SOCIAL SUPPORT AND HEART FAILURE: DIFFERING EFFECTS BY RACE

by

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Dissertation submitted to the Faculty of the
Medical and Clinical Psychology Graduate Program
Uniformed Services University of the Health Sciences
In partial fulfillment of the requirements for the degree of
Doctor of Philosophy 2016

UNIFORMED SERVICES UNIVERSITY, SCHOOL OF MEDICINE GRADUATE PROGRAMS
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DISSERTATION APPROVAL FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN THE MEDICAL AND CLINICAL PSYCHOLOGY GRADUATE PROGRAM

Title of Dissertation: "Social Support and Heart Failure: Differing Effects by Race"

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Doctor of Philosophy Degree
May 11, 2015

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ACKNOWLEDGMENTS

I would like to thank the United States Air Force for the opportunity to pursue my Ph.D. in clinical psychology. I would also like to extend thanks to all the faculty and staff at the Uniformed Services University for their support throughout my time here. Thank you especially to my to my dissertation committee chair Dr. Tracy Sbrocco, and members, Dr. Jeffrey Goodie and Dr. Cara Olsen for their incredible encouragement and input into this dissertation. Lastly, to my Academic advisor, Dr. David Krantz, thank you for being an exceptional model as I develop my professional identity as a researcher, clinician, and leader.

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ABSTRACT

Social Support and Heart Failure: Differing Effects by Race

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Background: There is a large body of research examining psychosocial correlates of heart failure (HF) including social support and social networks. There are also differences in progression and outcomes of HF and in the sources and functions of social support between Caucasian and African Americans. Although these factors have been studied independently and in some combinations with respect to cardiovascular diseases, the relationship of race to differing effects of social support on HF outcomes is unclear. **Purpose of study:** This purpose of this study was to examine the relationships among social support, race and HF outcomes, and to determine the moderating effects of race on the relationship between social support and HF outcomes. **Study Hypotheses:** Social support will predict HF outcomes and race will moderate those relationships. **Methods:** This project was conducted as part of a larger study called BETRHEART examining stress and psychosocial predictors of HF worsening. Patients completed several measures of social network, social support, symptoms and functional status, including the Social Network Index, Interpersonal Support Evaluation List – Short Form, the Kansas City Cardiomyopathy Questionnaire, a functional assessment (the 6 Minute Walk Test), and information was collected on HF hospitalizations and death over the course of the study. **Data analytic plan:** Data was analyzed using linear regressions, ANCOVAs, and multilevel mixed models for the continuous outcome variables and logistic regressions for the dichotomous outcome variable of HF hospitalizations or death. **Results:** Functional and some Structural Support measures were related to outcomes except hospitalization. There were no differences between African Americans and Caucasians in Social Support, however there were inconsistent interactions partially supporting hypotheses for moderation effects of race on the relationships between social support and outcomes. **Discussion:** Social Support impacts outcomes and varies by race. Future research should continue to examine these relationships and include measures of relationship quality and examine if more culturally appropriate measures of social support would influence results.

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CHAPTER 1: Introduction

Congestive Heart Failure

Congestive heart failure is a progressive disease resulting from the worsening ability of the heart to supply blood throughout the body (2). One of the major causes of heart failure is cardiac damage resulting from coronary heart disease (2). The Centers for Disease Control and Prevention (20) reports approximately 5.1 million individuals are living with heart failure (HF) in the United States. Heart failure prevalence for those over 20 years of age in the United States is 2.7% (16). Incident rates for new heart failure cases are reported to be 3.1 per 1000 persons (15) and lifetime risk of developing heart failure is 21% for men and 20.3% for women (88). Research also indicates that culture and ethnicity can also affect the incidence of heart failure as well as its outcomes with African Americans having higher incidence and poorer outcomes (84). Heart failure is also a major burden to the U.S. in terms of hospitalizations and utilization of health care services (2, 20). Heart failure also has ramifications for the individual living with the disease in terms of experience of symptoms, quality of life, ability to perform daily functions, and time spent in the hospital (40, 46, 99).

In addition to the traditional biomedical factors that contribute to morbidity and mortality, there are many psychosocial factors that contribute to the development of both coronary heart disease and heart failure. Specifically, many of the consequences of heart failure, including symptoms, reduced quality of life, impaired functional status and hospitalizations can be influenced by psychosocial factors (2, 5, 10, 13, 14, 50, 72, 76, 95). These psychosocial factors include but are not limited to depression, and whether the individual has a supportive social network.

The purpose of the proposed study is to determine the relationships among social networks, social support, and outcomes of heart failure, and to compare these factors in African American and Caucasian patients with heart failure. In the following sections, we will first review heart failure pathophysiology and outcomes including symptoms, functional status, and hospitalizations. Next, we will discuss the role of psychosocial risk factors including social support, social network size and diversity, and perceived social support in determining heart failure outcomes. Lastly, we will address cultural considerations in heart failure outcomes and the psychosocial risk factors of perceived social support, and social network size and diversity.

HEART FAILURE PATHOPHYSIOLOGY

Heart failure is a condition in which the heart is no longer able to pump sufficient blood to meet the body's metabolic needs (17). The disease is progressive, in part due to the body's compensatory homeostatic responses. These compensatory physiologic responses include increased sympathetic nervous system activity, inflammation, and constriction of blood vessels (17). These homeostatic responses may serve in the short term to reduce the ability of the heart to pump blood and increase the likelihood of symptoms, cardiac arrest and death (17).

Chronic heart failure can vary in severity of symptoms. The New York Heart Association (NYHA) is a classification system that ranges from class I to class IV and is based on symptom severity and exercise tolerance (2). Symptoms severity can range from no functional impairment (e.g., no symptoms of fatigue, shortness of breath, swelling that gets in the way of daily activities) or can have variations of symptoms severity up to having severe symptoms even at rest (2). In addition, an objective classification system is based on the presence or extent of cardiovascular disease and is labeled A-D where A is no objective evidence of disease and D is objective evidence of severe disease (2). These two terms are often combined to describe and classify patients' heart failure severity. There are also multiple other ways of assessing symptoms and functional status used in heart failure literature, several of which are described below. These include the 6 Minute Walk Test (6 MWT), self-report instruments such as the Kansas City Cardiomyopathy Questionnaire (KCCQ), and heart failure hospitalizations and death.

Heart failure risk factors and outcomes have also been found to vary across racial groups (38, 49, 58, 64, 75, 76, 87). African Americans are more susceptible to hypertensive states that lead to congestive heart failure and other chronic diseases as well as poorer outcomes and different rates of procedures when compared to Caucasians (38, 49, 58, 64, 75, 76, 87). Some authors report that differences in the rates and severity of diseases are brought about by physiological differences between African Americans and Caucasians. For instance the process by which sodium is processed in the body may vary between African Americans and Caucasians leading to a salt sensitivity in African Americans whereby they are more likely to develop hypertension and other associated cardiovascular and inflammatory diseases (76). One important hormone at work in the cardiovascular system is aldosterone and it may have a substantial impact on the salt sensitivity believed to play a role in the increased hypertension and associated diseases in African Americans (38, 49). For example, Huan suggests that based on his study it may be that insufficient suppression of aldosterone contributes to salt sensitivity in African Americans (49).

There are also reported differences in African Americans' utilization and outcomes of care for cardiovascular diseases and chronic heart failure (64, 87, 75). For instance African Americans are less likely to receive a percutaneous coronary intervention (angioplasty) as an intervention compared to Caucasians, but of those who do, the long term outcomes after 5 years were poorer for African Americans than for Caucasians (75). In their study, Pradhan et al (75) noted that the severity and comorbidity of disease at baseline was also significantly worse for African Americans. Sonel and colleagues also found that African Americans were less likely to receive such interventions post myocardial infarction using a set of data gathered from 400 different hospitals across the United States (87). Again, these authors point out that the African American patients tended to have a lower SES, more incidence of comorbidity, and were less likely to be covered by insurance than Caucasians. Such studies indicate the importance of examining differences between Caucasians and African Americans more fully both in terms of the physiological markers as done above and psychosocial factors as suggested in the current study.

HEART FAILURE SYMPTOMS, FUNCTIONAL STATUS, AND HOSPITALIZATION

Six Minute Walk Test

One way of measuring chronic heart failure severity is the measurement of objective functional status. Specifically, as heart failure progresses, there is increasing difficulty in completing physical activities due to symptoms such as shortness of breath and fatigue produced by decreasing perfusion and fluid backup into the lungs (17, 46). Measuring patients' functional abilities can provide a measure of heart failure effects during daily life (43).

The Six Minute Walk Test (6 MWT) was designed by Balke (3) and is commonly used in research as a measure of functional status in cardiac patients. It consists of having patients walk a premeasured distance for six minutes or as long as they are able (43). Guyatt, Sullivan, Thompson and colleagues (43) found the 6 MWT comparable to other standard measures of functional status (e.g., cycling) and sensitive enough to detect differences in treatment outcomes in clinical trials. In addition, the 6 MWT may be especially useful in measuring functional status in that it measures ability in a daily activity (walking) rather than activities that patients may or may not engage in on a regular basis (e.g., cycling) (43). There are standard administration guidelines suggested for administering the 6 MWT as an outcome measure of functional status in patients (33).

Self-Report Measurements

In addition to impaired functional status, heart failure can have profound impact on other domains of life (e.g., emotional adjustment, social functioning, and enjoyment of life) (5, 10, 13, 14, 30, 46, 50, 72, 77, 95). Therefore, measures of individuals' experiences in these domains can be an important outcome in heart failure research. Self-reported limitations in various areas of life as well as overall quality of life measurements provide the opportunity to assess information from patients' own experience in domains such as perceived function, symptoms specific to heart failure, and the impact of disease on various life domains and overall quality of life. These subjective reports can also be compared to objective measures of functional status as well and provide an alternative way of looking at the impact of heart failure on the patient's life. The KCCQ is a widely used and validated measure that can be used to provide such information (41). This instrument includes 7 scales measuring physical limitations, symptom frequency, severity, and change over time, self-efficacy and knowledge, social interference, and quality of life (41).

Hospitalizations

Finally, the high morbidity and mortality associated with heart failure often lead to hospitalizations and re-hospitalizations over the course of the illness (40, 93). Heart failure hospitalizations may occur after an increase or change in symptoms such as fluid overload and failure of the heart as a pump (40, 94). Therefore, hospitalizations for these causes are commonly used in heart failure literature as an index of the clinical severity and impact of the disease, and as an outcome measurement (30, 50, 47, 63, 72, 78).

PSYCHOSOCIAL RISK FACTORS FOR CHRONIC HEART FAILURE

In addition to standard risk factors for coronary heart disease (e.g., hypertension, elevated cholesterol levels, smoking), research has identified a set of psychosocial risk factors. These risk factors include traits such as anxiety (37, 51, 53), depression (50, 78), anger/hostility (32, 86), and characteristics of social environments such as social network (30, 72) and social support (30, 72). Particularly important for heart failure morbidity and mortality are depression and low social support (30, 50, 72, 78). Depression is thought to have negative impacts on the progression of disease, whereas social support may also act in a protective manner either indirectly lessening the harmful effects of stress and other psychosocial factors, or directly by providing resources to the individual. There is a large literature on depression as a predictor of outcomes in heart failure, and reviews of this literature can be found elsewhere (50, 78). However, this dissertation will focus on the role of social support and social networks.

In the present review, social support (i.e., emotional, instrumental, informational/appraisal, self-esteem, and overall social support) will be reviewed first, followed by a review of social networks (i.e., social network size and diversity). The possible mechanisms of the beneficial effects of social support are presented in the following section.

Social Support

Broadly, social support consists of the perceived and actual resources provided by individuals in ones social network (25). Perceived social support refers to the extent to which individuals experience their social support network as providing them with appropriate resources. Actual social support consists of measuring the objective availability of support provided by the network.

Research on social support uses both the structural measures of social network and network diversity as well as the functional support provided to individuals as measures of social support (e.g., 13, 30, 72). Structural social report refers to the number of other people and groups that individuals interact with (25). In contrast, functional support includes a variety of resources provided by social networks including emotional, instrumental, informational, and self-esteem support (25). Although both structural and functional support are often examined in the literature, there are few studies comparing the types of social support in their contribution to illness and recovery. One such study did compare functional and structural support and found that functional support, especially emotional support or feeling loved was predictive of disease above and beyond structural support (83). This finding indicates functional social support may be more important in predicting health status for men and women than structural social support.

When examining the impact of social support on health outcomes it appears that social support is important for both men and women (85). However, it also appears that while the relationships between social support and health follow the same direction (increased social support is related to increased health), these relationships have larger effects for women that for men (85). In one study, small gender differences were found in that men's risk ratio for mortality was higher when living alone compared to women and women's survival rate was higher when they reported more emotionally supportive relationships (34). Social isolation appears to be especially problematic for men rather than women (34). Within the context of social support as a risk factor, social isolation appears to be one of several important factors to consider including more functional aspects of social support (34, 37, 72).

In addition, social support appears to be a fairly stable measure over time (35). For instance, several studies have shown that over follow up intervals of several years (e.g., 3 years) social support measures remain stable (80). Studies examining longer time periods however have shown evidence for some changes in sources of social support over time (35, 42). Specifically, it appears that as men age they report more social support coming from their spouse or significant other, whereas for women, more social support is reported to be sourced from friendships and relationships outside the home (35). Of note, Gurung and colleagues found that while in general social support increased slightly over decades, for those individuals experiencing more psychological distress the interactions with others were more negative and contained more conflict (42).

Social Networks

A social network is the group of individuals that one interacts with (22). Social network size refers to the number of individuals one reports in their social network while diversity or scope of the network refers to the groups or locations where network members are known (e.g., church groups, work) (25). However, there has been relatively little research separating network diversity from overall size of the social network. There is an extensive literature on social networks and coronary diseases and heart failure. This will be reviewed in a later section.

Functional Support

Functional social support can be broadly divided into three categories including emotional support, instrumental support, and informational support (25). Another index, termed companionship support, relates predominately to having an individual or group with whom one can engage in enjoyed activities, especially recreational activities (25). Lastly, self-esteem support refers to an individual's perception of being as able or capable as others of completing necessary tasks (24). Often the indices of social support are combined to create a measure of overall social support. However, several studies have reported that using individual indices of social support can provide important information on the individual contributions of these distinct but related types of support (18, 24). In the coronary heart disease literature, the various indices of perceived support are most often not studied independently of one another, but are combined in an overall index of social support.

Emotional Support

Emotional support is an important dimension of functional support (25). Specifically, it refers to having individuals who can provide an outlet to discuss events and feelings, provide reassurance, validation, approval, and sympathy. Emotional support can come from a variety of individuals, for instance, friends, immediate family, extended family, or coworkers and acquaintances. Emotional support is thought to be beneficial because it increases self-esteem, confidence, adaptive appraisal of threats and stress, and adaptive coping, however, there are only a few studies that examine this dimension of functional support independently of others (25).

Krumholz and colleagues (56) addressed social support in relation to hospitalizations in heart failure patients and report that the absence of emotional support predicts fatal and non-fatal cardiovascular events in elderly women with heart failure. In addition, Lett (60) examined social support in relation to recovery from myocardial infarction using the ISEL and found that for patients with low levels of depression, high perceived emotional support was related to better outcomes. However, for those patients who reported high levels of depression (measured by the BDI) emotional support was not related to coronary disease outcomes and for those patients who were older, sicker and less-educated, emotional support was related to worse outcomes (60).

Although there is limited research on the individual components of functional social support in the heart failure literature, in the coronary disease literature it has been addressed more often (e.g., 82). Seeman and Syme (83) examined social support and specifically the indices of instrumental and emotional social support in relation to coronary atherosclerosis. They report that emotional support was negatively correlated with coronary atherosclerosis in that individuals with lower emotional support had more atherosclerosis than those with higher reported emotional support. Interestingly, they included two indices of emotional support, one “problem oriented” (i.e., advice or information and discussion of health or personal problems with family and friends) and one described in terms of individuals “feeling loved” (i.e., a sense of feeling loved by others) (83). The problem oriented emotional support was not related to coronary atherosclerosis measured via coronary angiograms, while the “feeling loved” emotional support was, although there was a trend regarding problem focused emotional support indicating lower coronary atherosclerosis for those reporting higher emotional support (83). This study focused on coronary atherosclerosis as an outcome, however given the relationship between coronary disease and subsequent heart failure, these results are important to consider.

Another study examining coronary heart disease in Lithuanian and Swedish men compared the two groups on psychosocial variables including social support (55). This study indicated that Lithuanian men who have a higher rate of mortality from coronary heart disease also had lower social support at work and lower emotional support compared to Swedish men. This study was cross sectional, examined coronary heart disease, and included a sample made up only of men (55). However, the results here suggest that there may in fact be important associations between social support and heart disease outcomes as well as cultural differences in the role of social support in heart diseases.

Instrumental Support

Although emotional support provides intangible (i.e., feelings of belonging, understanding, and being loved, advice, information, and discussion of personal problems) aspects of support, instrumental (also referred to as tangible support) support is the provision of material or practical support (25). For example, instrumental support may come in the form of money, tools, transportation to and from medical and other appointments, or helping to obtain and organize medications, among other things. This type of support is thought to provide several important benefits to individuals. These include increasing an individual's ability to take advantage of and receive medical care and engage in health related behaviors that will benefit physical and psychological health. Secondarily, instrumental support decreases the stress and distress associated with completing a variety of everyday as well as uncommon tasks, thereby increasing time for other more enjoyable or positive activities (25).

Similar to emotional support, few studies report on instrumental support independently of other indices of functional support. However, in a recent study, tangible support was positively related to quality of life as measured by the KCCQ in patients with heart failure (11). In one study by Seeman and Syme (83) and described above, instrumental support was investigated as it related to coronary atherosclerosis. The results of this study indicate that instrumental support was negatively correlated to coronary atherosclerosis in that individuals with lower instrumental support had more atherosclerosis than those with higher reported instrumental support. As described above, this study did not examine patients with heart failure, but should be considered given the relationship between coronary disease and subsequent heart failure.

Instrumental support has also bee studied in relation to overall quality of life in patients following a coronary artery bypass grafting (4). Increased instrumental support was predictive of positive changes in mental health in patients at 6 months post operation. Instrumental support also appears to be related to improved psychosocial adjustment in patients with coronary heart disease, although less often found to be related to physical outcomes (28, 60, 61).

Informational/Appraisal Support

Cohen and colleagues (25) describe two other types of functional support: an information support and a validation (appraisal) support. Both of these types of support provide information: one type is direct information about possible courses of action and outcomes for health and behavior, while the other is the provision of information regarding behavioral standards. They are combined in this section as they both provide individuals with a framework for decision-making that may be applied directly to engagement in health behaviors. Professionals often provide informational support, in contrast to other types of support, although friends and family can provide it as well. Informational support consists of providing information, advice and guidance (25). The provision of informational support can help individuals consider alternative options, engage in problem solving, and increase information regarding resources and services that may be needed. This can be a crucial type of support for individuals with chronic diseases such as chronic heart failure. In addition, validation or appraisal support represents the tendency for contact with others to provide standards for appropriate behavior and this type of support may also be important for heart failure patients in that it may increase or decrease the likelihood that individuals will follow through with advice or guidance provided by others. Appraisal support has been linked to functional status self-reports as well as quality of life in patients with heart failure, although these were cross sectional, correlational analyses (11).

Social Support and Heart Failure

Previously we reviewed the literature investigating indices of social support considered independently. However, overall measures of social support are investigated in the literature to a greater extent than the individual indices. In the following section, functional social support generally is discussed in greater depth to elucidate the relationships of functional social support to heart failure.

Social Support in Relation to Development and Prognosis of Heart Disease

Evidence indicates that lower social support is a risk factor for both the development and prognosis of heart disease (62). One of the initial studies in this area was the Alameda County Study (13). In this study, men and women with self-reported high and low social contacts were compared using mortality as an outcome at a nine-year follow up. This study suggests that low social contacts were related to increased risk of mortality for men and women regardless of self-reported physical health, SES, and traditional risk factors such as smoking, alcohol consumptions, obesity, physical activity, and preventative health practices. These results were replicated at a 17-year follow up analysis conducted by Seeman, Kaplan, Knudsen, Cohen, and Guranik (82). In addition, they established that marital status was a primary predictor for participants less than 60 years at baseline; while ties with close friends and/or relatives were of primary importance for those aged 60 and older.

Social support in terms of both the structure and function of the social network have been found to be associated with heart failure risk factors as well as hospitalizations and outcomes (30, 72). For instance, social support is related to a variety of self-care and health promoting activities such as checking with a doctor about weight and fluid gain, taking medication, and engaging in exercise (39). In a recent meta analysis examining psychosocial factors associated with prognosis in chronic heart failure, Pelle et al. (72), found being unmarried and having low levels of emotional support were related to all cause mortality in a population of inpatients with chronic heart failure. In addition, their meta analysis indicated that in 2 out of 4 studies, associations among social isolation, being unmarried, and having low levels of functional support were associated with all cause and cardiac mortality before controlling for a variety of covariates including age, gender, race, clinical severity, comorbidities, and functional status, but not after (72). Although many studies use an overall score of social support instead of looking at the specific subscales and types of social support, in one study, emotional support specifically appeared to be predictive of mortality following a myocardial infarction (12).

Social Support in Relation to Heart Failure Hospitalizations

In addition to mortality, social support is related to hospitalizations (10). Individuals with lower perceived social support and difficulty adhering to medication regimens are at a higher risk for cardiac events than those with higher support and who adhere to medication regimens (97). This study however used a combined index of social support and medication adherence. The study did not specifically examine hospitalizations, although a cardiac event may commonly lead to a hospitalization. For women, perceived loneliness was related to fewer social contacts, emotional contacts, lower satisfaction with social contacts and also more hospital readmissions (61). The direct relationship of emotional contact with social support to readmission was not examined in this study but the results indicate that lower social support may influence hospitalization through perceived loneliness. Age may also play a role in the influence of social support on hospitalizations. Specifically, in one study, while readmission to a hospital within 3 months of discharge was related to having no partner for all patients, individuals who were under 65 were 1.8 times more likely to be rehospitalized within 3 months while those who were over 65 were 2.2 more likely to be rehospitalized (47). On its own, instrumental support has been linked to chronic heart failure syndromes (10). That is, tangible (instrumental) support was marginally predictive of cardiovascular hospitalization and significantly predictive of heart failure related hospitalizations in heart failure patients (10).

Social Support in Relation to Quality of Life

Social support has also been examined in relation to quality of life in heart failure patients (5). As social support increases, so does quality of life (5). In another study examining psychosocial predictors of quality of life for patients with chronic heart failure, the authors measured both perceived functional social support and quality of life during a hospitalization and then 12 months later (10). Their findings indicate that changes in social support over the twelve months follow up period predicted changes in quality of life over that time period as well, but that social support did not predict quality of life. The authors attributed the variation in findings to the possibility that because participants may have been more sick and further along in the progression of the disease, they may have already developed appropriate social support networks providing them functional support and yet still had a lower quality of life due to the level of illness. Emotional support in particular appears to be related to quality of life, although this relationship may be mediated by both physical and depressive symptoms (48). In their article, Clarke, Tu, Weiner, and Murray (21) examined social support in relation to health related quality of life as measured by the KCCQ. Their findings suggest that individuals who were male, black, and had greater income, social support and communication with physicians also had higher health related quality of life scores in relation to chronic heart failure.

Social Support in Relation to Functional Status

Berard, Vandenkerhof, Harrison, & Trammer (14) examined social support and gender in relation to functional status in heart failure patients and found that for men but not women, lower levels of baseline social support were related to worsened functional status one year later. In addition, Witham, Argo, Johnston, Struthers, and McMurdo (95) examined predictors of ability on the 6MWT and found that psychosocial factors including loneliness significantly predict overall distance on the 6MWT in patients with heart failure.

Social Support Network: Size and Diversity

As noted previously, social support network is an important protective factor with regards to health outcomes. One common measure of an individual's social support network is the size or number of people in the network (25). Social network measures can also provide a measure of the density of the network, or how many interconnections there are among individuals in the network (25). In addition to the size of a social network being important for heart diseases, the diversity or scope of a social network may also be an important factor. As described earlier, network diversity includes grouping sources of network members from a variety of locations such as immediate family, extended family, work, school, or religious group. Although it may seem as though network size will reflect the amount of perceived and received support an individual receives, research indicates these factors are not always related and therefore are important to consider on their own as separate factors (e.g., 83).

Network Size, Network Diversity, and Heart Failure

One way in which social network seems to influence heart health outcome is due to the size or availability of individuals within a network (30, 70, 72). This may be due to the fact that the more individuals someone has around them the more likely they are to be able to seek out and/or receive aid. For instance, in their study, Murberg and Bru (70) found that perceived social isolation significantly predicted mortality over 24 months in a population of individuals with chronic heart failure controlling for among other things, depression and functional status. However, this study examined mortality and perceived social network rather than directly asking participants to report on the numbers of individuals and diversity within their social networks. Another study examined social network size in relation to quality of life in patients with chronic heart failure (59). This study reported that social network size accounted for a portion of the variance in quality of life scores, but did not report in what direction they were related and when run in a hierarchical regression the importance of this variable was trumped by the psychological distress term and NYHA class (59).

In a 12-month prospective study examining both social network size and partner stress, individuals with larger social networks were more likely to attend rehabilitation while smaller network size was related to poorer reported quality of life (69). Another study examining social network size and CAD risk factors in women found that higher scores on the Social Network Index (aka, increased social network size) had reduced coronary risk (e.g., lower blood pressure, lower smoking rates, hypertension, and diabetes), less severe CAD and lower death rates than those with low scores (79). Although this study examined CAD rather than CHD the relationship among these diseases and variables makes these results pertinent to the current study.

Social isolation also predicts mortality in chronic heart failure patients (37). Based on their study results, Vogt, Mullooly, Ernst, Pope, and Hollis (92) assert that social networks size and scope (e.g., diversity) may be related more to promoting recovery after illness than to preventing incidence. In addition, rehospitalization rates are lower for those heart failure patients with less contact with and smaller social networks than those with larger social networks (77). Network diversity may be especially important in promoting recovery in disease states or in slowing disease progression (92). There are few studies that have separated network size from diversity in examining heart failure symptoms, functional status, and hospitalizations (e.g., 92).

In summary, both functional and structural social support are correlated with better outcomes for a variety of chronic illnesses including heart failure. However, functional social support is most often studied as an overall term rather than as independent indices (e.g., belonging, appraisal, tangible support) and in direct comparison to functional support, structural support appears to predict outcomes less well. Although social support is important to outcomes for both men and women, there may be some differences in what specific aspects of social support are important for each group. In general social support appears to remain stable over the course of several years but may change over the longer term and in relation to other psychosocial factors such as psychological distress. It is important to examine these factors individually given that they seem to make unique contributions to health.

HEALTH DISPARITIES AND SOCIOECONOMIC STATUS

Health Disparities

Since the mid 1980s disparities in health care utilization and health in African Americans and other minority groups have been the focus of substantial research (36, 65). According to the World Health Organization the social determinants of health impact many chronic diseases across cultures including chronic heart diseases such as heart failure (96). The WHO has several studies examining health disparities and the social determinants of health including the Study on Global AGEing and Adult Health (SAGE), which examines data from several countries around the world. The SAGE study is designed to assess the social determinants of health in a variety of countries and cultures. These factors include an individual's genes and biology, their health behaviors, medical care accessibility and usage, environment and position within the environment. These factors, including social support and social environment may vary across cultures in makeup and importance and represent an important area for continued research (96). The current study looks to address several of these domains including health behaviors and social and societal environment. In heart disease specifically, there are disparities between health care utilization and disease severity between African Americans and Caucasians (65). A number of variables have been examined including availability of resources (i.e., access to adequate care/specialists, appropriate diagnosis and referral for treatments such as surgery), using preventative and screening services, and disease severity (36, 65). It appears from Mayberry and colleagues' (65) review that severity (including incidence and mortality) is higher among African Americans than Caucasians, while resources are more limited. Several explanations have been provided for these differences including SES, insurance, and adequate referrals by doctors. However, there also may be culturally driven decision processes that inhibit those African Americans from choosing to receive more invasive care (e.g., surgery or heart transplant) even when such options are recommended (65). However, these authors also discussed that when investigating health disparities in military settings (in which medical care is provided regardless of pay grade), there were no racial differences in rate of procedures including cardiac catheterization or revascularization, although Caucasians were considered for such treatments sooner than African Americans in this sample. There are many factors that may contribute to the disparity of health care utilization among African Americans and Caucasian individuals including SES, education, access to care, insurance coverage, and cultural belief systems (36, 65). One important factor to consider that may be interconnected with several of the other contributing factors is SES and is discussed in more depth below.

