Is There a Difference in Weight Over Time In Heart Failure Patients Based on Cognitive Function?

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Cognitive function and weight in HF patients

DEDICATIONS

This dissertation is dedicated to my family and friends without whose support this would not be possible. First to my husband Rob, without whose unfailing support, I could not have finished this monumental educational milestone. I want to dedicate this work to my mother who graduated with a BSN from Vanderbilt University in 1942 and who always supported my academic pursuits, even in grade school. She always said to me, “I know you can do this,” even when I felt overwhelmed. Even now, when I felt I could not go on, I hear her voice encouraging me, “You can do this.” To all my other cheerleaders, especially Iris, Stacey, Shirlene, and Sue, thank you.
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ABSTRACT

Is There a Difference in Weight Over Time In Heart Failure Patients Based on Cognitive Function?

Janet Riggs MSN, RN, DrNP(c)

Background and Objectives: Patients with heart failure (HF) have a high hospital readmission rate within 30 days of discharge due to dyspnea caused by water weight gain. Additionally, 22% of HF patients have cognitive impairment (CI) impacting their ability to engage in self-care activities. There is a paucity of research to measure the impact of cognitive function on change in weight over time.

Design: This was an observational, longitudinal study of adult patients, with Class II-IV HF who were evaluated at time of discharge (T₁) from a hospitalization for acute exacerbation of HF and at a clinic visit (T₂) 4-8 weeks after discharge. The participants completed a 30-point Montreal Cognitive Assessment (MoCA) Inventory tool, and were weighed at T₁ and T₂.

Results: Twenty-one participants (mean age 67.1 ± 12.2, 76.2% male, 81% Caucasian) completed both visits. The MoCA cutoff for mild CI was 24, where 42.9% of this sample scored below 24 at baseline. The change in weight between T₁ and T₂ was not statistically different (M change 0.43, SD 9.64; 95% CI, -4.08 to 4.94; p = .84). The Independent T test of a change in weight in those HF participants with and without CI was not statistically different (high MoCA score, M change in weight = 0.62, SD 11.22; low MOCA scores, M change in weight = 0.20, SD 7.94; t(df 18) = -0.09, p = .93). The re-hospitalization rate was 23.80% (n = 5). No cognitive assessment was documented in the medical record by healthcare professionals at time of hospital admission or at the clinic visit.
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Conclusion: Findings demonstrated there was no statistically significant difference in change in weight over time when participants were divided into low or high scores on the MoCA. The hospital readmission rate for HF was similar to that reported in other studies. This study found that assessments of cognitive function in HF are not being documented in the medical record. This study lays the groundwork for a larger study of the impact of CI on change in weight over time.

Key Words: cognitive impairment, heart failure, daily weights
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Chapter 1: Introduction and Overview

Introduction

Heart failure (HF) is a progressively deteriorating syndrome in which the pumping action of the heart is unable to deliver sufficient blood to the cells of the body to meet their needs for oxygen metabolism (Maliakkal & Sun, 2014; Yancy et al., 2013) leading to exercise intolerance (Parrinello, Torres, Paterna, di Pasquale, Licata, 2008). HF is further characterized by fluid retention, fatigue, and difficulty breathing which interfere with a person’s ability to carry on their usual activities of daily living (Aliti, Ragelo, Clausell, Rohde, Biolo, & Beck-da-Silva, 2013; Jessup et al., 2009; Linhares, Aliti, Castro, & Rabelo, 2010; Parrinello et al., 2008). Fluid accumulation and overload are the main causes of cardiac decompensation, pulmonary congestion, and hospitalization (Desai & Stevenson, 2012; Parrinello et al., 2008).

HF is increasing in incidence every decade due to improved survival of the chronic condition itself, and also advances in treatment of contributing conditions (e.g. myocardial infarctions, abnormal cardiac valve function, and hypertension) (Heidenreich et al., 2013; Herr et al., 2014). Untreated or under treated hypertension is responsible for most cases of diastolic HF (HFpEF), while injury to the left ventricle is responsible for most cases of systolic HF (HFrEF) (Gheorghiade, Vaduganathan, Fonarow, & Bonow, 2013; Yancy et al., 2013). The significance of this improved survival is there will be an increase in adults with HF over the next two decades who will require frequent hospitalizations and close follow-up in the home environment (Shah, Rahim, & Boxer, 2013).
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One reason for this increase in hospital admissions, apart from the sheer increase in numbers of people living with HF, is the complex nature of the treatment (Gheorghiade, Shah, et al., 2013; Linhares et al., 2010; Shah et al., 2013). It is difficult for patients to manage the multiple therapies required to treat HF resulting in missed medications, drinking too much fluid, and failing to monitor their weight on a daily basis (Lee et al., 2013; Linhares et al., 2010). Failure to adhere to these therapy regimens results in worsening function of the heart muscle, leading to an increase in hospital re-admissions and mortality (Desai & Stevenson, 2012; Linhares et al., 2010; Mockler, et al., 2009; Parrinello et al., 2008; Shah, et al., 2013).

Management of HF is multifactorial and complex. One of the cornerstones of therapy is to attempt to manage the intricate relationship between excess sodium and fluid intake by patients (d'Almeida, et al., 2014). In HF, the renin-angiotensin-aldosterone system (RAAS), along with other neurohormones, is activated and stimulates the thirst center (Allida, et al., 2014; Lee and Tkacs, 2008; Waldreus, van der Wal, Hahn, van Veldhuisen, and Jaarsma, 2014). Activation of the RAAS causes the body to retain sodium which results in water retention (Bock and Gottlieb, 2010; Palazzuoli, et al., 2014) and can lead to pulmonary congestion (Kemp and Conte, 2012). Additionally, it has been recently shown that increased salt intake was correlated with elevated high-sensitivity C-reactive protein (Hs-CRP) levels, suggesting that salt may also contribute to inflammatory damage in HF (Azak, et al., 2014).

The thirst precipitated by these neurohormonal changes is persistent and debilitating, making it almost impossible to find relief of this symptom using non-pharmacological therapies such as synthetic saliva (Allida, et al., 2014; Waldreus, et al.,
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2014). As a result, HF patients may not be able to follow a fluid restriction prescribed by their cardiologist leading to excessive water consumption, (Desai & Stevenson, 2012; Linhares et al., 2010; Parrinello et al., 2008; Shah, et al., 2013). The best way to follow this fluid accumulation is to weigh oneself daily (Linhares et al., 2010; Parrinello et al., 2008), since there is a direct relationship between amount of fluid consumed in volume and the weight of that fluid (Miller and Mullan, 2014). The goal for the patient is to maintain their same weight from day to day.

Adherence to HF regimens is problematic. The average adherence rate to HF therapies is reported to be 50% (Bissonette, 2008; Linhares et al., 2010; Perreault, et al., 2009; Shah, et al., 2013; Wu, Moser, Lennie, & Burkhart, 2008). One study found that 28.9% of participants did not adhere to medication regimens due to having HF as a new diagnosis, older age, multiple comorbidities and medications, and lack of sleep (Knafl & Riegel, 2014). Further, recent evidence demonstrates brain injury in HF patients in the areas of the brain responsible for memory, organization, planning, and problem solving (Woo, Kumar, Macey, Fonarow, & Harper, 2009). This new evidence may provide a possible explanation for some of the adherence issues in HF patients, including failure to weigh oneself on a daily basis. If a patient cannot organize the multiple tasks required to take care of themselves, if they cannot plan to weigh themselves every morning, if they cannot remember that they need to do that or have done that, then it will be difficult for patients to weigh themselves on a daily basis, or even figure out what to do with the information once they have weighed themselves. For a treatment plan to be successful, the patients must have the cognitive skills to comprehend the plan, agree to and be involved in the plan of care and rigorously adhere to the plan of care rigorously (Woo et
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al., 2009). Therefore, the purpose of this study is to examine whether weight changes differed based on the presence or absence of cognitive impairment in HF participants who were followed in the clinic one to two months after discharge from the hospital after an exacerbation of HF.

**Background**

HF greatly impacts the U.S. health care system. Current estimates are that 5.7 million Americans older than 20 years of age have HF (Mozaffarian, et al., 2015). Each year, there are 825,000 new HF cases (Loehr, Rosamond, Chang, Folsom, & Chambless, 2008) and by 2030 it is estimated that eight million Americans will have HF (Heidenreich et al., 2013). Hospitalization rates for HF are reported at 180 to 190 hospitalizations per 10,000 people for the years 2007 to 2010 (National Heart Lung & Blood Institute [NHLBI], 2012). Recent estimates place the direct and indirect cost of HF in the US to range from $29 billion (de Lissovoy et al., 2010; Gheorghiade, Vaduganathan, et al., 2013) to $33.7 billion dollars annually (Reed et al., 2010) with an average cost of $19,021 for each HF hospitalization (de Lissovoy et al., 2010). The increase in numbers of people with HF by 2030 will result in an increase in direct and indirect costs in the U.S. of $53 billion (Heidenreich et al., 2013). Current data reported by Vidic, Chibnall, and Hauptman (2015) states that rehospitalization penalties correlated with excess readmission rates (ERR) of HF patients more than any other diagnosis code (0.30; p< .001) and that in a regression analysis, the HF ERR explained the most variance in the penalty ($R^2$ range 0.21 – 0.44).

Additional costs for HF management occur when HF patients are readmitted to the hospital within < 30 days with the same diagnosis of acute exacerbated HF.
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According to Jenks, Williams, and Coleman (2009), 26.9% of 30-day re-hospitalizations from 2003-2004 were due to HF with HF being the leading cause of all re-hospitalizations. The Centers for Medicare and Medicaid (Suter et al., 2014) reported that in 2012, 22% of HF patients were readmitted nationwide within less than 30 days with acute exacerbation of HF, down from 23.5% in 2010. Jencks, Williams, & Coleman, (2009) estimated the cost of all re-hospitalizations to be $17.8 billion dollars. As HF is the most expensive DRG (Fida & Pina, 2012), it incurs $15 billion in costs annually, just in hospital readmissions. In order to reduce HF re-hospitalizations, there needs to be a global consensus on the management of HF.

Guidelines for the management of HF have been developed that advocate therapies proven to reduce morbidity and mortality (Jessup et al., 2009; Yancy et al., 2013). Adherence to these HF therapies such as medication, diet, exercise, and weight management is vital to a patient’s ability to manage their HF (Jessup et al., 2009; Yancy et al., 2013). Failure to adhere to medication, diet, and therapy regimens results in poor blood pressure control, worsening function of the heart muscle, shortness of breath, and edema resulting in an increase in hospital re-admissions and mortality (Albert, 2008; Mockler, et al., 2009; Wu, Moser, Lennie, & Burkhart, 2008; Yancy et al., 2013). A review of the literature reveals that these adherence rates are low.

Measurements of adherence to HF therapies place the behavior at anywhere from 15-100%, with an average adherence rate of 50%, depending on the method of measurement (Bissonnette, 2008; Knafl & Riegel, 2014; Perreault et al., 2009; Wu, Moser, Lennie, & Burkhart, 2008). Factors found to influence medication adherence include living with someone or being married, having social support, and having more education.
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(Wu, Moser, Lennie, Peden, et al., 2008). Knafl & Riegel (2014) found that having a new diagnosis of HF, being of older age, having multiple comorbidities and medications, and lack of sleep were important reasons for non-adherence. Osterberg & Blaschke (2005) reported that in the United States, 33%-69% of medication-related hospital admissions were due to poor medication adherence (across all illness groups) with a resultant cost of approximately $100 billion per year. For example, controlling hypertension rigorously could prevent most occurrences of HF (Perreault, et al., 2009; Yancy et al., 2013). Being able to control hypertension requires the ability of the patient with hypertension to take their medications exactly as prescribed every day. Commitment to and involvement in the plan of care by patients is vital to prevent or manage HF and thus prevent hospital readmissions for HF exacerbation.

