaluated measures of health behaviors utilizing a CFA to determine if items were significantly associated with their particular scales and would, therefore, be included in the model for the "Behavioral Protective Factor." Some of the variables could not be examined via a CFA because these variables were comprised of fewer than three items (e.g., Sleep Quality, Physical Activity, Dietary Compliance). As before, these variables were still included in the model for subsequent analyses because they had adequate Cronbach's alphas (Sleep Quality, Physical Activity, and Dietary Compliance) or were associated with better health outcomes in HF patients (119; 120; 127; 128; 131; 132). Other variables (e.g., Morisky Adherence Scale for medication adherence) were maintained in subsequent analyses but had particular items removed due to low factor loadings during the CFA. Further discussion of how particular measures or sample sizes for each scale (see Table 4) may have been impacted by sample demographics are discussed in the subsequent sections.

Aim Three CFA Analyses of Psychosocial Variables

Aim Three examined if the psychosocial variables (positive affect items, optimism items, self-efficacy items, acceptance-based coping, and coping through religion/spirituality) comprised a general "Psychosocial Protective Factor" in HF patients. As for items in analyses of Aims One and Two, some of these measures surprisingly did not yield large factor loadings for their items, and did not demonstrate adequate fit for the model based on various indices utilized (Chi-Square Test of Model fit, CFI, TLI, and RMSEA cut-offs). Therefore, those measures with low factor loadings (i.e., the ISEL, KCCQ self-efficacy subscale) were excluded from the final model. Again, this may be due to the characteristics of the study sample and the need for these particular

scales to be measured in more depth. The current study shows that several of the psychosocial variables were associated with each other. Individuals that had higher levels of positive affect also tended to report higher levels of self-efficacy, optimism, coping through religion, and acceptance based coping. Clustering of protective factors has not been seen widely within the literature and the majority of studies examining clustering of factors in HF patients have focused on risk factors. These various factors clustering together shows the different areas that may be important to examine and enhance in HF patients to improve their overall prognosis. A couple different factors did not cluster with the other psychosocial protective factors, at least in the current study, and these will be discussed more thoroughly below.

Social Support and the ISEL. The literature has shown adequate validity and reliability for the ISEL (140; 206), so it is unclear why the variables did not show a significant association when evaluated in the current study. One particular study noted that there is a lack of extensive examination of the reliability of the ISEL in minority samples, to include African Americans/Blacks (140). The ISEL has predominately been used with cardiovascular disease patients (234; 235) and examined as a CV risk factor in healthy populations (236; 237). However, the ISEL has not used as widely with HF patients (especially African Americans). One particular explanation for the lack of significant findings in the current study is that the ISEL may not be the best measure to examine social support with these particular sample demographics, as evidenced by the few reliability studies that focus on an African American sample with HF (238-240). Of the studies that have directly examined racial differences on the ISEL, African Americans have lower scores for overall (i.e., total social support) in comparison to Caucasians (239). However, a study conducted by Weiss (2015) found no race differences

while comparing Caucasians and African Americans on social support scales of the ISEL in the current study sample.

Studies looking at racial differences with the ISEL have also noted that participants that are classified as African American are more likely to be in a lower SES (238; 239), which may add more difficulty in determining how ISEL scores correlate with other protective measures in the current study. An overlap between covariates, such as SES and race, may also make it harder to determine which protective variable is impacting HF outcomes in the current study (due to the current sample also being predominately within a lower SES and African American).

In those studies that utilized the ISEL in HF patients (241; 242), social support was investigated for its potential impact on risk factors, such as depressive symptoms or while examining quality of life. In this research, there is some evidence of social support and “adaptive coping styles” (i.e., coping through spirituality/religion) being associated with better outcomes, such as increased adherence to self-care behaviors, medication adherence, and etc. (234; 242). Using another SEM analysis of the present study sample, Keith (2017) included Social Support in the final study model as a “higher order variable” but also incorporated the Social Network Index (SNI) measure. The incorporation of the additional SNI measure in the Keith 2017 study then makes it more difficult to determine the effects of social support because it is also examining the size of an individual’s social network vs. social support that may be tangible, offer a sense of belonging, etc. Additionally, there have been conflicting reports on how to best utilize and conduct a CFA with the ISEL (140; 207). One study found that the ISEL is valid both as a single factor (i.e., total score) and as a three-factor model (measuring Appraisal, Belonging, and Tangible support) (140). Another study argued that the ISEL should be examined instead as a four-factor model (207).

The lack of replication of social support in the current sample may then be due to conflicting views on how to best utilize the ISEL within an overall model, an overall skewness in the distribution of the data (e.g., predominately cohabitating, single/unmarried, African American, male, lower SES), and a lack of incorporation of additional measures that may examine more facets of “social support”. Additionally, the mixed arguments within the literature leave unresolved issues on how to best utilize the ISEL to examine social support in HF patients (i.e., as a single-factor or using the multiple factor components). It is possible to speculate then that other variables, such as health behaviors or other psychological variables (e.g., self-efficacy, optimism), may also have had a more significant impact on outcomes in HF patients in the current study.

Self-Efficacy. The current study included the self-efficacy subscale from the KCCQ because this scale was a component of the validated KCCQ measure. The KCCQ Self-Efficacy Scale is not as widely used as a predictor of HF outcomes, and has typically been measured by assessing the participant’s knowledge of their condition and utilization of self-care behaviors (i.e., medication adherence) (243).. On the original KCCQ scale, only two items measure self-efficacy (212), and they do not measure the concept of self-efficacy accurately because they assess for the participant’s knowledge of the disease (versus their perceived ability to manage their disease) (244). The current study sample did not find adequate factor loadings for the KCCQ self-efficacy scale, and its inclusion would have resulted in poor model fit indices, and this may then be due to in part the inability of the subscale to accurately assess for “self-efficacy.” The present study utilized an ad hoc measure for self-efficacy because of its high internal validity and ability to successfully measure self-efficacy in HF patients in a previous study (149).

Correlated measurement errors between observed psychosocial variables.

As expected, psychosocial variables that measured similar concepts or were from the same overall scale were strongly correlated with one another. Therefore, the resulting correlated measurement errors between items (i.e., coping styles from the Brief COPE and COPE, the POMS and PA items) had to be accounted for while conducting the CFA of the proposed “Psychosocial Protective Factor.” Overall, the remaining various psychosocial variables were associated with one another and comprised an overall latent factor (Psychosocial Protective Factor). The models with high factor loadings met adequate model-fit-indices, after accounting for correlated measurement errors.

Aim Four CFA Analyses of Behavioral Variables

Aim Four similarly examined if behavioral variables (physical activity items, medication adherence items, dietary compliance items, and sleep quality items) comprise “Behavioral Protective Factor” in HF patients. In contrast to findings for the Psychosocial Protective Factor, results indicated that there was not a significant association among health behavior variables in this study and that these variables did not form a single factor. For this reason, each of the variables was then analyzed as separate factors (Physical Activity, Sleep Quality, Medication Adherence, and Adherence to a Healthy Diet). Physical Activity in this study was not associated with any of the other behavioral variables, and therefore, could not be included as its own single factor in the CFA since it only was measured by one item.

As discussed previously, the current study used ad hoc measures for both Sleep Quality and Physical Activity. Physical Activity was only measured by one binary item (a factor within an SEM needs at least 2 items) and was therefore not included as a standalone behavioral protective factor. The inability to utilize a measure for Physical Activity was also noted by the

Keith (2017) study that examined the current study's sample, and was believed to be due to the one item not being a sufficient enough measurement of physical activity in individuals.

Furthermore, in prior research, "Physical Activity" as a concept also has its own limitations due to multiple definitions of what physical activity is (i.e., some studies describe it as exercise, different interpretations of the intensity or duration) (245). There has also been a lack of a reliability in examining physical activity (due to accelerometer differences and subjective self-reporting of exercise) (246). A shortcoming of the current study is a lack of more validated measures of physical activity. Future studies would benefit from clearly defining physical activity and validating measures of physical activity through measures with more than just one item.

Prior research (168; 170; 183; 194) has focused on how psychosocial protective variables are associated with protective health behaviors (e.g., medication adherence, dietary compliance, and physical activity). The current study differed by instead examining if various recognized behavioral protective factors were associated with each other and comprised a general factor. The lack of relationship between the Sleep Quality, Medication Adherence, and Dietary Compliance Factors in the present study may partially be explained by the lack of validity of these items but it may also suggest that these variables truly represent distinctly different behavioral factors. The remaining factors (Sleep Quality, Medication Adherence, and Adherence to a Healthy Diet) were retained for the final model as three separate factors (instead of the original theoretical one-factor model - "Behavioral Protective Factor").

Correlation analyses were conducted to determine if impacts on HF outcomes could be explained by standalone factors or if effects were being partially masked by factors being significantly correlated with each other. When examining unstandardized estimates, only

Psychosocial Protective Factor and Sleep Quality were significantly correlated with each other. Under further examination, only average PA scores and POMS scores were significantly correlated with Sleep Quality. Sleep Quality, the POMS positive affect items, and PA items from the Mood & Health Practices Questionnaire were all collected at baseline, so we can not determine if individuals with better sleep were also more likely to experience more positive emotions but instead can only determine that these elements are correlated.

It is less surprising that after standardizing values; a couple of the behavioral factors were significantly correlated with each other due to the study originally proposing that behavioral variables would create a larger factor. It is unclear why item number 7 in particular from the Morisky Adherence scale was significantly correlated with average Self-Efficacy scores, but it could be suggested that individuals that are “hassled” about taking their medications may feel their own level of self-efficacy is being questioned. The current study’s goal was to only examine how behavioral variables may cluster together and create a larger protective factor within HF patients, and not to determine specifically how behavioral and psychosocial variables may be related to each other. Similarly, the current study aimed to look at how various psychological and social variables may cluster together and create a larger “Psychosocial Factor”. The correlations seen between factors is not considered to be a significant concern for impacting the outcomes in the current study due to the correlations seen between factors only being within the small range for unstandardized estimates and the moderate range for standardized estimates. Additionally, the current study predominately was comprised of reliable measures from previous research and therefore unstandardized estimates were considered adequate for comparison to previous studies using similar measures in HF patients.

Aim Five SEM Analyses

The purpose of Aim Five was to determine if the protective factors (e.g., Sleep Quality, Medication Adherence, Adherence to a Healthy Diet, and Psychosocial Protective Factor) predicted better outcomes in HF patients, such as lower hospitalizations and lower reported symptom burden from HF symptoms. Aim Five additionally looked at both HF outcomes as short-term and long-term by examining participants both at nine months after baseline and up to 39 months after baseline.