Socioeconomic Status

Socioeconomic status (SES) is an important factor in determining health status. SES is related to health outcomes in that those who report higher SES generally have better health outcomes (1). SES has ben conceptualized as both a categorical (i.e., above vs. below poverty) and as a gradient variable (1). That is, historically, when used either as a covariate and/or as an independent variable, SES was considered in research as placing individuals either above or below the poverty line. However, in the last few decades, consideration of gradients in income level has been investigated in literature (1). The poverty threshold is flexible depending on how many individuals live in the home (103). The U.S. Health and Human Services office defines the poverty threshold for a one-person family to be at $11,770, and for a family of four to be at $24,250 (103). For each additional person living in a home an additional $4,600 should be added to the threshold for poverty (103). In addition, SES is often used to explain racial disparities in health and health care utilization (e.g., 1, 93). Racism and the chronic stress of discrimination is also considered a contributor to why in some cases individuals of different racial backgrounds in the same SES brackets tend to have differing health outcomes (93). In addition, it appears that higher education, one component often used in assessing SES, is related to social support in that higher education is associated with higher reported social support (71). It is important to continue to examine the effect of SES on health outcomes in individuals with heart failure.

RACIAL DIFFERENCES IN INTERPRETATION OF SYMPTOMS IN HEART FAILURE POPULATIONS

Although many researchers have controlled for race during analyses, more attention is being directed to study ethnic group and race as predictors (e.g., 8). Investigating differences among racial groups is warranted given that culturally acceptable health behaviors and risk factors in the U.S. vary across racial groups (57, 84). In one recent study, hospitalizations and mortality (both heart failure and cardiovascular related) were examined in Caucasian and black individuals (67). These authors found that not only were risk factors such as exercise performance as measured by the 6 MWT at an increased level compared to whites, but so were HF hospitalizations and cardiovascular mortality. Incidence of cardiac arrest in the CARDIA study also demonstrate higher incidence in African Americans compared to Caucasians and poorer survival rate following arrest (7). Another study investigating hospitalization differences among racial and ethnic groups in women found that black women have higher rates of heart failure than white, Asian/pacific islander, or Hispanic women (31). Differences found in this study were partially explained by lower household income as well as increased diabetes diagnoses. Lastly, race predicted overall perceived health ratings in patients who identified themselves as black in that they had worse overall perceived health than self-identified white individuals in patients with heart failure (19) Although overall perceived health is not identical to self reported symptoms as measured on the KCCQ, overall perceived health may be related to health outcomes and quality of life in patients with HF (19).

RACIAL DIFFERENCES IN PSYCHOSOCIAL RISK FACTORS FOR CHRONIC HEART FAILURE

Incidence of heart failure is approximately 9.1per 1000 persons in African Americans and approximately 6 per 1000 persons in Caucasians (84). These disparities may be due in part to modifiable risk factors such as hypertension, hyperglycemia, and smoking, as well as diabetes that appear at higher rates in African Americans than Caucasians (84), and which have been discussed in previous sections of this paper in greater detail. There may also be evidence for socioeconomic factors such as lower income and discrimination playing a role in seeking health care among this population

(84). We propose that psychosocial factors such as social support, and social network may also play a role in these differences.

Some evidence suggests that there may be specific differences between ethnic/racial groups in terms of the value placed on aspects of psychosocial functioning and specifically within the sphere of social network and social support (71, 81). That is, some cultural groups may have distinct social organizations, which emphasizes certain aspects of a social network or provision, acceptance, and value on certain functions of that network over others in alternate cultural groups (52, 81).

Historically, research on different ethnic and racial groups is based in predominantly mainstream Caucasian values and norms, and compares minority groups to those norms, rather than examining the unique characteristics of each culture (73, 81, 94). For example, in research examining family organization differences, four main approaches have been discussed including the Cultural Deficiency, and Cultural Resiliency, Structural Destruction, and Structural Resiliency models (81). The Cultural Deficiency model proposes that black families' social organization is "disorganized, dysfunctional and deficient" and that this is a result of cultural norms that are somehow deviant because they are not similar to the mainstream Caucasian culture (e.g., tolerance for having children out of wedlock, matriarchal organization) (81). Cultural Resilience models also highlight these differences, however they are framed in a positive light and reported as important to the maintenance of cultural values (81). Structural Resiliency focuses on the socioeconomic, education, and wealth differences in explaining the organization of black families (81). Lastly, Structural Destruction models focus on the history of oppression as the basis for explaining the organizational patterns in these cultures. Again, this implies that the structure and process of giving and receiving support is somehow deviant because it was compared to the mainstream Caucasian cultural organization of families. Sarkisian, & Gertsel, (81) investigated differences in support exchanges (i.e., provision of one type of support is reciprocated using the same or an alternate form of support) and cultural values (e.g., value of marriage) and found both distinct and similar organizational patterns and provision of support across white and black participants. Black family and social support organizations however, were not less organized than white family and social support organizations; simply different. There is a need to expand this view of cultural differences in terms of social organization and provision of resources to explore the differences and similarities across ethnic/racial groups without placing a value judgment on one over the other. Given that cultural groups may have distinct values and organizations, understanding the sources of social support and types of social support most useful, valued, and available to each group can help provide tailored interventions to patients suffering from chronic diseases such as chronic heart failure.

Racial Differences in Social Support

When considering the fact that different cultural groups may value the importance of various social resources over others, it is important to separate these resources and their sources for further study. Each index of social network and social support described above may have distinct sets of functions for patients, and these may vary across cultural groups.

Some studies have directly compared social support as measured by the ISEL Short Form in Caucasians and African Americans (e.g., 71). In terms of race, African

Americans reported lower scores on tangible, belonging, and total support, but higher scores on self-esteem support compared to Caucasians. There were no differences in appraisal support between the two groups. When gender is also considered, significant interactions between race and gender were revealed. Specifically, Caucasian women reported the highest levels of appraisal, belonging, and total support, followed by African American men then African American women and finally Caucasian men; for self-esteem support, African American men report higher levels than other groups (71). However this study compared social support between Caucasians and African Americans and did not look at health related outcomes. Other studies have included heart health risk factors and outcomes.

One study examined quality of life and psychosocial factors such as coping and social support in individuals with heart failure (6). Lower social support and sense of meaning/peace were associated with higher depression and anxiety. However for African Americans only, spiritual well being was associated depression (6). Another study that investigated social support and hypertension in blacks, whites, and Mexican Americans and found that social support was related to hypertension in African Americans (9). Those who had financial and emotional support did not have a decreased risk for hypertension (9). As explained by the authors, this may be due to increased physiological distress in blacks compared to whites and increased presence of chronic stressors (e.g., discrimination), such that social support as a buffer had little effect on health. Another study examining subjective well being found feelings of closeness within the family (similar the emotional support encompassing having a sense of belonging) to be important to well being for African Americans (90). However, this study included only a sample of African Americans and could not make a comparison to other groups.

Other studies examining social support and group differences have focused on depression as an outcome (74). Depression is a risk factor for heart disease and may be provide some information about differences among ethnic and racial groups and differences between them in terms of social support. This study found that whites had increased interpersonal problems compared to blacks and that interpersonal functioning was a mediator between group membership (black vs. white) and depressive symptoms (74). It seems that individuals whose cultures of origin are more collectivist in nature may place more emphasis on social interaction. This emphasis may then have a stronger influence on outcomes including both psychosocial and physiological factors.

In summary, the impact of social support on health appears to vary across racial/ethnic groups (6, 9, 71, 74). Evidence for impact of these variables on health across racial groups is mixed, however with some studies showing social support is associated with increased risk for African Americans others found it was associated with decreased risk (9, 74). There are many factors that may explain these findings including increased overall biological risk in African American populations, and/or chronic stressors faced by this group (e.g., discrimination, psychosocial stressors) that are not present in the majority culture. Another possible explanation is the differing importance of the social support systems.

Racial Differences in Social Network, Network Diversity, and Family Structure

There is some evidence that certain indices of network diversity may be more important for certain cultural groups than others. These factors may be important to investigate in patients with cardiovascular diseases and/or heart failure. For example, the previously reviewed study by Sarkisian and Gertsel (81) found that black women place less value on marriage, attend more religious services have lower incomes, less wealth and education, less likely to be in professional or managerial occupations and more likely to receive public assistance than white women in their sample. This study examined a sample of healthy adults however and did not focus on individuals with heart failure or cardiovascular diseases. It also focused on kin networks as sources of social support and discussed other extended support systems far less (e.g., religious and work systems). In addition, Kim and McKerny (52) found that different sources of support may be more important for some groups than for others. For example African American groups may tend to receive support more often from parents and children than Caucasians and be more likely to participate in religious groups than Caucasians, while Caucasians were more likely to participate in recreational groups. Taylor and colleagues (90) examined social support and social network variables in relation to subjective well being in African Americans. They report that several important sources of support within a network including friends, church attendance, and neighbors were related to subjective well being for African Americans in their sample. Other studies have found that structural support is more highly correlated with functional social support for Caucasians compared to African Americans (71).

It is important to note that involvement in religious activities may have a two-fold influence on individuals' well being. That is, in some studies (e.g., 65) involvement in religious activities is proposed to be beneficial to individuals because of its association with increased spirituality as a coping mechanism that may provide a sense of peace and meaning for those with terminal conditions. In other studies (e.g., 52, 89), involvement in religious activities is proposed to be beneficial to individuals because of the increase in social support received from attending a regular event with a group of individuals.

One model that has been proposed as a way of examining the impact of social support coming from family in African American culture is the Kinship Family Structure Model (73, 94). This model proposes that the extended family (non-nuclear family and community members), or kinship network, is a vital source of support for individuals with and without chronic diseases such as chronic heart failure. This model emphasizes the extended family and engagement as adaptive rather than harmful to individuals' social adjustment as well as health needs. However, this family structure has often been marginalized and viewed as a maladaptive organization of the family by researchers who compare married individuals to those in a marriage like relationship, or by including only nuclear family elements without assessing for the impact of and support received by extended family members (73, 94).

Lastly, although there is some evidence that African American individuals may receive support and be involved in more diverse networks (important support coming from a variety of sources such as neighbors, friends, and extended family), there is also some evidence that African Americans may actually have smaller networks (91). That is, although the sources of support may be more diverse, the number of individuals reported as part of the overall network may be fewer compared to Caucasians. These social supports may have less effect on health for African Americans compared to Caucasians (44, 91). Vina and colleagues (91) studied social network and support in African Americans and Caucasians contemplating knee replacements and found African

Americans reported smaller networks and less functional support than their Caucasian counterparts in the study. In addition, social support was predictive of receiving the knee replacement for Caucasians only. Havassy and colleagues (44) examined social support in relation to abstinence in cocaine recovery and found that greater social integration predicted abstinence for Caucasians but not African Americans.

SUMMARY AND RATIONALE FOR CURRENT STUDY

Evidence indicates that psychosocial factors play an important role in cardiovascular health outcomes including functional status, symptoms reporting, and hospitalizations among patients. Among the most important psychosocial factors are functional social support (e.g., emotional, instrumental, informational, and self-esteem support) and structural social support, including both network size and diversity. Social support and social networks vary by race and ethnicity and these variables may account for cardiovascular and protective risk factors. Therefore, the current study examines and compares the relationships among social support and network size and diversity to heart failure outcomes in African American and Caucasian individuals. Specific hypotheses to be addressed in this study include the following.

AIMS AND HYPOTHESES

Aim 1. Determine the relationships among perceived social support (appraisal, belonging and tangible subscales, and total support), and social network size (of overall and embedded networks of friends, family, neighbors, and church/temple) and diversity (number of embedded networks) and symptoms, functional status, and hospitalizations among individuals with heart failure.

Hypothesis 1. Size and diversity of social network and perceived social support will predict symptoms, functional status, and hospitalizations among individuals with heart failure. Specifically, larger social network, increased network diversity, and greater perceived social support will be related to decreased symptoms, functional status, and hospitalizations.

Aim 2. Determine the relationships among race and perceived social support (appraisal, belonging and tangible subscales, and total support), and social network size (of overall and embedded networks of friends, family, neighbors, and church/temple) and diversity (number of embedded networks) among patients with heart failure.

Hypothesis 2a. African Americans will report decreased tangible, belonging, and appraisal support compared to Caucasians in patients with heart failure.

Hypothesis 2b. Consistent with prior literature, African Americans compared to Caucasians will report smaller network size (of overall) and increased network diversity (number of embedded networks).

Hypothesis 2c. Within each church/temple, friend, and neighbor embedded networks African Americas will report more high contacts than Caucasians and fewer high contacts than Caucasians in the family embedded network.

Hypothesis 2d. The relationships above will persist independently of participants' level of depression.

Aim 3. Determine the relationships among race and perceived social support (appraisal, belonging and tangible subscales), and social network size (of overall and embedded networks of friends, family, neighbors, and church/temple) and diversity and symptoms, functional status, and hospitalizations among individuals with heart failure.

Hypothesis 3a. Race will moderate the relationship between perceived social support and symptoms, functional status, and hospitalizations among individuals with heart failure. Specifically, increased tangible, belonging, and appraisal support will predict better health outcomes (decreased symptoms and hospitalizations and increased functional status) among Caucasians compared to African American individuals.

Hypothesis 3b. Race will moderate the relationship between size and diversity of social network and symptoms, functional status, and hospitalizations among individuals with heart failure. Specifically, size of the social support network will more strongly predict heart failure outcomes (decreased symptoms and hospitalizations and increased functional status) for Caucasians compared to African Americans. Diversity of network will more strongly predict outcomes for African Americans compared to Caucasians.

Hypothesis 3c. The size of the embedded network family will more strongly predict outcomes in Caucasians compared to African Americans with increased size of this group having a stronger association with better heart failure outcomes. The social network groups of church/temple, friends, and neighbors will more strongly predict outcomes for African Americans compared to Caucasians with increased size of these groups related to better heart failure outcomes.

Hypothesis 3d. The relationships above will persist independently of participants' level of depression.

CHAPTER 2: Methods

The current study investigated social support and ethnic/racial differences in HF patients and how these factors are related to functional status, symptoms, and hospitalizations. This study was part of the ongoing, prospective study investigating psychosocial stress and outcomes in HF patients, Biobehavioral Triggers of Heart Failure (BETRHEART). The data for the current project was derived from the first phase of the study and from the long term follow up phase. The BETRHEART study consisted of a baseline clinic visit and interview, and a 3-month follow up clinic visit during which time psychosocial questionnaires were administered and assessments of functional status completed. Additionally, between the baseline and 3 month follow up visits, phone interviews were conducted with participants consisting of psychosocial measures. Lastly, the long term follow up phase consists of phone interviews every six months for 3 years during which further psychosocial variables are collected along with information regarding hospitalizations and HF symptoms.

PARTICIPANT RECRUITMENT

Participants (N=150) were recruited from the University of Maryland Medical Center (UMMC) in Baltimore MD and were physician referred to the study. This sample is appropriate for increasing understanding in a military population in that it is a VA sample and is drawn from a group of individuals who have prior service experience. Inclusion criteria were having a diagnosis of HF (NYHA class II-IV) for at least 3 months, ejection fraction less than or equal to 40%, and being at least 21 years old. Exclusion criteria were clinically significant mitral valve disease, myocarditis for less than 6 months, thyroid dysfunction as primary etiology of HF, current alcohol abuse within the past 6 months, cognitive impairments which would interfere with consent and questionnaire completion, left ventricular assist device, prior heart transplant, active cancer treatment, living in a nursing home, and being pregnant.

PROCEDURES

Patients were screened for exclusion and inclusion criteria at the UMMC Heart failure clinic and, if eligible, invited to participate in the study. If patients agreed to participate, a baseline visit was scheduled. Informed consent was obtained during the baseline visit along with detailed medical history, heart rate and blood pressure measurements, blood samples, functional status (6 Minute Walk Test), and several psychosocial and health questionnaires. During the interval phone interviews (every two weeks), participants were again administered several psychosocial questionnaires including the Interpersonal Support Evaluation List (ISEL) during phone interview 2 and the Social Network Index (SNI) during phone interview 3. During the 3 month follow up clinic visit all measures from the baseline visit were repeated including the 6 MWT. Lastly, the follow up phase consisted of phone interviews every 6 months during which information on psychosocial factors and symptoms, as well as hospitalizations were gathered using several questionnaires.

OUTCOME MEASURES

6 Minute Walk Test

The 6 MWT was used to assess functional status. Participants were measured using the 6 MWT during the baseline and 3 month follow up clinic visits. Specifically, participants were instructed to walk the length of a hallway (premeasured distance of 60 feet) for as long as they could without stopping. The 6 MWT was designed by Balke (3) and has been compared to other measures of functional status such as cycling with results indicating its utility for measuring functional status in cardiovascular patients in a clinical setting (43). The 6 MWT provides a continuous variable of distance traveled in the 6 minute time period for the test.

Kansas City Cardiomyopathy Questionnaire

The KCCQ was used to assess participants' self-reported symptoms of HF and quality of life. The 23 item measure contains the subscales of Physical Limitations, Symptoms Stability, Symptoms Frequency, Symptoms Burden, Total Symptoms Scores, Self-Efficacy, Quality of Life, Social Limitation, as well as an overall summary score and a clinical summary scale. The KCCQ has high convergent validity with other measures of symptomatology as well as high sensitive making it more useful than other measures (e.g., Minnesota Living with Heart Failure and SF-36) (41). The KCCQ provides continuous variables for each of the scales listed above. The scales to be used in the analyses for the current project will be the Total Symptoms Score, Quality of Life Score, and the clinical and overall summary scores.

Hospitalizations or Death

Hospitalizations were assessed via patient reports about their medical history at 3 month follow up and at each subsequent 6 month follow up for a period of 36 months. long term follow up assessment. Participants were queried regarding date and length of hospitalization, reason for hospitalization and location. As data were gathered rom participants reported hospitalizations were verified through obtaining hospital records when possible. Further, hospitalizations were divided into two groupings, heart failure related (pump failure or fluid overload) and all cause hospitalizations. To ensure the most complete data set, hospitalizations will be used up to the 24-month follow up.

PSYCHOSOCIAL AND DEMOGRAPHIC VARIABLES

Demographics

Demographics including race, gender, income, education level, marital status, and number of children were collected via questionnaire at the baseline visit. The importance of social isolation and marital status to health outcomes indicates that these may be variables of interest. Although not a main focus of the current study, exploratory analyses will examine number of people in the participant's household, marital status, and who the participant lives with in relation to the health outcome variables. In addition, given the possibility of significant gender differences on these variables, exploratory analyses that compare male and female participants will be conducted.

Social Network Index

The Social Network Index assess the size and diversity of social networks. Specifically, the measure provides the number of high contact roles, number of people in the social network and the number of embedded networks and individual has (22). High contact roles include roles in which the participant has contact with at least one person at least once every two weeks. These roles include spouse, parent, child, child-in-law, close relative, close friend, church/temple member, student, employee, neighbor, volunteer, and group member resulting in 12 possible roles or groups a person belongs to. The total number of people in the social network includes those who the respondent has regular contact with at least once every two weeks and the number of embedded networks reflects the number of different network domains in which the participant is involved.

These include family, friends, church/temple, school, work, neighbors, volunteering, and groups resulting in 8 possible groups. Whereas for high contact roles the respondent need only identify one member of their group with whom they are in contact at least every 2 weeks, for embedded network scores, the individual must report at least 4 high contact individuals in that domain. This measure has been used successfully to predict health outcomes and susceptibility in several studies (23, 22). In Berkman's original study (13) no mention of the racial and ethnic breakdown of the sample is included making it difficult to ascertain the appropriateness of the use of this study with multiple racial groups. However, the measure is commonly used in studies that do examine multiple ethnic and racial groups including African Americans (e.g., 98). The current study will utilize the total number of individuals in the social network, the number of embedded networks an individual is involved in, and the number of individuals reported in each of these embedded networks. The embedded network scales of family, friends, church/temple, and neighbors for analyses. For the purpose of this study, we truncated the number of High Contacts reported at 7 for the analyses in the study.

ISEL

The Interpersonal Support Evaluation List – Short Version (ISEL-12) was designed by Cohen and Hoberman (24) to assess 3 domains of social support, which include tangible, belonging, and appraisal support and an overall social support score. There is little information on the psychometric properties of the ISEL short version, however the ISEL, the measure from which the short form was derived has a test-retest reliability of 0.90 and internal consistency of the subscales ranging from 0.70 to 0.80. In addition, comparing the ISEL to another previously validated measure of social support

Cohen and Hoberman (24) found that each subscale on the ISEL made significant, unique contributions to outcomes including depression, and physical health. Although some authors have questioned using these individual subscales on their own because they are correlated with each other, further factor analyses indicate that examining them separately as well as considering an overall social support scale is warranted because of their unique contributions in analyses (18). The three subscales in the ISEL-12 (tangible, belonging, and appraisal) as well as the overall social support score will be used in the analyses for the current study. As with the SNI, Cohen and Hoberman (24) did not include in the demographic breakdown of the ISEL the racial groups within their sample. However, the ISEL12 was later validated for use with Hispanic and African American individuals (68, 71) and as with the SNI, the ISEL is commonly used with a variety of racial and ethnic groups including African Americans (e.g., 27).

STATISTICAL ANALYSES

Table 1. Operationalization of Study Measures

Variable	Quantification	Measurement Time
Social Network (Continuous IV)	SNI total number of people in network, total number of embedded networks, and number of people in embedded networks (family, friends, neighbors, church/temple)	a. Week 3
Perceived Support (Continuous IV)	ISEL Overall score and Belonging, Appraisal, Tangible scales	a. Week 2
HF Symptoms (Continuous DV)	KCCQ scales of Total Symptoms, Quality of Life, and the Clinical and Overall Summary scales	a. 6 month follow ups (up to 24 month) b. Average over follow ups used for each Individuals score
Functional Status (Continuous DV)	Distance walked (in feet) on the 6 MWT	a. 3 month follow up
Hospitalizations (Yes/no binary DV)	Cardiovascular Hospitalization or death	a. Weeks 2 and 3, 3 month follow up, and 6 month follow ups (up to 24 month)

Analysis Plan

SPSS 22.0 was used for data analysis. Specifically, linear and logistic regression analyses, ANCOVAs, and multilevel models were the primary analytic models used in analyses to investigate the relationships among race, social support indices, social network, functional status, symptoms, and hospitalizations. Dependent measures were be continuous variables except for hospitalizations (see Table 1).

To investigate Specific Aim 1, the relationships among the independent variables perceived social support, and social network size and diversity and the dependent variables symptoms, and functional status were examined using the subscales on the SNI (total network size, number of embedded networks, and number of people in the church/temple, friends, neighbors, and family embedded networks) and ISEL total score and subscales (overall support, and appraisal, belonging, and tangible subscales) and dependent variables of KCCQ subscales (Total Symptoms, Quality of Life, and the Clinical and Overall Summary scales), 6-MWT score, and heart failure hospitalizations or death (see Table 1). A series of linear regressions were run between the independent variables and the dependent variable of 6-MWT score. A series of multilevel mixed models were run between the independent variables and the dependent variable of KCCQ subscales and lastly, logistic regressions were run between the independent variables and the dependent variable of hospitalizations.

To investigate Specific Aim 2 (hypotheses 2a-2c), the relationships of race, to perceived social support, and social network size and diversity, a series of ANCOVAs were run between the independent variable race and the dependent variables of the subscales on the SNI (total network size, number of embedded networks, and number of people in the church/temple, friends, neighbors, and family embedded networks) and ISEL total score and subscales (overall support, and appraisal, belonging, and tangible subscales). To investigate hypothesis 2d that the relationships above will persist independently of individuals levels of depression, depression was added as a covariate in the models used in hypotheses 2a-2c.

To investigate Specific Aim 3 (hypotheses 3a-3c), the relationships among race, perceived social support (tangible, belonging, and appraisal and overall social support), and social network size and diversity (total network size, number of embedded networks, and number of people in the church/temple, friends, neighbors, and family embedded networks) and symptoms, functional status, and hospitalizations among individuals with heart failure, a series of regressions and multilevel mixed models were run. The main effects terms race and social support as well as the interaction term of race X social support were included in the second step of the linear and logistic regression models and the multilevel mixed models in aim 1 to determine the moderating effect of race on these variables. To investigate hypothesis 3d that the relationships above will persist independently of individuals levels of depression, depression will be added as a covariate in the models used in hypotheses 3a-3c. Where we found significant interactions, these were further investigated by running separate regressions for Caucasians and African Americans with the Social Support and Network indices predicting outcomes.

Covariates were entered in all analyses and included standard covariates selected based on prior literature. These covariates were gender, age, SES, smoking history, BMI, NYHA class, and hypertension history. For the logistic regressions a standard risk score was used combining smoking history, BMI, and hypertension history to increase the power of the model.

Statistical Concerns

Violation of Statistical Assumptions

After examining the data, statistical assumptions for these analyses including normality were not violated and the analytic plan above was used to assess the proposed relationships.

Type I Error

Given the large number of analyses proposed in the current study, it was important to address the possibility of findings being due to chance rather than to a true variation. To correct for this possibility, the conservative Bonferroni correction, to adjust the p level needed for significance was applied to all analyses. This made it more difficult to obtain statistical significance and less likely for results that were found to be significant to be due to chance. However, this as mentioned above is a very conservative measure and runs the risk of missing important differences by making requirements for significance too stringent. In addition, the Bonferroni correction was applied to individual analyses rather than adjusting the p values needed for significance across all models in the study. Another method for addressing type I error is by considering the overall patterns within obtained results rather than considering each result on its own. The current study addressed type I error by looking at overall patterns within the results and further, placing the results within the context of prior literature. By considering the context of these results and whether they are expected or unexpected results, it provided a better explanation as to whether the patterns and results observed in the data were true differences or better accounted for by chance. While we used the standard convention of p less than 0.05 to determine statistical significance, we also used the convention of p = 0.051 to 0.10 to determine marginally significant findings. The marginally significant findings were interpreted when they were consistent with predictions and fit the overall pattern of results.

Missing Data

KCCQ

There were several missing data points within the current data set due to several reasons including patient death, or being unable to reach patients because they have moved or were not available to complete the follow up. This was particularly a concern with the KCCQ measure and analyses involved with the KCCQ because symptoms are expected to worsen over time. Such issues may reduce the validity of findings because the accuracy of measurement over the course of the 24-month follow up period may be variable. Given concerns with this variable, a multilevel repeated measures mixed model was used for these analyses. This model not only accounts for missing values, but also allows for variation in variables over time. It is a sensitive and robust model for use with this type of analysis. Covariates, main effects, and interaction effects as listed above were still included in the overall mixed model analyses.

Hospitalizations and Death

Lastly, in order to accommodate the possibility of missing hospitalization or death data in the current sample, sensitivity analyses was completed. Specifically, separate logistic regressions were run assuming missing values indicate a hospitalization or death and assuming missing values indicate no missing hospitalization or death. The variability among the results was examined to assess the results of the original analysis. These analyses indicated the pattern of results was unchanged and can be considered valid.

Power Analysis

Power was calculated using G*power 3.1 using the outcome measure expected to have the smallest effect sizes based on prior research (26). The KCCQ reported as having a moderate effects size (26), therefore, for a fixed model, R^2 increase linear multiple regression with an expected medium effect size of .15, 2 tested predictors, alpha set at .05, and power set at .95, the total sample size needed was calculated to be at least 107. Preliminary analyses indicate the current sample has approximately a 40% hospitalization/death rate. For the logistic regressions, assuming 80% power and 5% significance, if 40% of patients are hospitalized, than a 1 standard deviation increase in the independent variable is associated with a 1.6 fold increase in hospitalizations requiring a sample size of at least 140 (44).

CHAPTER 3: Results

SAMPLE CHARACTERISTICS

The sample used consisted of 150 participants, 4 of whom were dropped at baseline; three were removed during the screening process and one withdrew. Of the remaining 146 participants, 40 were not reached for the 6 month follow up and 5 died during that time period. A total of 49 participants were not reached for the 12 month follow up and 7 died during that time while 62 were not reached at the 18^{th} month follow up and 5 died during that time period. Lastly, 72 participants were not reached at the 24 month follow and 6 died over those months. In total, there were 101 participants present at the 6 month follow up, 90 present at the 12 month follow up, 79 present at the 18 month follow up, and 68 present at the 24 month follow up.

At baseline, there were 113 (75.8%) males and 33(22.1%) females in the sample. There were 43(28.9%) Caucasian individuals and 103(69.1%) African American individuals in the sample. Demographics are presented separately for Caucasians and African Americans, as these are the primary comparison groups for the majority of analyses. The average age of participants at baseline was 63.5 years for Caucasians and 57.5 years for African Americans. For both Caucasians and African Americans, approximately 25% had a high school or lower education, while for African Americas, about 28% had either graduated high school or attended college and about 18% of Caucasians fell in these categories. More Caucasians than African Americans had a college degree or more. Just over half of the sample of African Americans and Caucasians were classified at and NYHA level of II. Sample demographics and key psychological and behavioral variables are presented in tables 2-7. In table 8 a correlation matrix investigating relationships among the independent variables is presented. As expected, many of the independent variables measuring social support are related. In addition, the BDI scores presented in the table are also correlated with several of the social support measures. The significance values for differences in covariates between African Americans and Caucasians are presented in table 2. The analyses used to compare means were t-tests for continuous variables and chi square analyses for categorical variables.