One of the most important predictors of adherence is having the cognitive function to learn about the medical therapies, to understand them, and to implement them (Woo et al., 2009; Wu, Moser, Lennie, & Burkhart, 2008). Several research teams have found evidence of cognitive deficits in HF patients, which may contribute to lack of adherence to medical therapies and subsequent re-hospitalization (Gallagher et al., 2013; Hajduk et al., 2013; Pressler, 2008). Pressler (2008) examined research studies between 2002-2007 and found that 25% – 50% of HF patients had cognitive impairments. Hajduk et al. (2013) found that 79% of 577 participants (M = 71 years, 44% female) were impaired in at least one cognitive domain and impaired memory was associated with lower self-care scores (p = .006) in multivariate models.

Cognitive function is considered to be the sum of multiple abilities and is comprised of receptive functions, memory and learning functions, and thinking functions which
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include organizing information, and expression (Lezak, Howieson, & Loring, 2004; Vogels, Oosterman, Van Harten, Gouw, et al., 2007). Cognitive impairment is characterized by altered speed of information processing, working memory capacity, and reduced long term memory (Athilingam, 2008; Athilingam, King, Burgin, Ackerman, Cushman, & Chen, 2011; Cameron, et al., 2009; Harkness, Demers, Heckman, & McKelvie, 2011). Woo et al. (2009) have documented areas of brain injury associated with executive function in HF patients that cannot be explained by diseases of aging, such as cerebrovascular disease, strokes, carotid plaques, or microvascular disease.

Patients’ abilities to adhere to HF therapies require relatively unimpaired cognitive functioning (Woo et al., 2009). Woo et al. (2009), in a study of patients with HF, found that brain injury correlated with impaired cognitive function. “Forgetting” was the common reason that HF patients gave for not adhering to medications (Conn, Taylor, & Miller, 1994; Kairuz, et al., 2008). Many hospitalizations for HF could be prevented by improvements in adherence to medical therapies for HF and in lifestyle modifications by patients (Moser & Riegel, 2004).

HF is characterized by fluid congestion that accumulates in the lungs as well as in the extremities and abdomen (Desai & Stevenson, 2012; Gruszczynski, Schuster, Regier, & Jensen, 2010; Guglin, 2011; Kemp & Conte, 2012; Parrinello et al., 2008). The congestion is associated with shortness of breath (dyspnea) and edema of the extremities (Francis & Tang, 2004; Konishi et al., 2009). Measuring the amount of fluid is difficult and is accomplished through measuring daily weights and urine output (Lee, et al., 2013; Miller & Mullan, 2014; Moser & Riegel, 2004). Physical examination revealing dyspnea, edema, neck vein distention, and increase in body weight are used as clinical surrogates
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for estimating presence of excess body fluid (Francis & Tang, 2004; Lindenfeld et al., 2010; Miller & Mullan, 2014). Excess body fluid is also estimated by the use of a right heart catheter which may demonstrate elevated filling pressures (Lindenfeld et al., 2010; Zile et al., 2011). Since fluid weighs 2.2 lbs per liter (Engineering Tool Box, 2011; Miller & Mullan, 2014), then weighing the patient with a common bathroom scale would be an readily accessible means of estimating changes in fluid volume (Gruszczynski et al., 2010; Miller & Mullan, 2014). Treatment focuses on fluid restriction of 1.5 to 2 liters per day and the use of diuretics such as furosemide and zaroxolyn to remove excess body fluid (Gruszczynski et al., 2010; Guglin, 2011; Lindenfeld et al., 2010; Miller & Mullan, 2014). This treatment regimen is now being challenged (Aliti et al., 2013; Travers et al., 2007) and will be discussed in Chapter 2.

Some research has been done to examine HF patient adherence to medical therapies (Albert, 2008; Holst, Willenheimer, Martensson, Lindholm, & Stromberg, 2007; Lee et al., 2013). Generally, adherence to medical therapies such as diet, medications, and low salt diet was about 50-60% (Wu, Moser, Lennie, and Burkhart, 2008). In a recent study, Knafl and Riegel (2014) found that 28.9% of their 63 adult patients with HFrEF (M 62.8 ± 11.6 years) had poor adherence. Very few studies examined whether patients weighed themselves or followed a fluid restriction and those that did reported a range of only 29%–50% of patients weighing themselves (Gonzalez et al., 2004; Holst et al., 2007; Ni et al., 1999). Ni et al. (1999) reported that thirty-eight percent of their sample believed they should drink a lot of fluids, which is exactly the opposite of what patients with HF should do. Even though this study by Ni et al. (1999) is old, few other studies on the topic of fluid management were found at this writing.
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(Jessup et al., 2009; McMurray et al., 2012). In another study by Michalsen, Konig, & Thimme (1998), 34% of the participants consumed more than 2.5 liters of fluid per day. In that study, only 26.3% of patients were aware of the need for fluid restriction or paid attention to their daily fluid intake. Only 38.2% of patients weighed themselves regularly, even though 86.6% of patients had scales at home.

Cognitive function was not evaluated in these studies, therefore, it would be useful to know if HF patients’ cognitive function were measurably within a normal range using standard psychometric tools and if they were able to minimize changes in weight by following a treatment plan that included recommended standard therapies such as a low sodium diet, fluid restriction, maintenance of their discharge weight, and medication appropriate for management of HF (Hunt et al., 2009). There are a limited number of studies that link cognitive function and changes in weight and none that focus primarily on the relationship of cognitive function to changes in weight (Conn et al., 1994; Kairuz et al., 2008; Pressler, 2008). This study will examine whether weight changes differed based on the presence or absence of cognitive impairment in HF participants who were followed in the clinic one to two months after discharge from the hospital after an exacerbation of HF.

Theoretical Framework

The framework for this study is based on Riegel’s Situation-Specific Theory of Heart Failure Self-care (Riegel & Dickson, 2008). Influenced by Dorothy Orem’s self-care theory (1985), Riegel developed a situation specific theory to describe self-care in the HF population that involves monitoring oneself for symptoms, recognizing the symptoms, evaluating whether the symptoms are related to their HF and determining the
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degree of severity of the symptoms, treating the symptom according to what they have learned from their healthcare providers, and evaluating the effectiveness of the treatment (Riegel & Dickson, 2008). According to this theory, self-care in the HF population has three components: Self-care Maintenance, Self-care Management, and Self-care Confidence (Riegel & Dickson, 2008). Self-care maintenance is the day-to-day business of managing one’s diet, weights, medications, and exercise program. Self-care management involves picking up on subtle changes in one’s sense of what constitutes normal for oneself, analyzing those changes for significance, choosing a treatment from among those prescribed for their care, and evaluating whether that treatment was effective. To manage their chronic HF condition, patients must have confidence in their ability to remember, understand and implement the therapies in their daily life (Riegel & Dickson, 2008). Riegel’s Model (2008) is illustrated by the following figure.

Figure 1: Copyright © Self-Care of Heart Failure Index (Riegel, 2009)
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In this model, self-care attributes in HF are defined as weighing oneself daily, eating a low sodium diet, taking medications as prescribed, participating in regular exercise such as walking, and recognizing HF symptoms such as shortness of breath, ankle swelling, and fatigue (Cameron et al., 2009; Gruszczynski et al., 2010). Following the model, the patient would be engaged in self-care maintenance by weighing themselves every day, eating a low sodium diet, taking medications as prescribed, etc. Monitoring oneself for a change in symptoms would also be considered self-care maintenance. Should the patient become aware that they experience shortness of breath or their weight has gone up by 1-2 pounds over night, then evaluation of those symptoms moves them into the Management phase of the model. The patient should be able to evaluate that the symptoms are related to their HF in order to implement a treatment plan. The treatment plan may be to call their HF nurse or to take a prn diuretic. Afterward, they should be able to evaluate that they feel less short of breath or their weight has gone back down. Having the ability to evaluate their symptoms and respond appropriately requires intact cognitive function.

Applying the model to managing weight and preventing weight changes greater than 2.0 pounds per day would look like Figure 2.

Figure 2: Self-care Model examining change in weight
It is within this framework that the significance of this study lies. A person’s ability to engage in self-care requires the physical and cognitive ability to perform those acts (Trupp & Corwin, 2008; Woo et al., 2009). HF patients must have intact cognitive function of organizing, planning, sequencing, and calculating in order to maintain their level of wellness appropriate for their degree of chronic HF. Applying Riegel’s theory to this phase of chronicity is consistent with Self-care Maintenance (Lee et al., 2013; Riegel & Dickson, 2008). Additionally, they must have the cognitive skills of analyzing, critical thinking, problem-solving, and abstract thinking in order to manage variations in their day-to-day physical status. Self-care Management applies to this phase of the HF patient’s experience. These cognitive skills are vital to the HF patient’s ability to care for themselves and without these skills their HF status deteriorates (Jessup et al., 2009; Trupp & Corwin, 2008). This study does not examine day-to-day weight maintenance, but instead sought to describe whether there was a difference in weight magnitude and direction from $T_1$ at enrollment to $T_2$, four to eight weeks later in the clinic.

**Research Aims**

**Primary Aim:** The primary aim of this study was to explore whether weight changes differed based on the presence or absence of baseline cognitive impairment in HF participants who were followed in the clinic one to two months after discharge from the hospital for an acute exacerbation of HF admission.

**Primary Research Question:** Is there a difference in weight change over time in HF patients with and without baseline cognitive impairment?

**Secondary Aim:** A secondary aim was to explore whether functional status, depression, or NYHA Class in HF patients followed in the clinic one to two month after
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discharge from the hospital for an acute exacerbated HF admission differed according to baseline cognitive impairment.

Secondary Research Question: Is there a difference in functional status, depression or NYHA Class at follow-up in those HF patients with and without baseline cognitive impairment?

Third Aim: The third aim of this study was to explore whether there was a difference in weight or baseline cognitive function in HF participants who received a high number or low number of diuretic dose adjustments one to two months after discharge from the hospital for an acute exacerbated HF admission.

Research Question: Is there a difference in weight change over time in those HF patients who had a low number of diuretic dose adjustments versus a high number of diuretic dose adjustments when followed in the clinic one to two months after discharge from the hospital for an acute exacerbated heart failure admission?

Research Question: Is there a difference in baseline cognitive status in those HF patients who had a low number of diuretic dose adjustments versus a high number of diuretic dose adjustments when followed in clinic one to two months after discharge?

Significance

This study is significant to nursing education, practice and research because patients’ abilities to minimize their weight changes depend on having the cognitive skills to take their medications as prescribed, to follow a fluid restriction and low sodium diet, and to weigh themselves daily. Patients must be able to analyze the significance of variations in their weight and engage in a problem solving process to determine the appropriate action to take when they determine that the weight variation is indicative of
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fluid overload. Because HF is such a serious illness with a multi-pronged approach to management, patients must be fully engaged and cognitively competent partners in their care.