Prior research examining longitudinal changes in HF patients has shown more benefits (i.e., higher KCCQ scores, less HF symptom burden) at shorter-term follow-up points (up to 24 weeks after being discharged from the hospital) than long-term (6-months after) (247). Theoretically for Aim Five, factors would then be expected to be more significantly predictive of better outcomes at a shorter-term follow-up due to overall less time in the study. Overall, only “Psychosocial Protective Factor” significantly predicted a better outcome in HF patients (lower HF symptom burden as indicated by higher short-term KCCQ scores). Although significant long-term effects were not seen in the current study, the importance of various psychosocial protective factors on short-term outcomes (reported HF symptom burden and health status as measured by the KCCQ Clinical Summary scale) was evident.

Additionally, psychosocial traits may be more predictive of shorter-term outcomes because they are subject to change over time (248). Another likely reason for the difference between results of the additional regression analyses versus the SEM for “Psychosocial Protective Factor” was correlated measurement errors between variables not being accounted for, such as acceptance-based coping and coping through religion/spirituality and the POMS-Vigor-Activity subscale and PA items. “Interpretation of and conclusions based on the size of the

regression coefficients, their standard errors, or the associated t-tests may be misleading because of the potentially confounding effects of collinearity”, which suggests the significant findings seen in the regression analysis should be interpreted with caution (231). Potential clinical implications are that protective psychosocial factors, such as positive adaptive coping styles to disease, positive emotions and affect, self-efficacy, in HF patients could be focused on and improved upon in part of a treatment intervention to help reduce HF symptom burden.

The other protective factors (Sleep Quality, Medication Adherence, and Adherence to a Healthy Diet) did not significantly predict lower HF symptom burden (as measured by KCCQ Clinical Summary scale scores) or hospitalizations. The lack of significant findings regarding hospitalizations in the current sample is not surprising due to the study conducted by Keith (2017), which also did not find the “Self-Care” or “Attitudes” factors associated with hospitalizations.

The present study results indicate that protective variables may represent a single overall factor, similar to Riegel’s Self-Care Heart Failure Index that indicates different variables cluster together to form general factors (e.g., treatment adherence, symptom monitoring, etc.) (249). Other studies, utilizing an SEM approach, have instead focused on looking at associations between HF symptom monitoring and treatment adherence (i.e., daily weighing, monitoring salt intake, consulting with a medical provider, physical activity) in HF patients (250) without examining the impact of these factors on other outcomes (e.g., re-hospitalizations, reported HF symptom burden).

SEM models have only recently been used in the HF literature, and additional research is needed to examine protective factors together in HF patients using this approach. The advantage of creating a latent variable through an SEM is it will “allow the estimation and removal of both

random and correlated measurement error (251).” In summary, an SEM model allows an examination of multiple variables at once within a larger context, while removing chances of measurement error, and results in a more accurate estimate of effects upon outcomes. In this case, an SEM was utilized in an attempt to determine if several protective factors clustered together to form a general factor and if this factor then more accurately predicted better outcomes in HF patients.

Multiple Regression Analyses of Psychosocial Protective Factor on Study Outcomes and the influence of Potential Covariates

Marital Status and Cohabitation. Additional regression analyses were conducted to determine if marital status or cohabitation were a significant covariate on the relationship between protective factors, either behavioral or psychosocial, and HF outcomes. Due to the larger literature’s evidence that social support is associated with better quality of life in HF patients (252), despite the severity of the disease, it was suspected that individuals cohabitating would then also report less HF symptom burden. Both marital status and cohabitation were not significant predictors of HF outcomes (hospitalizations and KCCQ scores), as determined by nonsignificant coefficients in additional regression analyses of suspected additional covariates for the current study.

Some studies have also indicated that the quality of a marriage is a bigger determinant of HF outcomes than if a participant is simply married (i.e., a single man is likely to report less HF burden than an unhappily married man) (158). Similarly, cohabitation and family members living at home with the HF patient can decrease treatment adherence if the patient feels concerned about being a potential burden or if the patient feels their family isn’t being supportive (253). Women that do not cohabitate and are within a lower SES are also considered the most at risk for adverse HF outcomes (254). It is unclear why the current study did not find marital status or cohabitation to be significant covariates on HF outcomes, but it may be due to skewness within

the data for demographic variables or the above-mentioned impact of the quality of the social support (i.e., marital relationship, cohabitation).

Regression analyses of relationship of Optimism to HF outcomes. The findings from the SEM show that a focus on improving affect/a feeling of “vigor” may have the strongest impact on reducing HF symptom burden for at least 9 months after initial assessment and/or intervention, and that other positive psychosocial factors (e.g., self-efficacy, coping through religion/spirituality, acceptance based coping) also play a role in reducing perceived HF symptoms but may not as largely impact recovery.

In contrast to prior research, the present study did not find the Optimism subscale, considered alone from the LOT, was predictive of either hospitalizations or of KCCQ health status. Another study had previously found that higher reported Dispositional Optimism (as determined by total scores from a modified LOT-R measure) was associated with lower depressive symptoms in HF patients (255), which could theoretically improve other outcomes associated with quality of life. Dispositional Optimism is also associated with lower incident heart failure in older adults (157).

Furthermore, in an earlier analysis of shorter-term follow-up data from BETRHEART, using a multiple logistic regression approach, Whittaker (2013) found that Dispositional Optimism was related to HF symptoms and decreased hospitalizations up to 3 months after baseline. It is not entirely clear why the present study did not find Optimism related to HF outcomes, but it may be due to differences in selected study measures and follow-up length (3-month vs. 9 or more months). The Whittaker (2013) study used the Overall Summary Score (which includes social limitations and quality of life items), while the current study only utilized the Clinical Summary score (physical function and total HF symptom scores) to avoid overlap of variables. A large study conducted by Kim et al. (2014), with promising findings for Optimism

in HF patients, only focused on an older adult sample and the current sample had an average age of approximately 57 years (see Table 4). Differences in outcome time-points and length of follow-up, methods of analysis of data, and sample selection (i.e., age, race differences) may have resulted in a lack of findings for Optimism in the present study.

How Optimism impacts HF is not widely understood and an area the research still needs to address. Meta-analyses and reviews have primarily examined the impact of Optimism on other protective factors, such as higher Optimism being associated with greater physical activity. (256). Another meta-analysis also noted Optimism has predominately been examined in HF patients through cross-sectional studies, which prevents further examination of longer-term outcomes (unlike the current study) (256). The lack of significant findings in the current study then does not negate the importance of optimism but instead demonstrates the need for further examination.

Regression analyses of relationship of PA to HF outcomes. As was the case with Optimism, there was a surprising lack of relationship between PA and HF outcomes. Garza (2018) found PA to be predictive of better outcomes, as measured by the KCCQ Clinical Summary and Overall Summary scales, in HF patients at a 3-month follow-up. The current study did not reflect those findings within exploratory analyses but that may be due to differing follow-up lengths and the overall way PA was depicted. Garza (2018) had examined PA as both as a state and trait variable, while the current study did not delineate PA into two separate categories. As discussed previously, psychosocial variables can change over time (248) and it is possible that PA being measured at baseline in the current study is not the best predictor of longer-term (9 months to 39 months) outcomes and also was only reflecting “state” PA (i.e., past 24 hours).

The clinical implications of this lack of significant (between PA and HF outcomes) is that PA is only predictive of better outcomes during the shorter-term (i.e., within 3 months of assessment) but that other factors, such as, the patient's level of "vigor" may be better associated with positive HF outcomes for a longer duration. Additionally, the PA items utilized were from the Cohen et al. (2003) study and have not been as widely utilized, unlike the PANAS (166).

The POMS subscale was also included in the current study due to it being a reliable and widely utilized measure within the heart disease literature, and because item adjectives have an overlap with the PA items being used (as evidenced by the correlation and correlated measurement errors). The POMS: Vigor-Activity subscale within the larger literature has been correlated with physical functioning in patients with heart disease (257). The findings from the current study and exploratory analyses, which showed the subscale from the POMS had the most significant predictive relationship of KCCQ scores, would then be consistent with the larger literature, since the Clinical Summary subscale includes functional status as a component.

Another explanation for why the results for affect may not reflect findings in the larger literature is conflicting definitions of what affect is or studies collapsing PA into a category with NA. For example, the Keith (2017) examined "Positive Affect" within an overall factor called "Attitudes" but this Factor also included negative affect (NA). As Garza (2018) found negative affect was associated with higher reported HF symptom burden (as measured by the KCCQ Clinical Summary scale). The collapsing of both NA and PA into one factor then prevents further examination of this variable as a protective factor in HF patients, due to it simultaneously including a known risk factor.

Regression analyses of relationship of acceptance based coping and coping through religion/spirituality to HF outcomes. The regression analysis, without

covariates included, showed that coping through religion or spirituality was a significant predictor of better health status and reduced HF symptom burden (as measured by KCCQ Clinical Summary scores). A lack of significance after controlling for covariates may be due to the sample being predominantly older, African American, male, and lower SES. Previous research has noted that African American participants, especially women, were more likely to utilize religion or a church as a form of social support (240). The current sample then may not have reflected those findings due to it being predominantly male. Future research may yield more promising results for coping through religion/spirituality with a sample that is more widely generalizable.

Study Limitations

The current study has several limitations that are important to note. The sample was predominately African American and male, and as a result, the findings may not be generalizable to a broader population of patients with HF. Additionally, the skewness of the demographics within the sample (see Table 3) made it impossible to determine if race or ethnicity had a significant impact on the relationship between psychosocial protective factors and health status in HF patients, and this is likely the reason why it was not found to be a significant covariate in the current study. The findings from the current study are not implying that race and ethnicity do not have a significant impact upon health in HF patients, but instead show the importance of replicating the results within a more diverse larger study sample to more clearly examine this impact.

The inclusion of a minority population could also be a major study strength. Prior research has found racial and ethnic differences for HF risk and hospitalization rates, with incident HF rates being more prevalent in African Americans than Caucasians (258; 259) and

readmission rates for hospitalizations being higher in Hispanics and Blacks than Caucasians (260). However; at least one study observed that despite African Americans/Blacks having higher incident rates of HF, there was not a significant difference seen in health status (per KCCQ scores) collected up to six months after a hospitalization (261). Prior research has also noted gender differences in regards to diagnosis of HF, with men having higher incident rates of HF (262) and women being more likely to be younger at the time of diagnosis and African American (263). However, the smaller proportion of women in the current study sample prevented further examination of gender differences.

During the initial CFA, some variables were only measured by two items and were then unable to be examined through a CFA approach. The lack of further analyses was a limitation because it prevented robust items from being selected to represent a general factor, and instead reliability testing through a Cronbach's alpha was relied on. Additionally, the current study contained ad hoc measures for a few variables (Sleep Quality, Physical Activity, Self-Efficacy) or scales that were not widely validated (i.e., adapted PA items). For example, the BETRHEART study administered the PSQI to only a portion of participants. Therefore there was a significant amount of missing data for that particular measure within the current study sample and an ad hoc measure was used. As reported in the methods, these two ad hoc items were correlated with the PSQI's sleep quality subscale, but they have not been previously validated.