Table 2. Demographic Characteristics of Sample

Demographic Variables			
Variable	African American	Caucasian	*p*
Gender			
Male	75 (72.8%%)	38 (88.4%)	<.05
Female	28 (27.2%)	5 (11.6%)	
Age (years)	Mean = 55.04 SD =10.2	Mean = 63.5 SD= 12.0	<.001
BMI	Mean = 30.8 SD = 7.43	Mean = 30.68 SD = 7.58	.93
BDI Range (0-63)	Mean = 12.28 SD = 10.025 Range (0-31)	Mean = 10.16 SD = 8.88 Range (0-36)	.81
Education			
≤HS	27(26.2%)	11(25.6%)	<.05
HS graduate	29(28.2%)	8(18.6%)	
Some College	29(28.2%)	8(18.6%)	
College Graduate	16(15.5%)	9(20.9%)	
Some Graduate school	1(1%)	2(4.7%)	
Graduate Degree	1(1%)	5(11.6%)	
Income			
<15K	39(37.9%)	12(27.9%)	<.05
15-30K	31(30.1%)	8(18.6%)	
30-70K	28(27.2%)	14(32.6%)	
>70K	5(4.9%)	8(18.6%)	
NYHA Class			
Class II	56(54.4%)	24(55.8%)	.87
Class III and IV	47(45.6%)	19(44.2%)	
Hypertension Hx			
Yes	85(82.5%)	31 (72.1%)	.16
No	18(17.5%)	12(27.9%)	
Smoking Hx			
Yes	74(71.8%)	29(67.4%)	.60
No	29(28.2%)	14(32.6%)	

Note. HS = High School; BMI = Body Mass Index; BDI = Beck Depression Inventory

Table 3. Key Independent variables for Caucasian

Key Independent variables for Caucasians		
Variable		
Social Support		
Appraisal (4-16)	13(2.52)	range = 7-16
Belonging (4-16)	12.8(2.48)	range = 6-16
Tangible (4-16)	13.07(2.76)	range = 5-16
Total (4-48)	38.88(6.19)	range = 22-48
Number of Individuals in Social Network		
Friends	3.1(2.4)	
Family	6.03(4.13)	
Neighbors	2.36(2.03)	
Religious Group	1.23(2.48)	
Total	16.67(9.83)	
Total Number of Embedded Networks	Mean = 1.56 SD = .995	

Table 4. Key Dependent variables for Caucasians

Variable	Key Dependent variables for Caucasians					
6MWT Range in feet (600-1608)	Mean = 1206.48 SD = 283.7					
KCCQ (Range 0-100)	Baseline	3Mth	6Mth	12Mth	18Mth	24Mth
KCCQTS	72.74 (23.74)	79.16 (19.95)	79.13 (20.43)	77.17 (24.29)	80.25 (23.72)	68.8 (26.86)
KCCQQoL	64.29 (26.24)	71.4 (21.92)	75.54 (22.15)	71.00 (25.24)	73.19 (23.29)	66.67 (26.79)
KCCQCS	72.44 (23.02)	79.48 (18.88)	79.55 (22.06)	79.24 (23.18)	80.34 (20.62)	71.42 (24.37)
KCCQOS	69.06 (23.07)	77.11 (18.15)	77.06 (22.86)	75.65 (22.93)	79.12 (20.32)	68.79 (24.07)
Heart Failure Hospitalizations or Death						
Yes	18(41.9%)					
No	25(58.1%)					

Note. KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary; range for all KCCQ subscales = 0-100

Table 5. Key Independent variables for African Americans

Key Independent variables for African Americans		
Variable		
Social Support		
Appraisal (4-16)	12.63(2.64)	range = 5-16
Belonging (4-16)	12.25(2.79)	range = 5-16
Tangible (4-16)	12.77(2.74)	range = 5-16
Total (4-48)	37.64(6.99)	range = 15-48
Number of Individuals in Social Network		
Friends	2.55(2.19)	
Family	7.82(4.8)	
Neighbors	2.34(2.25)	
Religious Group	2.64(3.16)	
Total	19.48(10.46)	
Total Number of Embedded Networks	1.71(1.056)	

Table 6. Key Dependent variables for African Americans

Key Dependent variables for African Americans						
Variable						
6MWT Range in feet (513-1730)	Mean = 1144.7 SD = 269.488					
KCCQ (Range 0 -100)	Baseline	3Mth	6Mth	12Mth	18Mth	24Mth
KCCQTS	72.58 (23.83)	81.55 (19.80)	78.32 (25.65)	79.23 (23.57)	83.23 (19.39)	78.45 (24.69)
KCCQQoL	67.73 (25.61)	74.62 (22.03)	74.07 (28.24)	75.49 (23.59)	75.6 (21.65)	75.44 (22.26)
KCCQCS	74.26 (20.06)	80.49 (18.96)	77.86 (24.12)	80.03 (21.99)	80.07 (19.6)	79.37 (20.99)
KCCQOS	72.82 (20.27)	79.59 (17.89)	78.11 (23.78)	79.89 (19.6)	79.7 (17.98)	78.4 (20.16)
Heart Failure Hospitalizations or Death						
Yes	38(36.9%)					
No	65(63.1%)					

Note. KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary; range for all KCCQ subscales = 0-100

Table 7. Correlation Table for Independent Variables

Correlations among Independent Variables

	ISEL Appraisal	ISEL Belonging	ISEL Belonging	ISEL Total	HC Friends	HC Family	HC Neighbors	HC Religious	Total number Embedded	Total number HC	BDI
ISEL appraisal		.479**	.578**	.810**	.314**	.228*	.230*	.093	.278**	.289**	-.374**
ISEL Belonging			.615**	.834**	.268**	.161	.229*	.086	.226*	.339*	-.305**
ISEL Tangible				.874**	.190*	.230*	.215*	.001	.201*	.251*	-.330**
ISEL Total					.308**	.248**	.274**	.072	.283**	.355**	-.400**
HC Friends						.135	.328**	.330**	.639**	.545**	-.355**
HC Family							.118	.259**	.494**	.589**	-.035
HC Neighbors								.141	.464**	.487**	-.196*
HC Religious									.645**	.630**	-.242**
Total number Embedded										.762**	-.275**
Total Number HC											-.289**
BDI											

Note. *p < .05. **p<.01. ***p < .001.

Aim 1

Hypothesis 1

Hypothesis 1 proposed that size and diversity of social network and perceived social support would predict symptoms, functional status, and hospitalizations among individuals with heart failure. For this hypothesis, larger social network, increased network diversity, and greater perceived social support were expected to be related to decreased symptoms (higher KCCQ scores), better functional status (distance walked in feet on the 6MWT), and lower heart failure hospitalizations or death. For the outcome of self-reported symptoms (KCCQ) a multilevel model was used; for the outcome of functional status (6MWT) linear regressions were used; and for the outcome of heart failure hospitalizations/death logistic regressions were used. All analyses controlled for gender, age, income, smoking history, BMI, NYHA class, and hypertension history unless otherwise noted. See Table 8 for the unique contributions of each covariate in step 1 of the regression analyses for 6MWT below:

Table 8. Hierarchical Multiple Regression Analyses Covariate Contribution in Step 1 with dependent variable of 6MWT

	Social Network Diversity	
Predictor	β	ΔR^2
Step 1		.26***
Gender	-.239**	
Smoking History	.049	
BMI	-.061	
Age	-.284**	
NYHA Class	-.265**	
Hypertension History	.143	
Income	.229*	

Note. *p < .05. **p<.01. ***p < .001.

Functional Status (6 MWT)

Social network size

Hierarchical multiple regression was used to assess the ability of social network size (Total Network Size) to predict functional status, after adjusting for the above listed covariates. After entering Total Network Size in step 2, the model continued to explain 26.1% of the variance in 6MWT status, a non-significant change from the 26% accounted for by the covariates (see Table 9).

Hierarchical multiple regression was used to asses the ability of number of High Contact Friends to predict 6MWT, after adjusting for the covariates. In Step 2, the number of High Contact Friends was entered into the model and the total amount of variance explained by the model as a whole was 28.7%, F (8, 99) = 4.99, $p < .001$. The number of High Contact Friends explained an additional 2.7% of the variance in functional support, after controlling for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history, R squared change = .027, F change (1, 99) = 3.78, p = .055, approaching significance. This result indicated a positive relationship between High Contact Friends and feet walked on the 6MWT (See Table 9).

Separate hierarchical multiple regressions were also used to asses the ability of number of High Contact Family members, number of High Contact Neighbors, and number of High Contact Church/Temple network members to predict functional status, after adjusting for covariates. After entering number of High Contact Family members, High Contact Neighbors, or number of High Contact Church/Temple network members in step 2 of each model, the models explained 27.5% (p = .163), 26.3% (p = .558), and 26.1% (p = .761) of the variance in functional status, respectively. Each of these changes was non-significant (see table 9).

Table 9. Hierarchical Multiple Regression Analyses Predicting Functional Status From Social Network

	Sources of social support									
	Total		Friends		Family		Neighbors		Church/Temple	
Predictor	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.26*		.26*		26*		.26*		.26*	
Control variables[a]										
Step 2	.001		.027*		.015		.003		.001	
Social support		.038		.17*		.12		.05		-.03
Total R^2	.261		.29*		.28		.26		.26	
n	123		125		124		122		123	

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. ***p < .001.

Increased network diversity

Next we assessed the ability of social network diversity (total number of embedded networks) to predict functional status after controlling for above covariates. In Step 2, the total number of embedded networks was entered into the model and the total amount of variance explained by the model as a whole was 29.5%, F (8, 98) = 5.13, $p <$ .001. The total number of embedded networks explained an additional 3.5% of the variance in functional support over the covariates, R squared change = .035, F change (1, 98) = 4.86, $p < .05$. Distance walked on the 6MWT increased as Network Diversity increased (See Table 10).

Table 10. Hierarchical Multiple Regression Analyses Predicting Functional Status From Social Network Diversity

	Social Network Diversity	
Predictor	ΔR^2	β
Step 1		
Control variables[a]	.26***	
Step 2		
Network Diversity (number of embedded networks)	.035*	.19*
Total R^2	.295*	
n	124	

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. ***p < .001.

Perceived social support

Hierarchical multiple regression was once again used to assess the ability of social support (Total Perceived Social Support) to predict functional status, after controlling for the same covariates listed above. In Step 2, Social Support scores were entered into the model and the total amount of variance explained by the model as a whole was 31.9%, F (8, 99) = 5.797, $p < .001$. Total perceived social support explained an additional 5.9% of the variance in 6MWT, R squared change over covariates = .059, F change (1, 99) = 8.57, $p < .01$, indicating a positive relationship between Social Support and distance walked on the 6MWT (See Table 11).

Next, the relationship between Appraisal Support and 6MWT was examined. In Step 2, appraisal support was entered and the amount of variance explained by the full model was 34.5%, F (8, 99) = 6.52, $p < .001$. Appraisal Support explained an additional

8.5% of the variance in 6MWT, R squared change = .085, F change (1, 99) = 12.83, $p <$ .001. The results indicate a positive relationship between Appraisal Support and distance walked on the 6MWT (see Table 11).

Next, Belonging Support was analyzed. In Step 2, Belonging Support was entered into the model. The total amount of variance explained by the model as a whole was 28.9%, F (8, 99) = 5.03, $p < .001$. Belonging Support explained an additional 2.9% of the variance in 6MWT, R squared change over the covariates = .029, F change (1, 99) = 4.02, $p < .05$, again indicating a positive relationship between Belonging Support and distance walked on the 6MWT (see Table 11).

For Tangible Support, after entering tangible support in step 2, the model explained 28.5% of the variance in functional status, a non-significant change (see Table 11).

Table 11. Hierarchical Multiple Regression Analyses Predicting Functional Status (6MWT) From Perceived Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.26***		.26***		.26***		.26***	
Control variables[a]								
Step 2	.059**		.085***		.029*		.025	
Social support		.252**		.306***		.18*		.164
Total R^2	.319**		.29***		.289*		.29	
n	132		132		132		132	

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

In summary, distance walked on the 6MWT was predicted to increase as the number of High Contact Friends increased, and as the Number of Embedded Networks, or network diversity increased. All functional support scales except Tangible Support (Total, Appraisal, and Belonging Support) also predicted distance walked on the 6MWT would increase as scores on these measures increased.

Symptoms

Social network size

To investigate Hypothesis 1, that size and diversity of social network and perceived social support will predict self-reported symptoms (KCCQ) scores a series of repeated measures multilevel models with unstructured covariance matrices were used. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history. Across all analyses using Social Network indices, NYHA status, income and BMI were the covariates that most consistently contributed to the variance in each KCCQ outcome. For NYHA status and BMI as these scores went up, KCCQ scores went down indicating poorer outcomes. However, as income went up so did KCCQ scores, indicating more positive outcomes. Across all analyses using Functional Social Support indices, NYHA was consistently significant and higher NYHA class indicated poorer outcomes. Of note, BMI was the only consistently significant covariate for analyses examining both Social Network indices and Functional Support indices for the KCCQ outcome variable of Quality of Life. High BMI scores indicated poorer quality of life.

When added to model with covariates, there were no significant relationships between social network (Total Network size, number of high contact friends, number of high contact family, number of high contact neighbors, number of high contact church/temple network members) and any of the KCCQ subscales examined (Total

Symptoms Scale, Quality of Life Scale, Overall Summary Score, Clinical Summary Score) ($p > .05$).

Network Diversity

When added to model with covariates, there were no significant relationships between social network diversity (number of embedded networks) and any of the KCCQ subscales examined (Total Symptoms Scale, Quality of Life Scale, Overall Summary Score, Clinical Summary Score).

Perceived Social Support and KCCQ

A series of repeated measures multilevel models were used to test the effects of perceived social support on KCCQ scores. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history unless otherwise specified. Higher KCCQ scores indicate fewer symptoms.

For KCCQ Total Symptoms Score, there was a significant main effect of Total Social Support $F(1, 113.157) = 15.55$, $p < .001$, indicating both Total Social Support and KCCQ Total Symptoms Scores increased together. There was also a significant main effect of Appraisal Support $F(1, 118.67) = 20.897$, $p < .001$, again indicating both variables increased together. There was also a significant main effect of Belonging Support $F(1, 108.765) = 4.014$, $p < .05$, with Belonging Support and KCCQ both increasing together. Lastly, there was a significant main effect of Tangible Support $F(1, 109.859) = 7.732$, $p < .01$, with both Tangible support and KCCQ increasing together (see Table 12).

Table 12. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Total Symptoms and Social Support

Predictor	Est.	SE
Total Social Support	1.11***	.282
Appraisal Support	3.19***	.698
Belonging Support	1.366*	.682
Tangible Support	1.922**	.691

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Quality of Life score, results of the model indicated that there was a significant main effect of Total Social Support F(1, 111.093) = 8.993, $p < .01$, indicating a positive relationship between Total Social Support and KCCQ Quality of Life scores. Results indicate that there was also a significant main effect of Appraisal Support F(1, 117.687) = 9.99, $p < .01$, again with a positive relationship between these variables. However, there was no significant main effect of Belonging Support for KCCQ Quality of Life scores. This model only approached significance F(1, 105.988) = 3.441, $p = .066$ and indicated a positive trend relationship between the variables. Lastly, there was a significant main effect of Tangible Support F(1, 107.152) = 5.369, $p < .05$, with a positive relationship between the variables (see Table 13).

Table 13. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Quality of Life and Social Support

Predictor	Est.	SE
Total Social Support	.927**	.309
Appraisal Support	3.466**	.780
Belonging Support	1.357	.732
Tangible Support	1.735*	.749

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Clinical Summary score, there was a significant main effect of Total Social Support $F(1, 112.300) = 13.331$, $p < .001$. This was a positive relationship. There was also a significant main effect of Appraisal Support $F(1, 116.156) = 18.999$, $p < .001$, with KCCQ scores increasing as Appraisal Support increased. In addition, there was a significant main effect of Belonging Support $F(1, 108.886) = 4.972$, $p < .05$, again with the results indicating a positive relationship between variables. Lastly, there was a significant main effect of Tangible Support $F(1, 110.41) = 5.523$, $p < .05$. This relationship was also positive (see Table 14).

Table 14. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Clinical Summary and Social Support

Predictor	Est.	SE
Total Social Support	.999***	.274
Appraisal Support	2.938***	.674
Belonging Support	1.469*	.659
Tangible Support	1.59*	.677

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Overall Summary Score, there was a significant main effect of Total Social Support $F(1, 111.874) = 14.427$, $p < .001$, indicating that KCCQ scores increased as Total Social Support increased. There was also a significant main effect of Appraisal Support $F(1, 116.831) = 18.699$, $p < .001$, with a positive relationship between these variables. In addition, there was a significant main effect of Belonging Support $F(1, 107.685) = 4.804$, $p < .05$. These variables were positively related. Lastly, there was a significant main effect of Tangible Support $F(1, 109.795) = 7.064$, $p < .01$, again with the results indicating the variables were positively related (see Table 15).

Table 15. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Overall Summary and Social Support

Predictor	Est.	SE
Total Social Support	1.11***	.282
Appraisal Support	1.003***	.264
Belonging Support	1.398*	.638
Tangible Support	1.733**	.652

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

Overall, for each of the KCCQ subscales only the functional support measures predicted increased scores on KCCQ (better health outcomes). As each support measure increased (Total, Belonging, Appraisal, and Tangible) so did the scores on each KCCQ subscale. Only Belonging Support was marginally significant for KCCQ Quality of Life scores. None of the structural measures of social support predicted any KCCQ scores.

Heart Failure Hospitalizations or Death

To investigate Hypothesis 1 for hospitalizations and death, logistic regressions were used. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history. For the logistic regressions, smoking history, BMI, and hypertension history were collapsed into one risk score yielding scores of 0, 1, 2, or 3 depending on how many of the risk factors a participant endorsed. This variable was collapsed this way to increase the power of the model after accounting for participant attrition. Table 16 shows each covariate's unique contribution to the analyses examining heart failure hospitalizations and death in Step 1 of the logistic regressions. This was not a significant model, X^2 (7, N = 122) = 11.687, p = .111, indicating that this model was not able to distinguish between respondents who were or were not hospitalized or did or did not die within two years. Taking into consideration the possibility for missing follow up interviews, a sensitivity analysis was run for each logistic regression analysis in this hypothesis to assess whether there would be a change in the results after assuming any missed follow ups would have resulted in a reported HF hospitalization or death. The sensitivity analysis did not indicate a change in the results.

Table 16. Logistic Regression Predicting Likelihood of Heart Failure Hospitalization or death

Predictor	B	S.E.	Wald	df	p	Odds Ratio	95.0% C.I. for Odds Ratio Lower	95.0% C.I. for Odds Ratio Upper
Female	-.018	.457	.002	1	.969	.982	.401	2.404
Age	.029	.017	2.747	1	.097	1.029	.995	1.064
Income								
>70k			3.866	3	.276			
30-70k	-.567	.689	.678	1	.410	.567	.147	2.189
15-30k	-.258	.712	.131	1	.717	.772	.191	3.119
< 15k	-1.112	.709	2.457	1	.117	.329	.082	1.321
NYHA Class	-.588	.392	2.254	1	.133	.555	.258	1.197
Risk	-.113	.274	.172	1	.678	.893	.522	1.526
Constant	-.867	1.436	.364	1	.546	.420		

Social Network Size

Separate Logistic regressions were used to assess the impact of the covariates and social network size (Total Social Network Size, High contact Friends, High Contact Family, and High Contact Neighbors) on the likelihood that respondents would report that they had been hospitalized. The models each contained 6 independent variables (gender, age, SES, NYHA class, risk score, and the social network variable). None of the full models, each containing all predictors were significant, indicating that these models were not able to distinguish between respondents who reported, or did not report a heart failure hospitalization or death within the two years follow up.

Lastly, for the number of high contact church/temple network members the model contained 6 independent variables (gender, age, SES, NYHA class, risk score, and the number of high contact church/temple network members). The full model containing all predictors was approached significance, X^2 (8, N = 122) = 15.056, p = .058, indicating that this model was able to distinguish between respondents who were or were not hospitalized or did or did not die within two years. The model as a whole explained between 11.6% (Cox and Snell R square) and 15.7% (Nagelkerke R square) of the variance in hospitalization, and correctly classified 66.4% of cases. As shown in table 17, none of the independent variables made a unique statistically significant contribution to this model.

Table 17. Logistic Regression Predicting Likelihood of Heart Failure Hospitalization or death

Predictor	B	S.E.	Wald	df	p	Odds Ratio	95.0% C.I. for Odds Ratio	
							Lower	Upper
Female	.063	.488	.017	1	.897	1.065	.410	2.770
Age	.031	.018	2.782	1	.095	1.031	.995	1.069
Income								
> 70k			2.954	3	.399			
30-70k	-.253	.721	.123	1	.725	.776	.189	3.191
15-30k	-.023	.746	.001	1	.975	.977	.226	4.220
< 15k	-.897	.755	1.410	1	.235	.408	.093	1.792
NYHA Class	-.724	.411	3.095	1	.079	.485	.217	1.086
Risk	-.196	.289	.458	1	.499	.822	.466	1.450

Number High Contact church/temple	.095	.068	1.974	1	.160	1.100	.963	1.256
Constant	-1.229	1.503	.669	1	.414	.239		

Network diversity

Logistic regression was used to assess the impact of the covariates and number of embedded networks on the likelihood that respondents would report that they had been hospitalized. The model contained 6 independent variables (gender, age, SES, NYHA class, risk score, and number of embedded networks). The full model containing all predictors was not significant, indicating that this model was not able to distinguish between respondents with versus without a heart failure hospitalization or death.

Greater Perceived Social Support

Logistic regression was used to assess the impact of the covariates and Total Social Support, Appraisal Support, Belonging Support, and Tangible Support on the likelihood that respondents would report hospitalizations or death. The models contained 6 independent variables (gender, age, SES, NYHA class, risk score, and social support scores). The full model containing all predictors was not significant for Total Social Support, Belonging Support, or Tangible Support, indicating that these models were not able to distinguish between respondents who reported, or did not report a hospitalization/death.

For Appraisal Support, the model contained 6 independent variables (gender, age, SES, NYHA class, risk score, and Appraisal scores). The full model for heart failure hospitalizations or death containing all predictors approached significance, X^2 (8, N = 131) = 15.282, p = .054. The model as a whole explained between 11% (Cox and Snell R square) and 14.9% (Nagelkerke R square) of the variance in hospitalization, and correctly classified 67.9 % of cases. As shown in table 19, none of the independent variables made a unique statistically significant contribution to this model, although two were marginally significant (age and appraisal scores) (see table 18).

Table 18. Logistic Regression Predicting Likelihood of Reporting a Hospitalization

Predictor	B	S.E.	Wald	df	p	Odds Ratio	95.0% C.I. for Odds Ratio Lower	Upper
Female	-.139	.465	.089	1	.765	.870	.350	2.167
Age	.033	.017	3.480	1	.062	1.033	.998	1.069
Income								
> 70k			2.508	3	.474			
30-70k	-.318	.711	.201	1	.654	.727	.181	2.928
15-30k	.115	.749	.024	1	.878	1.122	.259	4.868
< 15k	-.679	.753	.814	1	.367	.507	.116	2.217
NYHA Class	-.462	.402	1.323	1	.250	.630	.287	1.384
Risk	-.135	.279	.235	1	.628	.874	.506	1.509
Isel Appraisal	-.151	.081	3.470	1	.062	.860	.733	1.008
Constant	.575	1.633	.124	1	.725	1.778		

In sum, heart failure hospitalizations or death were only marginally related to the Number of High Contact Neighbors and Appraisal Support. There were no other significant relationships or relationships approaching significance.

AIM 2

Hypothesis 2a

To investigate hypothesis 2a that African Americans will report decreased Tangible, Belonging, and Appraisal support compared to Caucasians in patients with heart failure, a series of separate ANCOVAs were run with race as the independent variable and indices of perceived social support for each dependent variable. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history. After adjusting for the covariates listed above, there was no significant difference between Caucasians and African Americans in levels of Total Social Support F (1, 120) = .581, partial eta squared = .005, p = .447, Appraisal Support F (1, 120) = .586, partial eta squared = .005, p = .445, Belonging Support F (1, 120) = .287, partial eta squared = .002, p = .593, or Tangible Support F (1, 120) = .295, partial eta squared = .002 p = .588.

Hypothesis 2b

To investigate hypothesis 2b that African Americans compared to Caucasians will report smaller network size (of overall and embedded networks of friends, family, neighbors, and church/temple) and increased network diversity (number of embedded networks), a series of ANCOVAs were run with race as the independent variable and total number of individuals in the social network and total number of embedded networks as dependent variables. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history. After adjusting for the covariates listed above, there was no significant difference between Caucasians and African Americans in the total size of their social networks F (1, 111) = 2.256, partial eta squared = .020, p = .136, or the number of embedded networks in their social networks F (1, 112) = .647, partial eta squared = .006, p = .423.

Hypothesis 2c

Hypothesis 2c proposed that within the embedded networks of church/temple, friend, and neighbor, African Americas would report more high contacts compared to Caucasians and fewer high contacts than Caucasians in the embedded network of family. To investigate this hypothesis, a series of ANCOVAs were run with race as the independent variable and the embedded networks of friends, neighbors, church/temple, and family as dependent variables. After adjusting for covariates, there was no significant difference between Caucasians and African Americans in the number of high contact friends in their social network F (1, 113) = 1.390, partial eta squared = .012, p = .241, and no significant difference the number of high contact neighbors in their social network F (1, 110) = .074, partial eta squared = .001, p = .786. There was a marginally significant difference in the number of high contact family members in their social networks F (1, 112) = 3.626, partial eta squared = .031, p = .059, with African Americans reporting more contacts in their family (M = 7.297, SE = .965) compared to Caucasians (M = 6.388, SE = 1.159). This finding was opposite to the hypothesis. There was however a significant difference between Caucasians and African Americans in the number of high contact church/temple individuals in their social network F (1, 111) = 7.172, partial eta squared = .061, $p < .01$. As hypothesized, African Americans reported more high contact individuals in their church/temple embedded network (M = 3.112, SE = .487) compared to Caucasians (M = 1.292, SE = .571) (see Figure 1).

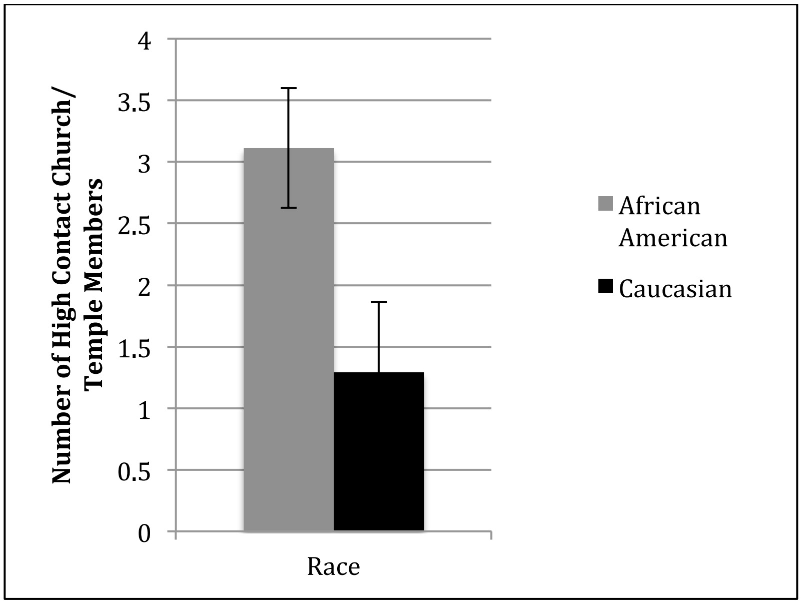


Figure 1. Number of High Contact Church/Temple Members for Caucasians and African Americans

Hypothesis 2d

Hypothesis 2d proposed that the relationships above will persist independently of participants' level of depression. To investigate this hypothesis, depression scores were added as covariates to the above models for hypotheses 2a, 2b, and 2c. For hypothesis 2a, after adding depression to the models above, there was still no significant difference between Caucasians and African Americans in levels of Total Social Support, Appraisal Social Support, Belonging Social Support, or Tangible Social Support.

For hypothesis 2b, after adding depression to the models above, there was still no significant difference between Caucasians and African Americans in the total size of their social networks, or in the number of embedded networks in their social networks.