There is little research exploring the impact of cognitive function on change in weight in HF patients. Yet a patient’s ability to manage their weight is directly linked with maintaining euvolemia and maximal cardiac output. Failure to follow a prescribed fluid management program and performance of daily weights can destabilize a patient clinically, leading to fluid accumulation in the pulmonary, venous, and lymphatic systems resulting in exacerbation of HF symptoms and hospital readmissions (Howlett, 2011; Hunt et al., 2009; Parrinello et al., 2008).

These multiple hospitalizations result in setbacks for the patients physiologically, as it has been demonstrated that patients have not returned to physiologic baseline at time of discharge, showing persistent HF symptoms at discharge (Paul and Hice, 2014). Additionally, re-hospitalizations for HF are costly for the patients and insurers and are no longer being covered by Medicare if they occur within 30 days after discharge from a hospital for the same diagnoses (Maliakkal & Sun, 2014).

Recovery at home can be lengthy with re-hospitalization sometimes occurring before the patient’s health status has returned to baseline (Kannel & Ramachandran, 2004). Early detection of cognitive deficits may facilitate the healthcare providers’ abilities to develop interventions for the patient and family to prevent re-accumulation of excess fluid in the lungs, thus preventing early and expensive re-hospitalizations (Maliakkal & Sun, 2014). Therefore the purpose of this study was to assess whether weight changes differed based on the presence or absence of baseline cognitive
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impairment in HF participants who were followed in the clinic one to two months after discharge from the hospital for an acute exacerbation of HF admission as a part of a comprehensive treatment plan for HF.

Implications for Nursing Practice

Nurses play a critical role in teaching patients about their diseases, medications, and all their medical regimens, such as weighing themselves, during hospitalization and at discharge (Paul & Hice, 2014). HF patients need to have the cognitive skills to learn and retain the information and then to translate that into their home environment in order to manage their weight and maximize the benefit of their medical therapies to prevent hospital re-admissions due to exacerbation of HF (Lee, et al., 2013). It would be beneficial for nurses to include the assessment of cognitive function as part of discharge planning.

HF experts recommend systematic assessment of cognitive function in HF patients (Cameron et al., 2009; Lee et al., 2013; Pressler et al., 2010; Riegel & Dickson, 2008). Additionally, while the U.S. Preventive Services Task Force found inconsistent and insufficient evidence to recommend routine screening for cognitive function among all older adults to identify early cognitive changes, their Guideline report also stated:

Early recognition of cognitive impairment,…, allows clinicians to anticipate problems the patient may have in understanding and adhering to recommended therapy. This information may also be useful to the patient’s care-givers and family member in helping to anticipate and plan for future problems…. (Boustani, Peterson, Hanson, Harris, & Lohr, 2003, p. 925).
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The 2014 update (Moyer, 2014) is essentially unchanged, stating that the evidence for screening for cognitive impairment is lacking and the ability to assess the harms of screening versus the benefits is indeterminable. Of importance is Moyer’s (2014) statement that it was not possible to find any published literature that demonstrated any effect, positive or negative on the effect of cognitive screening on decision making or planning by either the patients, their healthcare providers, or their caregivers. Lack of such evidence mandates further research on the impact of cognitive function screening on discharge planning in HF patients.

Nurses can take the lead to incorporate an assessment of cognitive function in HF patients as part of discharge planning. Further research on the impact of cognitive status on patients’ readmission rates and weight changes in HF patients is vital due to the dearth of research documenting this impact. Because of the need to for patients to organize and plan for their daily weights and fluid consumption, to be able to calculate the number of liters to drink, and to problem-solve discrepancies in their fluid and weight documentation, patients need to have full cognitive function in order to complete these tasks. If patients have deficits in the Executive Function areas of their brain, due to HF or other reasons, they will not be able to perform these tasks. Therefore, screening for mild cognitive impairment should be incorporated into discharge planning for HF patients. This study provides a better understanding of the impact of cognitive function on change in weight after discharge from the hospital.

Definition of Terms

Heart Failure: HF is a syndrome of progressive deterioration of right and/or left ventricular function (Eichhorn & Bristow, 2004) and is the reduction in the ability of the
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myocardium to pump enough blood to the tissue to meet the cellular needs for
oxygenation (Hoyle & Kahl, 2006; Parrinello, et al., 2008). This reduction in pump
function results in neurohormonal shifts, fluid retention, myocardial hypertrophy
followed by dilation and subsequent contractile failure due to over-stretched myocardial
fibers (Eichhorn & Bristow, 2004; Izumo & Pu, 2004; Katz, A.M., 2004). In this study,
HF was defined as being documented in the medical record as having an

echocardiographic ejection fraction of \( \leq 40\% \) in the last 12 months, coupled with
documented clinical signs and symptoms of dyspnea, edema, abdominal distention,
and/or neck vein distention.

**Cognitive Function:** Cognitive function, which comprises many capabilities, is
measured by observing behavior in multiple domains, such as memory and learning
functions; thinking functions, which include organizing information, and expressive
functions (Lee, et al., 2013; Lezak et al., 2004; Vogels, Oosterman, Van Harten, Gouw, et
al., 2007; Woo, Kumar, Macey, Fonarow, & Harper, 2009). In this study, these domains
were assessed using the Montreal Cognitive Assessment Tool (Lee et al., 2013;
Nasreddine et al., 2005).

**Change in Weight:** Body weight is the total weight of the patient measured in
pounds. In a hemodynamically stable patient, the body weight will remain basically
stable from day to day (± 2.0 lbs.) (Moser & Riegel, 2004). In this study, the change in
weight of the participant was the difference in weight from enrollment (T\(_1\)) to follow-up
in the clinic (T\(_2\)) using dedicated research scales.

**Diuretic Dose Adjustments:** It is the standard of practice with the HF cardiology
specialists at Penn Presbyterian Medical Center to have a HF nurse contact HF patients
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within 72 hours after discharge from the hospital following an acute exacerbation of HF. One of the purposes of this contact is to adjust the dose of the diuretic or add a prn diuretic as appropriate, based on patient reports of symptoms or daily weights. The nurse records any diuretic dose adjustments in the patient’s medical record. In this study, the number of diuretic dose adjustments (including addition of a prn diuretic) was tracked between discharge and the clinic visit at 4-8 weeks after discharge.

Summary

HF is a syndrome resulting from a variety of cardiac conditions such as myocardial infarction, valve abnormalities, under treated hypertension, etc. As the population of the United States (US) continues to age, the incidence of HF will continue to increase. More people are surviving cardiac conditions which previously were lethal, which further increases the number of people living with HF (Heidenreich et al., 2013). As a result, there will be an increased burden on the healthcare system to keep these patients out of the hospital and successfully treat HF patients in the home.

There are multiple, complex therapies to manage HF in the community environment, requiring the HF patient to be an engaged, conscientious partner in their own care. However, the association between HF and changes in cognitive function which impairs the HF patient to manage their therapies has been demonstrated in several studies. Changes in cognitive function can be very subtle. A patient’s apparent appropriate behavior, such as knowing who he is and where he is, could lead the average observer to conclude that the individual is fully competent to care for himself. Brain injury in HF patients in the areas of the brain responsible for attention deficits, short term memory, complex reasoning, abstract thinking, organization, sequencing, and patterning
Cognitive function and weight in HF patients can render a person unable to organize complex tasks, remember to weigh themselves, or to make the connection between a two pound weight gain and the pathophysiology of their HF. There is a paucity of research on the association between cognitive function in HF patients and their ability to minimize weight changes after a hospitalization for acute exacerbation of HF. It is therefore necessary to examine this relationship in order to document whether it is necessary for healthcare providers to perform sensitive cognitive screenings in order to ensure that patients are capable of managing their weight in the home environment to keep changes in weight to a minimum.
Chapter 2: Review of the Literature

Introduction

Heart failure is a progressively deteriorating condition of heart function that has a very large impact on healthcare services utilization nationally (Lindenfeld et al., 2010; Shah, et al., 2013). The poor pumping action of the heart results in accumulation of fluid in the lungs and extremities, which causes the patients to experience dyspnea with exertion which interferes with their activities of daily living and even their ability to be gainfully employed (Aliti et al., 2013; Desai & Stevenson, 2012; Jessup et al., 2009; Lindenfeld, et al., 2010; Linhares et al., 2010;). Patients with HF (HF) are expected to adhere to many therapies in the management of their chronic illness, including, but not limited to medications, low sodium diet, fluid restriction, daily weights, and an exercise program (Heidenreich et al., 2013; Knafl & Riegel, 2014; Riegel & Dickson, 2008; Salyer, Schubert, & Chiaranai, 2012; Yancy et al., 2013). The complex nature of the therapies for this condition are so challenging, even for those patients with intact cognitive function, that non-adherence to prescribed medical therapies is very high resulting in frequent hospitalizations, even re-hospitalizations within less than 30 days, resulting in a strain on health care economics, poor quality of life, and high mortality (Jencks et al., 2009; Knafl & Riegel, 2014; Lee, Moser, Lennie, & Riegel, 2011; Thomas, 2007).

Little research has been done to measure the impact of cognitive function on change in weight in patients. This literature review examines the evidence surrounding the care of HF patients, and the pathophysiology of HF and its therapies. The components of cognitive function and weight maintenance will also be examined along with
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depression, which is associated with cognitive function. Functional activities, which have been shown to correlate strongly with cognitive function, are also reviewed. These constructs are viewed from the perspective of self-care using the Situation –Specific Theory of Heart Failure Self-care by Dr. Barbara Riegel (Riegel & Dickson, 2008).

**Heart Failure**

An important cause of HF exacerbations is failure by the patient to adhere to medication, diet, daily weights, and therapy regimens, which results in poor blood pressure control, worsening function of the heart muscle, shortness of breath, and edema (Cotter, Felker, Adams, Milo-Cotter, & O'Conner, 2008; Parrinello, 2008; Shah, et al., 2013). These symptoms result in an increase in hospital re-admissions and mortality (Parrinello, 2008; Shah, et al., 2013; Wu, Moser, Lennie, & Burkhart, 2008).

Normal heart function is associated with a state of euvolemia, where the amount of fluid consumed is balanced with the amount of fluid excreted through the kidneys or transpired through the lungs, skin, and GI tract (Parrinello, 2008). With normal heart function, fluid does not accumulate in the lungs or extremities causing a limitation to one’s ability to engage in activities. Once the heart begins to fail, then the balance between fluid consumed or excreted shifts, resulting in an increase in total body water. The body then develops many mechanisms to restore itself to a compensated state (Cotter et al., 2008; Parrinello, 2008; Zile et al., 2011; Zuccalà et al., 2005).

HF patients in distress usually present with shortness of breath (SOB) or dyspnea, especially on exertion (DOE) and easy fatigability. Clinical signs of HF include crackles in the posterior lung fields, swelling in dependent areas of the body, usually legs/ankles/feet, abdominal enlargement, distended neck veins, and a gallop sound heard
Cognitive function and weight in HF patients during cardiac auscultation (Desai & Stevenson, 2012; Francis & Tang, 2004; Parrinello, 2008; Yancy et al., 2013). Diagnostic tests that aid in the diagnosis of HF include chest X-rays that show increased radiopacities in the bilateral lung fields and enlargement of the heart silhouette. The echocardiogram may reveal an ejection fraction of $\leq 40\%$ in the setting of systolic dysfunction, but is of no help in a HF diagnosis in the setting of preserved left ventricular function where the ejection fraction appears to be within normal limits ($40\% - 75\%$) (Francis & Tang, 2004; Lindenfeld et al., 2010; Parrinello, et al., 2008; Yancy et al., 2013). If a right heart catheter is inserted to assist with diagnosis and management of the HF patient, then the pulmonary and left ventricular end-diastolic measurements will be elevated and the cardiac index will be reduced, usually $< 2.0$ (Francis & Tang, 2004; Zile et al., 2011).