Physical activity was also considered an important component of the study model since physical activity is seen as important in the prevention of CHD and has been associated with better prognosis in CHD patients (121; 122). The BETRHEART study unfortunately did not include validated measures of physical activity, and avertedly assessed physical activity by inquiring about functional status (i.e., "The Six Minute Walk Test") and asking if the individual

had exercised in the past 24 hour. The inability to utilize “Physical Activity” as a form of a behavioral protective measure is similar to limitations reported by Keith (2017), in which the authors argued that their findings might lack reliability due to the inability to replicate constructs from the Riegel’s Self-Care Heart Failure Index (weighing oneself, getting a flu shot, physical activity, etc.) (249). A lack of reliable measures for behavioral protective factors is also a limitation of this study and relies purely on subjective reporting. The lack of reliable measures is not a limitation that is isolated to the current study but has been noted in the larger literature, particularly in regards to measuring physical activity (e.g., variability in heart rate monitors) (246). It is important to note that this concern also pertains to the perceived reliability of subjective self-reporting of sleep and medication adherence, particularly because there were not objective measures used in conjunction to verify reporting (e.g., overnight sleep studies with observation, monitored medication by a medical provider, etc.).

Similarly, the COPE measure items were comprised from two different versions of the scale and therefore lacked reliability. Ad hoc scales, such as the self-efficacy measure, also lacked reliability studies to verify their utility in this particular study sample. The overall results for the psychosocial factors pertaining to coping styles and self-efficacy on hospitalizations in HF patients should then be interpreted with caution due to reliability concerns of the measures.

Additionally, there was variation in the timeline of when original study measures were administered (see Table 2). Although time in study was accounted for as a potential covariate in study analyses (and found to not be significantly related in the majority of analyses), the variation in measure timelines could have also impacted results. Participants may have reported, for example, more or less optimism as the study progressed depending on their overall health status.

Surprisingly, some known protective factors for HF patients were similarly not included in the model because they yielded poor model fit indices in the current study sample. As discussed previously, this lack of a significant finding does not negate the importance of these variables, such as social support, but only argues for more robust and validated measures with this particular population to further promote overall health.

Additionally, although the sample sizes for particular measures and factors were sufficient given the previously described power considerations for analyses, it is recommended that SEM analyses utilize larger sample sizes to further ensure adequate power (231). Given the smaller sample size of the current study (N =147), means or sums of subscales were used as indicators of the general factor instead of a second order CFA. In addition, hospitalization counts were collapsed into categorical variables and the subsequent number of variables was kept within the guidelines discussed in Chapter 3: Power Analysis.

Study Strengths and Clinical Implications

Despite the described limitations, the current study has several strengths. One particular strength is the expansion of the examination of multiple potential protective factors and how they may be related to each other. The current study also examined both reported health status and hospitalizations in HF patients at two different follow-up periods. Additionally, SEM analyses have the strength of reducing modeling error and the ability to examine multiple observed variables as indicators of a general factor.

Most prior research has focused on the association of psychosocial variables, such as social support and positive affect, with greater self-care behaviors (e.g., medication adherence, physical activity, dietary compliance). Other studies have collapsed protective variables into categories with risk factors, such as PA and NA in "Attitudes" (149), which prevents direct

examination of potential protective factors on HF patients. Most of the research previously has focused on helping medical providers identify risk factors for developing HF or having a poorer prognosis (26, 29, 38). Positive psychology and its related components, such as the psychosocial variables reviewed in the current study, is still an area that is continuing to grow in understanding.

The current study took the perspective that protective variables fit together within a larger Psychosocial Protective Factor, and that these would be predictive of better outcomes in HF patients. For example, those with higher PA may also have better self-efficacy, and this pattern would be predictive of lower hospitalization counts and reduced HF symptom burden. The findings from the current study are then promising because it helps argue for the enhancement of various psychosocial elements *together* for HF patients. There is not currently any known studies on interventions to enhance multiple psychosocial areas in HF patients' lives as a holistic approach. The current study findings suggest that an intervention could be formed to help encourage optimism, self-efficacy, positive affect, and adaptive coping styles to improve overall HF outcomes. At the least, the findings for the study help show the importance of monitoring these positive areas in HF patients to help improve their overall care. Although the current study did not have significant findings with the current sample up to 39 months, it did at least show promising benefits up to 9 months after baseline in HF patients.

Protective Factors in African Americans. Although this study could describe the skewness of the sample demographics as a potential limitation, it also helps shed additional light on HF in a predominately African American male sample within a lower SES and could help form better tailor treatment interventions. Most of the research examining African Americans

and Blacks has focused on risk factors; with only a few studies examining cardiovascular disease and HF related processes (2; 28; 36; 37).

There have been even fewer studies that have examined potential protective factors in African Americans, but these studies have predominately focused on children and adolescents, decreasing risk (e.g., suicide, substance abuse), and enhancing academic environments (264-266). A couple reviews have reported that social support (e.g., extended family, churches, community members), self-efficacy, positive affect, and individual coping styles play an integral role in helping African Americans become more resilient to stressful events (264; 265). However; another study suggested that tangible (e.g., receiving services, financial assistance, etc.) social support, versus the number of people in their social network, had a larger impact on HF outcomes in African Americans (267). Better HF outcomes in African American then may be due partially to having better support to obtain medications, assistance in attending medical appointments, financial assistance, etc. In older African Americans (ages 65-89), religion and spirituality aspects are related to better overall psychological well being and treatment is recommended to incorporate these elements to reduce distress (266). However; overall, the area of protective psychosocial and behavioral factors for African Americans (particularly related to disease processes) is severely lacking research and would benefit from a more thorough examination to provide a better understanding of disease processes and prevention with these individuals.

The positive findings from the current study then have clinical implications on how to provide better care for individuals with similar demographics by enhancing psychosocial areas of their lives. Finally, the current study sample was comprised of individuals with a more severe category of HF as evidenced by their ejection fraction percentage (refer to Table 3). Similar

positive benefits (i.e., psychosocial variables being associated with reduced HF burden and better reported health status) may be seen in a clinical population with less severe HF, which could aid prevention efforts and improve overall prognosis in the wider HF population.

Military Relevance. The current study focused on HF patients as a general sample that is most consistent with research within the civilian population, however portions of the sample were Veterans within the Baltimore area. Furthermore, similar to the larger population, cardiovascular disease is the leading cause of death of Veterans enrolled within the Veterans Administration (VA) healthcare system (268). In particular, re-hospitalizations and mortality have been noted as concerns for Veterans with chronic cardiovascular conditions, such as HF (268). Frequent hospitalizations contribute to the staggering overall cost within the healthcare system which is only projected to increase (16). Among 117,870 patients within the VA healthcare system, HF related costs were estimated to be around \$30,719 annually and inpatient hospitalizations contributed to the majority of these costs (269). Recommendations to improve mortality risk and prognosis (i.e., decrease hospitalization rates) in Veterans with HF have included: improved understanding of the importance of their medication regime, reminders to exercise, and receiving information on adhering to a healthy diet (268). The current study examined similar protective factors and their relationship with HF outcomes, such as hospitalizations, as the findings within the VA healthcare system and showed that at least psychosocial factors did impact health status in HF patients.

Additionally, as described in the introduction, the various psychosocial and behavioral factors examined in the current study have been found to improve prognosis and the initial development of HF in individuals. Although the current study sample was most closely related to a civilian or Veteran population, the positive findings from the current study suggest active duty

service members with higher levels of psychosocial protective factors may then reduce their risk of developing HF if psychosocial protective factors are intact. The protective psychosocial factors examined also overlap with components of “Resilience” within the Positive Psychology field (e.g., Optimism, Self-Efficacy, Faith, social support, and positive emotions and attitude) that are often discussed when attempting to assist service members in adapting to stressors (270; 271). Although the current study sample focused on HF patients, if positive outcomes (e.g., better health status) were seen in individuals with higher levels of protective psychosocial factors then a similar outcome could be anticipated in healthy individuals (e.g., active duty service members). Further research needs to be conducted in this growing area of resilience to determine if a similar relationship is seen within an active duty military population, and if this proposed relationship can help improve overall health and decrease risk of developing chronic health conditions.

Future Directions. In addition to the potential implication the current findings may have for research further into psychosocial protective factors and resilience within a Veteran or active duty military population, the findings from the study did present additional questions that could be further explored. In the current study, only hospitalizations and HF health status were examined as potential outcomes in the sample. Considering that HF continues to be a leading cause of death within the United States (5), mortality as a potential outcome should also be examined in this population when trying to identify which protective psychosocial factors for individuals help improve their prognosis and reduce their mortality risk.

The protective factors identified in the current study are areas of an individual’s life that can be potentially adjusted or enhanced over time. It is suspected that if these protective areas were enhanced in HF patients that it may help improve their prognosis or reduce their

experienced HF symptoms. Further examination into when would be the most efficient time to target potential protective areas for individuals, such as focusing on improving optimism or positive affect, could then help form more effective and efficient treatment for individuals.

Overall, potential modifiable psychosocial and behavioral factors have only started to become increasingly examined in HF patients. The current study only had significant findings seen when examining the impact of “Psychosocial Protective Factor” on HF health status up to 9 months, but how enhancement in these various areas (e.g., positive affect, optimism, etc.) as part of treatment was not examined. There have been some studies that have examined how quality of life could be targeted to reduce depressive symptoms in HF patients (98) but in general, there has been limited research on improving protective factors as part of the overall HF treatment process. In addition to the potential protective factors examined in this study, further research could be completed on identifying additional areas that may be of relevance for HF patients (e.g., quality of life, a more thorough examination of social support and types of support, etc.).

Finally, as mentioned previously, there is still a substantial gap within the literature in regards to identifying protective factors related to health outcomes in African Americans. Considering there are certain suspected factors, that may place African Americans at greater risk of developing HF, further examination into factors that are potentially modifiable (e.g., behavioral, psychosocial), could help mitigate this risk in these individuals.