For hypothesis 2c, after adding depression to the models above, there were no changes in the pattern of results investigating significant difference between Caucasians and African Americans in the number of high contact neighbors or religious group members in their social network. There were no significant differences but, unlike prior analyses, there were trends regarding the number of high contact friends in their social network F (1, 112) = 3.122, partial eta squared = .027, p = .080, and the number of high contact family in their social network F (1, 111) = 3.659, partial eta squared = .032, p = .058. Caucasians reported more high contact friends (M = 2.969, SE = .546) compared to African Americans (M = 1.840, SE = .455) while African Americans still reported more high contact family members (M = 7.313, SE = .971) compared to Caucasians (M = 6.372, SE = 1.167).

AIM 3

Hypothesis 3a

Functional Status

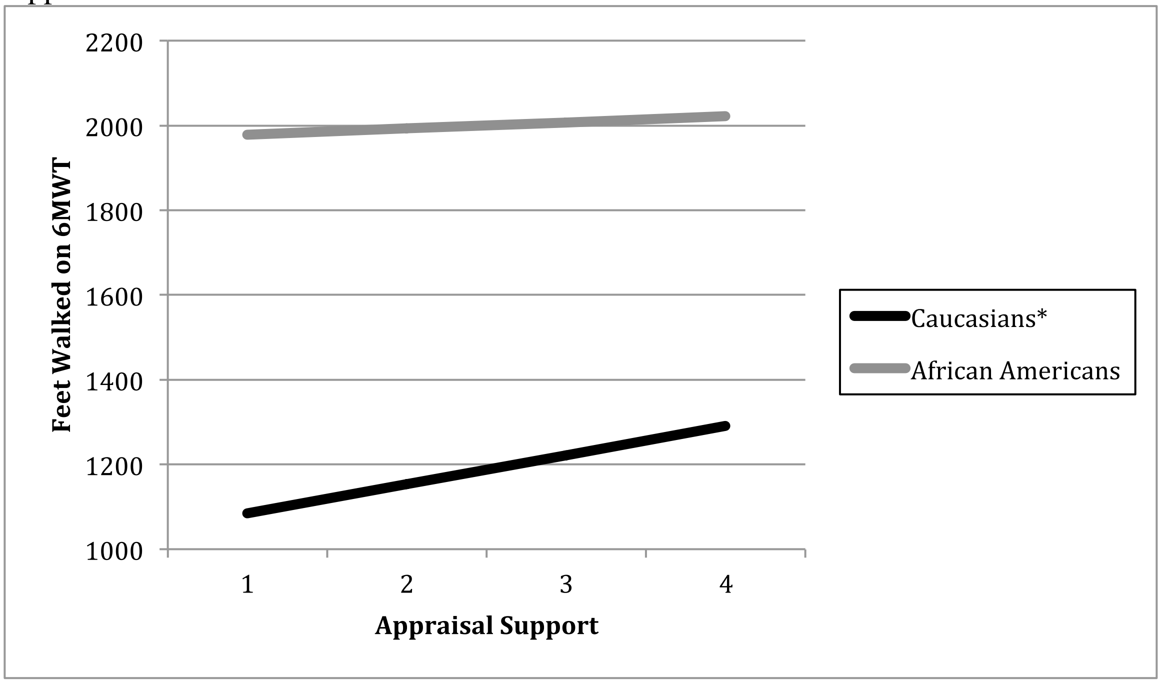
Hypothesis 3a proposed that race would moderate the relationship between perceived social support and 6MWT. A series of hierarchical multiple regressions were used to test this hypothesis. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history unless otherwise noted. The models used in hypothesis 1 were used with the addition of a race X social support interaction term to investigate hypothesis 3a. Refer to Table 8 for the unique contributions of the covariates entered into Step 1 of the below analyses. For all analyses in hypothesis 3, significant interactions were investigated by separating the data set by race and running regression or mixed models without the interaction term.

For Total Social Support, the Total Social Support score, race, and the interaction term for race X Total Social Support were entered into the model in step 2 and the total amount of variance explained by the model as a whole was 34.0%, F (10, 97, = 5.004, p < .001. Total Social Support, race, and the interaction term explained an additional 8.0%

of the variance in Functional Support, after controlling for covariates, R squared change = .080, F change (3, 97) = 3.935, $p < .05$. The interaction term (*beta* = -.781, $p = .182$) and the main effect for race (*beta* = .659, $p = .257$) did not provide a statistically significant contribution to the model as a whole. However, as in the prior analyses, there was still a main effect for Total Social Support. Total Social Support and distance walked in the 6MWT were still positively related (see Table 19).

For Appraisal Support, the Appraisal Social Support score, race, and the interaction term for race X Appraisal Social Support were entered into the model in step 2 and the total amount of variance explained by the model as a whole was 38.1%, F (10, 97, = 5.970, $p < .001$. Appraisal Support, race, and the interaction term explained an additional 12.1% of the variance in 6MWT after controlling for the influence of covariates, R squared change = .121, F change (3, 97) = 6.318, $p < .01$. The interaction term (*beta* = -1.008, $p < .05$) was significant indicating that race does in fact moderate the relationship between appraisal support and 6MWT. Follow up analyses revealed that for Caucasians, Appraisal support made a unique contribution to distance walked in the 6MWT in that higher levels of social support indicated further distanced walked (B = 68.688, *beta* = .610, $p < .01$) while for African Americans, there was no significant contribution made by Appraisal support (B = 14.75, *beta* = .144, $p = .152$) (see Figure 2). The main effect for race (*beta* = .878, $p = .071$) did not provide a statistically significant contribution to the model as a whole. However, as in the original analyses, there was a main effect for Appraisal Support, indicating appositive relationship between the variables (See Table 19).

Figure 2. Unstandardized Regression Slopes for Distance Walked on 6MWT and Appraisal Scores for Caucasians and African Americans



Note. Constant = 1015.973 for Caucasians, $\Delta R^2 = .291$, $p < .01$; Constant = 963.063 for African Americans, $\Delta R^2 = .018$, $p = .152$

For Belonging Support and Tangible Support, the social support scores, race, and the interaction term for race X Belonging or Tangible Social Support were entered into step 2 of separate models. The change in variance on the 6MWT was non-significant for both models with the model containing Belonging Support explaining 30.1% and the model containing Tangible Support model explaining 29.5% of the variance in 6MWT (see table 19).

Table 19. Hierarchical Multiple Regression Analyses Predicting Functional Status (6MWT) From Perceived Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.26***		.26***		.26***		.26***	
Control variables[a]								
Step 2	.080*		.121**		.041		.035	
Race		.659		.878		.178		.010
Social Support		.458*		.598***		.270		.199
Interaction		-.781		-1.008*		-.299		-.127
Total R^2	.340*		.381**		.301		.295	
n	134		134		134		134	

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

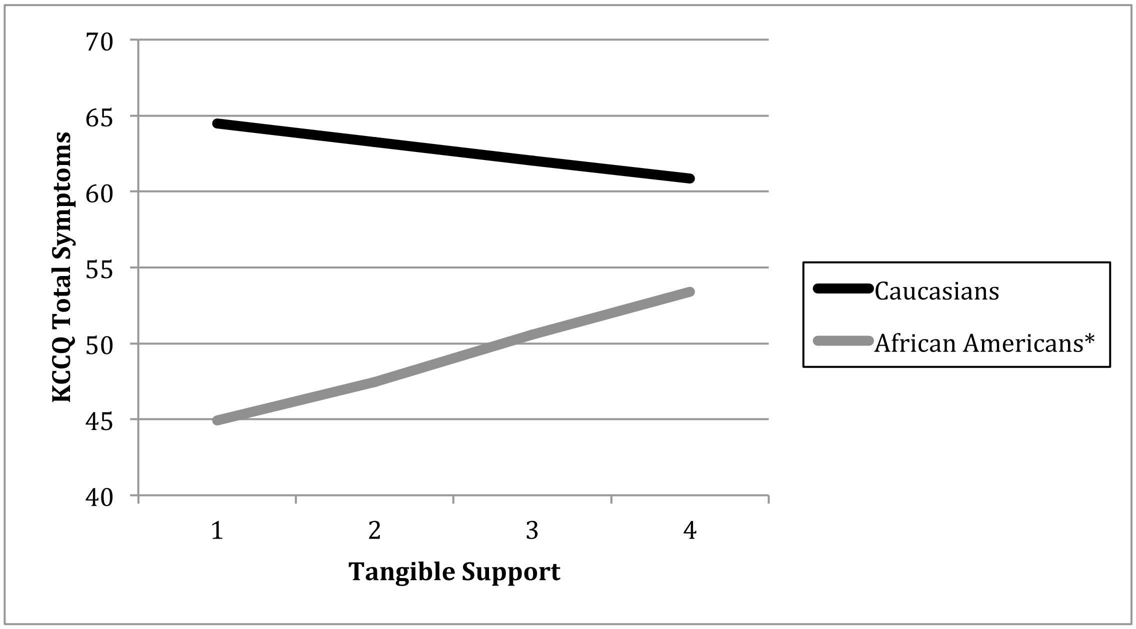
In sum, there was only a significant interaction between race Appraisal Support for 6MWT with increased Appraisal Support being related to increased distance walked on the 6MWT for Caucasians,. There were no significant interactions for any other functional support subscale or for Total Social Support.

Symptoms

Hypothesis 3a also proposed that race would moderate the relationship between perceived social support and symptoms (KCCQ scores). A series of repeated measures multilevel models with unstructured covariance matrices were used to test this hypothesis. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history unless otherwise noted. The models used in hypothesis 1 were used with the addition of a race X social support interaction term to investigate hypothesis 3a.

For KCCQ Total Symptoms Score, results of the model indicate that there was no significant interaction between race and Total Social Support, or main effect of race. However, as in the prior analyses, there was a significant main effect of Total Social Support $F(1, 112.466) = 6.881$, $p < .05$), still indicating both variables increased together. Results of the model indicate that there was no significant interaction between race and Appraisal Support, or main effect of race. However, there was a significant main effect of Appraisal Support $F(1, 116.113) = 15.771$, $p < .001$, again still indicting a positive relationship between these variables. For KCCQ Total Symptom score there was no significant interaction between race and Belonging Support, or main effect of race or, unlike original analyses without the interaction term, of Belonging Support. Results of the model indicate that there was a significant interaction for race and Tangible Support $F(1, 107.921) = 5.115$, $p < .05$. Further analyses to examine this interactions indicate that Tangible support was not significant for Caucasians (Estimate = -1.21, SE = 1.64, $p = .466$) but did significantly predict KCCQ Total symptoms for African Americans $F(1, 70.175) = 14.470$, $p < .001$). For African Americans, as Tangible support increased, so did KCCQ Total Symptoms Scores (Estimate = 2.833, SD = .745) while the relationship was inverse for Caucasians (See figure 3). Unlike previous analyses, there was no significant main effect of Tangible Support, but there was a significant main effect of race $F(1, 108.750) = 4.129$, $p < .05$, indicating that African Americans report higher KCCQ Total Symptom Scores (i.e., better condition) (Mean = 78.669, SE = 3.068) compared to Caucasians (Mean = 75.522, SE = 3.580) (see Table 20).

Figure 3. Slopes for KCCQ Total Symptoms scores and Tangible Scores for Caucasians and African Americans



Note. Intercept = 65.69 for Caucasians, Est. = -1.21, $p = .47$; Intercept = 42.09 for African Americans, Est. = 2.55, $p < .001$

Table 20. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Total Symptoms and Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	27.71	24.87	8.29	19.86	24.42	20.82	39.33*	19.36
Social Support	1.29***	.31	3.49***	.82	1.83	.76	2.81	.76
Interaction	-.79	.62	-.873	1.46	-2.10	1.57	-3.23*	1.43

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Quality of Life score, there was no significant interaction between race and Total Social Support, or main effect of race. However, as before there was a significant main effect of Total Social Support F(1, 112.525) = 5.789, $p < .05$). Results indicated a positive relationship between KCCQQoL and Total Social Support. There was no significant interaction between race and Appraisal Support, or main effect of race.

However, there was still a significant main effect of Appraisal Support $F(1, 115.986) = 9.530$, $p < .01$ that indicated a positive relationship between the variables. Results of the model indicate that for KCCQ Quality of Life scores there was no significant interaction between race and Belonging or Tangible Support, or main effect of race. There was still a marginally significant main effect of Belonging Support ($p = .052$), but no longer a significant main effect of Tangible Support (see Table 21).

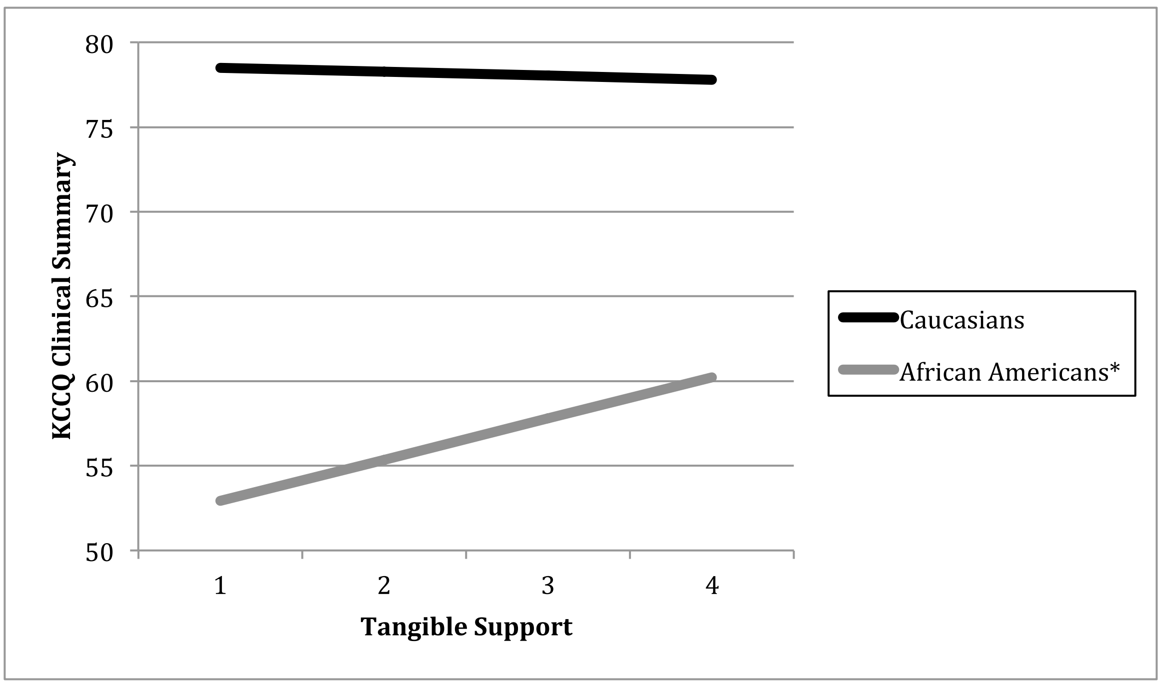
Table 21. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Quality of Life and Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	3.82	27.40	-10.52	22.05	4.12	22.42	29.98	21.02
Social Support	1.04**	.34	2.48**	.91	1.61*	.82	2.51	.84
Interaction	-.25	.68	.35	1.62	-.72	1.69	-2.68	1.55

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Clinical Summary score, there was no significant interaction between race and Total Social Support, or main effect of race. However, there was still a significant main effect of Total Social Support $F(1, 111.047) = 6.077$, $p < .05$), with a positive relationship between the variables indicating better clinical status. There was no significant interaction between race and Appraisal Support, or main effect of race. However, there was still a significant main effect of Appraisal Support $F(1, 113.561) = 16.067$, $p < .001$. This was still a positive relationship between Appraisal Support and KCCQCL scores. For KCCQ Clinical Summary score there was no significant interaction between race and Belonging Support, or main effect of race, or unlike prior analyses, a main effect of Belonging Support. There was however a significant interaction for race and Tangible Support F(1, 106.897) = 4.797, $p < .05$. Further analyses to examine this interactions indicate that Tangible Support was not significant for Caucasians (Estimate = -.24, SE = 1.59, $p = .88$) but did significantly predict KCCQ Clinical Summary Score for African Americans F(1, 71.834) = 10.972, p < .01). As Tangible Support increased for African Americans, so did KCCQ Clinical Summary Scores (Estimate = 2.432, SD = .735, $p < .001$) (see Figure 4). There was no longer a significant main effect of Tangible Support, but there was a significant main effect of race F(1, 107.402) = 4.019, $p < .05$, indicating that African Americans report higher KCCQ Clinical Summary scores (M = 78.296, SE = 2.974) compared to Caucasians (M = 75.975, SE = 3.482) (see Table 22).

Figure 4. Slopes for KCCQ Clinical Summary scores and Tangible Scores for Caucasians and African Americans



Note. Intercept = 78.75 for Caucasians, Est. = -0.24, $p = .88$; Intercept = 50.5 for African Americans, Est. = 2.43, $p < .001$

Table 22. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Clinical Summary and Social Support

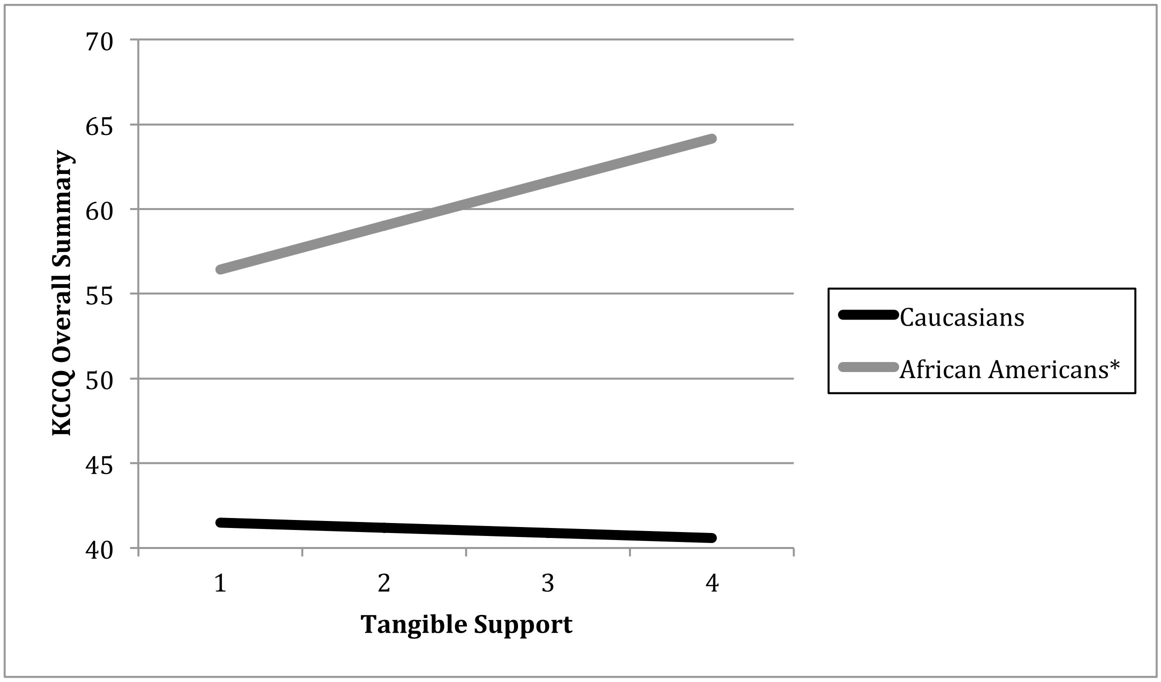
	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	22.64	24.17	-3.70	19.20	27.34	20.02	37.95*	19.93
Social Support	1.14***	.29	2.94***	.79	1.99**	.73	2.39	.76
Interaction	-.65	.60	.08	1.41	-2.27	1.51	-3.06*	1.4

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Overall Summary Score, there was no significant interaction between race and Total Social Support, or main effect of race. However, there continued to be a significant main effect of Total Social Support $F(1, 110.336) = 7.655$, $p < .01$), with a positive relationship between Total Social Support and KCCQOS scores. There was no significant interaction between race and Appraisal Support, or main effect of race. However, there was still a significant main effect of Appraisal Support $F(1, 114.027) = 16.663$, $p < .001$. Results indicated a positive relationship between the variables. Results of the model indicate that for KCCQ Overall Summary score there was no significant interaction between race and Belonging Support, or main effect of race or, unlike prior analyses, a main effect of Belonging Support. Results of the model indicate that there was a significant interaction for race and Tangible Support $F(1, 106.357) = 4.636$, $p < .05$. Further analyses to examine this interactions indicate that Tangible support was not significant for Caucasians (Estimate = -.31, SE = 1.38, $p = .83$) but did significantly predict KCCQ Overall Summary score for African Americans $F(1, 69.419) = 12.918$, $p < .01$). For African Americans, as Tangible Support increased, so did KCCQ Overall

Summary Scores (Estimate = 2.57, SE = .71, < .001) (see Figure 5). There was no significant main effect of Tangible Support or race (see Table 23).

Figure 5. Slopes for KCCQ Overall Summary scores and Tangible Scores for Caucasians and African Americans



Note. Intercept = 41.82 for Caucasians, Est. = -0.31, $p = .83$; Intercept = 53.86 for African Americans, Est. = 2.57, $p < .001$

Table 23. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Overall Summary and Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	15.44	23.23	-6.25	18.50	20.03	19.39	33.93	18.20
Social Support	1.14***	.29	2.88***	.76	1.84	.71	2.5	.73
Interaction	-.51	.58	.11	1.36	-1.84	1.46	-2.89*	1.34

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

Overall for KCCQ scores, there were significant interactions between Tangible Support and race for KCCQ Total Symptom Score and for KCCQ Clinical Summary Score only. The results indicated that these scores increased together for African

Americans. There were no other significant interactions for functional social support and KCCQ scores.

Heart Failure Hospitalizations or Death

Separate logistic regressions were used to assess the impact of the covariates, social support, race, and the interaction term of social support and race on the likelihood that respondents would report that they had been hospitalized for heart failure or died over the two year follow up period. The models contained 8 independent variables (gender, age, SES, NYHA class, risk score, social support scores, race, and the interaction term of social support X race). The full model containing all predictors was not significant for Total, Appraisal, Belonging, or Tangible Support, indicating that these models were not able to distinguish between respondents who were or were not hospitalized for heart failure or did or did not die. Taking into consideration the possibility for missing follow up interviews, a sensitivity analysis was run for each logistic regression analysis in this hypothesis to assess whether there would be a change in the results after assuming any missed follow ups would have resulted in a reported HF hospitalization or death. The sensitivity analysis did not indicate a change in the results.

Hypothesis 3b

Functional Status

Hypothesis 3b proposed that race would moderate the relationship between size and diversity of social network and symptoms and functional status and specifically that size of the social support network will more strongly predict heart failure outcomes (decreased symptoms, heart failure hospitalizations, and increased functional status) for

Caucasians compared to African Americans and that diversity of network will more strongly predict outcomes for African Americans compared to Caucasians. To investigate this hypothesis, a series of hierarchical multiple regressions were used. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history unless otherwise noted.

For Total Network Size, covariates were entered in Step 1, explaining 26% of the variance in functional status. In Step 2 the Total Network Size, race, and the interaction term for race X Total Network Size were entered into the model and the total amount of variance explained by the model as a whole was 27.4%, a non significant change p = .613 (See Table 24).

For the total number of embedded networks, the total number of embedded networks, race and the interaction term of total number of embedded networks X race were entered into the model in step 2. Results indicated that the total amount of variance explained by the model was 33.2%, F (10, 96) = 4.765, $p < .001$. The total number of embedded networks, race the interaction term explained an additional 7.2% of the variance in 6MWT distance, after controlling for covariates, R squared change = .072, F change (3, 96) = 3.433, $p < .05$. The interaction term (*beta* = -.438, p = .067) and the main effect of race (*beta* = .141, p = .417) did not provide a statistically significant contribution to the model as a whole. However, there was still a significant contribution of the total number of embedded networks with a positive relationship between 6MWT and number of embedded networks (*beta* = .479, $p < .01$) (see Table 24).

Table 24. Hierarchical Multiple Regression Analyses Predicting Functional Status (6MWT) From Social Network

	Social Network			
	Total Network Size		Number of Embedded Networks	
Predictor	ΔR^2	β	ΔR^2	β
Step 1	.26***		.26***	
Control variables[a]				
Step 2	.014		.072*	
Race		-.062		.141
Social Network		.108		.479**
Interaction		-.094		-.438
Total R^2	.274		.332*	
n	127		128	

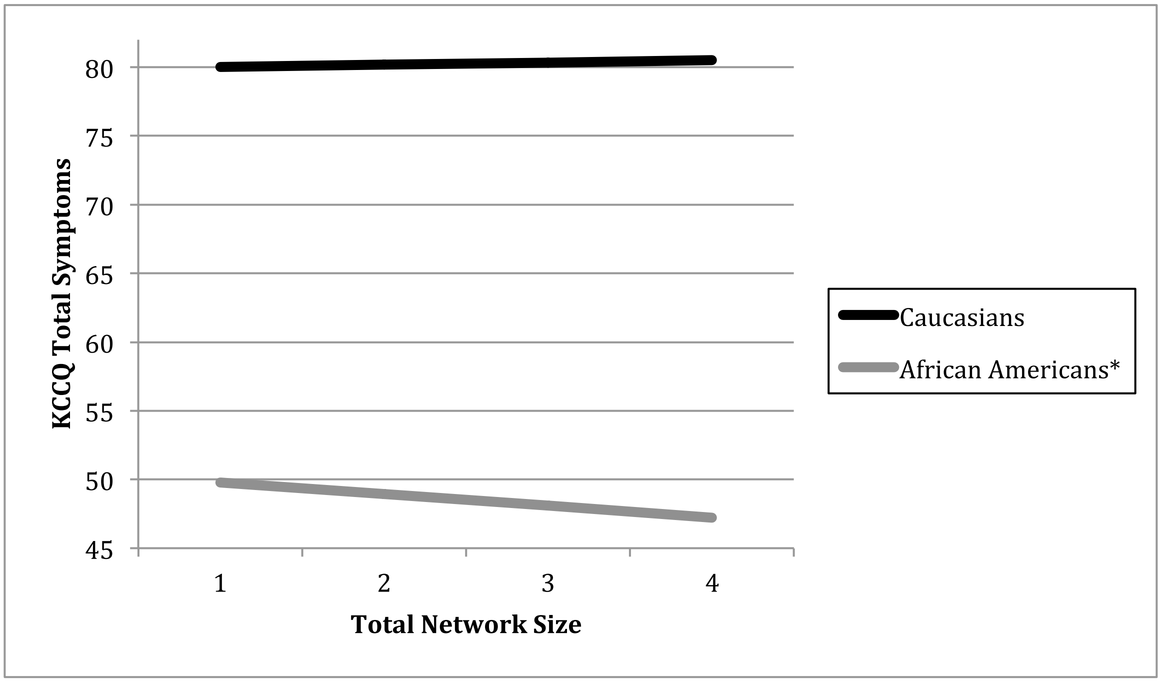
Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

Symptoms

Hypothesis 3b also proposed that race would moderate the relationship between Social Network Size and diversity and symptoms (KCCQ scores). A series of repeated measures multilevel models were used to test this hypothesis. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history unless otherwise noted. The models used in hypothesis 1 were used with the addition of a race X social network interaction term to investigate hypothesis 3b.

For KCCQ Total Symptoms Score there was a significant interaction between race and Total Network Size F(1, 100.914) = 6.203, $p < .05$. Further analyses to examine this interactions indicate that opposite to the hypothesis, Total Network Size was not significant for Caucasians (Estimate = .16, SE = 17, $p = .36$) but did significantly predict KCCQ Total symptoms for African Americans F(1, 22.365) = 4.469, p < .05). As Total Network Size increased for African Americans, KCCQ Total Symptoms Scores decreased (Estimate = -.86, SD = .41, $p < .05$) (See Figure 6) (see Table 25). There was still no main effect of Total Network Size ($p = .115$) or race ($p = .093$).