Management of HF is very complex. Non-pharmacological therapies have historically included a fluid restriction of 1.5 to 2 Liters of fluid per day, low sodium diet of 1.5 to 2 Gm per day, and exercise (Gruszczynski et al., 2010; Moser & Riegel, 2004; Yancy et al., 2013). The patient is instructed to weigh themselves every day and to call the cardiologist’s office for an overnight weight gain of 2 pounds or more or for a 5 pound weight gain in a week (Lindenfeld et al., 2010; Yancy et al., 2013).

**Fluid and sodium restriction.**

However, there is currently a developing controversy against that practice of restricting fluid and sodium based on some research done by Travers et al. (2007) and Aliti et al. (2013). In a single-blinded, randomized study of two groups, one fluid restricted ($n = 34$) and the other not ($n = 33$), it was found that there was no significant difference in clinical stability of serum urea, creatinine, and sodium between the groups.
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(p = .17) nor in time to discontinuation of intravenous diuretic therapy (p = .70) (Travers et al., 2007). Since the N was small, a larger randomized trial was recommended.

Aliti et al. (2013) argued that this practice had never really been studied in a randomized clinical trial. Seventy-five patients with HF (ef M = 26%) were divided into two groups, one with an 800 mL/d fluid restriction and 800 mg/d sodium restriction while the other received a standard hospital diet with liberal fluid and sodium intake for up to seven days while hospitalized with acute decompensated HF. There was no significant difference in weight loss between the two groups (0.25 kg [95% CI, -1.95 to 2.45]; p = .82). Thirst was worse in the Intervention group (p = .01). There was no significant between-group difference in the readmission rate at 30 days (p = .41). Their conclusion was that restricting fluid and sodium had no effect on weight loss or clinical stability (Aliti et al., 2013).

The Aliti et al. study (2013) elicited significant controversy in the journals (Cheitlin, 2013; Rami, 2013). Cheitlin (2013) took issue with the population of HF patients who enrolled in the study, stating that of the potential pool of patients admitted during that time frame to their hospital, only 9% were actually enrolled, suggesting that the population was a small, biased, convenience sample. Another point made by Cheitlin (2013) was that the patients had already received up to 36 hours of diuretic therapy before being enrolled in the study, and that there was no way to monitor for patients sneaking extra fluid or food high in sodium. Cheitlin (2013) pointed out that management of patient hospitalized for acute decompensated HF is different from management of stable outpatients with HF.
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A different review noted the same flaws to the Aliti et al. study as Cheitlin above, but took a middle of the road conclusion (Rami, 2013). Rami (2013) stated that the aggressive salt and fluid restriction implemented in Aliti’s et al. (2013) protocol would activate harmful neurohormonal pathways, but that liberalization of fluids and salts on all HF patients admitted with decompensation would be just as harmful, recommending the ACCF/AHA guidelines of a more reasonable approach appropriate for individual patients. The 2013 ACCF/AHA guidelines state that fluid restriction is reasonable in stage D patients, especially in the setting of hyponatremia (Yancy et al., 2013). In citing the study by Travers et al. (2007), it is felt by the ACCF/AHA that fluid restriction in less advanced stages of HF are not helpful (Yancy et al., 2013).

Pharmacologic therapies include diuretics to remove fluid (Guglin, 2011; Parrinello, 2008; Rami, 2013), antihypertensives from the Angiotensin-Converting Enzyme Inhibitor or Angiotensin Receptor Blocker families to reduce preload and afterload and occasionally digoxin to improve contractility (Albert, 2008; Lindenfeld et al., 2010; Yancy et al., 2013). Many patients have an average of 10 medications which they must take on a daily basis making adherence a significant problem due to many factors including expense, but also due to confusion (Albert, 2008; Knafl & Riegel, 2014). For this reason it is vital that patients have fully intact cognitive function in order to take their medications as prescribed, as well as set up their medication administration box, with the pills organized and sequenced as to right medications, right times, and right doses.
Self-care in heart failure.

Dr. Riegel pioneered research studies designed to describe self-care abilities in HF patients (Carlson, Riegel, & Moser, 2001; Riegel, Carlson, & Glaser, 2000; Riegel & Dickson, 2008). Self-management refers to a patient’s ability to identifying signs and symptoms in themselves and responding appropriately according to information provided by their healthcare provider to control their HF symptoms (Riegel & Dickson, 2008). In this model, the role of cognitive function is described thoroughly as a main underpinning of the HF patient’s ability to engage in self-care (Riegel et al., 2000). In an early study, 209 elderly (M 73 years), Class III HF patients responded to the Self-care of HF Instrument (Rockwell & Riegel, 2001). It was found that patients with higher education and those who were symptomatic were more likely to engage in self-care than those who were poorly educated or asymptomatic.

In one of the initial studies, 139 participants (age 69.27 +/- 13.88 years; 74% male; 39% Class III HF) (Carlson, et al., 2001) were recruited to document self-care abilities. Participants completed an investigator-developed survey mailed to their home after discharge from the hospital. About 72% of participants reported some degree of functional impairment, half of whom reported marked limitations in ordinary activity. Visual and hearing impairments further contributed to self-care difficulties. Most patients (88%) claimed to follow a low-sodium diet, although 12% admitted to not restricting their sodium intake. Sudden weight gain was not recognized by 60% of responders as being a symptom of HF(93.8% of newly diagnosed HF patients vs 33.3% of patients experiences with HF, p = .0001). In the domain of self-care management behaviors, 32% reported increasing their diuretic dose. For sudden weight gain, 63.3% reported
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decreasing the sodium intake, increasing their diuretic dose (46.9%), and decreasing their
fluid intake (44%). Less than half the group (45.7%) felt very or highly confident in their
ability to take action to relieve symptoms.

A follow-up study (Riegel & Carlson, 2002), was designed to discover what HF
patients perceive to be the facilitators and barriers to managing their own self-care.
Qualitative data were obtained from 26 HF patients (mean age 74.4 +/- 10 years; length
of time with HF 3.4 +/- 3.86 years, 65.4% male). Common challenges elicited from these
patients included, among several challenges, coping with the treatment regimen and not
feeling as if they had enough knowledge to manage their own care. Additional
information came out of the focus groups that included having difficulties recognizing
symptoms as being related to HF and following the treatment regimen. Many patients
reported trying to improve their knowledge and coping skills by buying books to read
more about HF and their medications. These results demonstrated that many HF patients
had poor self-care abilities, from following a standard HF therapy program of
medications, diet, and daily weights, to recognizing their symptoms, to understanding
that the symptoms were related to HF, and then responding appropriately.

Lee et al., (2011) found in a study of 195 older adults with HF, that patients who
engaged in self-care management had as low a risk of an event (all-cause mortality,
hospitalization or emergency room admission) during follow-up as those who were
symptom-free (p < .05). This finding speaks to the importance of HF patients being able
to manage their own symptoms. In a study examining cognitive impairment and self-care
in HF, the MoCA and the 9-item European Heart Failure Self-care Behaviour Scale were
used to measure cognitive function and self-care respectively in a sample of 577 patients
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(M 71 years, 44% female) hospitalized for HF at five medical centers in the U.S. and Canada (Hajduk et al., 2013). They found that 79% of their sample (n = 453 patients) were impaired in at least one cognitive domain and that impaired memory was associated with lower self-care scores (p = .006). These studies demonstrate the link between HF patients’ abilities to manage their own care and the impact of cognitive function on that ability.

As can be seen from the above discussion, HF is a very complex and debilitating condition requiring significant personal and social resources. The economic impact on society is profound and will increase over the next forty years as the Baby-boomer generation continues to age and therapies for preventing deaths from myocardial infarctions and cardiomyopathies improve. The HF patients must be fully engaged in their own care and they must have intact cognition in order to follow a complex regimen of pharmacologic and non-pharmacologic therapies, all aimed at keeping the cardiac function optimal and at keeping the patient out of the hospital with acute exacerbations of HF.

Variables

Cognitive Function.

Intact cognitive function is critical to a patient’s ability to adhere to complex medical therapies for the treatment of HF. Defining what is meant by cognitive function is important to being able to measure it. Cognitive function is considered to be the sum of multiple abilities that are measured by observing behavior in multiple domains (Lezak et al., 2004; Vogels, Oosterman, van Harten, Scheltens, et al., 2007) and is comprised of receptive functions, memory and learning functions, thinking functions which include
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organizing information, and expressive functions (Lezak et al., 2004; Ogren, Fonarow, & Woo, 2014). Within these functional domains are the attributes of executive and visuospatial capabilities along with mental speed and attention (Levin et al., 2014; Ogren et al., 2014; Pressler, et al., 2010; Vogels, Oosterman, van Harten, Scheltens, et al., 2007). In this study, these attributes were organized into the domains of Memory, Executive Function, Visuospatial abilities, Language, Mental Speed and Attention. Some of the factors that influence cognitive function, assuming the absence of delirium, drugs, and electrolyte imbalance, are functional abilities (Katz, S., 1983; Meiner, 2011) and depression (Butters et al., 2004; Cameron, Worrall-Carter, Riegel, Lo, & Stewart, 2009; Clark & McDougall, 2006; Frasure-Smith et al., 2009; Meiner, 2011; Pullicino et al., 2008).

A review of the literature revealed a variety of testing tools and neurological perspectives on cognition. Three studies were found that examined Memory, Executive Function, Visuospatial abilities, Language, Mental Speed and Attention in HF patients. Cognitive performance was examined in patients with and without HF (Serber, et al., 2008) using the Mini Mental State Exam (MMSE), Trail Making A & B from the National Institute of Health Stroke Scale, and the Watson Clock-Drawing test. These test scores were then compared to magnetic resonance T2 relaxometry. All participants scored normally on the MMSE, so it was discarded from analysis. Using the other measuring tools, up to 20% of the participants had abnormal cognitive scores and significant brain injury appeared in the participants who had the abnormal test scores. Clock drawing scores related to the greatest extent of injury, so as a result may be the most sensitive for evaluating overall structural injury.
In a study comparing clinical testing against brain structure and function, MRI research, also using T2 relaxometry, was done on younger HF patients to document the presence of cerebral atrophy (Woo et al., 2009). Proton-density and T2-weighted images were acquired from 13 HF patients (age 54.6 +/- 8.3 years, LV EF .28 +/- 0.07) and 49 controls, with similar demographics. Higher T2 relaxation values, indicating injured brain areas (p < .005), emerged in sites that control autonomic, analgesic, emotional, and cognitive functions in the HF patients. The areas involved correlate with inhibition of pain and emotional lability, including depression. There was a pattern of injury which is related to short-term memory deficits, attention deficits, difficulty with complex reasoning, and confusion. No brain areas showed higher T2 values in the control group. A limitation of this study was that patients who were enrolled had a mean age of 54.6 years and whose HF was mostly nonischemic in origin, which does not reflect the demographics of the vast majority of HF patients. The strength of this study was that these patients did not have age-related changes in white and gray matter, ischemia caused by atherosclerotic cerebral blood vessels, and/or multiple comorbidities. Therefore, the changes in the MRI reflected the contribution of HF toward brain injury.