Table 1. Proposed Latent Variables, Observed Variables, and Measures

Proposed Latent Variables	Measures Utilized//Observed Variables
<i>Psychosocial Protective Factors</i>	
<i>Positive Affect</i>	1. Mood and Health Practices Questionnaire (MHPQ)-Average PA score (9 items) 2. Profile of Mood States (POMS) – Vigor-Activity Scale Average score (6 items)
<i>Optimism</i>	3. Life Orientation Test (LOT)-Optimism Average Subscale score (4 items)
<i>Social Support</i>	4. Interpersonal Support Evaluation List (ISEL)-Average Score (12 items)
<i>Coping through Spirituality</i>	5. COPE and Brief COPE-Religion and Spirituality Subscale Average Score (2 items)
<i>Acceptance Based Coping</i>	6. COPE and Brief COPE-Religion and Spirituality Subscale Average Score (2 items)
<i>Self-Efficacy</i>	7. Kansas City Cardiomyopathy Questionnaire (KCCQ): Self-Efficacy Scale-Average Score (2 items) 8. Ad Hoc Self-Efficacy Scale-Average Score (14 items)

Behavioral Protective Factors

Sleep Quality

1. MHPQ - How many minutes of sleep did you lose..." and "Did you feel rested..." (2 items)

Physical Activity

2. Mood and Health Practices Questionnaire (MHPQ) – "Did you exercise...past 24 hours" (1 item)

Medication Adherence

3. Morisky Adherence Scale – Total Score (8 items)

Adherence to a Healthy Diet

4. Dietary Compliance Survey – Total Score (3 items)

Table 2. Measures Utilized and Study Timeline

Measure Utilized	Time of Administration
1. “Mood and Health Practices Questionnaire”	Baseline
2. Profile Of Mood States	Baseline
3. Life Orientation Test	Phone Follow-Up #3
4. Interpersonal Support Evaluation List	Phone Follow-Up #2
5. COPE and Brief COPE	Phone Follow-Up #1
6. Kansas City Cardiomyopathy Questionnaire	9-Month – 39-Month Follow-Up
7. Ad Hoc Self-Efficacy Scale	Phone Follow-Up #4
8. Demographics Form	Baseline
9. Morisky Adherence Scale	Baseline
10. Dietary Compliance Survey	Baseline

Table 3. Physiological and Demographic Characteristics at Baseline Assessment (N = 147)

Variable	Mean $\pm$ SD or %
Age (yrs.)	57.41 $\pm$ 11.46
Male Sex (%)	76.4
Race	
African American (%)	70.1
Caucasian (%)	29.3
Other (%)	0.68
BMI (kg/m ²)	30.81 $\pm$ 7.58
Ejection Fraction (%)	23.14 $\pm$ 7.48
Heart Failure Type	
Ischemic (%)	45.4
Non-Ischemic (%)	54.6
*Systolic Blood Pressure	121.16 $\pm$ 20.96
*Diastolic Blood Pressure	75.92 $\pm$ 12.70
History of Smoking (%)	70.75

Note. BMI = body mass index; BP = blood pressure; NYHA = New York Heart Association. * N for blood pressure was 121 due to missing data for participants.

Table 4. Psychological and Social Characteristics of Patients (N=147)

Variable	N	Mean $\pm$ SD or %
Psychosocial Variables		
Positive Affect	147	22.73 $\pm$ 8.37
Vigor-Activity"	145	1.60 $\pm$ 0.98
Optimism	126	11.81 $\pm$ 3.19
Social Support	133	38.08 $\pm$ 6.76
Self-Efficacy (Ad Hoc scale)	126	53.19 $\pm$ 10.7
Self-Efficacy (KCCQ subscale)	146	87.4 $\pm$ 15.1
Acceptance based coping	137	3.02 $\pm$ 0.85
Coping through Spirituality/Religion	137	0.87 $\pm$ 1.14
Behavioral Variables		
<i>Sleep Quality</i>		
Minutes of Sleep Loss	147	80.46 $\pm$ 109.17
"Felt Rested"	146	65.1
Exercise in past 24 hours	147	37.7
Adherence to a Healthy Diet	146	7.70 $\pm$ 2.78
Medication Adherence	143	1.78 $\pm$ 1.82
Months in the Study		
		26.10 $\pm$ 13.89

Note. Average values for psychosocial and behavioral variables are based on their original scales and do not reflect any values that were re-coded.

Table 5. Unstandardized Factor Loadings and Standard Error from Single Factor Model CFA for PA utilizing the MHPQ (N = 147)

Item	Unstandardized	SE
PA1 – “happy”	1.00	0.00
PA2 – “calm”	0.74	0.14
PA4 – “pleased”	0.84	0.10
PA7 – “cheerful”	0.93	0.10
PA8 – “at ease”	0.84	0.10
PA9 – “relaxed”	0.96	0.09

Note: Items were originally scored on a five point Likert scale ranging but were collapsed into two binary values for the purpose of conducting a categorical CFA. This table also reflects the factor loading values after removing items that did not fit within the factor for the model, “full of pep”, “lively” and “energetic.”
Goodness of fit indices: CFI = 0.99, TLI = 0.99, RMSEA = 0.00, $\chi^2(9) = 9.24$.

Table 6. Unstandardized Factor Loadings and Standard Error from Single Factor Model CFA for PA utilizing the POMS (N = 144)

Item	Unstandardized	S.E.
POMS 5 – “lively”	1.00	0.00
POMS 9 – “active”	1.12	0.08
POMS 13 – “energetic”	1.12	0.08
POMS 24 – “cheerful”	1.10	0.08
POMS 32 – “full of pep”	1.16	0.08

Note: Items were originally scored on a five point Likert scale ranging but were collapsed into two binary values for the purpose of conducting a categorical CFA.
Goodness of fit indices: CFI = 0.99, TLI = 0.99, RMSEA = 0.05, $\chi^2(5) = 0.71$.

Table 7. Unstandardized Factor Loadings and Standard Error from Single Factor Model CFA for Optimism (N = 126)

Item	Unstandardized	S.E.
LOT1 – “... I usually expect the best.”	1.00	0.00
LOT4 – “... bright side of things.”	0.99	0.17
LOT5 – “... always optimistic...”	1.02	0.16
LOT11 – “... every cloud has a silver lining.”	0.98	0.18

Note: Goodness of fit indices: CFI = 1.00, TLI = 1.00, RMSEA = 0.00, $\chi^2(2) = 0.45$.

Table 8. Unstandardized Factor Loadings and Standard Error from Single Factor Model CFA for Social Support (N = 133)

Item	Unstandardized	S.E.
ISEL1 – “... I usually expect the best.”	1.00	0.00
ISEL2 – “... bright side of things.”	0.98	0.19
ISEL5 – “... always optimistic...”	0.89	0.18
ISEL7 – “... every cloud has a silver lining.”	0.69	0.20
ISEL8 – “... every cloud has a silver lining.”	1.26	0.19
ISEL12 – “... every cloud has a silver lining.”	0.83	0.20

Note: Items were originally scored on a five point Likert scale ranging but were collapsed into two binary values for the purpose of conducting a categorical CFA. Factor loading estimates reflect the goodness-of-fit indices after removing the six items with weaker associations. Goodness of fit indices: CFI = 0.99, TLI = 0.98, RMSEA = 0.04, $\chi^2(9) = 10.95$.

Table 9. Unstandardized Factor Loadings (Standard Error) for Single Factor Model CFA for Medication Adherence (N = 142)

Item	Unstandardized	S.E.
MA1- "... sometimes forget to take your pills?"	1.00	0.00
MA2 - "... were there any days when you did not take your medication?"	0.84	0.15
MA3 – "Have you ever cut back or stopped taking your medication..."	0.53	0.17
MA4 – "...do you sometimes forget to bring along your medication?"	0.74	0.16
MA5_R – "Did you take all of your medicines yesterday?"	0.78	0.39
MA6 – "When you feel your problem is under control, do you sometimes stop taking your medication?"	0.97	0.18
MA7 – "Do you ever feel hassled about sticking to your treatment..."	0.66	0.16
MA8 – "How often do you have difficulty remembering to take your medicines?"	0.96	0.16

Note. MA5_R is a reversed scored binary item within the measure. MA8 on the original Morisky Adherence measure has 5 potential values but participants only responded to three, which is why only those three categories are included for factor loading estimates. Goodness of fit indices: CFI = 0.96, TLI = 0.95, RMSEA = 0.04, $\chi^2(20) = 25.25$.

Table 10. Unstandardized Factor Loadings and Standard Error for CFA of the theoretical "Psychosocial Protective Factor"

Item	Unstandardized	S.E.
	1.00	
1. PA –POMS subscale score	0.81	0.00
2. PA – PA subscale score from MHPQ	0.81	0.13
3. Optimism – LOT Optimism Subscale	0.80	0.17
4. Self-Efficacy – Ad Hoc	0.06	0.15
5. Self Efficacy –SE Subscale score from KCCQ	0.70	0.04
6. Coping through Religion – subscale score from COPE	0.55	0.21
7. Acceptance based Coping – subscale score from COPE	0.35	0.17
8. Social Support – ISEL score		0.13

Note. All eight variables included within the original proposed theoretical model for "Psychosocial Protective Factor." Goodness of fit indices: CFI = 0.81, TLI = 0.73, RMSEA = 0.06, $\chi^2(20) = 52.68$.

Table 11a. Overall Structure of the Four-Factor CFA

Items	Factor 1 (Dietary Compliance)	Factor 2 (Medication Adherence)	Factor 3 (Sleep Quality)	Factor 4 (Psychosocial Protective Factor)
DC1 – “avoid salty foods?”	1.00			
DC2 – “read labels?”	1.76			
MA1- “... sometimes forget to take your pills?”		1.00		
MA2 - “... were there any days when you did not take your medication?”		1.07		
MA3 – “Have you ever cut back or stopped taking your medication...”		0.78		
MA4 – “...do you sometimes forget to bring along your medication?”		0.96		
MA5 – “Did you take all of your medicines yesterday?”		1.13		
MA6 – “When you feel your problem is under control, do you sometimes stop taking your medication?”		1.32		
MA7 – “Do you ever feel hassled about sticking to your treatment...”		0.88		
Sleep Loss			1.00	
"Did you feel rested?"			1.08	
POMS - vigor-activity subscale				1.00
PA - positive affect items				0.79
LOT - Optimism subscale				0.93
SE - Self-Efficacy average				0.88
COPE_R - Coping through religion				0.65
COPE_A - Acceptance based coping				0.53

Note: Goodness-of Fit-indices; CFI= 1.00, TFI = 1.00. RMSEA = 0.00, $\chi^2(111) = 101.98$, $p = 0.72$.

All observed variables were associated with their own factor at a magnitude of at least 0.50. Factor loading estimates reflect the model prior to DVs being added in.

Table 11b. Factor Loading Estimates for the Four-Factor CFA with Correlations

Items	Factor 1 (Dietary Compliance)	Factor 2 (Medication Adherence)	Factor 3 (Sleep Quality)	Factor 4 (Psychosocial Protective Factor)
Factor 1 (Dietary Compliance)				
Unstandardized Estimates (Standard Error)	-	0.99 (0.06)	-0.08 (0.06)	0.10 (0.05)
Standardized Estimates (Standard Error)	-	<i>0.32 (0.14)</i>	-0.24 (0.15)	<i>0.29 (0.12)</i>
Factor 2 (Medication Adherence)				
Unstandardized Estimates (Standard Error)	-	-	0.12 (0.07)	0.07 (0.05)
Standardized Estimates (Standard Error)	-	-	0.30 (0.15)	0.18 (0.11)
Factor 3 (Sleep Quality)				
Unstandardized Estimates (Standard Error)	-	-	-	<i>0.19 (0.07)</i>
Standardized Estimates (Standard Error)	-	-	-	<i>0.42 (0.11)</i>
Factor 4 (Psychosocial Protective Factor)				

Note: Italicized values refer to a significant association of $p \leq .05$. All factors, except for sleep quality and Psychological Protective Factor, were not significantly associated with each other ($p > .05$).