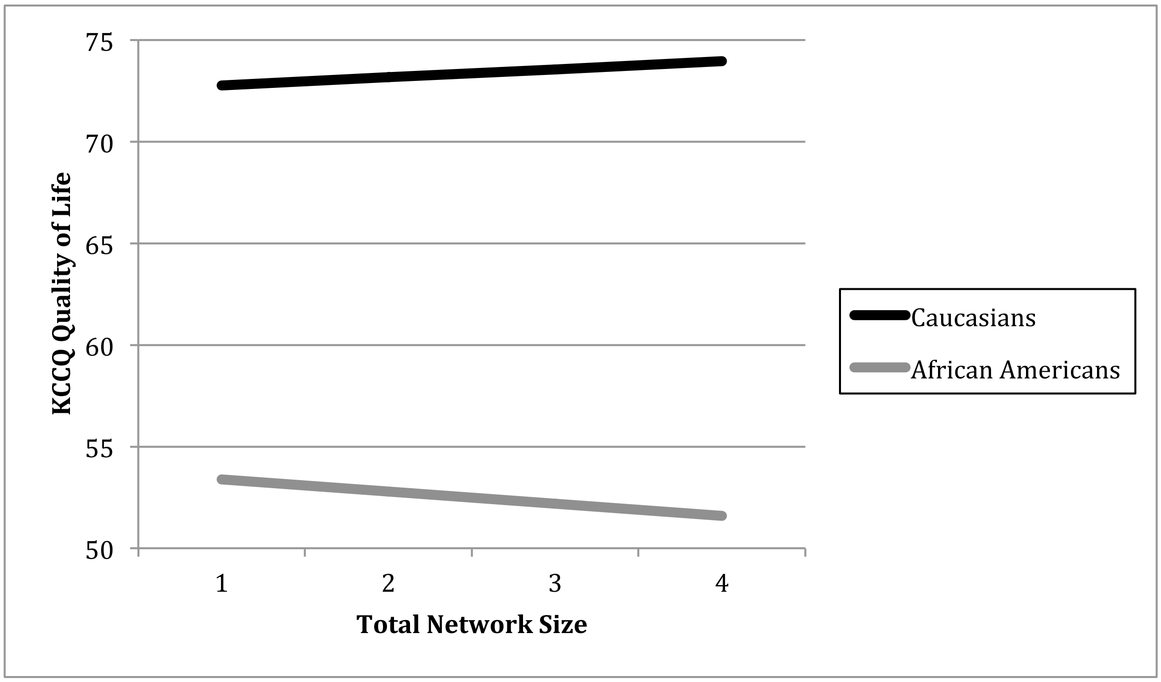
Figure 6. Slopes for KCCQ Total Symptoms scores and Total Network Size for Caucasians and African Americans



Note. Intercept = 79.86 for Caucasians, Est. = 0.16, p = .36; Intercept = 50.66 for African Americans, Est. = -0.86, $p < .05$

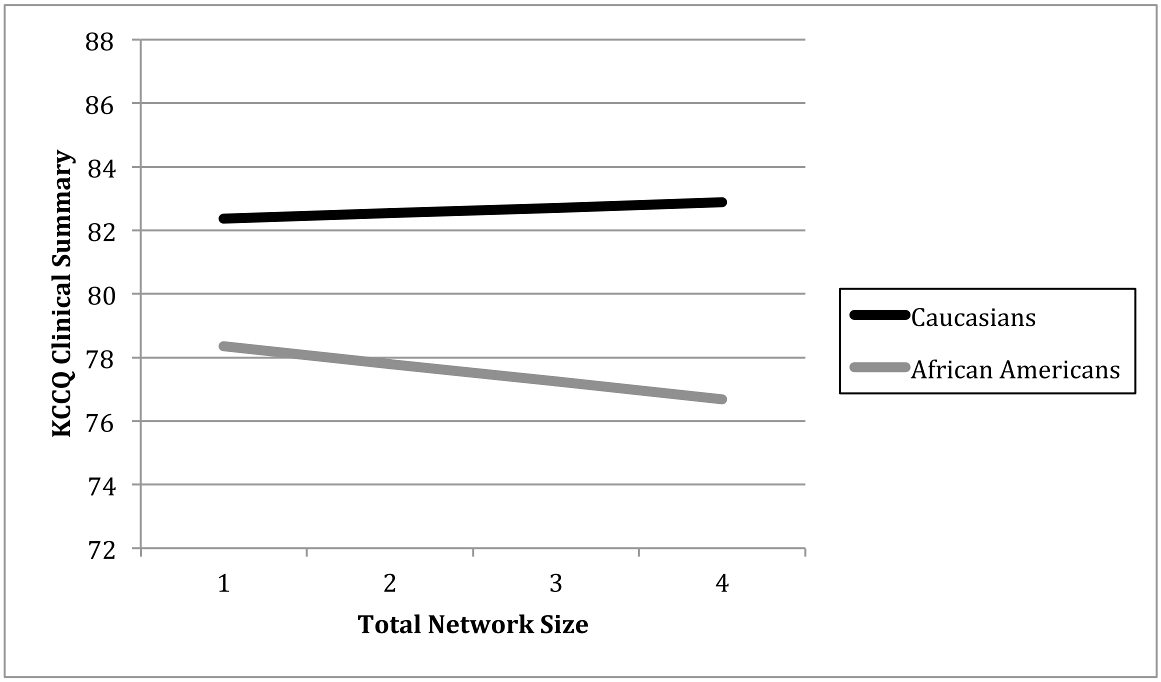
There was also a significant interaction between race and Total Network size for KCCQ Quality of Life Scores $F(1, 94.958) = 3.948$, $p = .05$. Further analyses to examine this interactions indicate that Total Network size significantly predicted KCCQ Quality of Life scores for Caucasians $F(1,53.449) = 4.161$, $p < .05$, but did not significantly predict KCCQ Quality of Life for African Americans (Estimate = -.60, SE = .32, p = .078). For Caucasians, as Total Network size increased so did KCCQ scores (Estimate = .40, SD = .20, $p < .05$) (see Figure 7). However, there was no main effect of race (p = .189) or Total Network Size (p = .675) for KCCQ Quality of Life. In addition, for the KCCQ Clinical Summary Score, there was a significant interaction between race and Total Network Size $F(1, 103.387) = 4.164$, $p < .05$ but no main effect for either race (p = .143) or Total Network Size (p = .170). Further analyses to examine this interaction indicate that Total Network Size was not significant for Caucasians (Est. = .17, SE = .16, p = .317) or African Americans (Est. = -.56, SE = .42, p = .199). Figure 8 demonstrates the relationship of each regression slope for African Americans and Caucasians to clarify this interaction. Last, for the KCCQ Overall Summary Score there was no significant interaction between race and Social Network Size (p = .087), or a main effect of race (p = .301) or Total Network Size (p = .449) (see Table 25).

Figure 7. Slopes for KCCQ Quality of Life scores and Total Network Size for Caucasians and African Americans



Note. Intercept = 72.37 for Caucasians, Est. = .4, $p < .05$; Intercept = 53.99 for African Americans, Est. = -0.6, p = .078

Figure 8. Slopes for KCCQ Clinical Summary Score scores and Total Network Size for Caucasians and African Americans



Note. Intercept = 82.2 for Caucasians, Est. = 0.17, p = .317; Intercept = 78.92 for African Americans, Est. = -1.36, p = .199

Table 25. Estimate and Standard Errors for Mixed Models Analysis of KCCQ and Social Network

	KCCQ Subscales							
	KCCQTS		KCCQQoL		KCCSCS		KCCQOS	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	12.59	7.43	10.85	8.2	10.87	7.37	7.33	7.05
Social Network	.18	.18	.34	.19	.13	.17	.18	.17
Interaction	-.96	.39	-.84*	.43	-.79*	.39	-.64	.37

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history
KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary
*p < .05. **p < .01 ***p < .001.

There was no significant interaction of number of embedded networks and race (p = .489) or main effect of race (p = .852) or number of embedded networks (p = .47) for KCCQ Total Symptoms. Similarly, there was no significant interaction of number of embedded networks and race (p = .413) or main effect of race (p = .835) or number of embedded networks (p = .784) for KCCQ Quality of Life Scores. In addition, there was no significant interaction of number of embedded networks and race (p = .831) or main effect of race (p = .963) or number of embedded networks (p = .664) for KCCQ Clinical Summary Score. Lastly, there was no significant interaction of number of embedded networks and race (p = .544) or main effect of race (p = .954) or number of embedded networks (p = .681) for KCCQ Overall Summary Score (see Table 26).

Table 26. Estimate and Standard Errors for Mixed Models Analysis of KCCQ and Embedded Networks

	KCCQ Subscales							
	KCCQTS		KCCQQoL		KCCSCS		KCCQOS	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	1.34	7.14	1.65	7.91	-.33	7.01	.18	6.67
Embedded Network	-.05	1.74	1.20	1.91	-.43	1.73	.37	1.63
Interaction	-2.75	3.97	-3.60	4.39	-.84	3.91	-2.27	3.72

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history
KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary
*p < .05. **p < .01 ***p < .001.

In sum, there were significant interactions between race and Total Network size for KCCQ Total Symptoms, KCCQ Quality of Life, and KCCQ Clinical Summary scores only. KCCQ Total Symptoms, Quality of Life and Clinical Summary scores decreased for African Americans as Total Network Size increased while KCCQ Total Symptoms, Quality of Life, and Clinical Summary scores increased for Caucasians as Total Network Size increased.

Heart Failure Hospitalizations or Death

Separate logistic regressions were used to assess the impact of the covariates, social network, race, and the interaction term of social network and race on the likelihood that respondents would report that they had been hospitalized for heart failure or died over the two year follow up period. The models contained 8 independent variables (gender, age, SES, NYHA class, risk score, Social Network Scores, race, and the interaction term of Social Network X race). The full models containing all predictors were not significant for Total Network Size or for the Number of Embedded Networks, indicating that these models were not able to distinguish between respondents who were or were not hospitalized or did or did not die. Taking into consideration the possibility for missing follow up interviews, a sensitivity analysis was run for each logistic regression analysis in this hypothesis to assess whether there would be a change in the results after assuming any missed follow ups would have resulted in a reported HF hospitalization or death. The sensitivity analysis did not indicate a change in the results.

Hypothesis 3c

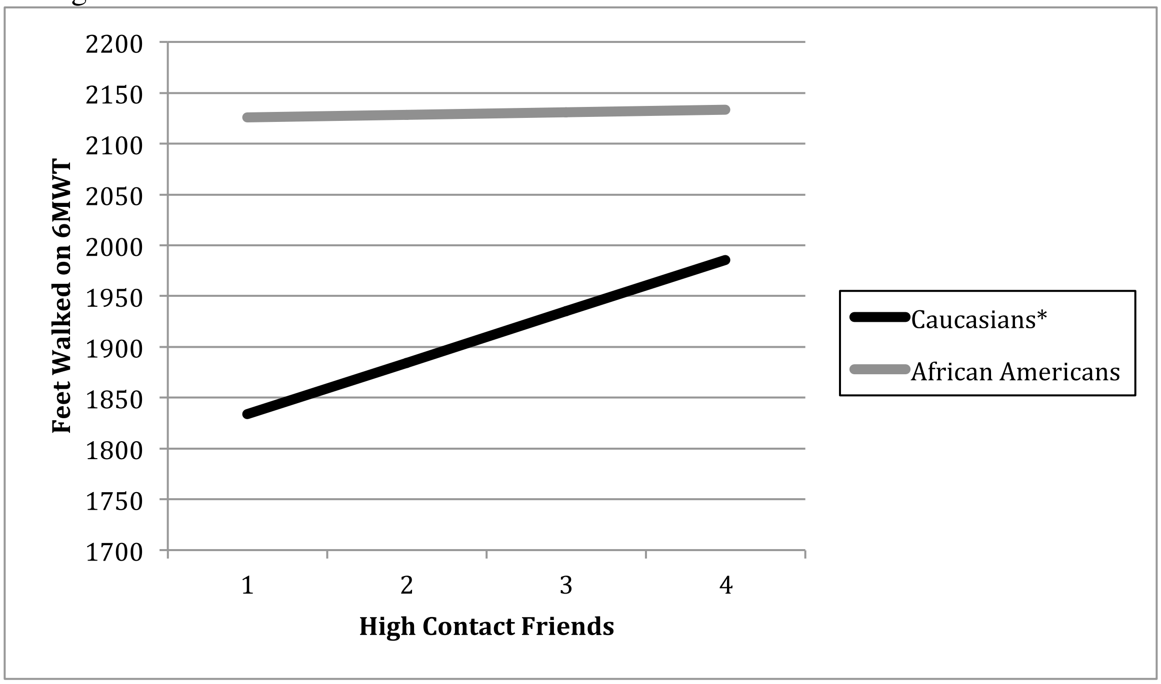
This hypothesis proposed that size of the embedded network family would more strongly predict outcomes in Caucasians compared to African Americans, with increased size of this group having a stronger association with better heart failure outcomes. The social network groups of church/temple, friends, and neighbors will more strongly predict outcomes for African Americans compared to Caucasians with increased size of these groups related to better heart failure outcomes.

Functional Status

Hypothesis 3c proposed that race would moderate the relationship between social network and 6MWT. To investigate this hypothesis, a series of hierarchical multiple regressions were used. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history unless otherwise noted. The models used in hypothesis 1 were used, with the addition of a race X social network interaction term to investigate hypothesis 3c. See table 9 for the unique contributions of covariates in step 1 of the below analyses.

The number of High Contact Friends, race, and the interaction term for race X number of High Contact Friends were entered into the model in step 2. The total amount of variance explained by the model as a whole was 32.4%, F (10, 97) = 4.641, p < .001. Number of High Contact Friends, race, and the interaction term explained an additional 6.4% of the variance in 6MWT after controlling for the influence of covariates, R squared change = .064, F change (3, 97) = 3.041, p < .05. The interaction term (*beta* = -.360, p < .05) was significant indicating that race does in fact moderate the relationship between number of High Contact friends and 6MWT. Follow up analyses indicate that for Caucasians, the number of high contact friends seen in the past two weeks made a unique contribution to distance walked on the 6MWT in that more contact was predictive of increased distance walked on the 6WMT (B = 50.656, *beta* = .429, p < .05), while for African Americans the number of high contact friends did not make s significant contribution to distance walked on the 6MWT (B = 2.519, beta = .021, p = .219) (see Figure 9). The main effect for race (*beta* = .854, p = .395) did not provide a statistically significant contribution to the model as a whole. However, there was still a main effect for number of High Contact Friends, indicating a positive relationship between the variables (See Table 27).

Figure 9. Unstandardized Regression Slopes for Distance Walked on 6MWT and Number of High Contact Friends for Caucasians and African Americans



Note. Constant = 1782.906 for Caucasians, $\Delta R^2 = .162$, $p < .05$; Constant = 2123.186 for African Americans, $\Delta R^2 = .000$, $p = .827$

Separate hierarchical multiple regressions were also used to assess the ability of the interaction terms of race X High Contact Family members, race X High Contact Neighbors, and race X High Contact Religious members to predict functional status, after adjusting for covariates. After entering the number of High Contact Family members, High Contact Neighbors, or High Contact Religious members in step 2 of each model, the models explained 29.1% ($p = .25$), 27.3% ($p = .66$), and 28.3% ($p = .39$) of the variance in functional status, respectively. Each of these changes was non-significant (See Table 27).

Table 27. Hierarchical Multiple Regression Analyses Predicting Functional Status (6MWT) From Social Network

	Embedded Networks							
	Family		Friends		Neighbors		Religious	
Predictor	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.26***		.26***		26***		26***	
Control variables[a]								
Step 2	.031		.064*		.013		.023	
Race		-.198		.125		-.122		-.048
Social Network		.076		.409**		.034		.222
Interaction		.104		-.360*		.020		-.276
Total R^2	.391		.324*		.273		.283	
n	128		129		126		127	

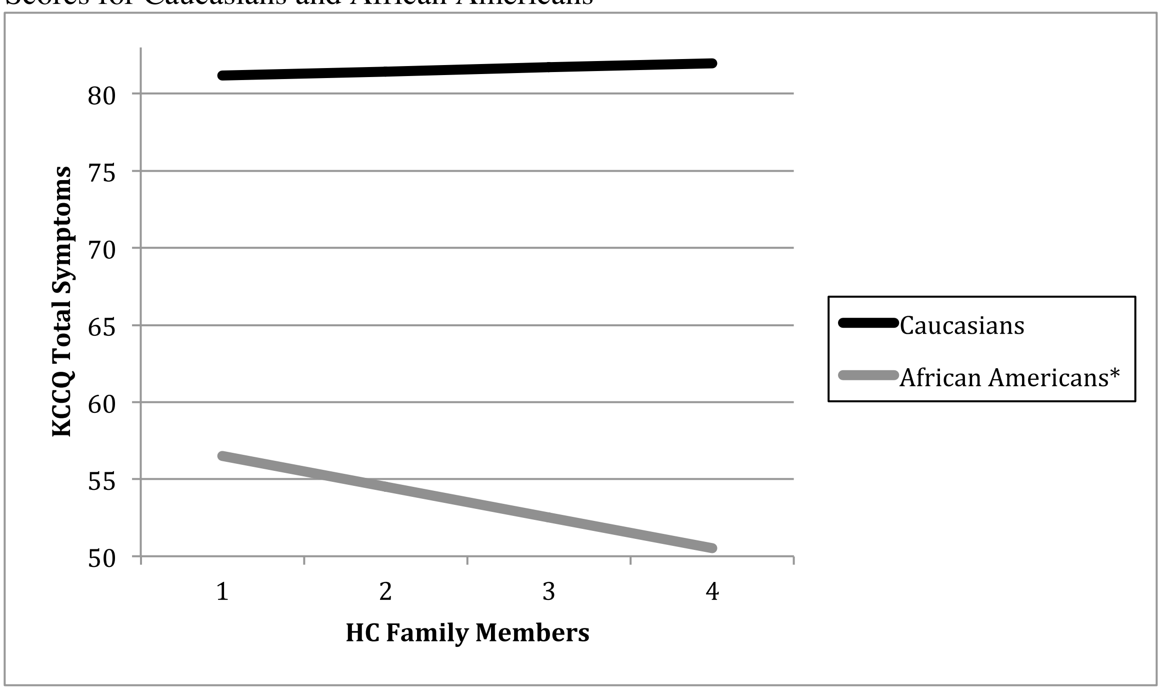
Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

Symptoms

Hypothesis 3c also predicted that race would moderate the relationship between Perceived Social Support and symptoms. To investigate this hypothesis, a series of repeated measures multilevel models were used. All analyses controlled for gender, age, SES, smoking history, BMI, NYHA class, and hypertension history unless otherwise noted. The models used in hypothesis 1 were used with the addition of a race X social network interaction term to investigate hypothesis 3c.

For KCCQ Total Symptoms Score, there was a significant interaction between race and number of High Contact Family members F(1, 100.730) = 5.920, $p < .05$. Further analyses to examine this interaction indicate that number of High Contact Family members was not significant for Caucasians (Estimate = .27, SE = .37, $p = .48$) and was approaching significance for African Americans F(1, 19.941) = 4.139, p = .055). For African Americans as the number if High Contact Family members increased, KCCQ Total Symptoms Scores decreased (Estimate = -1.99, SE = .98, $p = .055$) (See Figure 10). Surprisingly, this means that African Americans reported poorer health status with more high contact with family members. There was no main effect of race (*p* = .137) or, as in prior analyses, of number of High Contact Family members (*p* = .094). There was no significant interaction (p = .129) between race and number of High Contact Neighbors or main effects of race (p = .610) or number of High Contact Neighbors (p = .880). There was no significant interaction (p = .168) between race and number of High Contact Religious members or main effects of race (p = .148) or number of High Contact Religious members (p = .998). There was also no significant interaction (p = .603) between race and number of High Contact Friends or main effects of race (p = .847) or number of High Contact Friends (p = .221) (see Table 28).

Figure 10. Slopes for KCCQ Total Symptoms scores and High Contact Family Members Scores for Caucasians and African Americans



Note. Intercept = 80.89 for Caucasians, Est. = 0.27, *p* = .48; Intercept = 58.48 for African Americans, Est. = -1.99, *p* = .055

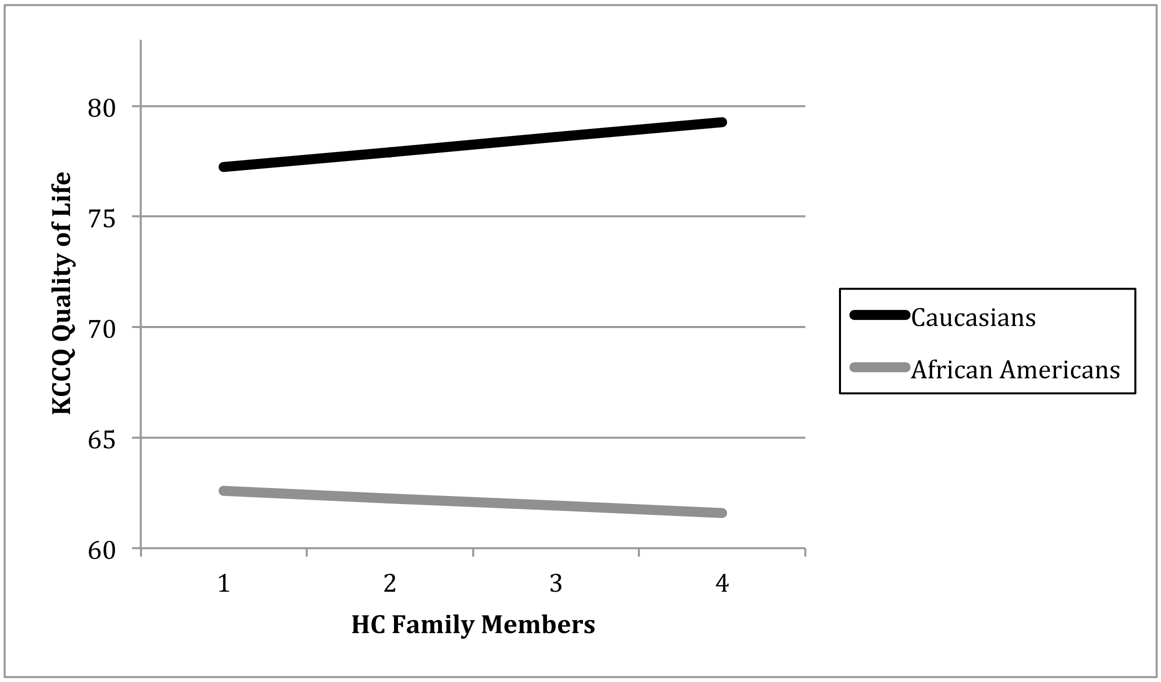
Table 28. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Total Symptoms and Social Support

	Domains of social support							
	HC Family		HC Neighbors		HC Religious		HC Friends	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	9.99	6.67	2.75	5.34	-6.33	4.34	-1.13	5.8
HC members	.35	.39	1.42	.87	-1.02	.60	1.3	.84
Interaction	-2.18*	.89	-2.57	1.68	2.03	1.46	-.76	1.45

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Quality of Life Scores, there was a significant interaction between race and number of High Contact Family members F(1, 92.801) = 5.730, $p < .05$. Further analyses to examine this interaction indicate that High Contact Family Members was not significant for Caucasians (Est. = .68, SE = .44, p = .131) or African Americans (Est. = -.33, SE = .78, p = .685). However, figure 11 demonstrates the relationship of each regression slope for African Americans and Caucasians to clarify this interaction. There was no main effect of race (p = .129) or number of High Contact Family members (p = .321). There was no significant interaction (p = .235) between race and number of High Contact Neighbors or main effects of race (p = .891) or number of High Contact Neighbors (p = .310). There was no significant interaction (p = .097) between race and number of High Contact Religious members or main effects of race (p = .121) or number of High Contact Religious members (p = .487). There was no significant interaction (p = .113) between race and number of High Contact Friends or main effects of race (p = .609) or number of High Contact Friends (p = .750) (see Table 29).

Figure 11. Slopes for KCCQ Quality of Life scores and High Contact Family Members Scores for Caucasians and African Americans



Note. Intercept = 76.55 for Caucasians, Est. = 0.68, p = .131; Intercept = 62.91 for African Americans, Est. = -0.33, p = .685

Table 29. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Quality of Life and Social Support

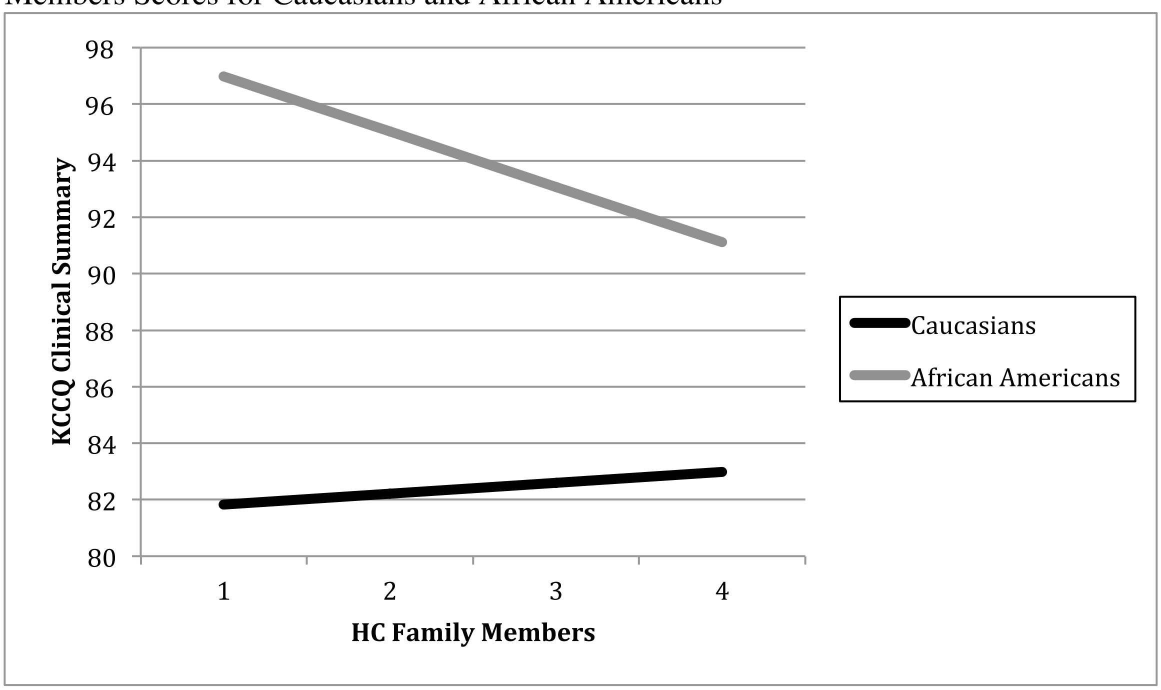
	Domains of social support							
	HC Family		HC Neighbors		HC Religious		HC Friends	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	11.22	7.32	.80	5.88	-7.53	3.82	3.27	6.38
HC Members	.69	.43	2.06	.95	-.79	.67	1.52	.92
Interaction	-2.34*	.98	-2.19	1.84	2.69	1.61	-2.52	1.58

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Clinical Summary Score, there was a significant interaction between race and number of High Contact Family members $F(1, 103.114) = 6.082$, $p < .05$. Further analyses to examine this interaction indicate that the number of High Contact Family members was not significant for Caucasians (Est. = .39, SE = .36, p = .279) or

African Americans (Est. = -1.96, SE = .98, *p* = .059). However, figure 12 demonstrates the relationship of each regression slope for African Americans and Caucasians to clarify this interaction. There was no main effect of race (*p* = .088) or number of High Contact Family members (*p* = .113). There was no significant interaction (p = .479) between race and number of High Contact Neighbors or main effects of race (p = .883) or number of High Contact Neighbors (p = .632). There was no significant interaction (p = .321) between race and number of High Contact Religious members or main effects of race (p = .257) or number of High Contact Religious members (p = .564). There was no significant interaction (p = .929) between race and number of High Contact Friends or main effects of race (p = .653) or number of High Contact Friends (p = .204) (see Table 30).