Finally, Pressler et al. (2010) investigated whether cognitive impairment was a predictor of mortality in adults with systolic HF. The study population was 166 stable outpatients (M = 65.6 ± 13.8 years) with HFrEF who completed a battery of neuropsychological and depressive symptom testing and was followed for a year. The cognition battery comprised tests of short-term and delayed memory, visuospatial ability, cognitive processing speed, and executive function. Twenty-one of the 145 patients who died scored lower on measures of global cognitive function, memory, and executive
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function, with memory loss being the most predictive cognitive function variable ($\chi^2 = 17.97$, $p < .001$). This study was the first to report that cognitive impairment, especially in the areas of working memory and executive function, were predictors of one year all-cause mortality.

These three studies examined cognitive function in HF patients using $T_2$ Relaxometry (two studies) and a variety of cognition batteries that were comprised of various memory testing, visuospatial skills, processing speed, and executive function. All three found that memory and executive function were impaired in HF patients. However the etiology of the injury to the brain and these specific areas is unclear. Debate centers around decreased cardiac output, low blood pressure, low cerebral perfusion pressure and the occurrence of emboli in 20-23% of patients, but there is no consistency with the presence of emboli and the presence of injury (Ogren, Fonorow, & Woo, 2014). Other causes of this brain injury are speculated to be nutritional deficits, specifically thiamine deficiency, which affects 33% of HF patients (Ogren et al., 2014). Sleep-disordered breathing is also postulated as a cause, since over half of HF patients have obstructive sleep apnea (Ogren et al., 2014).

**Cognitive Impairment.**

Cognitive impairment is a term referring to any of several causes of diminished cognitive skills, such as delirium and dementia (Meiner, 2011; Muwaswes, 1993). Delirium is a rapidly occurring state of reduced ability to maintain attention to external stimuli and is characterized by disorganized thinking or rambling speech and is usually reversible due to correction of serum imbalances such as low sodium levels or reduction of serum levels of offending drugs such as anesthesia (Meiner, 2011; Muwaswes, 1993).
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Dementia, on the other hand, is a condition that develops over many years and is characterized by short and long-term memory problems, impaired abstract thinking skills and judgment, difficulty in engaging in self-care activities such as bathing and dressing, and is not reversible (Meiner, 2011; Muwaswes, 1993).

Cognitive impairment occurs on a continuum between normal cognitive function and total cognitive disability/dementia and is evidence of diminished cognitive skills which may include short term memory disorders, and problems with organizing and problem solving (Lee, et al., 2013; Ogren, Fonarow & Woo, 2014; Pressler, Kim, Riley, Ronis and Gradus-Pizlo, 2010). Cognitive impairment can be caused by normal diseases of aging such as Alzheimer’s disease, as well as by depression and altered vision, hearing and acute medical conditions (Meiner, 2011).

Cognitive impairment can be documented with any of several measuring tools such as the Mini Mental State Exam (MMSE) (Folstein, Folstein, & McHugh, 1975), multiple clock drawing tools, the Short Portable Mental Status Questionnaire (Pfeiffer, 1975) and many others. Declining cognitive functioning is characterized by altered speed of information processing, working memory capacity, and long term memory (Lee, et al., 2013; Ogren, Fonarow, & Woo, 2014; Pressler et al., 2010).

Increasingly, cognitive impairment is recognized as being associated with HF (Dodson, Truong, Towle, Kerins, & Chaudhry, 2013; Lee, et al., 2013; Ogren, Fonaorw, & Woo, 2014; Pressler et al., 2010; Pressler, Suubramanina, et al., 2010; Wolfe, Worrall-Carter, Foister, Keks, & Howe, 2006). Research has shown that the cognitive skills of memory and learning, attention deficits, problem-solving, abstract thinking, critical thinking skills, and visuospatial skills, as well as skills associated with executive
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functioning, such as sequencing and organizing, are impacted (Bauer, et al., 2012; Beer et al., 2009; Heckman et al., 2007; Ogren et al., 2014; Wolfe et al., 2006).

An increasing number of studies examining the prevalence and correlates of cognitive impairment in HF are being conducted with the goal of identifying the contributors to cognitive impairment so that interventions can be developed to address these problems, improve quality of life and reduce re-admissions and expense. According to Ogren, et al. (2014), impairments in Executive function are caused by injuries to the prefrontal and anterior cingulate cortices, where the anterior cingulate shows a loss of gray matter in HF patients. The caudate nucleus is also damaged, which has an important role in goal directed actions, such as deciding on which behavior to engage in to achieve a desired outcome. An example of dysfunction in the caudate nucleus would be having difficulty following HF medical and nursing therapies resulting in deficits in self-care skills (Ogren et al., 2014).

In a study examining the profile of cognitive impairment in chronic HF, 58 outpatients (mean age 68.7 ± 9.1 years, 26% female, mean LVEF 27% ± 7.2) who did not have a previous diagnosis of dementia. The participants completed with an extensive battery of neuropsychological tests of cognitive speed, executive function, memory, verbal skills, and visuospatial function (Vogels, Oosterman, Van Harten, Gouw, et al., 2007). The results were that 14 (25%, p = .04) of the 58 HF patients showed more problems with executive function, memory, language, mental speed and attention compared one (4%) of 26 healthy controls. The factors associated with cognitive impairment were smoking (p .01), lower diastolic blood pressure (p .008), and duration of heart disease (p =.02). Neuroimaging was used to investigate the relationship between
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cerebral abnormalities detected by MRI and cognitive performance. Medial temporal lobe atrophy (MTA) correlated with memory ($r = -0.353, p < 0.01$), with executive functions ($r = -0.383, p < 0.01$) and the MMSE ($r = -0.343, p < 0.05$). The MMSE score ranged from 24 to 30 points out of a possible 30 points (MM = 27.6), which would not have identified any cognitive impairment.

A study examining factors contributing to cognitive impairment in HF evaluated 14,089 participants of the Reasons for Geographic and Racial Differences in Stroke cohort (Pullicino et al., 2008). It was revealed that participants with HF were 1.51 times more likely to have cognitive impairment than those without HF (95% CI: 1.15-1.96). Characteristics associated with cognitive impairment in HF were older age, male gender, and black race ($p < .0001$). Additional characteristics associated with cognitive impairment were annual income $< 25,000$, education $\leq$ high school, current alcohol and tobacco use, and having the comorbidities of diabetes, hypertension, atrial fibrillation, heart disease, low hemoglobin ($< 13$), depression, and prior stroke (all with $p < .0001$).

Beer et al (2009) examined contributors to cognitive impairment in HF by having 31 patients with HF (LVEF $< 40\%$, mean age 54.3, male 83.9\%) and 24 controls without HF (mean age 56.1, male 83.3\%) participate in a battery of cognitive testing (the CAMCOG portion of the Cambridge Examination for Mental disorders of the Elderly), a depression scale, a 6-minute walk test, and semi-quantitative magnetic resonance imaging (MRI). The results showed that the HF patients had a mean CAMCOG score of 93.5 (SD 6.1) compared to 99.9 (SD 2.4) in the healthy participants ($p < .001$). Characteristics associated with statistical significance were shorter distance on the 6-minute walk ($p < .001$), higher rennin concentration ($p < .001$), higher aldosterone concentration ($p .003$),
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and more prominent right medial temporal lobe atrophy (p .03) which is consistent with memory disorders.

Research has been published in the nursing literature in the last 20 years to examine cognitive function in HF patients due to the importance that patients’ abilities to adhere to HF therapies and engage in self-care activities require relatively unimpaired cognitive functioning. In a study examining 148 participants (57 ± 12 years) with Class III/IV HF, 33.1% of the participants had mild cognitive impairment using 26 as the cutoff on the MoCA tool (Lee et al., 2013). When 24 was used as the cutoff, 14.2% had mild cognitive impairment, but improved ability to detect blunted self-care skills. Participants who scored lower reported 21.5% worse self-care skills than those who scored > 26.

Bauer, & Pozehl (2010) explored patterns of cognitive impairment to see whether there were differences between systolic and diastolic HF etiologies. Forty eight adults (75 ± 9 years) in the systolic dysfunction group were compared to 32 adults (68 ± 15 years) in the diastolic dysfunction group on the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), Trail Making Test Part A and B, and Letter Fluency. They found that 66% of the participants with systolic dysfunction were impaired on memory tests vs. only 21% of those participants with diastolic dysfunction, with immediate (p = .027) and delayed memory (p = .001) being more significantly impaired in the systolic dysfunction group.

Another nursing study to assess cognitive function in HF patients (LVEF < 40%) examined 38 patients (mean age 64 ± 7.62; 76.3% male) using several neuropsychological tests including the Wechsler Abbreviated Scale of Intelligence (WASI), the Wisconsin Card Sorting test (WCST), the Schonell Graded Word Reading
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Test SGWRT), and the Repeatable Battery for Assessment of Neuropsychological Status (RBANS) (attention, immediate and delayed memory) (Wolfe et al., 2006). The results of the study revealed impaired memory and impaired executive functioning with RBANS scores being significantly different from age-expected scores ($p < 0.001$). The immediate memory score was significantly lower than the age-adjusted norms ($p = 0.014$) and likewise the delayed memory score ($p < 0.001$). The Visuospatial constructional index score was also less than age-expected scores ($p < 0.001$). Similar results were found for the WCST tests of executive functioning ($p < 0.001$).

A descriptive, correlational design was used to describe cognitive impairment in HF patients (Riegel, Bennett, et al., 2002). Four screening measures of cognition were tested in 42 patients with HF. Cognitive impairment was detected in 12 (28.6%) of the participants. The Draw-a-Clock Test indicated impairment in 50% of the 12 impaired patients, while the other tests, including the MMSE, varied in effectiveness. The Draw-a-Clock test used in this study cannot be used to detect problems with verbal learning or delayed recall. The authors recommended using it in conjunction with other tests.

There has been more research on cognitive function in HF resulting in evidence of cognitive impairment due to brain injuries from HF. A study of prevalence and documentation of cognitive impairment in older adults with HF showed that cognitive impairment was present in 132 of 282 patients (46.8%) (Dodson, et al., 2013). Using the Folstein Mini-Mental State Examination, 25.2% scored mild cognitive impairment and 21.6% scored in the moderate to severe range for cognitive impairment. Hajduk, et al. (2013) assessed cognitive impairment in the domains of memory, processing speed, and executive function using a standardized neuropsychological battery of tests to find an
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association between cognitive impairment and adherence to self-care in patients hospitalized with HF. They studied 577 patients and found that 79% were impaired in at least one cognitive domain and that impaired memory was associated with lower self-care scores \((p = .006)\) (Hajduk et al., 2013).

Another in-hospital study investigated the prevalence of cognitive impairment in the cognitive domains of memory, processing speed, and executive function using standardized measures (Levin et al., 2014). Levin et al. (2014) studied 744 patients hospitalized with acute decompensated HF and found that 593 (80%) were impaired in at least one cognitive domain and that 17% were impaired in all three cognitive domains.