Table 12a. Standardized and Unstandardized Regression Coefficients
(Standard Error) for SEM of the Short-Term KCCQ Clinical Summary Score with Four Predictive Factors

Item	Unstandardized	95% CI	<i>p</i>	Standardized	95% CI	<i>p</i>
1. Dietary Compliance	-3.81 (8.09)	-24.67 – 17.04	0.64	-0.08 (0.18)	-0.53 – 0.37	0.64
2. Medication Adherence	0.98 (0.11)	-18.83 – 20.78	0.90	0.03 (0.16)	-0.50 – 0.55	0.90
3. Sleep Quality	0.11 (6.91)	-17.68 – 17.90	0.99	0.00 (0.21)	-0.53 – 0.54	0.99
4. Psychosocial Protective Factor	11.62* (4.97)	-1.18 – 24.42	0.02	0.33* (0.13)	-0.01 – 0.67	0.02

Note: Goodness-of Fit-indices; CFI= 1.00, TFI = 1.00, RMSEA = 0.00, $\chi^2(124) = 119.18$, $p = 0.61$.

* Refers to this variable being significantly associated with the outcome at a 0.02 level or less. No covariates were significantly associated with short-term KCCQ scores and therefore, were not included within the model.

Table 12b. Standardized and Unstandardized Regression Coefficients
(Standard Error) for Covariates on Short-Term KCCQ Clinical Summary Scores

Covariate Variable	Unstandardized (SE)	<i>p</i>	Standardized (SE)	<i>p</i>
1. Time in Study	0.36 (0.25)	0.15	0.21 (0.14)	0.13
2. Age	0.14 (0.22)	>.05	0.07 (0.11)	>.05
3. Race	-3.46 (3.59)	>.05	-0.07 (0.08)	>.05
4. Gender	4.26 (6.03)	>.05	0.08 (0.11)	>.05
5. SES/Income	8.11 (4.84)	>.05	0.17 (0.10)	>.05
6. BMI	-0.52 (0.32)	>.05	-0.17 (0.10)	>.05

Note: None of the covariates were significantly associated with KCCQ Clinical Summary scores.

Table 13a. Standardized and Unstandardized Regression Coefficients
(Standard Error) for SEM of the Short-Term All Cause Hospitalizations

Item	Unstandardized (SE)	95% CI	<i>p</i>	Standardized (SE)	95% CI	<i>p</i>
1. Dietary Compliance	0.13 (0.42)	-0.96–1.22	0.76	0.06 (0.22)	-0.49 – 0.63	0.76
2. Medication Adherence	0.37 (0.28)	-0.35 – 1.09	0.18	0.23 (0.17)	-0.20–0.66	0.17
3. Sleep Quality	-0.15 (0.33)	-1.00–0.71	0.65	-0.10 (0.23)	-0.70–0.49	0.65
4. Psychosocial Protective Factor	-0.17 (0.27)	-0.86–0.52	0.52	-0.11 (0.17)	-0.56 – 0.33	0.52

Note: Covariates were not included within the model due to not having a significant association.

Goodness-of –model-fit indices: CFI= 1.00, TFI = 1.00, RMSEA = 0.00, $\chi^2(124) = 115.19$, $p = 0.70$.

Table 13b. Standardized and Unstandardized Regression Coefficients
(Standard Error) for Covariates on Short-Term All Cause Hospitalizations

Covariate Variable	Unstandardized (SE)	<i>p</i>	Standardized (SE)	<i>p</i>
1. Time in Study	0.00 (0.01)	0.85	0.02 (0.10)	0.85
2. Age	0.00 (0.01)	0.99	0.00 (0.10)	0.99
3. Race	-0.02 (0.19)	0.90	-0.01 (0.09)	0.90
4. SES/Income	-0.05 (0.21)	0.83	-0.02 (0.10)	0.83
5. BMI	0.01 (0.01)	0.44	0.08 (0.11)	0.43

Note: None of the covariates were significantly associated with short-term all cause hospitalizations.

Table 14a. Standardized and Unstandardized Factor Regression Coefficients (Standard Error) for SEM of the Short-Term CV Related Hospitalizations

Item	Unstandardized (SE)	95% CI	<i>p</i>	Standardized (SE)	95% CI	<i>p</i>
1. Dietary Compliance	0.36 (0.45)	-0.81 – 1.53	0.43	0.18 (0.24)	-0.43 – 0.79	0.44
2. Medication Adherence	0.21 (0.30)	-0.56 – 0.98	0.48	0.13 (0.18)	-0.34 – 0.60	0.47
3. Sleep Quality	-0.80 (0.34)	-0.97 – 0.81	0.82	-0.06 (0.24)	-0.68 – 0.57	0.82
4. Psychosocial Protective Factor	-0.17 (0.28)	-0.91 – 0.56	0.54	-0.11 (0.18)	-0.58 – 0.36	0.54

Note: Goodness-of-fit model-fit indices: CFI= 1.00, TFI = 1.00. RMSEA = 0.00, $\chi^2(124) = 115.98$, $p = 0.68$.

Table 14b. Standardized and Unstandardized Regression Coefficients (Standard Error) for Covariates on Short-Term CV Related Hospitalizations

Covariate Variable	Unstandardized (SE)	<i>p</i>	Standardized (SE)	<i>p</i>
1. Time in Study	-0.00 (0.00)	0.86	-0.02 (0.10)	0.86
2. Age	-0.00 (0.01)	0.58	-0.05 (0.09)	0.58
3. SES/Income	0.09 (0.21)	0.68	0.04 (0.10)	0.68
4. BMI	0.00 (0.14)	0.85	0.02 (0.11)	0.85

Note: None of the covariates were significantly associated with short-term CV related hospitalizations.

Table 15a. Standardized and Unstandardized Factor Regression Coefficients (Standard Error) for the Short-Term HF Related Hospitalizations

Item	Unstandardized (SE)	95% CI	<i>p</i>	Standardized (SE)	95% CI	<i>p</i>
1. Dietary Compliance	0.34 (0.50)	-0.86 – 1.55	0.47	0.17 (0.24)	-0.45 – 0.80	0.47
2. Medication Adherence	0.25 (0.30)	-0.51 – 1.02	0.40	0.16 (0.18)	-0.31 – 0.62	0.39
3. Sleep Quality	-0.12 (0.35)	-1.02 – 0.78	0.73	-0.08 (0.24)	-0.71 – 0.54	0.73
4. Psychosocial Protective Factor	-0.38 (0.32)	-1.20 – 0.43	0.23	-0.24 (0.20)	-0.76 – 0.27	0.22

Note: Covariates were not included within the model due to not having a significant association.

Goodness-of –model-fit indices: CFI= 1.00, TFI = 1.00. RMSEA = 0.00, $\chi^2(158) = 114.24$, $p = 0.73$

Table 15b. Standardized and Regression Coefficients (Standard Error) for Covariates on Short-Term HF Related Hospitalizations

Covariate Variable	Unstandardized (SE)	<i>p</i>	Standardized (SE)	<i>p</i>
1. Time in Study	0.00 (0.01)	0.93	0.00 (0.01)	0.93
2. Age	0.01 (0.01)	0.32	0.10 (0.10)	0.31
3. Race	-0.05 (0.24)	0.83	-0.03 (0.12)	0.83
4. SES/Income	-0.12 (0.26)	0.65	-0.06 (0.13)	0.65
5. BMI	0.01 (0.02)	0.64	0.05 (0.12)	0.64

Note: None of the covariates were significantly associated with short-term HF related hospitalizations.

Table 16a. Standardized and Unstandardized Regression Coefficients
(Standard Error) for the Last KCCQ Clinical Summary Score
on the Four Factors

Item	Unstandardized (SE)	95% CI	<i>p</i>	Standardized (SE)	95% CI	<i>p</i>
1. Dietary Compliance	61.26 (337.30)	-807.56 – 930.10	0.86	1.42 (7.84)	-18.78 – 21.62	0.83
2. Medication Adherence	-29.23 (179.05)	-490.42 – 431.96	0.87	-0.82 (5.00)	-13.71 – 12.10	0.87
3. Sleep Quality	64.00 (295.15)	-696.30 – 824.24	0.83	1.85 (8.45)	-19.91 – 23.61	0.83
4. Psychosocial Protective Factor	-34.00 (201.93)	-554.12 – 486.13	0.87	-1.02 (6.06)	-16.64 – 14.59	0.87

Note: None of the covariates were significantly associated with long-term KCCQ scores. Goodness-of-model-fit indices: CFI= 1.00, TFI = 1.00. RMSEA = 0.00, $\chi^2(158) = 116.54$, $p = 0.067$

Table 16b. Standardized and Unstandardized Regression Coefficients
(Standard Error) for Covariates on Long-Term KCCQ Clinical Summary Scores

Covariate Variable	Unstandardized (SE)	<i>p</i>	Standardized (SE)	<i>p</i>
1. Time in Study	0.08 (0.22)	>.05	0.05 (0.14)	>.05
2. Age	-0.20 (0.17)	>.05	-0.10 (0.09)	>.05
3. Race	-2.73(3.12)	>.05	-0.06 (0.07)	>.05
4. Gender	-2.22 (-0.44)	>.05	-0.10 (0.22)	>.05
0.09 (0.09)	4.09 (4.15)	>.05		>.05
6. BMI	-0.26 (0.28)	>.05	-0.09 (0.10)	>.05

Note: None of the covariates were significantly associated with long-term KCCQ scores.

Table 17a. Standardized and Unstandardized Regression Coefficients
(Standard Error) for SEM on Long-Term All Cause Hospitalizations

Item	Unstandardized (SE)	95% CI	<i>p</i>	Standardized (SE)	95% CI	<i>p</i>
1. Dietary Compliance	0.09 (0.42)	-0.10 – 1.18	0.83	0.04 (0.20)	-0.48 – 0.56	0.83
2. Medication Adherence	0.12 (0.33)	-0.72 – 0.96	0.72	0.06 (0.17)	-0.38 – 0.50	0.72
3. Sleep Quality	-0.21 (0.34)	-1.09 – 0.66	0.53	-0.14 (0.21)	-0.69 – 0.41	0.52
4. Psychosocial Protective Factor	0.04 (0.28)	-0.67 – 0.76	0.70	0.03 (0.16)	-0.39 – 0.44	0.87

Note: TIS and Age were included within the model due to being significantly associated covariates for all cause long-term hospitalizations. Goodness-of-fit model-fit indices: CFI= 0.96, TFI = 0.96. RMSEA = 0.02, χ^2 (158) = 168.25, p = 0.27.