Figure 12. Slopes for KCCQ Clinical summary scores and High Contact Family Members Scores for Caucasians and African Americans



Note. Intercept = 81.43 for Caucasians, Est. = 0.39, *p* = .279; Intercept = 98.95 for African Americans, Est. = -1.57, *p* = .059

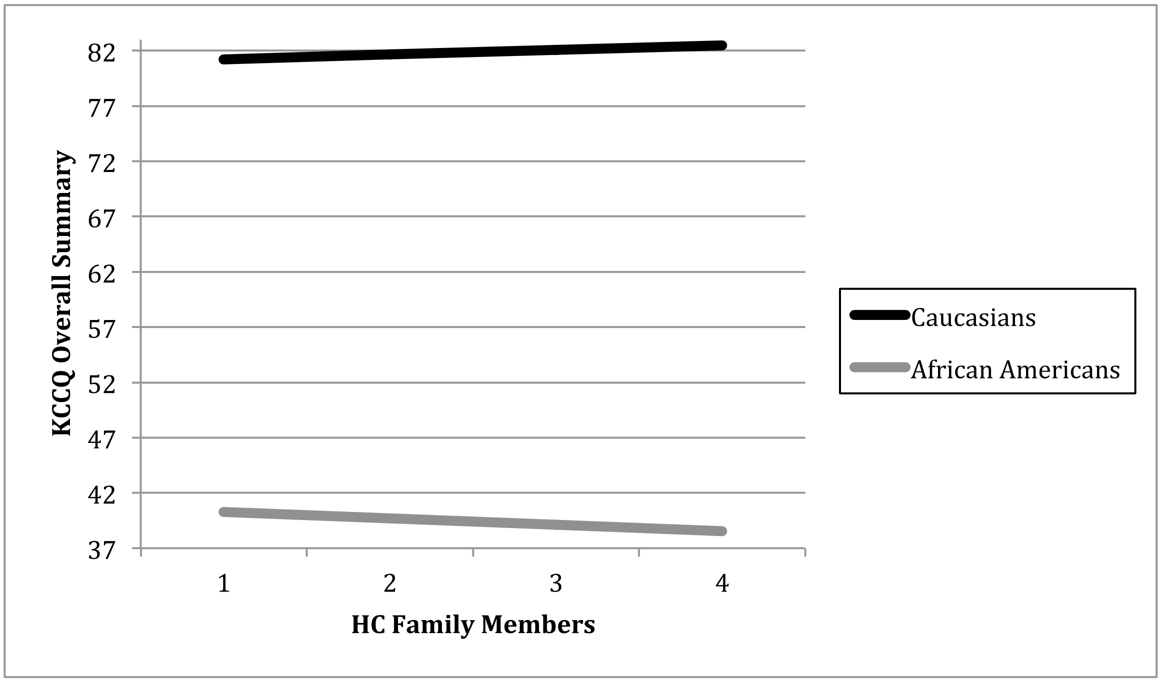
Table 30. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Clinical Summary and Social Support

	Domains of social support							
	HC Family		HC Neighbors		HC Religious		HC Friends	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	11.29	6.55	.78	5.3	-4.85	4.26	-2.59	5.74
HC Members	.39	.38	1.00	.86	-1.13	.59	.88	.83
Interaction	-2.18*	.89	-1.18	1.66	1.44	1.44	.13	1.43

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Overall Summary Score, there was a significant interaction between race and number of High Contact Family members $F(1, 100.180) = 5.920$, $p < .05$. Further analyses to examine this interaction indicate that the number of High Contact Family members was not significant for Caucasians (Est. = .43, SE = .35, $p = .227$) or African Americans (Est. = -.58, SE = .71, $p = .420$). However, figure 13 demonstrates the relationship of each regression slope for African Americans and Caucasians to clarify this interaction. There was no main effect of race ($p = .148$) or number of High Contact Family members ($p = .176$). There was no significant interaction (p = .267) between race and number of High Contact Neighbors or main effects of race (p = .895) or number of High Contact Neighbors (p = .133). There was no significant interaction (p = .181) between race and number of High Contact Religious members or main effects of race (p = .141) or number of High Contact Religious members (p = .902). There was no significant interaction (p = .664) between race and number of High Contact Friends or main effects of race (p = .766) or number of High Contact Friends (p = .454) (see Table 31).

Figure 13. Slopes for KCCQ Overall Summary scores and High Contact Family Members Scores for Caucasians and African Americans



Note. Intercept = 80.79 for Caucasians, Est. = 0.43, *p* = .227; Intercept = 40.84 for African Americans, Est. = -0.58, *p* = .42

Table 31. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Overall Symptoms and Social Support

	Domains of social support							
	HC Family		HC Neighbors		HC Religious		HC Friends	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Race	9.08	6.23	.66	5.02	-6.04	4.08	-1.64	5.50
HC Members	.46	.36	1.60	.81	-.84	.57	.83	.79
Interaction	-2.04*	.84	-1.75	1.57	1.85	1.37	-.59	1.4

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

In short, only the Number of High Contact Family members interacted significantly with race. This interaction was significant for each of the four KCCQ subscales. For each of the KCCQ subscales, as the number of High Contact Family members increased for Caucasians, so did the KCCQ scores, while for African

Americans, as the number of High Contact Family members increased, KCCQ scroes decreased.

Heart Failure Hospitalizations or Death

Separate logistic regressions were used to assess the impact of the covariates, race, and social network size on the likelihood that respondents had been hospitalized for heart failure or died over the two year follow up. The model contained 8 independent variables (gender, age, SES, NYHA class, risk score, race, number of high contact individuals in embedded network, and the interaction term of number of high contact individuals in embedded network and race). The models used in hypothesis 1 were used, with the addition of race and the interaction term of race and Social Network Size. For the models investigating the number of High Contact Friends, High Contact Families, High Contact Neighbors, and High Contact Religious Members the full models containing all predictors were not significant. This indicates that these models were not able to distinguish between respondents who were or were not hospitalized or did or did not die over the two year follow up. Taking into consideration the possibility for missing follow up interviews, a sensitivity analysis was run for each logistic regression analysis in this hypothesis to assess whether there would be a change in the results after assuming any missed follow ups would have resulted in a reported HF hospitalization or death. The sensitivity analysis did not indicate a change in the results.

Hypothesis 3d

Hypothesis 3d proposed that the relationships above will persist independently of participants' level of depression. To investigate this hypothesis, depression scores were added as covariates to the above models for hypotheses 3a, 3b, and 3c. Following are the adjusted results for the models in hypothesis 3a. Table 32 provides the unique contribution of the covariates for the below hierarchical regression analyses.

Table 32. Hierarchical Multiple Regression Analyses Covariate Contribution in Step 1 for Hypothesis 3d

	Social Network Diversity	
Predictor	β	ΔR^2
Step 1		.269***
Gender	-.244**	
Smoking History	.040	
BMI	-.062	
Age	-.297**	
NYHA Class	-.247**	
Hypertension History	.141	
Income	.221*	
Depression	-.096	

Note. *p < .05. **p<.01. ***p < .001.

Hypothesis 3a Adjusted for Depression

6MWT

For Total Social Support, Appraisal Support, Belonging Support, and Tangible Support, after adjusting for depression scores, the pattern of results were the same as the original analyses (see Table 33).

Table 33. Hierarchical Multiple Regression Analyses Predicting Functional Status (6MWT) From Perceived Social Support adjusting for depression

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.26.9***		.26.9***		26.9***		26.9***	
Control variables[a]								
Step 2	.073*		.112**		.037		.030	
Race		.693		.878		.257		.081
Social Network		.455*		.596***		.277		.200
Interaction		-.820		-1.009*		-.389		-.209
Total R^2	.341*		.381**		.306		.299	
n	134		134		134		134	

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

Symptoms

Hypothesis 3a also proposed that race would moderate the relationship between perceived social support and symptoms (KCCQ scores). The models used in hypothesis 3a were used with the addition of depression scores as a covariate to investigate hypothesis 3d.

After adjusting for depression for KCCQ Total Symptoms Score, there was still no significant interaction between race and Total Social Support, or main effect of race. Unlike the prior results, there was also no significant main effect of Total Social Support ($p < .317$). There was also a significant main effect of depression F(1, 107.826) = 18.471, $p < .001$, a negative correlation between the two scores. Results of the model remained unchanged for Appraisal Support as well. Depression was also a significant contributor to the variance in symptoms again, with a negative correlation between depression and KCCQTS scores. For KCCQ Total Symptom Scores there were no changes in the pattern of results for Belonging Support. There was a significant main effect for depression F(1, 108.073) = 25.805, $p < .001$, indicating a negative relationship between the variables. Unlike prior results, after adjusting for depression, there was no longer a significant interaction between race and Tangible Support ($p = .093$). There was still no significant main effect of Tangible Support. Further, there was no longer a significant main effect of race ($p = .104$). There was a significant main effect of depression F(1, 109.043) = 20.410, $p < .001$. Results again indicated this was a negative relationship (see Table 34).

Table 34. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Total Symptoms and Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-.75***	.17	-.74***	.17	-.85***	.17	-.78***	.17
Race	27.14	23.16	16.27	18.50	16.27	18.94	19.50	18.02
Social Support	.69	.31	2.45**	.79	.64	.72	1.32	.79
Interaction	-.71	.57	-1.28	1.35	-1.26	1.43	-2.27	1.33

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Quality of Life score, as in previous analyses, there was still no significant interaction between race and Total Social Support, or main effect of race. However, unlike prior analyses, there was also no significant main effect of Total Social Support ($p = .836$). There was a significant main effect of depression F(1, 103.095) = 29.878, $p < .001$, with the results indicating a negative relationship between these variables. As was found in prior analyses, there was still no significant interaction between race and Appraisal Support ($p = .98$), or main effect of race ($p = .94$). In addition and dissimilar to the prior findings, there was no longer a significant main effect of

Appraisal Support (p = .23). There was a significant main effect of depression F(1, 99.805) = 30.752, p, with the relationship between 6MWT and depression being negative. Results of the model indicate that for KCCQ Quality of Life scores, there were no changes to the pattern of results for Belonging Support or Tangible Support after adding depression. There was a significant main effect of depression in regards to the Belonging Support model F(1, 104.642) = 38.811, $p < .001$, and the Tangible Support model F(1, 104.665) = 31.800, $p < .001$, which again both represented negative relationships (see Table 35)

Table 35. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Quality of Life and Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-1.00***	.18	-.97***	.18	-1.05***	.17	-1.02***	.18
Race	3.05	24.47	-1.56	19.67	-7.13	19.62	16.81	18.86
Social Support	.26	.33	1.56	.84	.14	.75	.50	.83
Interaction	-12	.61	-.05	1.44	.43	1.48	-1.38	1.40

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Clinical Summary score, there was still no significant interaction between race and Total Social Support (p = .32), or main effect of race (p = .34). However, unlike prior analyses, there was also no significant main effect of Total Social Support (p = .265). There was also a significant main effect of depression F(1, 106.823) = 13.765, $p < .001$. This was a negative relationship. The pattern of results remained unchanged in regards to Appraisal Support and Belonging Support and there were also significant main effect of depression for Appraisal Support models F(1, 107.075) =

13.822, $p < .001$, and Belonging Support models F(1, 107.248) = 18.847, $p < .001$, both of which indicated negative relationships between the variables. Unlike the prior results, there was no longer a significant interaction effect of Tangible Support and race (p = .096) after the addition of depression as a covariate. There was still no significant main effect of Tangible Support ($p = .99$), and there was also no significant main effect of race ($p = .10$). There was also a significant main effect of depression F(1, 107.575) = 16.299, $p < .001$, which as before, indicated a negative relationship (see Table 36)

Table 36. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Clinical Summary and Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-.64***	.17	-.62***	.17	-.72***	.16	-.69***	.17
Race	21.93	22.87	2.66	18.25	19.00	18.71	29.56	17.87
Social Support	.66*	.31	2.06**	.79	1.01	.71	1.10	.78
Interaction	-.56	.57	-.23	1.34	-1.44	1.41	-2.23	1.32

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Overall Summary Score, there still was no significant interaction between race and Total Social Support ($p = .44$), or main effect of race ($p = .49$). However, unlike prior analyses, there was also no significant main effect of Total Social Support ($p = .29$). There was also a significant main effect of depression F(1, 104.655) = 27.047, $p < .001$ with depression and KCCQOS scores being negatively related. For Appraisal Support and Belonging Support, there were no changes in the pattern of results after adding depression as a covariate. There was also a significant main effect of depression for the model examining Appraisal Support F(1, 104.489) = 27.598, $p < .001$

and for the model containing Belonging Support $F(1, 106.301) = 34.914$, $p < .001$ with increasing BDI scores being related to decreasing KCCQOS scores. Once again, after adjusting for depression, there was no longer a significant interaction for race and Tangible Support ($p = .137$). There was still no significant main effect of Tangible Support ($p = .96$) or race ($p = .16$). There was also a significant main effect of depression $F(1, 106.308) = 30.8326$, $p < .001$, which was a negative relationship (see Table 37).

Table 37. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Overall Summary and Social Support

	Domains of social support							
	Total		Appraisal		Belonging		Tangible	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-.82***	.16	-.79***	.15	-.89***	.15	-.86***	.16
Race	14.48	20.84	2.03	16.65	9.89	16.99	22.86	16.28
Social Support	.52	.28	1.73*	.72	.68	.65	.87	.71
Interaction	-.41	.52	-.29	1.22	-.82	1.28	-1.81	1.21

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

In summary, for KCCQ symptom scores there were no longer any significant interactions between race and social support when depression was added into the models as a covariate.

Heart Failure Hospitalizations or Death

Logistic regressions were also used for hypothesis 3a to examine the impact of covariates, social support, race, and the interaction term of social support and race on the likelihood that respondents had been hospitalized for heart failure or died during the two year follow up. After adjusting these analyses to control for depression, the pattern of result obtained was unchanged from the original models. Specifically, the models including depression were not significant for Total, Appraisal, Belonging, or Tangible Support, indicating that these models were still not able to distinguish between respondents who had or had not been hospitalized or did or did not die.

Hypothesis 3b Adjusted for Depression

6MWT

After adjusting for depression, the results investigating whether race moderated the relationship between Total Network Size and 6MWT remained unchanged. Depression was not a significant predictor in this model (See Table 38). For the total number of Embedded Networks after adjusting for depression scores, the pattern of results was somewhat different than the original analyses and depression was not a significant contributor to the variance in 6MWT in step 1 or 2 (*beta* = -.101, p = .281). In Step two the total number of Embedded Networks, race and the interaction term of total number of Embedded Networks X race were entered into the model and the total amount of variance explained but he model was 34%, F (11, 95) = 4.447, p < .001. The total number of Embedded Networks, race the interaction term explained an additional 7.1% of the variance in 6MWT distance R squared change = .071, F change (3, 95) = 3.421, p < .05. The main effect of race (*beta* = .171, p = .331) did not provide a statistically significant contribution to the model as a whole. However, there was a significant contribution of the total number of Embedded Networks in that increased number of embedded networks was related to increased distance walked on the 6MWT. In addition, and dissimilar to the original results, the interaction term (*beta* = -.500, p = .042) also made a unique contribution to the variance in 6MWT (see Table 38).

Table 38. Hierarchical Multiple Regression Analyses Predicting Functional Status (6MWT) From Social Network

	Social Network			
	Total Network Size		Number of Embedded Networks	
Predictor	ΔR^2	β	ΔR^2	β
Step 1	.26.9***		.26.9***	
Control variables[a]				
Step 2	.017		.071*	
Race		-.001		.171
Social Network		.138		.479**
Interaction		-.202		-.500*
Total R^2	.285		.340*	
n	127		128	

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

Symptoms

Hypothesis 3b also proposed that race would moderate the relationship between social network size and diversity and symptoms (KCCQ scores). The models used in hypothesis 3b were used with the addition of depression scores as a covariate to investigate hypothesis 3d.

After adjusting for depression, for KCCQ Total Symptoms Score there was no longer a significant interaction between race and Total Network Size ($p < .151$). In addition, dissimilar to the original results, there was a main effect of Total Network Size F(1, 99.417) = 4.477, $p < .05$. Contrary to expectations, results indicated a negative relationship between Total Network Size and KCCQTS scores. There was still no main effect of race ($p = .324$). There was also a significant main effect of depression F(1, 108.690) = 29.301, $p < .001$, with higher depression scores being related to lower KCCQTS scores. Unlike the original results, there was no longer a significant interaction between race and Total Network size for KCCQ Quality of Life Scores ($p = .606$) when depression was added as a covariate. There was still no main effect of race ($p = .837$) or

Total Network Size (p = .537) for KCCQ Quality of Life. There was a significant main effect of depression F(1, 106.404) = 33.451, p < .001, again results indicated an inverse relationship between the variables. In addition and unlike original analyses, for the KCCQ Clinical Score, there was no longer a significant interaction between race and Total Network Size (p = .375). There was still no main effect for either race (p = .494) or Total Network Size (p = .076). There was also a significant main effect of depression F(1, 108.276) = 24.887, p < .001 and the results again indicated this was an inverse relationship. Last, for the KCCQ Overall Summary Score the results were unchanged and there was also a significant main effect of depression F(1, 109.475) = 39.232, p < .001 with the results again indicating a negative relationship (see Table 39).

Table 39. Estimates and Standard Errors for Mixed Models Analysis of KCCQ and Social Network

	KCCQ Subscales							
	KCCQTS		KCCQQoL		KCCSCS		KCCQOS	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depresion	-.88***	.16	-1.03***	.18	-.81***	.16	-.93***	.15
Race	6.70	6.76	1.53	7.39	4.66	6.79	-.27	6.16
Social Network	-.11	.17	-.01	.18	-.15	.17	-.14	.15
Interaction	-.52	.38	-.20	.39	-.32	.36	-.09	.33

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history
KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary
*p < .05. **p < .01 ***p < .001.

After adjusting for depression, the patter of results remained unchanged for KCCQ Total Symptoms, KCCQ Quality of Life, KCCQ Clinical Summary, and KCCQ Overall Summary. There was a significant main effect of depression for KCCQ Total Symptoms F(1, 109.006) = 32.503, p < .001, KCCQ Quality of Life Scores F(1, 106.511)

= 40.608, $p < .001$, KCCQ Clinical Summary Score $F(1, 108.446) = 27.663$, $p < .001$, and KCCQ Overall Summary Score $F(1, 109.236) = 43.889$, $p < .001$ with the results of each showing an inverse relationship between depression and KCCQ scores (see Table 40).

Table 40. Estimate and Standard Errors for Mixed Models Analysis of KCCQ and Social Network

	KCCQ Subscales							
	KCCQTS		KCCQQoL		KCCSCS		KCCQOS	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-.91***	.16	-1.09***	.17	-.84***	.16	-.95***	.14
Race	-.29	6.35	-1.39	6.85	-1.77	6.31	-.69	5.69
Embedded Network	-2.37	1.61	-1.90	1.72	-2.74	1.62	-2.33	1.45
Interaction	-.51	3.54	-.36	3.81	1.18	3.54	.14	3.19

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history
KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary
*p < .05. **p < .01 ***p < .001.

Overall, for KCCQ symptoms, there were no longer any significant interactions between social support and race when depression was added as a covariate. There were main effects of depression for the KCCQ subscales.

Heart Failure Hospitalizations or Death

Logistic regressions were also used for hypothesis 3b to examine the impact of covariates, Social Network, race, and the interaction term of Social Network and race on the likelihood that respondents had been hospitalized or died during the two year follow up. After adjusting these analyses to control for depression in hypothesis 3d, the pattern of result obtained was unchanged from the original models. Specifically, the models including depression were not significant for the number of High Contact Friends, Family, Neighbors, or Religious members, indicating that these models were not able to distinguish between respondents who had or had not been hospitalized or did or did not die.

Hypothesis 3c Adjusted for Depression

Depression was added to the analyses used in hypothesis 3c to determine if the relationships among race, social network, and the outcome variables remained unchanged.

6MWT

For the number of High Contact Friends, after adjusting for depression scores, the pattern of results were the same as the original analyses and depression was not a significant contributor to the variance in 6MWT in step 1 or 2 (*beta* = -.068, p = .475) (See Table 41). For the number of High Contact Neighbors, High Contact Family members, and High Contact Religious members, separate regressions were run for each variable after adjusting for depression scores, the pattern of results were the same as the original analyses and depression was not a significant contributor to the variance in 6MWT in step 1 or 2 of each models (High Contact Neighbors: *beta* = -.104, p = .286; High Contact Family members: *beta* = -.099, p = .289; High Contact Religious members: *beta* = -.116, p = .211) (see Tables 21, 29, and 41).

Table 41. Hierarchical Multiple Regression Analyses Predicting Functional Status (6MWT) From Social Network adjusting for depression

	Embedded Networks							
	Family		Friends		Neighbors		Religious	
Predictor	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1 Control variables[a]	.26.9***		.26.9***		26.9***		26.9***	
Step 2	.031		.059*		.013		.026	
Race		-.167		.123		-.107		-.051
Social Network		.119		.391*		.050		.203
Interaction		.032		-.371*		-.033		-.284
Total R^2	.299		.327*		.281		.295	
n	128		129		126		127	

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

Symptoms

For KCCQ Total Symptoms Score there was no longer a significant interaction between race and number of High Contact Family members (p = .135) following the addition of depression to the model. There was still no main effect of race (p = .295) or number of High Contact Family members (p = .352). There was a main effect of depression F(1, 110.33) = 26.078, p <.001. The patter of results remained unchanged for High Contact Neighbors, High Contact Religious Members, and High Contact Friends. There was a significant main effect of depression for the models containing Hgih Contact Neighbors F(1, 107.506) = 24.093, p < .001, High Contact Religious members F(1, 109.563) = 36.974, p < .001, and High Contact Friends F(1, 108.525) = 27.33, p < .001 (see Table 42).

Table 42. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Total Symptoms and Social Support

	Domains of social support							
	HC Family		HC Neighbors		HC Religious		HC Friends	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-.80***	.16	-.80***	.16	-.99***	.16	-.863***	.17
Race	6.42	6.10	2.33	4.92	-4.14	3.82	1.28	5.28
HC Members	.25	.35	.33	.82	-1.48	.54	-.08	.81
Interaction	-1.25	.83	-1.48	1.55	1.49	1.27	-.66	1.30

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Quality of Life Score there was no longer a significant interaction between race and number of High Contact Family members (p = .225). There was still no main effect of race (p = .402) or number of High Contact Family members (p = .949). There was a significant main effect for depression $F(1, 106.058) = 36.007$, $p < .001$. The pattern of results for number of High Contact Neighbors, number of High Contact Religious Members, and number of High Contact Friends remained unchanged. There were significant main effects of depression for the models containing High Contact Neighbors $F(1, 104.074) = 35.682$, $p < .001$, High Contact Religious members $F(1, 106.611) = 59.12$, $p < .001$, and High Contact Friends $F(1, 104.245) = 42.714$, $p < .001$ (see Table 43).

Table 43. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Quality of Life and Social Support

	Domains of social support							
	HC Family		HC Neighbors		HC Religious		HC Friends	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-1.00***	.17	-1.03***	.17	-1.29***	.17	-1.12***	.17
Race	5.43	6.46	-.76	5.15	-4.49	3.91	5.57	5.47
HC Members	.51	.37	.72	.87	-1.45	.56	-3.7	.84
Interaction	-1.07	.87	-.57	1.62	2.09	1.28	-2.17	1.34

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Clinical Summary Score there was no longer a significant interaction between race and number of High Contact Family members (p = .111) There was still no main effect of race (p = .196) or number of High Contact Family members (p = .337). There was a significant main effect of depression F(1, 109.418) = 21.006, p < .001. The pattern of results for number of High Contact Neighbors, number of High Contact Religious Members, and number of High Contact Friends remained unchanged. There were significant main effects of depression for the models containing High Contact Neighbors F(1, 106.709) = 21.523, p < .001, High Contact Religious members F(1, 108.15) = 30.965, p < .001, and High Contact Friends F(1, 108.911) = 23.402, p < .001 (see Table 44).

Table 44. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Clinical Summary and Social Support

	Domains of social support							
	HC Family		HC Neighbors		HC Religious		HC Friends	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-.72***	.16	-.75***	.16	-.98***	.16	-.79***	.16
Race	7.91	6.08	.42	4.89	-2.61	3.81	-.66	5.27
HC Members	.28	.35	-.03	.83	-1.57	.53	-.38	.81
Interaction	-1.33	.83	-.18	1.55	.94	1.28	.34	1.31

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

For KCCQ Overall Summary Score there was no longer a significant interaction between race and number of High Contact Family members ($p = .188$). There was still no main effect of race ($p = .403$) or number of High Contact Family members ($p = .570$). There was a significant main effect of depression $F(1, 109.923) = 36.201$, $p < .001$. The pattern of results for number of High Contact Neighbors, number of High Contact Religious Members, and number of High Contact Friends remained unchanged. There were significant main effects of depression for the models containing High Contact Neighbors $F(1, 107.123) = 35.014$, $p < .001$, High Contact Religious members $F(1, 108.663) = 54.319$, $p < .001$, and High Contact Friends $F(1, 109.199) = 44.116$, $p <.001$ (see Table 45).

Table 45. Estimate and Standard Errors for Mixed Models Analysis of KCCQ Overall Summary and Social Support

	Domains of social support							
	HC Family		HC Neighbors		HC Religious		HC Friends	
Predictor	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Depression	-.85***	.14	-.87***	.15	-1.05***	.14	-.98***	.15
Race	4.59	5.46	-.25	4.40	-3.91	3.36	.55	4.70
HC Members	.29	.32	.42	.74	-1.39	.47	-.76	.72
Interaction	-.99	.74	-.54	1.39	1.44	1.12	-.39	1.16

Note. [a]Control variables included gender, age, SES, smoking history, BMI, NYHA class, and hypertension history.
*p < .05. **p < .01 ***p < .001.

Overall, for each of the KCCQ subscales there were no longer any significant interactions between race and the number of High Contact Family Members when depression was added as a covariate. There were significant main effects of depression for the KCCQ subscales.

Heart Failure Hospitalizations or Death

Logistic regressions were also used for hypothesis 3c to examine the impact of covariates, social network size, race, and the interaction term of social network size and race on the likelihood that respondents had been hospitalized or died during the two year follow up. After adjusting these analyses to control for depression, the pattern of results obtained was unchanged from the original models. Specifically, the models including depression were not significant for Total Network Size or the number of embedded networks, indicating that these models were not able to distinguish between respondents who had or had not been hospitalized or did or did not die.

EXPLORATORY ANALYSES

Living Environment

For the exploratory analyses examining the social home environment (i.e., who lives in the home, how many people live in the home, marital status) in relation to the three outcome variables (6MWT, KCCQ, and hospitalizations or death) several correlations and ANCOVAs were used. The only significant relationships were small to medium correlations between who lives (i.e., with spouse, with children, with friends) in the home and KCCQ Quality of Life scores at 12 month follow up $r = .255$, $p < .05$, $n = 76$ and 18 month follow up $r = .277$, $p < .05$, $n = 65$ and the KCCQ Overall Summary score at 18 month follow up $r = .277$, $p < .05$, $n = 65$. Given that these were the only significant results and do not represent any consistent pattern, they should be interpreted with caution.

Gender

For exploratory analyses regarding gender and the outcome variables, a series of regressions and mixed models were used. Of note is the large discrepancy between the number of males ($n = 113$) and females ($n = 33$) in the sample, which make comparisons across gender difficult. The only significant results for these analyses were for the hierarchical regression examining gender predicting 6MWT R squared change = .054, F change $(1, 102) = 7.45$, $p < .01$. These results indicate that women walked a smaller distance than men on the 6MWT. These results should be interpreted with caution given the discrepancy between the number of males and females in the sample and that this was the only significant result of the 6 analyses examining gender.

Social Support Ranges

In order to further examine the median, range, and distribution social support variables among African Americans and Caucasians, box plots were created. The box plots present participants' scores in quartiles with the dark line representing the median score. Please see Figures 14 – 23 for this information.