These studies highlight the importance of intact cognitive function on HF patients’ abilities to perform daily weights, follow a fluid restriction and take diuretic medications as prescribed. The cognitive skills required to perform these tasks include organizing, sequencing, planning, problem-solving, and math calculations. The area of the brain that performs these tasks is the Executive Function area of the brain and this is precisely the area of the brain that has demonstrated damage in MRI’s of the brain reported in the literature (Vogels et al., 2007; Woo et al., 2009). Therefore, if HF patients have this brain damage, then they will be unable to perform the tasks of organizing their medications, calculate the amount of fluid they are allowed to drink, and remember to weigh themselves, or even problem-solve the meaning of changes in their weight.

**Cognitive Assessments.**

There is very little research done on screening for cognitive function in HF patients (Athilingam et al., 2011; Athilingam & King, 2007-2008). A review of the literature reveals a paucity of cognitive function screening tools for use by the bedside
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clinician to quickly and accurately assess patients and to plan for their care in the
community setting (Athilingam & King, 2007-2008; Pressler, 2008; Riegel, et al., 2002).
Just in the last decade, a new screening tool has been developed called the Montreal
Cognitive Assessment (MoCA) tool that may provide the bedside clinician with a rapid,
accurate assessment of cognitive function that will not be a burden on seriously ill HF
patients who fatigue easily (Nasreddine et al., 2005). The testing components of the
MoCA are drawn from multiple testing tools, such as the National Institutes of Health
Stroke Screening Tool (NIHSS) (NIH, 2009), the Mini-Mental State Exam (Folstein, et
al., 1975), and the Clock Drawing test (Watson, Arfken, & Birge, 1993). These
components are designed to screen for abnormalities in the Executive Function areas of
the brain, including visuospatial capabilities, verbal, and calculation capabilities
(Nasreddine et al., 2005).

The MoCA has been tested on a wide variety of populations such as those with
Alzheimer’s Disease (Luis, Keegan, & Mullan, 2009), cardiovascular disease
(McLennan, Mathias, Brennan, Russell, & Stewart, 2010), aging issues (Koski et al.,
2009), Huntingdon’s Disease (Videnovic et al., 2010), Parkinson Disease (Dalrymple-
Alford et al., 2010), Stroke (Godefroy et al., 2011; Pendlebury, Cuthbertson, Welch,
Mehta, & Rothwell, 2011), Stroke Rehabilitation (Aggarwal & Kean, 2010), and
substance abuse disorders (Copersino et al., 2009). While most published studies report
participants from the outpatient setting, the MoCA has also been tested on patients in the
acute care setting (Godefroy et al., 2011) and an in-patient rehab setting (Aggarwal &
Kean, 2010). The MoCA has also been tested on HF patients (Athilingam, 2008;
Athilingam et al., 2011; Gallagher et al., 2013; Harkness et al., 2011; Lee et al., 2013).
In the Harkness et al. (2011) study, 44 HF patients (mean age 76 +/- 6.6), NYHA Class I-IV, with no suspected or documented cognitive impairment, completed the MoCA. More than 70% scored below the MoCA cutoff score of 26. However, 91% of patients with NYHA Classes III-IV had a MoCA scored < 26, while 52% of patients with NYHA Class I-II scored below 26 (p = 0.004). Cognitive domain sub-scores showing significant differences were short-term memory, visuospatial function, executive function, and language (p < 0.01). The Montreal Cognitive Assessment tool was used to study 128 HF participants in which it was found that 22% were classified as impaired, scoring < 22 on the MoCA (M 80.65 years) in the domains of delayed recall, visuospatial/executive function and abstraction (Gallagher, et al., 2013). In a study examining whether impairment in certain cognitive abilities could predict self-care ability in patients with systolic impairment, 148 stable HF outpatients completed the Montreal Cognitive Assessment (MoCA) tool, which measures short term verbal memory recall, visuospatial ability, executive function (organizing, sequencing, problem-solving, math calculation), attention, concentration, working memory, language, and orientation (Lee et al., 2013). The results showed that 14.2% of the participants scored lower than 24 on the MoCA. They reported 21.5% worse self-care scores (European HF Self-care Behavior Scale-9) than the participants whose MoCA scores were > 24 (p = .014) and 51% worse consulting behaviors (p < .001).

The Mini Mental State Exam (MMSE) is an exam that was originally developed to quantify cognitive impairment and to attempt to differentiate organic from psychiatric etiologies (Folstein et al., 1975). It has proved extremely useful since its inception to diagnose cognitive impairment, including dementia. A literature review for this study
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found that in one study, comparing the MMSE and MoCA provided equivocal results (Godefroy et al., 2011), but in others, the MMSE was not sensitive enough to quantify deficits in Executive Dysfunction (Dong et al., 2010; Kaufer et al., 2008; Luis et al., 2009; Pendlebury et al., 2011; Serber et al., 2008; Watson et al., 1993; Woo et al., 2009).

Athilingam et al., (2011) enrolled 90 community dwelling adults with HF aged 50-89 years (mean 62, SD 9) and administered both the MMSE and MoCA. Most (77%) had systolic HF as evidenced by an ejection fraction of < 40%. Among the participants, 54% scored < 26 on the MoCA, while only 2.2% scored below 24 on the MMSE, yet was not statistically significant ($\chi^2[1] = .348, p = .49$). The mean MoCA score was 24.86 (SD 2.81), while the mean MMSE was 28.96 (SD 1.66). The authors felt that part of the reason their study failed to show statistical significance on the score difference might have been due to a predominance of NYHA Class II patients who had less cognitive impairment. Class III-IV patients enrolled in fewer numbers due to feeling fatigued. Additionally, the cardiology services at their institution utilized the services of advanced-practice nurses using a transitional-care model and cardiologists with disease-specific competencies. The authors felt that these attributes may have resulted in improved patient outcomes and reduced use of resources. Therefore, the results possibly do not represent all community-dwelling individuals with HF who may have been unable to seek care at a University Medical Center with up-to-date HF services.

Pendlebury et al. (2011) tested 413 patients with transient ischemic attack and stroke. It was found that both the MMSE and MoCA were highly correlated ($r^2 = 0.80$), but that the MMSE scores were more skewed than the MoCA, which were more normally distributed. From that sample, 291 (70%) had a MoCA score of < 26 /30, while 162 had
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an MMSE of ≥ 27/30. On the other hand, only 5 patients had a MoCA ≥ 26 when the MMSE was < 27 (p < .0001). Additionally, in patients with an MMSE ≥ 27 and the MoCA < 26, the patients had higher Rankin scores (p = .0003), indicating greater functional disability and had deficits in delayed recall, abstraction, visuospatial/executive function, and sustained attention. These results demonstrate that the MMSE demonstrated scores within an acceptable normal range, when in fact there were measurable cognitive deficits that would impact a patient’s ability to care for themselves.

Still comparing the MoCA and the MMSE, 100 post-mild stroke patients without significant physical disability, dysarthria, aphasia, or pre-existing dementia were evaluated using the MMSE and MoCA (Dong et al., 2010). Fifty-seven patients had normal MMSE scores (> 24). Of those 57, 18 (32%) had MoCA scores < 21, which was the definition of impairment in this study. In contrast, only 2 out of the 41 with unimpaired MoCA scores had impaired MMSE scores. The cut-off of 21 in the MoCA was determined by the sensitivity and specificity statistics. At 21/22, the MoCA had a sensitivity of 90.3%, and a specificity of 76.8%. The lower the score, the less sensitive the test became, but the specificity improved. The same rational for the sensitivity and specificity of the MMSE cutoff score of 24 (85.5%/82.1%) (Dong et al, 2010). Dong et al. (2010) postulated that the weakness in the MMSE is the absence of visuospatial, executive function, and abstract reasoning tests.

Many of the therapies, such as taking many medications throughout the day and following a low-sodium diet and fluid restriction, require utilization of the cognitive skills of planning, organizing, and sequencing in order to successfully adhere to the program. These executive functions are not readily apparent in patients on a day-to-day
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basis, so many patients, apparently cognitively intact, are discharged to home with the usual discharge instructions, only to return in a few short weeks with acute exacerbation of HF and a marked lack of understanding about how that happened (Miller & Shaper, 2015; Ogren, Fonarow, & Woo, 2014; Paul & Hice, 2014; Pressler et al., 2010).

Recent research has begun to document the presence of mild cognitive impairment in HF patients, particularly in the areas of executive function. Therefore, assessing cognitive function by discharge from an acute care facility would be an important part of discharge planning, as these patients, and their families, may need additional support in the home to follow these HF therapies. The search for a rapid, accurate, ease-of-administration cognitive assessment tool is underway, with most of the published research comparing various tools to the MMSE. However, as described above, the MMSE is frequently unable to test for delayed recall, abstraction, visuospatial and executive function. As a result of this mounting evidence, the MMSE will not be used in this study to quantify cognitive function, but rather the MoCA (Appendix C) will be used to screen for cognitive function. This study will attempt to bridge the gap in knowledge and practice concerning assessment of cognition and the impact of cognitive function on change in weight in HF patients.

Change in Weight.

According to Gibson (2005), “Body weight is the sum of the protein, fat, water, and bone mass in the body” (p. 257). Since fat contains essentially no water, the remaining components, protein, bone mass and water, the “fat free” mass, are 73% water (range of 67% to 77%) in healthy individuals (Gibson, 2005). In steady state individuals, fat mass remains relatively constant, so any fluctuations in body weight in a one-to-five
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day period would be related to fluid fluctuations, not fat (Heymsfield & Baumgartner, 2006; Konishi et al., 2009). Body weight is considered to be that weight where the cardiac output for an individual is maximized, and evidence of excessive fluid accumulation in the lungs, abdomen and extremities is not present (Lindenfeld et al., 2010). For this reason, and to maintain body weight, HF patients are prescribed a fluid restriction of 1.5 – 2 Liters per day from all sources (Gruszczynski et al., 2010; Guglin, 2011; Lindenfeld et al., 2010).

Research studies have shown that many HF patients do not weight themselves daily to monitor for weight gain (Howlett, 2011; Moser, Doering, & Chung, 2005; Riegel, Dickson, Goldberg, & Deatrick, 2007). Two hundred two patients with Class III-IV HF, recently discharged from the hospital within 3-7 days, were assessed on many physiologic, functional and psychological variables, including adherence to several self-care attributes (Moser et al., 2005). These attributes included adherence to medications, low-sodium diet, daily weights, and symptom monitoring. It was found that only 14% of these patients weighed themselves daily (Moser et al., 2005).

Preventable causes of hospital admissions for decompensated HF were examined in a quantitative study where 179 HF patients (mean age 75.4 years; 88.1% were New York Heart Association [NYHA] Class II or IV) were interviewed about medications, diet, sodium intake, fluid management, and daily weights (Michalsen et al., 1998). Of these patients, 75% reported taking their drugs intermittently. Daily fluid intake could only be estimated in 92.2% of the patients and of those, 34% consumed more than 2.5 liters per day. Only 26.3% of patients were aware of the need for fluid restriction or paid attention to their daily fluid intake. Only 38.2% of patients weighed themselves regularly,
even though 86.6% of patients had scales at home. Lack of correlation between knowledge and adherence was also found in this study. Overall, it was found that 41.9% of causes of acute decompensation in this population were due to non-adherence to drugs or diet.