Table 17b. Standardized and Unstandardized Regression Coefficients
(Standard Error) for Covariates on Long-Term All Cause Hospitalizations

Covariate Variable	Unstandardized (SE)	<i>p</i>	Standardized (SE)	<i>p</i>
1. Time in Study	0.03 (0.01)*	0.00	0.35 (0.10)*	0.00
2. Age	0.02 (0.01)*	0.02	0.23 (0.09)*	0.01
3. Race	0.14 (0.21)	0.50	0.07 (0.10)	0.49
4. SES/Income	-0.08 (0.21)	0.70	-0.04 (0.10)	0.70
5. BMI	0.01 (0.01)	0.37	0.09 (0.10)	0.36

Note. * Refers to statistically significant regression estimated.

Table 18a. Adjusted Standardized and Unstandardized Regression Coefficients
(Standard Error) for SEM on Long-Term CV Hospitalizations

Item	Unstandardized (S.E.)	95% CI	<i>p</i>	Standardized (S.E.)	95% CI	<i>p</i>
1. Dietary Compliance	0.29 (0.42)	-0.80 – 1.38	0.49	0.14 (0.20)	-0.38 – 0.66	0.49
2. Medication Adherence	-0.06 (0.31)	-0.87 – 0.75	0.84	-0.03 (0.17)	-0.46 – 0.40	0.85
3. Sleep Quality	-0.12 (0.34)	-1.01 – 0.77	0.73	-0.08 (0.22)	-0.63 – 0.48	0.73
4. Psychosocial Protective Factor	-0.12 (0.30)	-0.88 – 0.65	0.70	-0.07 (0.17)	-0.51 – 0.38	0.70

Note: TIS and Age were included within the model due to being significantly associated covariates for CV related long-term hospitalizations. Goodness-of-fit indices: CFI= 0.97, TFI = 0.97. RMSEA = 0.02, $\chi^2(158) = 165.67$, $p = 0.32$.

Table 18b. Standardized and Unstandardized Regression Coefficients
(Standard Error) for Covariates on Long-Term CV related Hospitalizations

Covariate Variable	Unstandardized (SE)	<i>p</i>	Standardized (S.E)	<i>p</i>
1. Time in Study	0.42 (0.11)*	0.00	0.03 (0.01)*	0.00
2. Age	0.23 (0.09)*	0.01	0.02 (0.01)*	0.01
3. Race	-0.05 (0.22)	0.82	-0.02 (0.10)	0.82
4. SES/Income	-0.25 (0.22)	0.26	-0.11 (0.09)	0.26
6. BMI	0.02 (0.02)	0.19	0.15 (0.011)	0.17

Note: * Refers to statistically significant regression estimated.

Table 19a. Adjusted Standardized and Unstandardized Regression Coefficients (Standard Error) for SEM on Long-Term HF Hospitalizations

Factor	<i>B</i> (S.E.)	95% CI	<i>p</i>	β (S.E.)	95% CI	<i>p</i>
1. Dietary Compliance	0.07 (0.45)	-1.10 – 1.23	0.89	0.03 (0.23)	-0.56 – 0.62	0.89
2. Medication Adherence	-0.03 (0.33)	-0.88 – 0.83	0.94	-0.02 (0.21)	-0.54 – 0.51	0.94
3. Sleep Quality	0.08 (0.34)	-0.80 – 0.97	0.81	0.06 (0.25)	-0.57 – 0.70	0.81
4. Psychosocial Protective Factor	-0.07 (0.30)	-0.81 – 0.68	0.81	-0.04 (0.19)	-0.52 – 0.43	0.81

Note. Goodness-of-fit model-fit indices: CFI= 1.00, TFI = 1.00. RMSEA = 0.00, $\chi^2(124) = 116.60$, $p = 0.67$.

Table 19b. Standardized and Unstandardized Regression Coefficients (Standard Error) for Covariates on Long-Term HF related Hospitalizations

Covariate Variable	<i>B</i> (S.E.)	<i>p</i>	β (S.E.)	<i>p</i>
1. Time in Study	0.02 (0.14)	0.10	0.23 (0.14)	0.09
2. Age	0.01 (0.01)	0.50	0.08 (0.12)	0.50
3. Race	0.13 (0.27)	0.50	0.07 (0.13)	0.62
4. SES/Income	-0.27 (0.26)	0.29	-0.13 (0.12)	0.28
5. BMI	0.03 (0.02)	0.07	0.22 (0.12)	0.06

Note. None of the covariates were significantly associated with long-term HF hospitalizations.

Table 20. Correlation Matrix of Psychosocial Protective Factor measures and Outcome Variables, while controlling for covariates.

Variable	PA	POMS-Vigor-Activity	Optimism	Self-Efficacy	Religion/Spirituality	Accept.	All Cause Hosp	HF Hosp	CV Hosp	KCCQ (9-Month)	KCCQ (Long-Term)
PA	1	0.50***	0.34***	0.41***	0.13	0.25**	0.05	0.07	0.07	(-) 0.00	-0.10
POMS-Vigor-Activity	-	1	0.52***	0.48***	0.26**	0.30**	-0.06	0.06	-0.01	0.19	0.15
Optimism	-	-	1	0.54***	0.34***	0.33**	-0.01	-0.06	0.02	0.21	0.16
Self-Efficacy	-	-	-	1	0.33***	0.33**	-0.07	-0.04	-0.05	0.17	0.15
Religion/Spirituality	-	-	-	-	1	0.40**	-0.02	0.11	0.04	-0.02	0.09
Acceptance	-	-	-	-	-	1	0.02	-0.04	0.02	0.15	0.08
All Cause Hosp	-	-	-	-	-	-	1	0.22*	0.80***	-0.12	-0.22*
HF Hosp	-	-	-	-	-	-	-	1	0.64***	-0.24*	-0.16
CV Hosp	-	-	-	-	-	-	-	-	1	-0.21	-0.21
KCCQ (9-Month)	-	-	-	-	-	-	-	-	-	1	0.37***
KCCQ (Up to 39 Month)	-	-	-	-	-	-	-	-	-	-	1

Note: Covariates being controlled for include Gender, Race, Age, BMI, Income level (SES), Time in Study, and KCCQ Clinical Summary scores from the

baseline. * - $p \leq .05$, ** - $p \leq .01$, and *** - $p \leq .00$

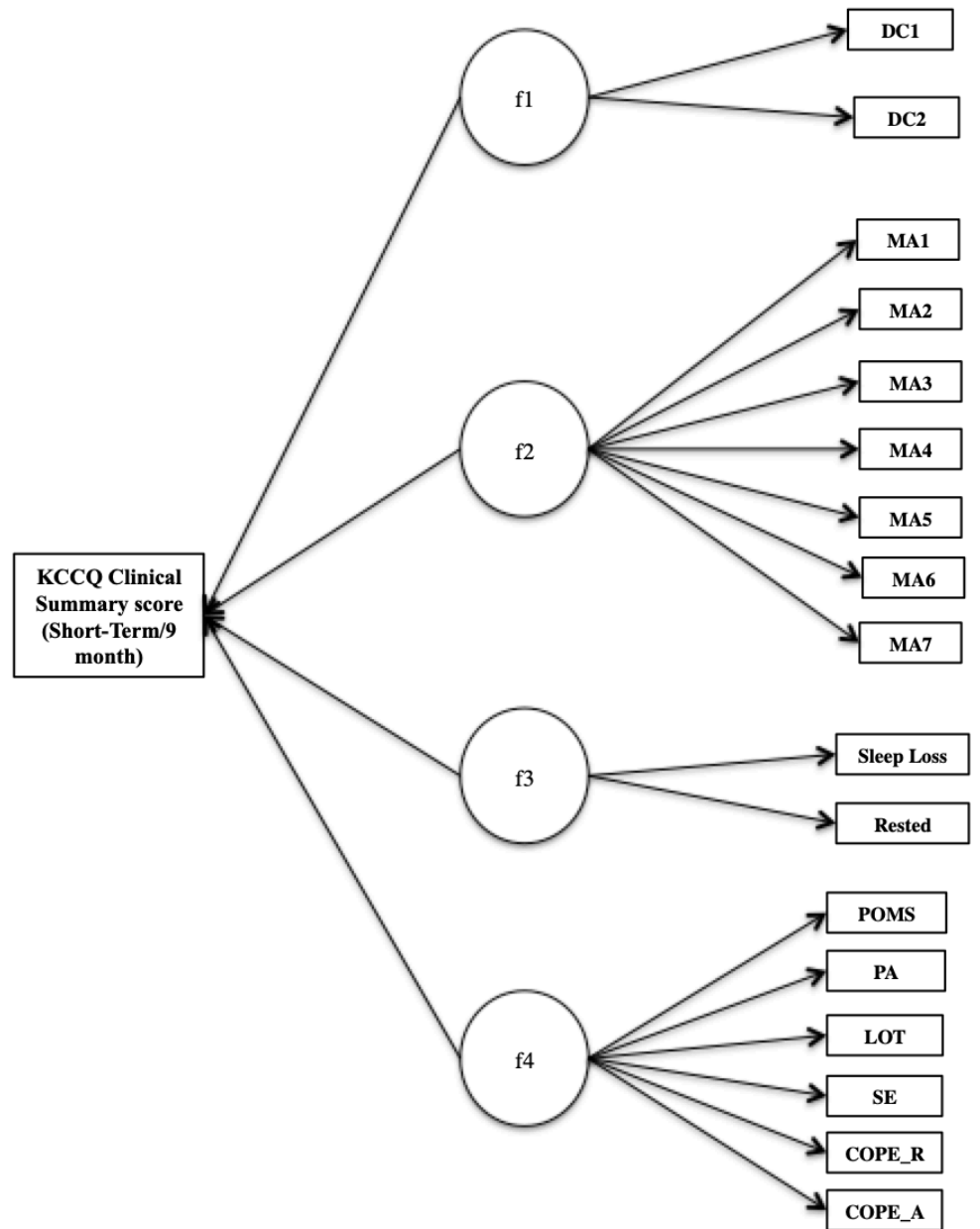
Table 21. Correlation Matrix of Psychosocial Protective Factor measures and Covariates.