Figure 14. Box Plot for ISEL Appraisal Scores Separated by Race

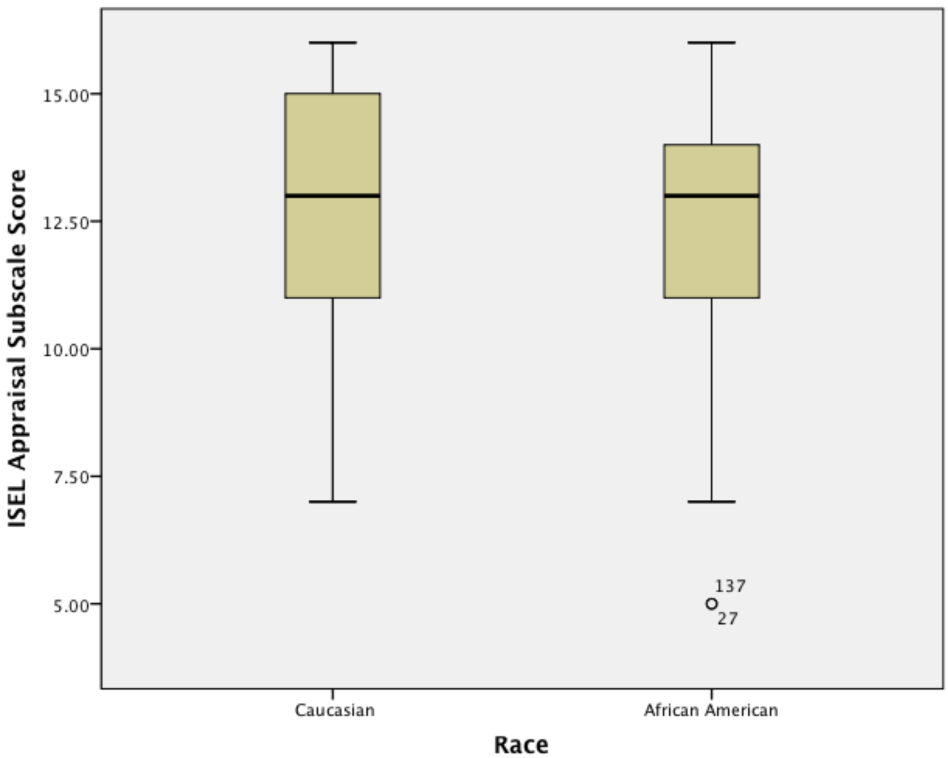


Figure 15. Box Plot for ISEL Belonging Scores Separated by Race

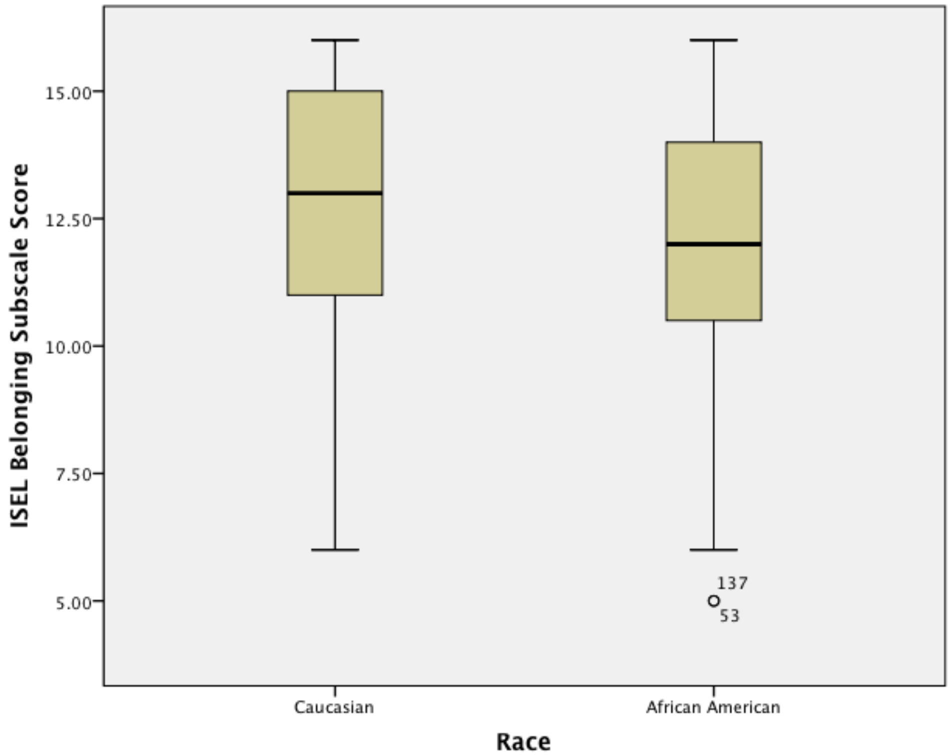


Figure 16. Box Plot for ISEL Tangible Scores Separated by Race

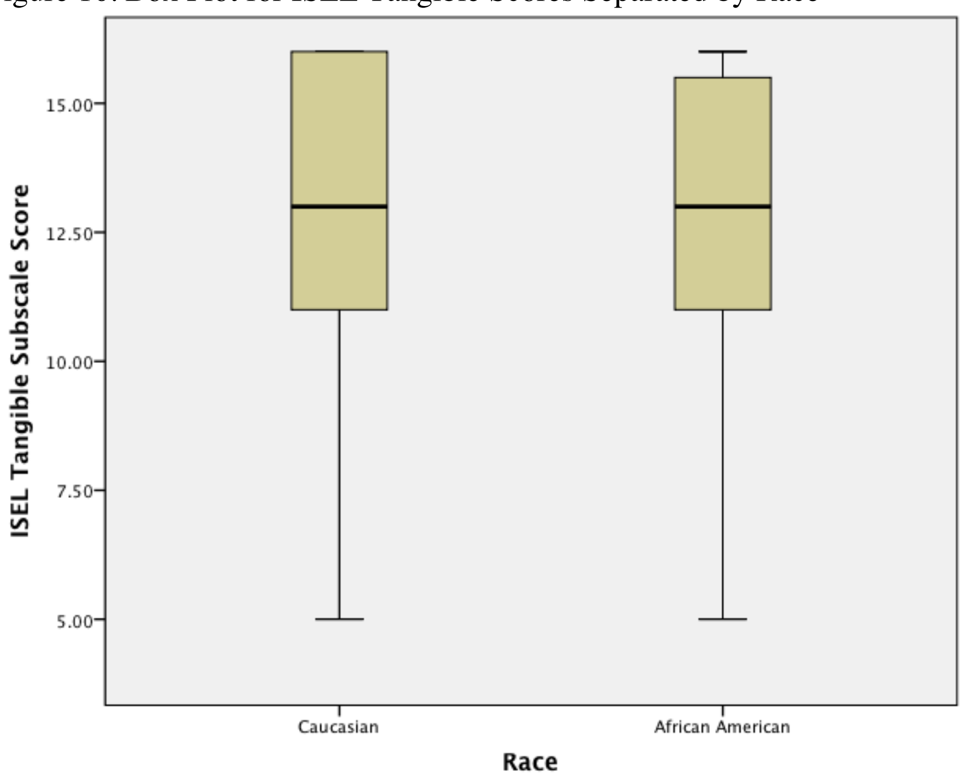


Figure 17. Box Plot for ISEL Total Scores Separated by Race

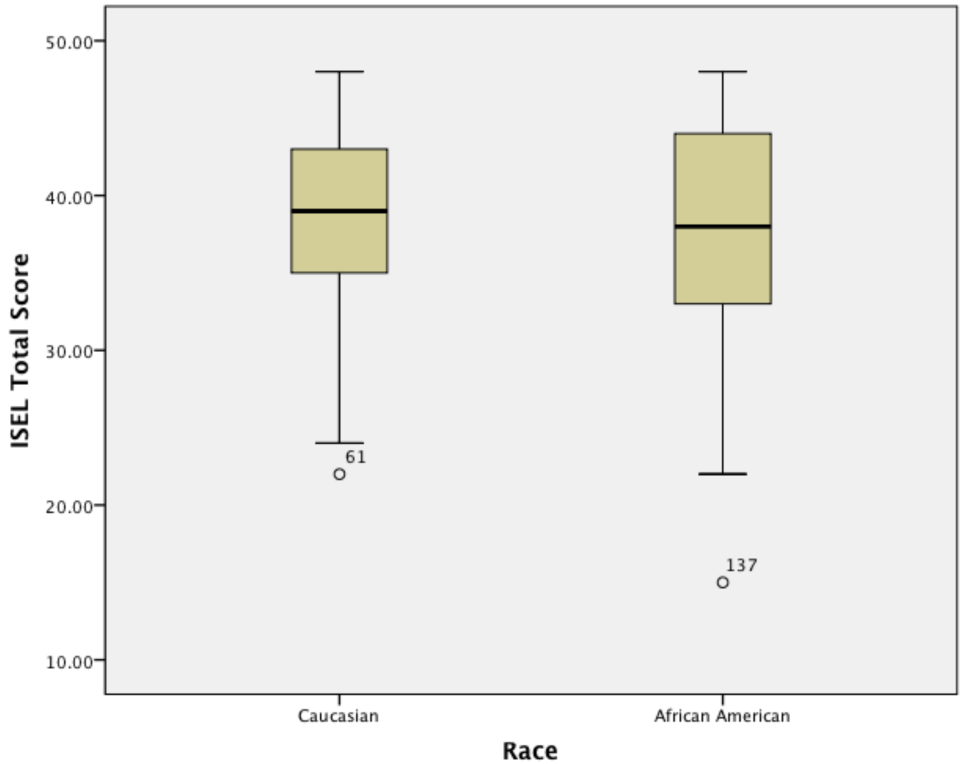


Figure 18. Box Plot for Number of HC Friends Separated by Race

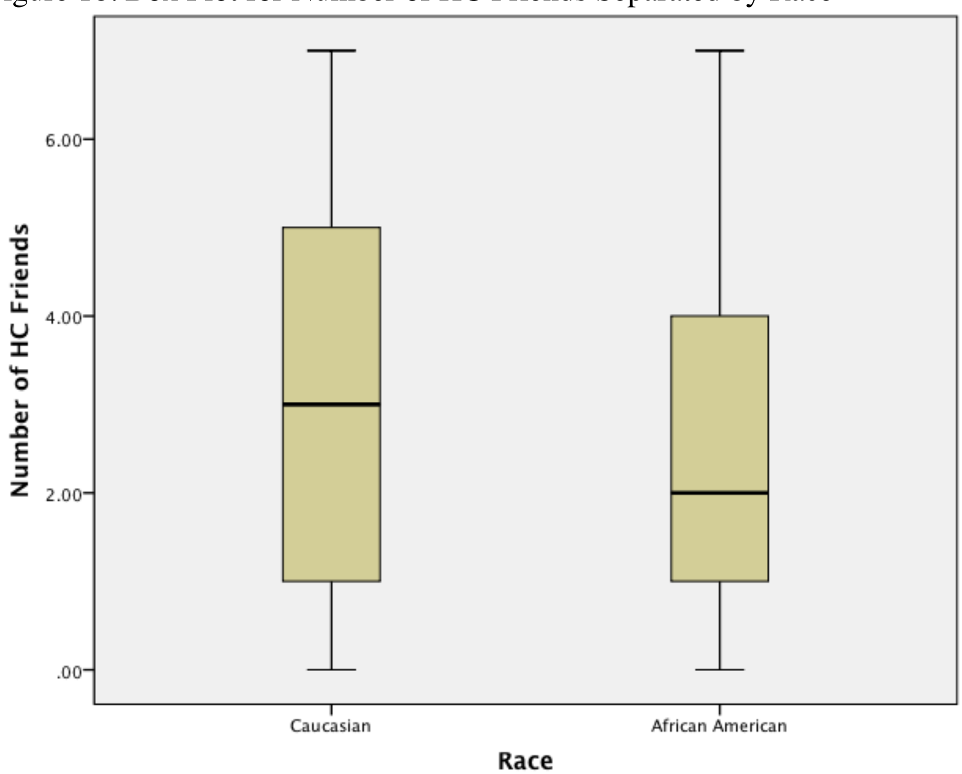


Figure 19. Box Plot for Number of HC Family Separated by Race

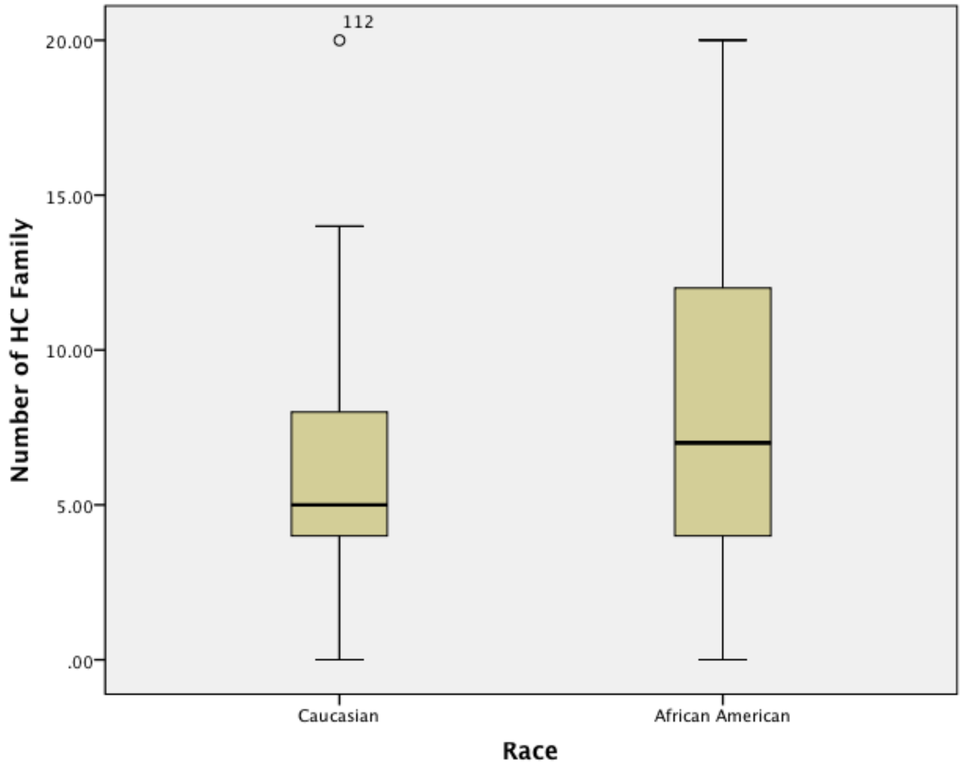


Figure 20. Box Plot for Number of HC Neighbors Separated by Race

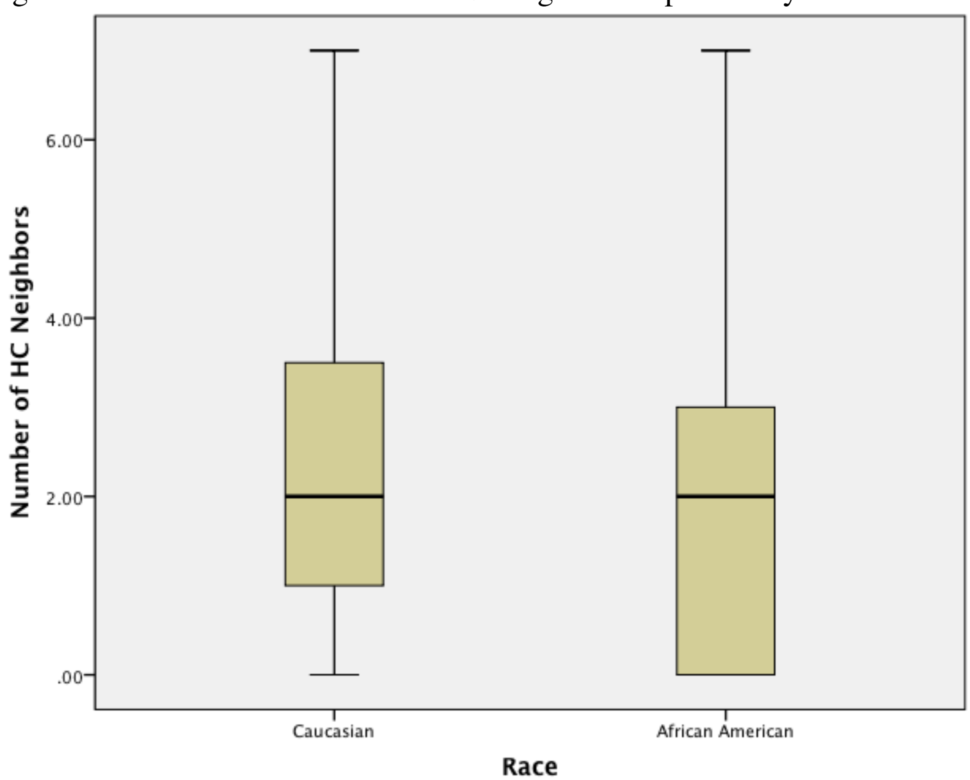


Figure 21. Box Plot for Number of HC Religious Separated by Race

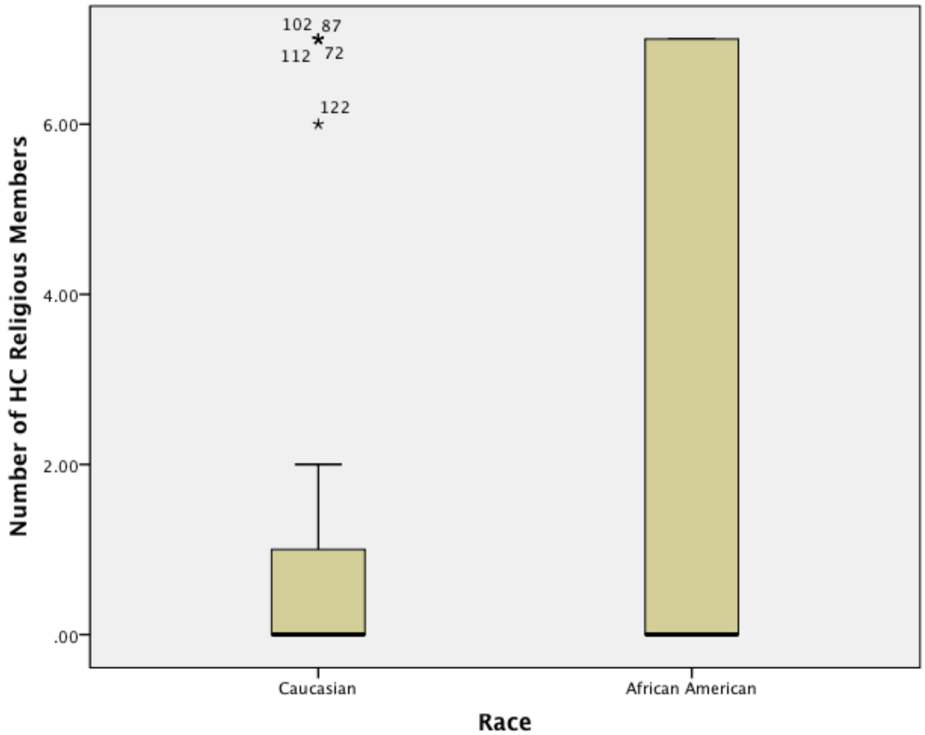


Figure 22. Box Plot for Number of Embedded Networks separated by Race

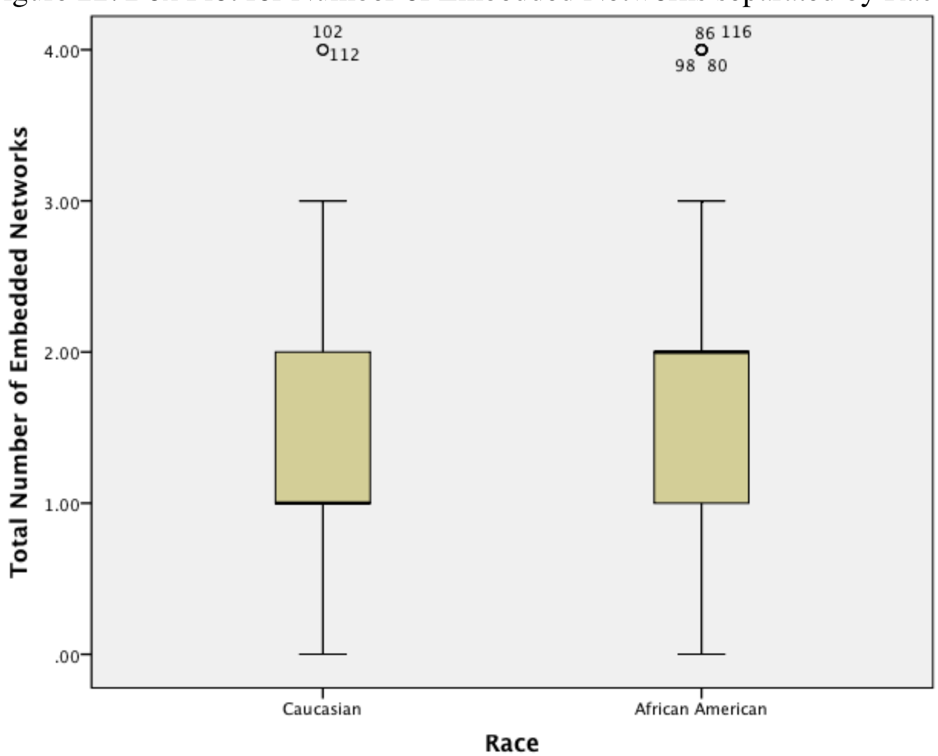
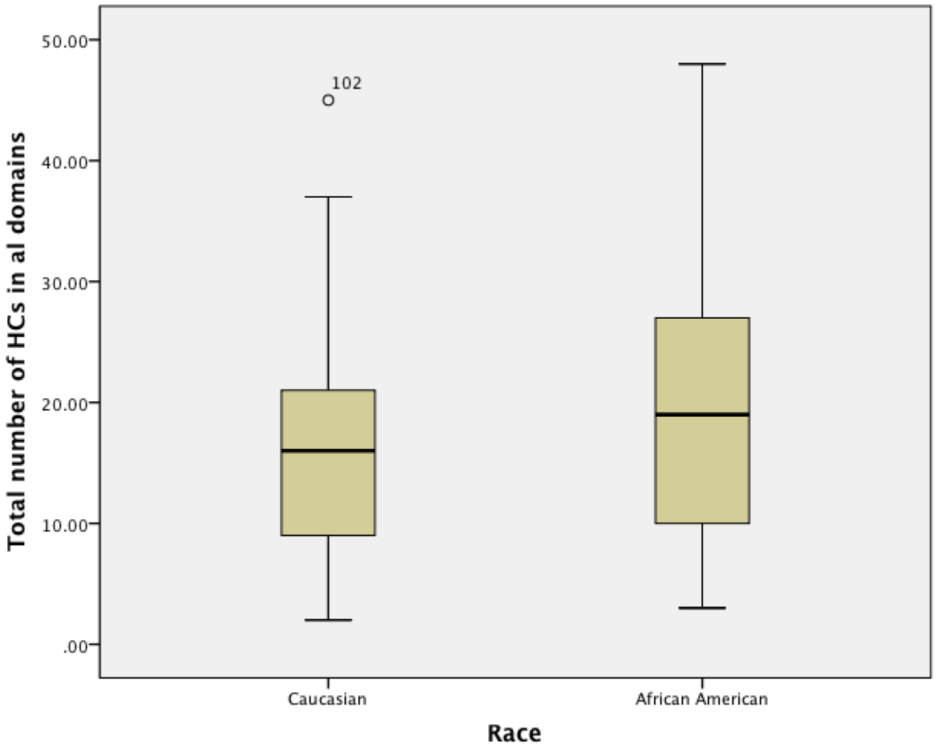


Figure 23. Box Plot for Total Number of HCs separated by Race



In addition, the correlations between dependent variables are presented in Table 46. These correlations will be further considered in the discussion section with respect to understanding differences in outcomes for each of the dependent measures. The correlations in Table 46 represent 6MWT and KCCQ scores from the three-month follow up while the hospitalizations cover two years of long-term follow-up. It can be seen from Table 46 that while 6MWT and KCCQ scales (except for Quality of Life scale) are significantly associated with hospitalizations, the associations are small to moderate at best therefore they might better be considered as separate outcomes rather than a uniform marker of heart failure outcomes.

Table 46. Correlation Table for Dependent Variables

Correlations Between Dependent Variables						
	6MWT	KCCQTS	KCCQQoL	KCCQCS	KCCQOS	HF/Death
6MWAT		.295**	.001	.277**	.158	-.307**
KCCQTS			.538**	.897**	.818**	-.182*
KCCQQoL				.598**	.822**	-.093
KCCQCS					.914**	-.212*
KCCQOS						-.190*
HF/death						

Note. *p < .05. **p<.01. ***p < .001.

Summary Table of Results

For a summary of results for all the main analyses refer to tables 46-48. These tables outline the results for each hypothesis organized by independent variable and further by the outcome variables.

Table 47. Summary of Results for Aim 1 Hypothesis 1

Summary of Results For Aim 1		
Hypothesis	*Independent Variable*	*Results*
Hypothesis 1 Larger social network, increased network diversity, and greater perceived social support will be related to decreased symptoms, functional status, and hospitalizations.	Total Network Size	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS
	Number HC Friends	6MWT: significant; KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS
	Number HC Family	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS
	Number HC Neighbors	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS
	Number HC Religious	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS: NS; HF Hospitalizations/death: marginal (p=.058)
	Number of Embedded Networks	6MWT Significant; KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS
	Total Social Support	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS: Significant; HF Hospitalizations/ death: NS
	Appraisal Support	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS: Significant; HF Hospitalizations/death: marginal (p=.054)
	Belonging Support	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS: Significant; HF Hospitalizations/ death: NS
	Tangible Support	6MWT NS; KCCQTS, KCCQQoL, KCCQCS, KCCQOS: Significant; HF Hospitalizations/ death NS

Note 6MWT = Six Minute Walk Test; KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary; HF = Heart Failure

Table 48. Summary of Results for Aim 2 Hypotheses 2a, 2b, 2c, and 2d

Summary of Results for Aim 2		
Hypothesis	*Independent Variable/Hypothesis*	*Results*
Hypothesis 2a AAs will report decreased tangible, belonging, and appraisal support compared to Cs in patients with heart failure	Race	Total Support, Appraisal Support, Belonging Support, Tangible Support: NS
Hypothesis 2b AAs compared to Cs will report smaller network size (of overall) and increased network diversity (number of embedded networks)	Race	Overall Network Size, Number of Embedded Networks: NS
Hypothesis 2c Within each church/temple, friend, and neighbor embedded networks AAs will report more high contacts than Cs and fewer high contacts than Cs in the family embedded network	Race	Number HC Friends, Number HC Neighbors: NS; Number HC Family: marginal (p=.059) Number HC Religious: significant
Hypothesis 2d The relationships above will persist independently of participants' level of depression	Hypothesis 2a	No Change
	Hypothesis 2b	No Change
	Hypothesis 2c	Number HC Friends changed to marginal (p=.08) Number HC Family marginal no change (p=.058) Number HC Neighbors NS no change; Number HC Religious significant no change

Note 6MWT = Six Minute Walk Test; KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary; HF = Heart Failure

Table 49. Summary of Results for Aim 3 Hypotheses 3a, 3b, 3c, and 3d

Summary of Results for Aim 3		
Hypothesis	*Independent Variable/Hypothesis*	*Results*
Hypothesis 3a Increased tangible, belonging, and appraisal support will predict better health outcomes among Cs compared to AAs	Total Support	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS: Main effect of social support only; HF Hospitalizations/ death: NS
	Appraisal Support	6MWT significant interaction and main effect of support only; KCCQTS, KCCQQoL, KCCQCS, KCCQOS: Main effect of social support only; HF Hospitalizations/ death NS
	Belonging Support	6MWT, KCCQTS, KCCQCS, KCCQOS: NS; KCCQQoL marginal main effect; HF Hospitalizations/ death NS
	Tangible Support	KCCQTS, KCCQCS: interaction and main effect of race; KCCQOS interaction only; 6MWT, KCCQQoL, HF Hospitalizations/ death: NS;
Hypothesis 3b Size of the social support network will more strongly predict heart failure outcomes for Cs compared to AAs. Diversity of network will more strongly predict outcomes for AAs compared to Cs	Total Network Size	KCCQTS, KCCQQoL, KCCQCS: interaction only; 6MWT, KCCQOS, HF Hospitalizations/ death: NS
	Number of embedded Networks	6MWT Main effect of embedded networks only; KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS
Hypothesis 3c Increased size of the embedded network family will more strongly predict better outcomes in Cs compared to AAs. Increased size of social network groups of church/temple, friends, and neighbors will	Number HC Friends	6MWT interaction and main effect for HC Friends; KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS
	Number HC Family	KCCQTS, KCCQQoL, KCCQCS, KCCQOS: interaction only; 6MWT, HF Hospitalizations/ death NS
	Number HC Neighbors	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS
	Number HC Religious	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: NS

more strongly predict better outcomes for AAs compared to Cs		
Hypothesis 3d The relationships above will persist independently of participants' level of depression	*Hypothesis 3a*	
	Total Support	KCCQTS, KCCQQoL, KCCQCS, KCCQOS: No longer a main effect of social support; 6MWT, HF Hospitalizations/ death No change
	Appraisal Support	KCCQQoL: No longer a main effect of social support; 6MWT, KCCQTS, KCCQCS, KCCQOS, HF Hospitalizations/ death: No change
	Belonging Support	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: No change
	Tangible Support	KCCQTS, KCCQCS: no longer an interaction or main effect of race; KCCQOS: no longer an interaction; 6MWT, KCCQQoL, HF Hospitalizations/ death No change
	Hypothesis 3b	
	Total Network Size	KCCQTS: no longer an interaction and now a main effect of size KCCQQoL, KCCQCS: no longer interaction; 6MWT, KCCQOS, HF Hospitalizations/ death: No change
	Number of embedded Networks	6MWT Changed to significant interaction with original main effect of number of networks; KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: No change
	Hypothesis 3c	
	Number HC Friends	6MWT interaction and main effect for HC Friends; KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: No change
	Number HC Family	KCCQTS, KCCQQoL, KCCQCS, KCCQOS: no longer an interaction; 6MWT, HF Hospitalizations/ death No change
	Number HC Neighbors	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: No change
	Number HC Religious	6MWT, KCCQTS, KCCQQoL, KCCQCS, KCCQOS, HF Hospitalizations/ death: No change

Note 6MWT = Six Minute Walk Test; KCCQTS=KCCQ Total Symptoms, KCCQQoL = KCCQ Quality of Life, KCCQCS = KCCQ Clinical Summary, KCCQOS = KCCQ Overall Summary; HF = Heart Failure

CHAPTER 4: Discussion

Overview

The current study examined the prospective relationships of functional and structural social support to self-report and objective measurements of chronic heart failure and to endpoints such as hospitalizations and death. These relationships were investigated in African Americans and Caucasians. First, the findings of this study are described. The discussion is organized by hypotheses and addresses the following topics: the effects of Structural and Functional Social Support, analyses regarding social support and race, and analyses exploring how depression relates to these variables. We will then discuss possible mechanisms by which social support may impact health status and explain the results. Next, we discuss the implications of this research, the limitations and strengths of this study, and future directions based on this study. Possible mechanisms of action that may explain the relationships are also described throughout the discussion where applicable.