Konishi et al. (2009) examined the clinical characteristics of 194 patients admitted for acute decompensated HF. It was noted that some patients had a rapid onset of symptoms of dyspnea with more pulmonary congestion, while others had a slower onset, occurring over several days which was also associated with peripheral edema to a greater extent (p < .001). An analysis of these two groups showed that the rapid on-set group was associated with excessive water intake (80%), whereas the gradual progression had a lower proportion of patients who consumed excess water (32%) (p < 0.001). Unfortunately, the amount of weight lost during the hospitalization, which would be a measure of the amount of excess intravascular fluid (Francis & Tang, 2004), was not reported. The authors report that a weakness of this study was that it was a retrospective chart review, so precise quantification of the amount of water consumed was impossible. The definition of excess water consumption, a critical factor in the patients’ progression to acute decompensated HF was defined loosely as “…the consumption of more drinks than usual” (p. 304) (Francis & Tang, 2004).

Weight Assessments.

In a hemodynamically stable patient, the body weight will remain stable from day to day in the short term ± 2 lbs. (Lindenfeld et al., 2010; Moser & Riegel, 2004). In Riegel’s Situation-specific heart failure self-care theory, the ability of the patient to maintain this stability is called weight maintenance. Patients with HF who are beginning
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to retain fluid volume, will typically demonstrate an increase in weight (Francis & Tang, 2004). An overnight change of weight of > 1 lb. as measured by simple bathroom scales would not be fat accumulation, but rather water weight (Jessup & McCauley, 2003; Miller & Mullan, 2014; Moser & Riegel, 2004).

The importance of helping patients understand the need to weigh themselves daily, to assess the significance of any weight gain, to implement a treatment regimen, and to evaluate its effectiveness cannot be overstated. Patients must be engaged in their own self-care and must have the cognitive skills to engage in these self-care behaviors. It has been demonstrated that a significant number of patients do not weigh themselves daily, let alone assess significance, implement a treatment, or evaluate its effectiveness.

Little research has been done to document weight maintenance in this population, although weight maintenance is critical in the management of this chronic condition.

**Depression.**

It is becoming well documented that individuals with HF have a significant incidence of depression (Alosco, et al., 2013; de Jonge et al., 2006; Faller et al., 2011; Frasure-Smith et al., 2009; Heo, Moser, Pressler, Dunbar, Dekker, and Lennie, 2014; Nabi et al., 2010; O'Connor et al., 2010; Ogren et al., 2014; Pressler et al., 2010; Rutledge, Reis, Linke, Greenberg, and Mills, 2006; Stewart, Fitzgerald, & Kamarck, 2010; Tang, Yu, & Yeh, 2010; Thombs et al., 2010; Tousoulis et al., 2010; Turvey, Schultz, Arndt, Wallace, & Herzog, 2002; Woo et al., 2009). While the occurrence of depression in the general population has been estimated to be around 7% (Compton, Conway, Stinson, & Grant, 2006), 22% (Ogren et al., 2014), and 40% (Tousoulis et al., 2010), depression in the cardiovascular population has been variously measured to be
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anywhere from 10% (de Jonge et al., 2006) to 31% (Heo, et al., 2014) and 42% in Class IV patients (Rutledge, Reis, Linke, Greenberg, & Mills, 2006).

Rutledge et al. (2006) did a meta-analysis of existing literature prior to 2006 and put the number of depressed HF patients at 21.5% of all HF patients, but doubling that rate among patients with more severe HF (Rutledge et al., 2006). Rutledge (2006) did not specify whether patients being studied were in-patients or out-patients due to the fact that they were reviewing 36 articles that studied depression in HF patients. Some articles discussed changes in depression in follow-up after being hospitalized for treatment. Whether that hospitalization was for treatment of HF or for depression is unclear. For hospitalized HF patients, one study documented the prevalence of depression to be as high as 51% (Freedland et al., 2003).

It is documented that there are biologic mechanisms at work in HF patients that contribute to depression over and above a psychological unhappiness about having a terminal illness (Tousoulis et al., 2010). Depression in HF patients has been attributed to impaired function of monoamine adrenergic neural receptors, increased activity of the rennin-angiotensin-aldosterone system as well as the hypothalamus resulting in increased circulating glucocorticoids (Ogren et al., 2014). There are also alterations in the autonomic nervous system, chronic systemic inflammatory process mediated by cytokines, and increased serotonin levels and catecholamine levels (Ogren et al., 2014).

Transcranial doppler (TCD) ultrasonography was employed to assess cerebral blood flow velocity and compared to scores on the BDI-II in 89 outpatients with NYHA Class II-III HF (M = 67.61, s.d 11.78 years; 73% male) (Alosco et al., 2013). On the
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basis of established cut-off scores for the BDI-II, 15.7% of the participants exhibited mild, moderate and severe depressive symptoms.

Coupled with those biologic factors are psychologic factors related to feelings about reduced ability to exercise, increased fatigue, decreased ability to engage in usual self-care activities and minimal social support systems (Tousoulis et al., 2010). It has been demonstrated that the experience of depression is more severe in patients with NYHA Class IV than Class I, quite possibly related to worsening dyspnea and fatigue (Freedland et al., 2003 (Ogren et al., 2014; Rutledge et al., 2006; Tousoulis et al., 2010).

Freedland et al (2003) administered the Beck Depression Inventory (DPI) to 613 hospitalized patients (age >40, 50.5% female, 61.7% Caucasian) and found that while 51% scored ≥ 10, thus meeting the DPI criteria for some level of depression, it was found that evidence of depression varied widely depending on age (< 60 vs. > 60), male vs. female, NYHA classification IV > I, and whether there were certain comorbidities such as COPD, sleep apnea, or history of depression. In a study examining depression following myocardial infarction, de Jonge et al (2006) found that 216 out of 1, 972 patients (10.9%) met the diagnosis of clinical depression according to ICD-10 criteria. Frasure-Smith et al. (2009), examined 974 HF patients (66 ± 11 years of age; 17.7% women) with atrial fibrillation from ten countries using the Beck II Depression Inventory (BDI-II). Overall, 32% had BDI-II scores ≥ 14 (mild to mod symptoms of depression) (p = .001). In a study examining whether depression predicted coronary heart disease and cerebrovascular disease, 23,282 adults (9,507 men), aged 20-54 years were followed for seven years. Using the Beck Depression Inventory II, 19.6% of all participants scored ≥ 10, indicative of depression (Nabi et al., 2010).
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While examining the relationship between cognitive deficits and health related quality of life in 249 HF patients, Pressler et al. (2010) measured depressive symptoms using the Patient Health Questionnaire 8 (PHQ-8) and found the mean score was 6.5 where a score above four was the cutoff for increasing degrees of depression. Specifically, 26% had moderate or high depressive symptoms because of PHQ-8 scores of ≥ 10 out of 24. Heo, Moser, Pressler, Dunbar, and Dekker (2014) documented that depressive symptoms in 145 HF patients were more prevalent in the presence of a high circulation of the inflammatory markers tumor necrosis factor (TNF), interleukin-6, and soluble TNF receptors I and II (F = 7.915, p = .005).

One hundred seven participants (aged 42-89, mean 69.31), predominantly male (53.3%) were assessed for depression as part of a fatigue in HF study (Tang, et al., 2010). In this study, the BDI-II mean score, was 15.9 (SD 6.23), consistent with mild depression. Neither the number nor percent of the participants with depression in this study was reported. An early study, aimed at quantifying the prevalence of depressive symptoms in community dwelling patients with HF, used the Center for Epidemiologic Studies – Depression Scale (CES-D) with 6,125 people aged ≥ 70 years. The study revealed that 11 % of HF patients met criteria for depression, compared to 4.8% of patients with other cardiac diagnoses and only 3.2 % of those with no reported heart condition.

In the research done on the brains of younger HF patients using MRI (Woo, et al., 2009), it was found that the areas involved showing brain injury correlated with emotional lability, including depression. Three hundred six patients (82% Caucasian male) with coronary heart disease completed an Inventory to Diagnose Depression which
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found that 8.6% met the DSM-II-R criteria for Major Depressive Disorder (Doerfler, Pbert, & DeCosimo, 1997). Neuroimaging was used by Vogels, Oosterman, Van Harten, Gouw, et al. (2007) to investigate the relationship between cerebral abnormalities detected by MRI and cognitive performance in 58 HF patients (mean age 68.7 ± 9.1 years, 26% female, mean LVEF 27% ± 7.2) who did not have a previous diagnosis of dementia. Depression was also assessed and it was found that white matter hyperintensities were correlated with depression and anxiety scores (p < 0.05).

Not all studies support the presence of significant depression in people with cardiovascular diseases other than HF. Stewart et al. (2010) studied the emotional risk factors for coronary artery disease of depression and hostility in 296 men and women aged 50-70 years over 6 years and found BDI-II mean scores of only 3.8 (± 3.9) at baseline and 5.1 (± 5.1) at the end of the study. In a study examining the effect of somatic complaints on 477 post-acute myocardial patients’ self-report of depression, the BDI-II scores were 9.2 (SD = 7.9) (Thombs et al., 2010).

Clearly, there is evidence that results of studies may vary as described so well by Freedland et al. (2006) due to differences among studies as to age, gender, NYHA Classification, various depression measuring tools, and comorbidities. However, there is strong support for the occurrence of depression in HF patients that by many measures may exceed the occurrence of depression in the general population.

Cognitive Impairment and Depression.

A review of the literature reveals a growing body of research on the correlation of depression and cognitive impairment (Butters et al., 2004; Cameron et al., 2009; Clark & McDougall, 2006; Frasure-Smith et al., 2009; Meiner, 2011; Pullicino et al., 2008).
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However, the correlation between the two is proving to be inconsistent. Turvey et al. (2002) examined the rates of depression in 6,125 older patients (mean age 76 ± 6) using the CES-D, but also cognitive status using a Telephone Interview for Cognitive Status, which was modeled after the MMSE. It was found that the “CES-D score, comorbid illness, physical and cognitive disability and fatigue … entirely accounted for the association between HF and depression” (p > .0001) (p. 2006). A study examining factors contributing to cognitive impairment in HF evaluated 14,089 participants of the Reasons for Geographic and Racial Differences in Stroke cohort (Pullicino et al., 2008). It was revealed that participants with HF were 1.51 times more likely to have cognitive impairment than those without HF (95% CI: 1.15-1.96). Cognitive impairment was found to be associated with depression (p < .0001).

While examining the relationship between cognitive deficits and health related quality of life in 249 HF patients (mean age 62.9, SD 14.6; 63.5% male; 67 % white, 31.7% African American), Pressler et al. (2010) measured cognitive status using the MMSE, the Wechsler Test of Adult Reading, the Boston Naming Test, the Digit Span, the Hopkins Verbal Learning Test, Figure Copy, Digit Symbol, Trail Making Test A & B, and the Controlled Oral Word Association Test. The sample included patients from all four NYHA Classes, 73% of which were Class II & III, with a mean ejection fraction of 28.3 % (SD 10.2). In this study, 26% had moderate to high depressive symptoms and 24% had cognitive deficits in three or more domains. Since this study was examining the relationship of cognitive deficits to Health Related Quality of life, a statistical relationship between cognitive deficits and depression was not reported.
Neuroimaging was used by Vogels, Oosterman, Van Harten, Gouw, et al. (2007) to investigate the relationship between cerebral abnormalities detected by MRI and cognitive performance in 58 HF patients (mean age 68.7 ± 9.1 years, 26% female, mean LVEF 27% ± 7.2) who did not have a previous diagnosis of dementia. It was found that while memory and executive functions were associated with changes in the medial temporal lobe atrophy (MTA), depression was associated with changes in the total and deep white matter hyperintensities (WMH) and that cognition and depression were not statistically correlated. The authors concluded that this lack of correlation was compatible with other reports in the literature that were unable to demonstrate a consistent association between the two.