Variable	PA	POMS	Optimis m	Self- Efficac y	Religio n/Spirit uality	Acce pt.	Gende r	Race	SES	Age	BMI	TIS
PA	1	0.50***	0.34***	0.41***	0.13	0.25**	-0.09	0.19	-0.09	0.04	-0.19	-0.12
POMS	-	1	0.52***	0.48***	0.26**	0.30***	-0.17	0.22*	-0.08	0.00	-0.16	-0.01
Optimis m	-	-	1	0.54***	0.34***	0.33***	-0.02	-0.13	-0.07	0.20	-0.03	-0.14
Self- Efficacy	-	-	-	1	0.33***	0.33***	-0.01	-0.07	-0.25	0.21*	-0.18	-0.09
Religion /Spiritua lity	-	-	-	-	1	0.40***	-0.15	0.19	-0.22*	0.21*	-0.19	-0.17
Accept.	-	-	-	-	-	1	-0.03	-0.05	0.09	0.25*	-0.06	-0.04
Gender	-	-	-	-	-	-	1	0.27*	-0.09	0.11	-0.20	-0.05
Race	-	-	-	-	-	-	-	1	-0.10	-	0.06	-0.04
SES	-	-	-	-	-	-	-	-	1	-0.07	0.28**	0.16
Age	-	-	-	-	-	-	-	-	-	1	-0.27*	-0.03
BMI	-	-	-	-	-	-	-	-	-	-	1	0.25*
TIS	-	-	-	-	-	-	-	-	-	-	-	1

Note: KCCQ refers to Clinical Summary Scores at baseline. And TIS refers to time in study since baseline in months.

* - $p \leq .05$, ** - $p \leq .01$, and *** - $p \leq .00$.

Figure 1. Theoretical SEM model of four separate predictive factors on outcome variables



Note: f1 = Dietary Compliance Factor, f2 = Medication Adherence Factor, f3 = Sleep Quality Factor, and f4 = Psychosocial Protective Factor. Solid lines refer to proposed significant associations between variables and factors. Circles on the model reflect factors within the study (latent variables) while rectangles are observed variables. The model reflects the same anticipated relationships between all DVs, to include: Long-Term KCCQ Clinical Summary scores and all hospitalization types (both short and long-term).

Assessment Time Points

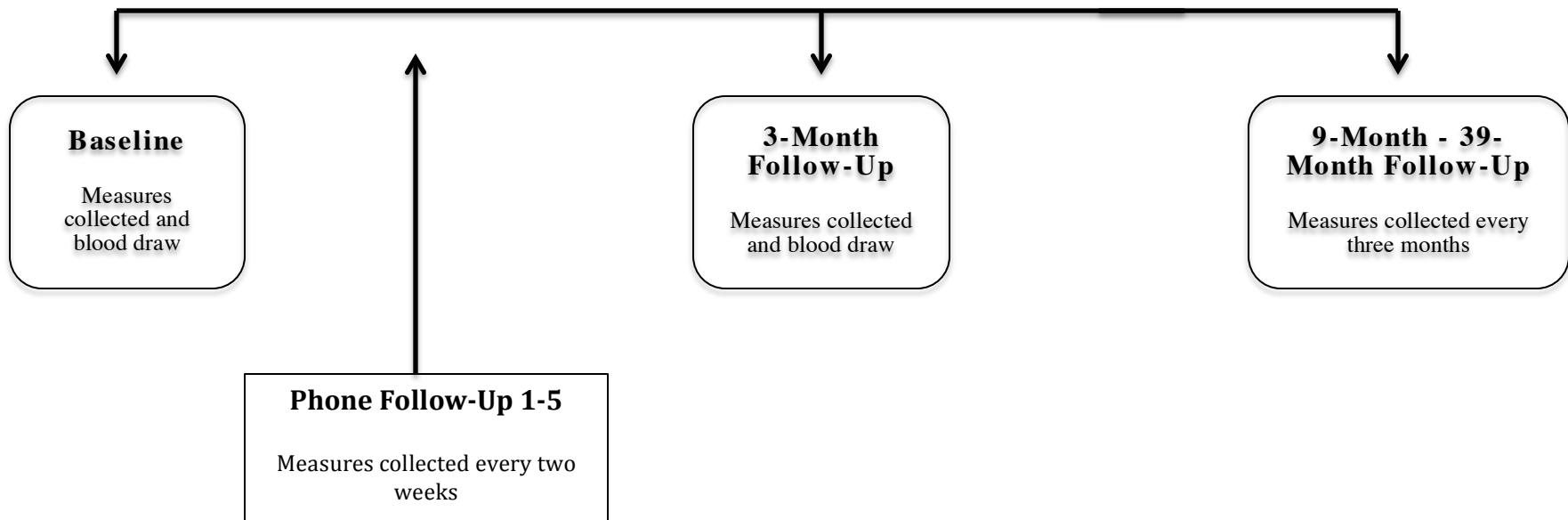


Figure 2. Original BETRHEART study timeline for collection of measures.

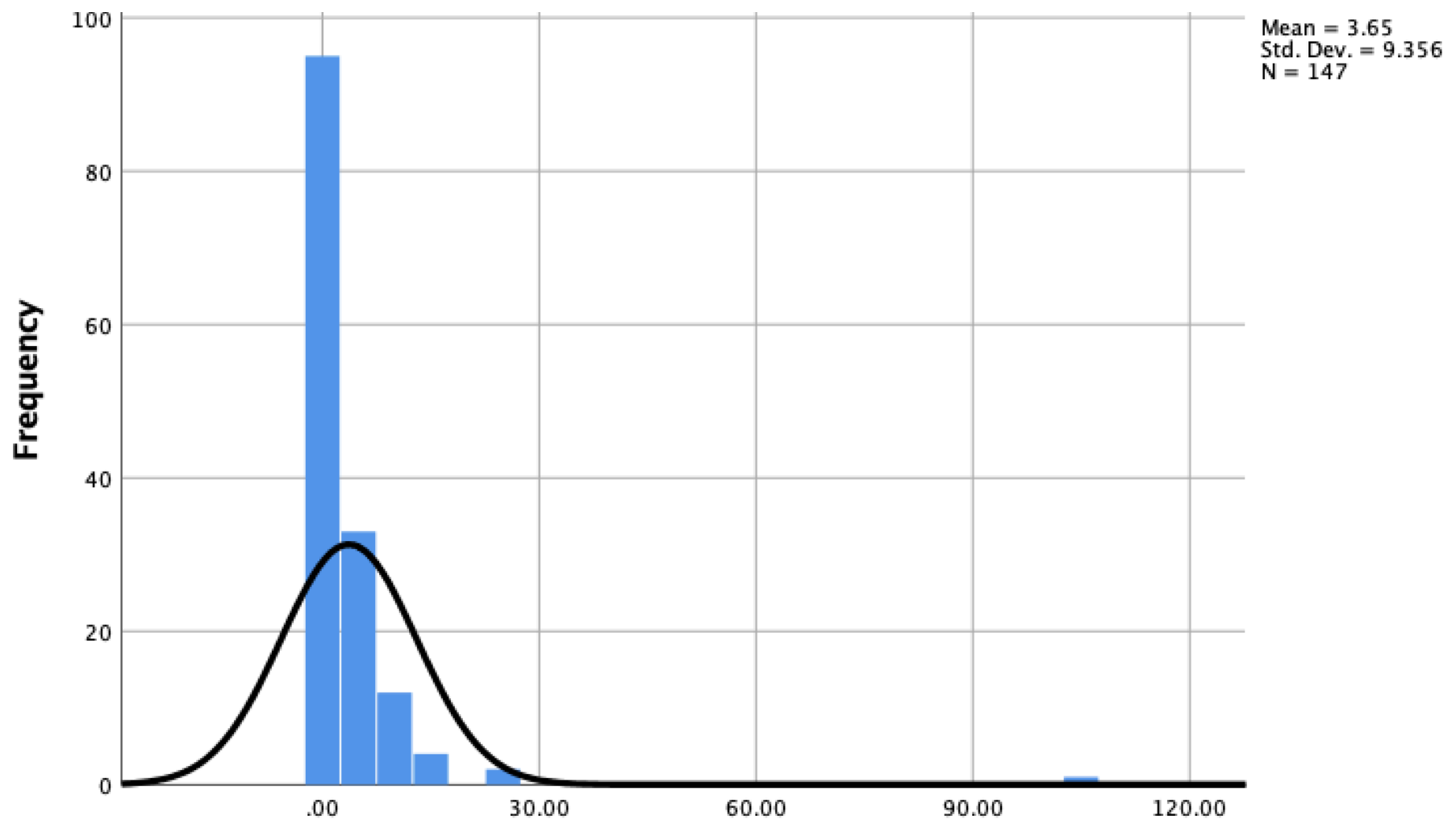


Figure 3. Histogram of all-cause hospitalization counts.

Note. Frequency depicts up to 120 on the graph due to this representing the raw hospitalization data. There was one participant that was an outlier. Means and standard deviations are reflected next to the Histogram. Categorical/binary variables were created for analyses due to the skewness of the data (the majority reported no hospitalizations). For short-term analyses there were 40.8% hospitalized and 46.9% for long-term analyses.