Hypothesis 1: Structural and Functional Social Support Predicting Outcomes

Functional Social Support

Hypothesis 1 examined the prospective relationships among Structural and Functional Social Support in relation to outcome measures. This hypothesis proposed that more social support (e.g., larger social network, increased network diversity, and greater perceived social support) would be related to decreased symptoms, increased functional status, and fewer hospitalizations, and was partially supported by the study results (see table 46). The overall pattern of results indicates that in this sample, components of

Functional Social Support are more often related to outcome measures (KCCQ and 6MWT) than are components of Structural Social Support. Consistent with prior literature, each index of Functional Social Support (Total, Appraisal, Belonging) was related to the KCCQ subscales and to the 6MWT, except for Tangible Support, which was only related to each KCCQ subscale and not the 6MWT (e.g., 11). As each of the indices of Social Support increased, so did the scores on KCCQ and 6MWT, indicating as hypothesized, that in this sample, higher social support was related to better outcomes. The current sample had just lower than average levels of total social support when considering social support levels measured by the ISEL and presented in prior literature (e.g. 106).

Appraisal Support in particular appeared to be very robust as a predictor of outcomes in the current study. Although all indices of Functional Social Support were related to outcomes, Appraisal Support had main effects of social support that were more robust than the other indices of Social Support when the interaction terms were added to each model. This is in accordance with a prior study using the present sample but conducting cross sectional analyses at baseline (11). The provision of information (Appraisal Support) may influence individuals' decision-making process by providing alternative opinions, consequences to behaviors, or social norms for comparison (25). Appraisal Support in particular tends to come from a variety of sources including professionals and medical providers meaning that it may be more available and the information may be reinforced, increasing the ability of this type of support in predicting health outcomes (25). The relationship between Appraisal Support and KCCQ is further explained in that the KCCQ contains items pertaining to patients' perception of their own knowledge about heart failure and managing symptoms (e.g., *Heart failure symptoms can worsen for a number of reasons. How sure are you that you know what to do, or whom to call, if your heart failure gets worse?*). Each of the Functional Support indices (Appraisal, Belonging, Tangible) may act on an individual as a buffer reducing stress or distress in a situation (24), which might play a role in the perception of symptoms or even the perception of or attitude toward physical activity (6MWT).

It is important to consider the results in terms of possible clinical versus statistical significance. Clinically significant change on the KCCQ is considered to be a 5-11 point change in scores on a scale (41, 104). Looking more closely at the present results reveals that many of the changes in KCCQ scores are in the range of 1-2.5 point changes for every one-point change on the social support scales. In the present sample, the range of scores on each social support subscale was 5-16 points, indicating that the relationships reported in this study may in fact reflect clinically significant associations between social support and KCCQ outcomes. There were small to medium effects sizes for 6MWT in this study, amounting to a range for most results between 16 to 70 feet differences for every one-point difference on the social support scales. Clinically significant differences on this measure are generally considered to be about 90 feet (107). Thus, it is reasonable to infer that the associations of social support with walk test performance likely were clinically significant. Regardless of these numerical estimates, we might consider that for the ability to walk without impairment, even the ability to walk to and from the front door or different rooms of the home might make an important impact on an individual's ability to function and perform daily activities, so while the findings might not represent huge differences in distance walked, the differences may be important to individuals.

Structural Social Support

In contrast to the findings regarding Functional Support, Structural Social Support was related to objective functional status (6MWT) only, and only in two instances: Number of High Contact Friends and Network Diversity. Both of these results were significant in the hypothesized direction, lending some support to the notion suggested in prior literature that examining individual components of one's social network may better inform our understanding of how social networks relate to health outcomes. However, given the small number of significant results in regards to Structural Social Support, these results should be interpreted with caution. In sum, the present results lend support to the idea presented in prior literature that Functional Social Support may be a more important predictor of heart failure health outcomes rather than simply a count of who is available to provide support (83). This conclusion makes intuitive sense as well because regardless of who is available in the network that may provide support, the individual's perception of available resources and willingness to engage with those resources is necessary to actually receive the support.

If Structural Support is viewed as the presence of possible sources for social support (Network), and Functional Support is the actual social support the individual reports being available to them (perceived Appraisal, Belonging, Tangible Support) then it would be expected that outcomes would be influenced more by the perceived support rather than having available possible sources of social support (22, 23, 24, 25, 83), as is described in prior literature. The quality of a relationship (the context of the social support) may impact how social support acts as a buffer or a stressor of its own by possibly generally increasing distress or having less of an impact on reducing distress

(24, 69, 74). Therefore, regarding Structural Support, even if there are individuals available in the social network, the quality of those relationships may be such that they are not supportive. This may also help explain why Functional rather than Structural Support is more consistently related to outcomes in this study. Unfortunately, however, there were no measures examining relationship quality in this study. Therefore we were not able to investigate this hypothesized mechanism, which may be an important area for future research.

Heart Failure Hospitalizations and Death

None of the social support measures, whether Functional or Structural, were related to the HF hospitalization or death outcome measure, with exception of Appraisal Support, which was marginally related to hospitalizations (see Table 46). Although this relationship with heart failure hospitalizations and death should be viewed cautiously due to many comparisons in the study, it is consistent with prior literature in that decreased overall social support has been found to be related to increased hospitalizations (10, 63, 97). However, Tangible Support has been found to be related to hospitalizations in prior literature rather than appraisal support, making this one marginal effect found in the current study inconsistent with prior literature (47). However, most of the findings in the current study do not indicate that social support is related to hospitalizations, a set of findings not consistent with prior literature (10, 63). It seems more plausible that statistically, there may not have been enough power to find significant results for these analyses, even after combining separate risk factors into a single risk score. A priori power analyses indicated a sample size of at least 140 participants was needed for power of 80%, and our sample had 146 participants with 131 included in the analyses examining

HF hospitalizations and death due to some missing data. In addition, in order to check this concern about power, analyses were rerun removing covariates one at a time to ascertain whether it was a matter of power. The results remained nonsignificant even with these modifications, suggesting that while the original analyses may have not have been fully powered there also may not be a significant relationship between social support and HF hospitalizations or death.

The current study also examined hospitalizations as a dichotomous variable rather than using the number of hospitalizations in analyses. As shown in Tables 3 and 5, 49.1% of Caucasians and 36.9% of African Americans reported heart failure hospitalizations or death in the current sample. This study looked specifically at whether patients reported being hospitalized or died over the course of two years and did not ask about how many hospitalizations occurred over that time frame, although this is an important topic for a future study. It may be that there are differences between individuals who report different numbers of hospitalizations over the course of the two-year follow up. In order to check whether individuals who reported their first hospitalization later on in the follow up period differed in terms of social support from those who reported their first hospitalization earlier on in the study, and whether that might account for the lack of findings in the original analyses, all hospitalization analyses were rerun including the additional covariate of time (in months) until first reported hospitalization or death. The above model with time until first hospitalization or death included did not provide any changes in the results.

To explore the possibility that measures of support might account for cardiovascular hospitalizations that include heart failure, but also involve broader cardiovascular causes such as myocardial infarction, coronary angioplasty, etc., all hospitalization analyses were run using cardiovascular hospitalizations. Again, there was no evidence that using this broader cardiovascular hospitalization category changed the pattern of results, and these analyses remained nonsignificant.

Prior literature has also reported increased hospitalizations for women reporting low social support and loneliness, and also for individuals who are older (47). The current sample consisted of mostly men, and was a younger cohort (average age Caucasians = 63.5; African Americans = 57.5) than those reported in the literature and these differences could explain why our findings do not match the literature. There are many other factors that may impact hospitalizations as well, such as access to insurance, and norm based decision making about hospitalizations. For instance our sample is predominantly African American and these individuals may be less likely to seek out medical care (65).

In addition, the predictive relationship of social support to 6MWT and KCCQ, but not to hospitalization might be explained by different mechanisms underlying links between social support and these outcomes. As shown in Table 46, there was a significant negative correlation between hospitalizations and other outcomes and the correlations with hospitalizations were small to moderately sized. This again indicates that hospitalizations should be considered a separate outcome rather than a marker combined with KCCQ and 6MWT. KCCQ, 6MWT, and social support may be related more in terms of perception in that the perception of social support may influence attitude or response to distress and stress (e.g. symptoms) (24, 69, 74) whereas hospitalizations may have more physiological mechanisms underlying them, which were not examined in the current study The possibility of different mechanisms for these 3 dependent variables is supported by the results in Table 46, indicating a moderate correlation at best among KCCQ, 6MWT, and hospitalizations, with a significant negative correlation between hospitalizations and the symptom and functional status outcomes.

While the models examining hospitalizations were not significant, the direction of findings surprisingly indicated that hospitalizations increased with higher social support. The explanation here may be that those with increased social support are receiving better care by being admitted to the hospital more often. The negative correlation between outcomes also indicates that as individuals are hospitalized, they are actually experiencing fewer symptoms and/or better functional status, perhaps due to the increased, more thorough, or better care they are receiving during hospitalizations. While in general we may think of hospitalizations as a negative outcome resulting from feeling more poorly, we may also consider them a positive outcome at times and an indicator of increased care being received. This may be especially important and considered positive in the current sample given that it is a predominantly African American sample, a population who may not seek or receive care as often as others (65).

Hypotheses 2a, 2b, and 2c: Comparing Social Support Indices Across Race

Hypotheses 2a, 2b, and 2c compared African Americans and Caucasians on measures of Structural and Functional Social Support and proposed that African Americans would report decreased Tangible, Belonging, and Appraisal Support, smaller Networks Size, increased Network Diversity, more High Contacts in their Religious, Friend, and Neighbors Embedded Networks, and fewer High Contacts in their Family Embedded Network compared to Caucasians. Examining the differences in social support between Caucasians and African Americas, the results for the most part did not support these hypotheses (see table 47). In our sample, differences were found in the Embedded Network of Religious Group only, although there was also a trend for the Embedded Network of Family as well. For both of the above findings, African Americans reported more high contact members than did Caucasians. While this result was as hypothesized for the Number of Religious Contacts, for Family Members, this was opposite to the hypothesized direction, with African Americans having both larger family and more members in their Religious Network. Prior research had found differences in the Size and Diversity of social networks, with Caucasians reporting larger Network Size, and African Americans more diverse networks, as well as differences in Functional Social Support between African Americans and Caucasians that vary across studies and are described in detail in the introduction of this dissertation (52, 61, 73, 81, 94), but these findings were not replicated in the current study.

The WHO Model

As described earlier in this dissertation, the WHO's social determinants of health model takes into consideration the environment and individuals' roles within that environment, including who individuals may expect to receive and receive social support from (96). Consistent with this model and as demonstrated in prior literature, it was believed that African Americans would report smaller numbers in their family networks was because they may have smaller nuclear families and larger extended families (20, 52, 61, 73, 81, 94, 96). However, the High Contact Family Member item included grandparents as part of the family, which may have influenced these findings away from the hypothesized direction but still support the idea that individuals had more contact with extended family due to the inclusion of relatives often considered extended family (e.g., grandparents).

Considering that race was used in this study as a proxy for culture, and the social support measures in this study were created based on mainstream cultural values, the utility of these measures in terms of accurately categorizing types of support across cultures may be questionable. However, both the ISEL and the SNI are commonly used in study samples comprised of a variety of cultures including African Americans (e.g., 27, 98). As discussed in earlier sections of this dissertation, the ISEL has been validated for use in samples of African Americans (27, 68, 71, 98). However, studies developing and validating the SNI do not explicitly describe the composition of their samples nor do they appear they have been validated specifically with African American populations, although they are commonly used with other cultures (27, 68, 71, 98). In this regard, there may be facets of the social environment (96) that add important components to the measure of social support across cultural groups that are not recorded by these measures. While not explicitly discussed in the literature in regard to the ISEL and SNI, these measures may not be accurately assessing the full spectrum of social support in these cultures, and the present findings may not therefore be based on differences or similarities of actual social support among these groups. If this is true and the measures are not fully appropriate for this sample, this might explain the lack of findings in the current study.

In addition, SES may play a large role in the results of this study. SES is thought to be associated with health outcomes and may be important in explaining differences in health outcomes in different racial groups (36, 65, 87). The current sample had a small range of income with most reporting a household income of under $30,000. It may be that many of these individual are living under the poverty threshold for their family size or within near poverty and this may account for the lack of findings across the two racial groups.

Hypotheses 3a, 3b, and 3c: Social Support indices, Race, and Outcome Variables

Hypotheses 3a, 3b, and 3c examined interactions between race and social support in relation to outcome measures. It was proposed that race would moderate the relationship between social support and outcomes (see table 48). In terms of race moderating relationships between social support and outcome measures the results varied for different social support and outcome measures. Hypothesis 3a was not supported by these findings. However, hypotheses 3b and 3c were partially supported. The details of each of the findings will be discussed in greater detail below, but, in general, in relation to KCCQ outcomes a moderating effect of race was observed most often for Tangible Support, the number of High Contact Family Members and the Total Network. A moderating effect of race was observed less often for measures of social support other than Tangible Support and the number of High Contact Family Members, and for the 6MWT outcome variable. Results did not support hypotheses 3a, 3b, or 3c for the outcome variable of heart failure hospitalizations and death. As was the case with hypothesis 1, of Functional Support, the Total Social Support and Appraisal Support measures demonstrated main effects on most outcome measures, including KCCQ and 6MWT. However the expected interactions were not observed, thereby not supporting the hypotheses, but indicating this main effect to be fairly robust. In addition, the main effects observed between Belonging Support and KCCQ and 6MWT outcomes were attenuated with the addition of the race terms such that there were no longer significant effects of Belonging Support except for a marginal effect regarding KCCQQoL.

Functional Social Support

The findings for Tangible Support and KCCQ scores are opposite to what was predicted by Hypothesis 3a. The Tangible Social Support measure appears to have more positive effects for African Americans but not for Caucasians. As Tangible Support increased for African Americans, KCCQ scores (KCCQTS, KCCQCS, KCCQOS) increased as well. For Caucasians on the other hand, as Tangible Support increased, KCCQ scores (KCCQTS, KCCQCS, KCCQOS) decreased non-significantly. Therefore it seems that African Americans who report receiving Tangible Support from others also perceive themselves as experiencing fewer symptoms. However Tangible Support does not have a similar effect on Caucasians' perceptions of symptoms. Social support can act on health outcomes by putting individuals in positions where they are more able to take advantage of a variety of resources including attending medical appointments (24, 25). The explanation for the current findings may be that Tangible Support is more critical for individuals at a lower socioeconomic standing who have less access to resources and therefore may benefit more from the provision of resources (e.g., rides to medical appointments, financial support) than those who are more well off (1). In prior literature it has been shown that African Americans report higher incidence of heart failure (31), as well as higher levels of symptoms (7, 19, 67) as was found in the current study.

Structural Social Support

In contrast, results obtained for Total Network size (Hypothesis 3b) and High Contact Family Members (Hypothesis 3c) are in line with the hypothesized relationships, in that Caucasians who reported higher numbers of contacts in their social network and in their family also reported fewer symptoms. African Americans reported higher numbers of contacts in their Social Network and Family and increased symptoms. Hypothesis 3c also predicted that the number of High Contact Friends would be related to better outcomes for African Americans compared to Caucasians but the present results do not support this hypothesis. Specifically, Caucasians who reported more High Contacts Friends had better functional status on the 6MWT. For African Americans, functional status also increased as the number of High Contact Friends increased, but the number of High Contact Friends did not predict further distance walked on the 6MWT. Finally, Hypothesis 3b that diversity of the network would more strongly predict outcomes for African Americans compared to Caucasians was not supported.

Prior research indicates that Caucasians may have larger overall social networks, while African Americans may have more diverse social networks, and these larger networks may effect health outcomes (91). Some studies also indicate differential importance of these social supports for African Americans' and Caucasians' health outcomes such that they are less important for African Americans (44, 91). However, our results for Total Network Size and Network Diversity (Hypothesis 3b) were only partially supported as described above, indicating that as in prior research, the importance of the structure of a social network for Caucasians may be the Network Size (91). Our hypothesis that Network Diversity would be more important for African Americans compared to Caucasians was not supported. Some prior research indicates that Social Network might have minimal impact on health outcomes for African Americans, however, which is similar to our findings (44, 91).

It is unclear why the aspects of social network described above may have such different effects on the health outcomes of African Americans and Caucasians. It may be that relationship quality has some impact on whether the structure of the network would in fact provide some support or buffer to the disease outcomes (24, 74, 69), which could have impacted our findings in that the network structure appeared less important for African Americans. Specifically, prior research indicates that higher interpersonal functioning may be protective and that minority individuals may demonstrate higher interpersonal functioning (69, 74). That is, the stress of relationships may act to worsen either the experience or perception of symptoms or difficulties in functioning while if relationships are more positive they may provide protection against the experience or perception of symptoms or difficulties in functioning, regardless of the structure of the social network.

Hypotheses 2d and 2c: Depression Effects

Hypotheses 2d and 3d predicted that the relationships examined in this study would remain unchanged with the addition of depression as a covariate in the analyses (see Tables 47 and 48). These hypotheses were partially supported in that the results changed in some, but not other analyses with the addition of depression as a covariate. For most hypotheses examining race and social support interactions, the interactions were no longer significant with the addition of depression as a covariate. However, main effects of social support remained as before. This raises the possibility that the effects of social support on KCCQ, 6MWT, and heart failure hospitalizations or death may be mediated by depression.

As described in earlier sections of this dissertation, the current study was designed to examine social support in relation to race and outcomes. However due to the high rates of depression in cardiovascular patients, and the importance of and possible overlap of depression with social support in the literature (50, 78) confirming whether the current results could stand alone regardless of depression levels appeared to be important. The results of the current study indicate that depression does in fact attenuate the relationships between social support, race, and the outcomes examined in this study. However, depression was not a significant predictor in all analyses, so depression cannot fully mediate these relationships. The mechanism explaining this finding may be the social withdrawal commonly associated with depression accounting for some of the impact the size and diversity of the social network may have on health outcomes, which makes sense given prior literature that asserts that those in psychological distress may report fewer social contacts over time compared to those who do not report psychological distress (42).

POSSIBLE MECHANISMS

The results of this study indicate that functional social support is related to several heart failure outcomes involving symptom report and functional status. However, Structural Social Support is less important to outcomes except for family and religious groups. The relationship between social support and outcomes is moderated by race in that some social support indices (e.g., Tangible Support) are related to better outcomes for African Americans than Caucasians and others (e.g., Number of Family Members) are related to better outcomes for Caucasians than African Americans. There are several possible mechanisms linking social support to heart failure outcomes in the literature and described previously in this discussion. There are psychological, behavioral, and physiological mechanisms that may link social support to heart failure (1, 24, 25, 69, 74). For instance, the provision of Tangible Social support may impact patients' behavior in that they are more able to attend medical appointments, retrieve medication, or buy healthier foods (1, 24, 25). It also may be that social support works through psychological mechanisms such as knowledge about heart failure, or attitudes about appropriate responses and behavior (24, 25). Lastly, prior research suggests that there is a link between social support and stress, which in turn may influence several physiological processes including inflammation, a major contributor to cardiovascular diseases such as heart failure (24, 69, 74). The current results support both psychological and behavioral mechanisms, although we did not measure physiological responses in this study and therefore cannot comment on how these may be involved in the findings between social support and health outcomes.

With regards to ethnicity, there are several mechanisms that may be involved in the relationship between social support and heart health outcomes. For instance, in this sample, African Americans reported lower SES and therefore may benefit more from the provision of Tangible Support than those who are better off (1, 24, 25). Also, as described in the introduction to this dissertation, there are physiological differences between African Americans and Caucasians, which may put them at a higher risk, such as a higher sensitivity to salt (38, 49, 58, 64, 75, 76, 87). In addition, African Americans reported more High Contact Religious Members compared to Caucasians, but these differences did not impact heart failure outcomes. For Number of High Contact Family members, the results indicate better outcomes for Caucasians than for African Americans.

Prior literature suggests that Caucasians have a family structure made up of a more traditional grouping of individuals in the immediate family (44, 73, 91, 94). In the present study, this structure is associated with better heart failure outcomes. Literature further indicates that African Americans have a different family structure, which includes more extended family members and does not appear to be related to better heart failure outcomes in this study (44, 73, 91, 94). Thus, the measures of family contacts in this study might not have accurately captured family structure that is most relevant for African Americans.

Alternatively, although this study examined the prospective relationship between social support as a predictor of HF outcomes, it is important to note the possibility that increased symptoms and poorer functional status may also impact social support. For instance, if an individual is experiencing difficulty in walking they may have less interaction with their social network because they are less able to travel to see friends and family. In addition, fewer social contacts due to fatigue impacting the ability to go out and interact with others may lead to lower perceived functional social support.

Clinical and Research Implications and Possible Military Relevance

There are several clinical implications of the current research. First, this study adds to the literature reporting social support as an important factor in predicting disease progression and outcomes for patients with chronic heart failure (e.g., 4, 10, 11, 12, 14, 30, 56, 60, 62, 72, 82, 83, 95). As noted previously, the obtained associations between social support, symptoms, and functional status may indeed be of clinically significant magnitude.

Prior research as well as the results of the current study, indicate it is important for providers to take into consideration patients' social and environmental factors in developing and implementing patients' health care and treatment plans (96). This may be particularly important for the assessment of symptoms and measurement of functional status. Based on the findings of this prospective study, it may be helpful to assess and encourage increases in Functional Social Support for patients in order to lessen perceived symptoms and improve functional status.

Although, this dissertation was not an intervention study, examining the findings in the broader context of such literature is important. Prior intervention research examining interventions focused on social support and depression, studies such as ENRICHD, have found that targeted interventions may improve perceptions of social support and decrease depression slightly, however these improvements have not been found to substantially impact cardiovascular outcomes in participants of these studies (107, 109). Although HF symptoms and functional status are clearly associated with hospitalizations (Table 46), the present study also found that social support was associated with the HF outcomes that were more "psychological" or "behavioral" in nature (i.e., walk test and self-reported symptoms). However, since ENRICHD and other intervention studies (e.g., 107, 109) have not found these interventions to be effective for medical outcomes, it is necessary to be cautious before generalizing the present findings to clinical interventions. However, even if medical outcomes are not affected by psychosocial interventions, reducing depression and improving social support may be important for heart failure patients.

In addition, there were racial differences found in studies examining treatment efficacy such that the interventions seemed to work better for white males than other racial groups or females (108). The current research also directly examines how racial group identification might require different types of support interventions. For instance, the results of the current study suggest that for African Americans increasing the availability of Tangible Functional Social Support and participation in religious embedded networks may be beneficial, while for Caucasian patients, it may be more beneficial to support increases in family contact.

Results of this study also indicate that it may be important for providers to monitor depression levels in patients in conjunction with considering the social supports in their patients' lives. While the current study used the ISEL and SNI to assess social support, other studies have also used just a few simple questions to address whether patients believe they have enough social support or feel supported by their social network (109). Thus, medical providers might be able to screen for social support and depression using briefer scales and questions than the instruments used in the present study.

In addition, this study addresses important issues not examined in prior research including how race might interact with social support to impact health outcomes. Further research is needed however to continue to clarify these relationships. Many of the comparisons completed in the current study that examined race were not significant. It is quite possible that there is no significant relationship to be found comparing individuals identifying with different racial and cultural groups on levels of social support and health outcomes, but that is contrary to prior research (e.g., 6, 9, 71). Instead, as discussed earlier on in this discussion, it may be helpful to more closely examine the appropriateness of measures of social support cross culturally in order to identify whether there are important aspects of these structures which are missed or misplaced using current measures. It also may be important to continue to examine the specific mechanisms by which social support impacts health, including how depression and social support are related, and what role relationship quality plays.

Although the present study may not have direct military relevance, there is indirect military relevance due to the sample being recruited through a VA. In addition, Tricare spending in the Disease Management Program for a sample of 5004 patients requiring intervention for chronic heart failure was about 69 million dollars in 2006 (102), and according to the 2013 Medical Surveillance Monthly Report there were 1,741 hospitalizations of active duty service members with MI as a primary cause between 2004 and 2012 (101). Between 1998 and 2012 there were 1,639 deaths attributed to cardiovascular conditions in active duty service members (101). Last, since heart failure is a progressive disease that worsens and is more prevalent with increased age, retired service members may have increased diagnosis and death for cardiovascular diseases and chronic heart failure.

STUDY STRENGTHS

There were several notable strengths of the current study. First, this was a prospective study and data was analyzed longitudinally. This allowed us to draw conclusions about the predictive ability of independent variables and examine long-term outcomes facing patients with heart failure. We also utilized several outcomes providing rich information on not only self-reported symptoms (KCCQ) but also the more objective functional status measures (6MWT) and hospitalizations and death. Prior research commonly collapses forms of social support into an overall measure and the current study looked at not only the individual indices of the ISEL, but also Social Network Diversity and sources of Social Support which has rarely been done in the past but is suggested in the literature (18, 24). By looking at these individual aspects of social support we were able to provide a more detailed exploration and explanation of the relationships between social support and health outcomes. Several studies have compared Caucasians, African Americans, and other racial groups on their levels of social support and on health outcomes, but few, if any have examined the moderating effect of self-identified racial classification on the relationship between social support and health outcomes (8, 52, 57, 81, 84). Given the importance of looking at the social determinants of health in such chronic diseases as heart failure, the current study provides an important addition to the field by examining social support and social network structure across two different populations (96).

STUDY LIMITATIONS

The current study has several limitations that should be noted. First, the study uses race as a proxy for culture. Previous research commonly uses race as a demographic division and comparison point within samples (e.g., 6, 9, 71, 73, 74, 81, 93) but social support and its documented utility in predicting health outcomes may differ between cultural groups. In this study, there is no way to be sure that individuals who have self identified as Caucasian or African American ascribe to similar sets of values (e.g., 6, 9, 71, 74). For instance, there may be a subculture within the self-identified racial classification that impacts values so they are not consistent across the entire group classified as African American or Caucasian. Unfortunately, the demographic form used in this study included only African American as an option and did not offer alternatives (e.g., Caribbean etc.), thereby limiting the options for specific self-identification. However, as demonstrated by the common use of race as an independent variable in studies looking at similar issues the term appears to be adequate in the current study (6, 9, 61, 64, 75).

In addition, there may be other mechanisms by which social support and race influence health outcomes that were not measured in the current study. For example, relationship quality and level of conflict may have an impact on whether or not, and how social support may affect health outcomes (69, 74). Contentious relationships may detract from social support rather than add positive support. In addition, environmental structures such as accessibility of resources that lead to increased social contacts may influence the size and makeup of a social network (1, 71) and were not examined in the current study. Nor were possible physiological mechanisms such as inflammation. The current study also did not take into account the possibility that patients use electronic media to obtain social support. Electronic media may be a substantial source of social interaction for many adults, including those in our sample age demographic (29), although some studies have shown increased electronic media use to be related to a decline in communication with other sources of support (e.g., 54).

Another limitation of the current study is the use of multiple statistical analyses, which present the risk of findings being due to type I error. Some concerns for type I error are reduced because all analyses were conducted using a Bonferroni correction. However, the Bonferroni correction used in this study corrected for each individual model rather than for all models used in the study as a whole. In addition, the results revealed several overarching patterns as described above, and many of the analyses had multiple significant findings (e.g., main effects and interactions). Last, the a priori power analyses indicated that the study had sufficient power for the analyses used. The use of a dichotomous variable to examine hospitalizations might be considered a limitation, however the question posed by the current dissertation asked only whether or not individuals had been hospitalized or died and not how many times they had been hospitalized so it was appropriate to answer the study questions. Future studies may wish to examine the number of hospitalizations specifically with regard to social support.

CONCLUSION AND FUTURE DIRECTIONS

Chronic heart failure is a leading cause of death in the United States, and outcomes for this progressive disease are related to many physiological and psychological risk factors. Gaining a better understanding of the relationships among these factors and for what specific individuals they may apply may help guide treatment. The current study examined functional and structural social support as well as race in relation to self-reported and objective measurements of disease progression and hospitalizations and death. The results of this study indicate that certain aspects of ones' social support network, especially the overall size and diversity of the social network, and the functions the network provides, such as Appraisal and Tangible Support are related to outcomes, and that these relationships vary across racial groups. Further research is needed to address the limitations identified above in order to further aid providers in implementing the most appropriate and helpful care to individuals struggling with chronic heart failure.

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