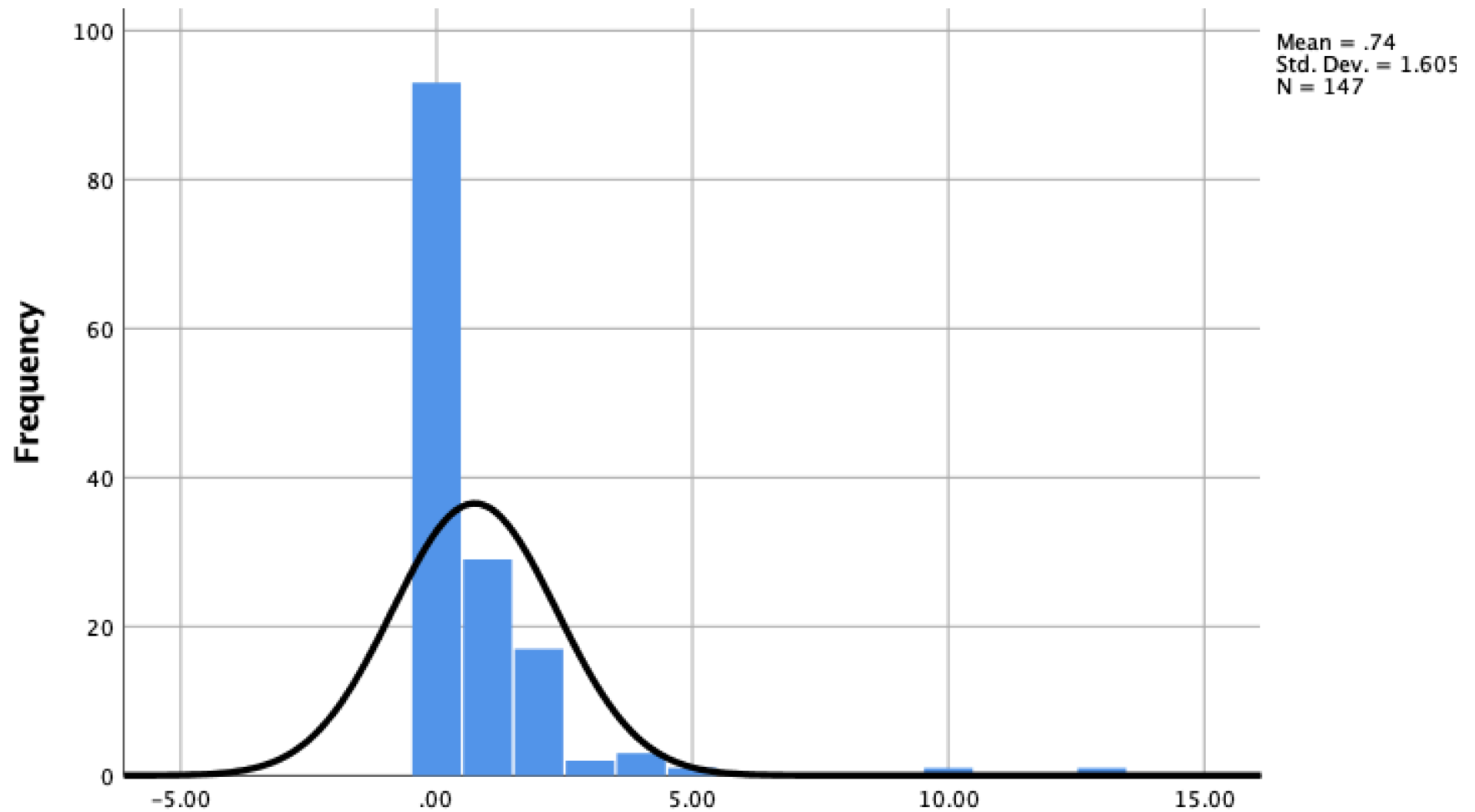


Figure 4. Histogram of CV related hospitalization counts.

Note: Hospitalization counts reflect raw data with outliers to the right. The majority of participants indicated zero CV related hospitalizations. Means and standard deviations are reflected next to the Histogram. Categorical/binary variables were created for analyses due to the skewness of the data (the majority reported no hospitalizations). For short-term analyses there were 48%% hospitalized and 37% for long-term analyses.

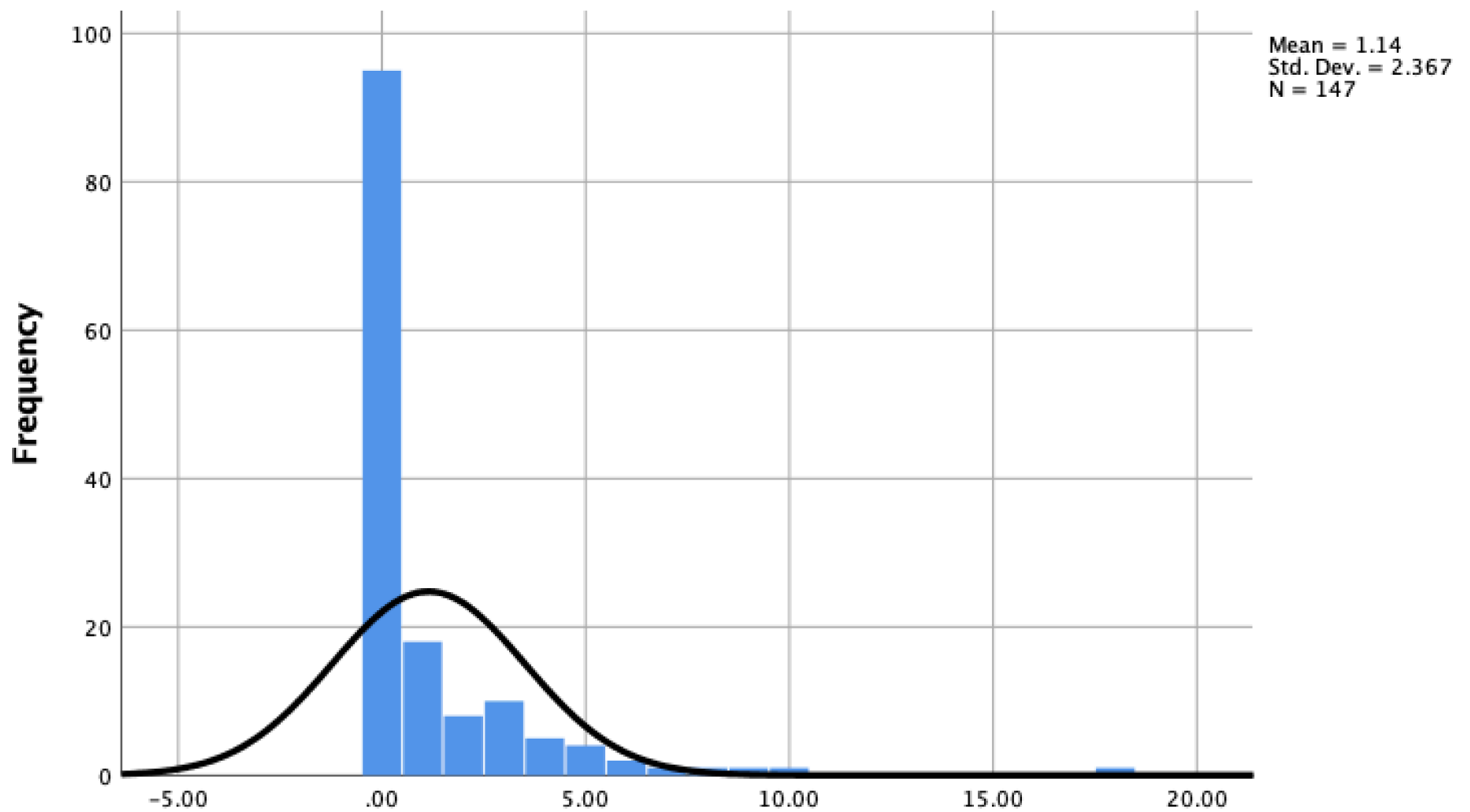
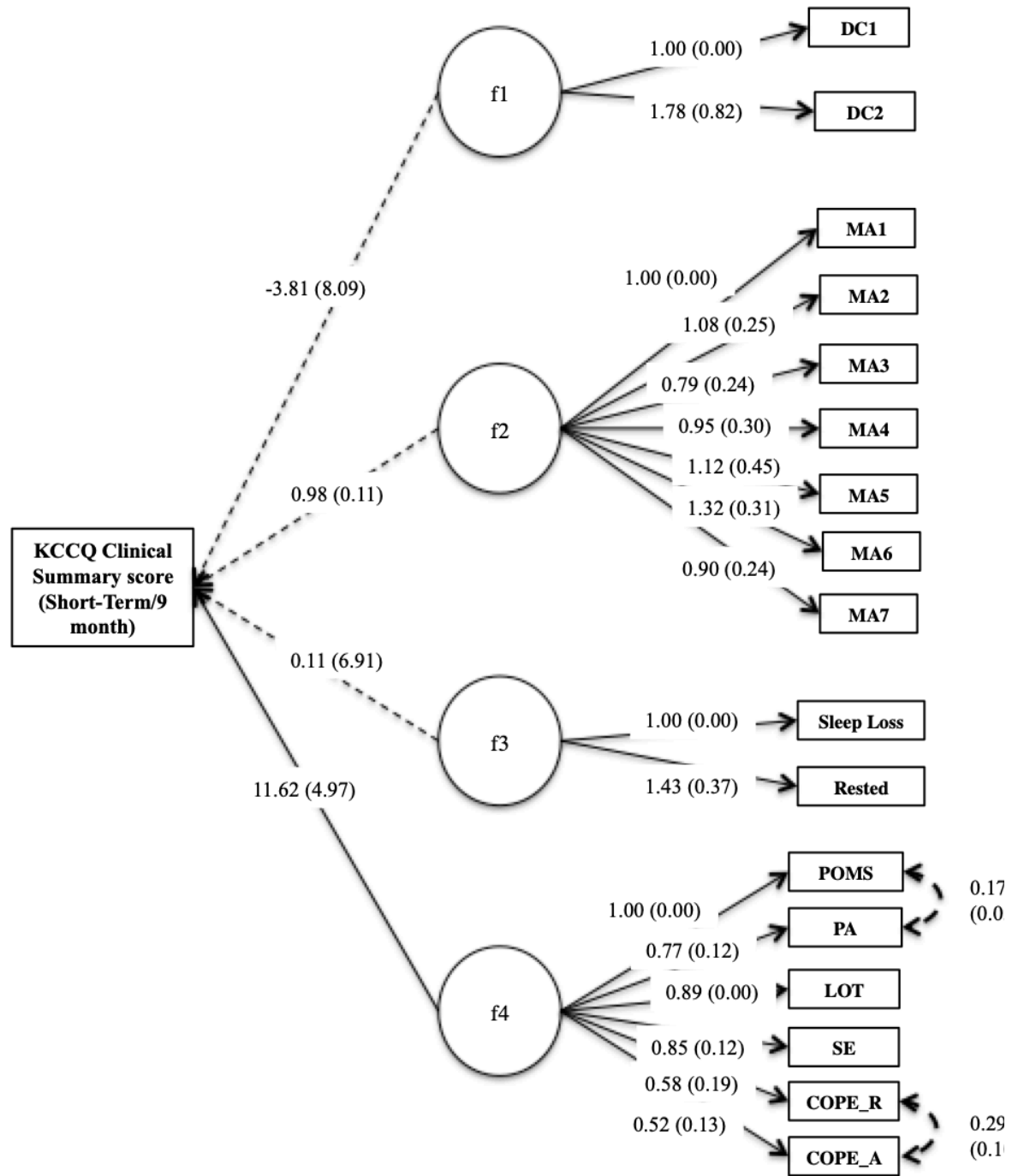


Figure 5. Histogram of HF related hospitalization counts.

Note: Hospitalization counts reflect raw data with outliers to the right. The majority of participants indicated zero HF related hospitalizations. Means and standard deviations are reflected next to the Histogram. Categorical/binary variables were created for analyses due to the skewness of the data (the majority reported no hospitalizations). For short-term analyses, 21.08% were hospitalized and 24% for long-term analyses.

Figure 6. SEM of four-factor model of relationship of predictive factors to outcome variables



Note: f1 = Dietary Compliance Factor, f2 = Medication Adherence Factor, f3 = Sleep Quality Factor, and f4 = Psychosocial Protective Factor. Dotted curved lines refer to correlated measurement errors between observed variables, dotted straight lines refer to nonsignificant associations, and solid lines refer to significant associations. This model reflects the same anticipated relationships between all DVs; to include: Long-Term KCCQ Clinical Summary scores and all hospitalization types (both short and long-term). Only f4 was significantly associated with short-term KCCQ scores (not long-term and not hospitalizations). The other three factors were not significantly associated with any of the covariates. Additionally, covariates were not included in this model example due to time in study only being significantly associated with long-term all cause and CV related hospitalizations.

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