**Depression Assessments.**

Because of the inconsistencies in research demonstrating that the presence of depression may or may not impair cognition (Kinsinger, Lattie, & Mohr, 2010; Pullicino et al., 2008), it is necessary to document the presence or absence of depression in this HF population and to assess whether there is a difference in cognitive function scores on the MoCA between patients who have depression and patients who do not. Beck, Ward, Mendelson, Mock, and Erbaugh (1961) developed and tested what became known as the Beck Depression Inventory II. The Beck Depression Inventory II was chosen for this study (Appendix D), because it has a proven track record for screening for the presence of depression in cardiovascular patients (Frasure-Smith et al., 2009; Nabi et al., 2010; Stewart et al., 2010; Tang et al., 2010; Thombs et al., 2010).
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**Activities of Daily Living (ADL).**

With moderate to severe cognitive impairment, it may be noted that the individual may have difficulties completing basic care activities such as bathing and dressing (Meiner, 2011). It has been demonstrated that a patient’s ability to care for themselves and engage in activities of daily living correlates with cognitive function (Katz, S., 1983). The Katz Index of Activities of Daily Living (ADL) Tool (Katz, Downs, Cash, & Grotz, 1970) (Appendix A) is a useful way of documenting the presence of impairments in function in the areas of bathing, dressing, toileting, transferring, continence, and feeding (Katz, S., 1983; Katz, et al., 1970; Meiner, 2011). This tool has been in use for four decades to document functional decline in the cognitively impaired, as well as in persons with disability (Chen & Kane, 2001; Graf, 2006; Katz, S., et al., 1970; Wallace & Shelkey, 2007). It is used by health care providers to plan for care in the acute care setting as well as in the community setting and to quantify decline in functional ability through repeated measures over time (Wallace & Shelkey, 2007).

In a study examining functional outcomes in 214 community dwelling elders (mean age 77 years +/- 7), who required hospital admission for community-acquired pneumonia, exacerbations of chronic HF, chronic obstructive pulmonary disease (COPD), or cellulitis, 84 were treated in Hospital at Home (HaH) and 130 were treated in an acute care hospital (Leff et al., 2009). The Katz ADL tool was used to quantify the status of Activities of Daily Living from 1 month before admission to 2 weeks post-admission in each group. In another study, the Katz ADL tool was used as a gold standard comparator to test a Short Physical Performance Battery (SPPB) to quantify functional status in a group of 92 women and men (49% women) ≥ 65 years of age (mean
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age 77.7 years; range 65-94) who were able to walk and who were admitted to the hospital with HF, pneumonia, chronic obstructive pulmonary disease (COPD), or minor stroke (Volpato et al., 2008). The results of the positive correlations (-.45 on admission, p < .0001 and -.54 at discharge, p < .001) of the SPPB with the Katz ADL tool provided the first evidence of the utility of the SPPB for lower extremity physical function measures.

**Activities of Daily Living Assessments.**

Over the years, the Katz ADL tool has been modified or combined with the Lawton and Brody Instrumental Activities of Daily Living Tool (IADL) to meet the measurement needs for special populations. An example of this modification is apparent in a study examining the ADL’s of older persons in primary health care who have HF (Norberg, Boman, & Löfgren, 2008). In this study, the basic Katz ADL tool was extended to form the Staircase of ADL (11) and was used to identify and obtain an overview of the participants’ perceived dependencies in ADL activities. The assessment comprised five personal activities of daily life (bathing, dressing, toileting, transfer, and feeding), plus four instrumental activities of daily life (cleaning, shopping, transportation and cooking). Performance level on each item was ranked on a 3-point scale of independent, partly dependent or dependent. The modified tool (the Staircase of ADL [11]) was then used to quantify the ADL-ability of older people with CHF syndrome. Forty persons > 65 years of age (mean age 81) with NYHA Class I-IV HF participated. Participants who were Class III/IV had significantly increased effort when performing ADL-tasks (OR: 15.5, CI 2.40-100.1, p = 0.004) compared to those in NYHA Class I/II.
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**Instrumental Activities of Daily Living (IADL).**

When cognitive impairment presents as short term memory loss, difficulty organizing and sequencing, and problem solving, it may be noted that the individual is also having difficulties completing more complex tasks such as using a telephone, shopping for oneself, preparing food using multiple steps, banking, and doing housekeeping (Graf, 2006; Katz, S., 1983; Lawton & Brody, 1969; Meiner, 2011). Lawton and Brody (1969) developed a tool called the Instrumental Activities of Daily Living Tool (IADL) (Appendix B) to quantify the ability of individuals to care for themselves in those domains as well as laundry, transportation, self-medication, and handling finances. This tool is used by health care providers to plan for care in the community setting and to quantify decline in functional ability through repeated measures over time (Graf, 2007). In this study, the IADL’s tool will be used to document this more advanced functional status. This tool is different from the ADL tool by Katz because it measures behavior that requires more complex cognitive skills (Katz, S., 1983; Lawton & Brody, 1969).

The IADL tool was used in a study examining the effects of using consumer and expert ratings of an activities of daily living scale to predict functional outcomes of patients hospitalized for stroke HF, COPD, hip fracture and hip replacement (Chen & Kane, 2001). In this study, another tool had been developed based on both the ADL and IADL and was being tested in these special populations. Leff et al. (2009) used the IADL tool in a study comparing functional outcomes of 214 community dwelling elders who required hospital admission for pneumonia, HF, or COPD. Eighty-four were treated in a Hospital at Home (HaH) situation and 130 were treated in a traditional acute care
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hospital. Measurements included a change in the IADL scores from 1 month before admission to 2 weeks post admission to HaH or acute hospital. Volpato et al. (2008) used the IADL as a gold standard against which to compare of the Short Physical Performance Battery (SBBP) in 92 older patients (mean age 77.7 years; range 65-94), who were admitted to the hospital with HF, pneumonia, COPD, or minor stroke. The SBBP was judged to be of future utility in the assessment of lower extremity physical function measures when it correlated with the IADL (-0.51, p < 0.001 on admission and -0.51, p < 0.001 at discharge).

In a study examining whether cognitive impairment contributes to limitations in instrumental activities of daily living, the Lawton and Brody IADL tool was used (McLennan et al., 2010). Two hundred nineteen patients with HF and diabetes were recruited from outpatient clinics. The IADL was used to measure functional ability and the MoCA was used to quantify cognitive function. Greater independence was associated with younger age (rs = .35, p < .001) more years of education (rs = -.026, p < .001), fewer cardiovascular diseases (rs = 0.26, p < .001) and better cognitive performance (rs = -.27, p < .001).

The IADL tool was used to document disability in a HF population of participants who were NYHA Class II-IV recruited from an outpatient clinic (Seo, Roberts, LaFramboise, Yates, & Yurkovich, 2011). The objective of this study was to identify factors that contributed to IADL disability. A convenience sample of 48 men and 53 women (mean age, 59.5 years) revealed that 71% of the variance in IADL’s was explained by dypnea (B = .67), functional capacity (B = -.25) and age (B = .19).
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**Instrumental Activities of Daily Living Assessments.**

Studies such as those described above provide important information about the more complex activities of daily living and provide guidance to healthcare providers in developing plans of care to target those factors that contribute to disability. In this study, the Lawton & Brody IADL tool will be used to assess more advanced levels of daily functioning (Lawton & Brody, 1969).

**Summary**

HF is a complex disease requiring many therapies for treatment. Because of the importance of weight maintenance in this population, it is important to document whether HF patients can maintain their weight over six weeks, preventing an expensive < 30-day hospital readmission. Riegel’s Situation-specific heart failure self-care theory, will provide guidance for the theoretical approach to this issue.

Weight maintenance is dependent on the HF patient’s ability to take all medications as prescribed, including multiple doses of diuretics, follow a low sodium diet and fluid restriction, weigh themselves daily and remember to call the health-care provider should their weight rise more than a couple of pounds above their discharge weight. Clearly, having intact cognitive function to plan, organize, sequence, and problem-solve is vitally important to maintain this regimen. Therefore, it would be useful to know whether cognitive function impacts changes in weight between discharge and the clinic follow-up appointment four to eight weeks later. It would also be critical to know whether diuretic dose adjustments make a difference in these weight changes in order to avoid expensive and debilitating re-hospitalizations.
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Cognitive function in HF is infrequently measured, but is recently being identified as a predictor of mortality in HF patients (Pressler et al., 2010). Intact cognitive function is critical to a patient’s ability to follow the complex treatment plan required for maintaining maximal cardiac output and maintaining body weight. Patients with memory loss may not be able to remember instructions resulting in errors with medication administration and fluid consumption resulting in increased weight and fluid shifts to the lung tissue. Health care providers, as well as family members may not be aware of early memory loss and difficulties with organizing, sequencing, complex reasoning and problem-solving skills. Therefore, patients with HF should be routinely assessed for impairments in these cognitive skills.

There are a large number of clinical tests used to measure cognitive function. The MMSE has been used in many studies (Conn, Taylor, & Miller, 1994; Gravely & Oseasohn, 1991; Naylor, Stephens, Bowles, & Bixby, 2005; Serber et al., 2008) to document the presence of cognitive impairment, but it has been documented to not be sensitive enough to capture early cognitive decline or impairments in Executive Function (Serber et al., 2008; Watson et al., 1993; Woo et al., 2009). However, the MoCA screening tool has been shown to test for Executive Function (Dong et al., 2010; McLennan et al., 2010; Nasreddine et al., 2005), so was used to document cognitive function in this study. Depression has been inconsistently shown to influence cognition while functional status has been shown to have a positive correlation with cognition and are frequently used as surrogate markers for cognition. Therefore depression and functional status was examined in this study in order to explore their influence on cognitive function. Since the HF nurses provide a variety of interventions, including use
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of additional diuretics to the participants after discharge in order to prevent readmissions, the number of additional diuretics used to prevent weight gain, was also tracked. As a result, the foregoing literature review of critical variables provided the underpinnings for examining whether there was a difference in weight change over time in those HF patients who scored low versus high on a cognitive assessment tool. The literature review also provided support for whether there was a difference in weight change over time in those HF patients who had a low number of diuretic dose adjustments versus a high number of diuretic dose adjustments when followed in the clinic one to two months after discharge from the hospital for an acute exacerbated HF admission.
Chapter 3: Design and Methodology

Research Design

The impact of cognitive function on change in body weight in HF patients was investigated using an observational, longitudinal, descriptive design. The main research variables in this study were cognitive function and change in weight. Change in weight was the difference in weight between discharge (T₁) and six-week follow-up (T₂) (+/- 2 weeks). Secondary variables known to impact cognitive function and body weight were measured in this study and included functional status (activities of daily living and instrumental activities of daily living) and depression. The number of times diuretic dosing was adjusted was also tracked.

Sample and setting

The participants were recruited using a convenience sample from the inpatient practices of three HF cardiologists at Penn Presbyterian Medical Center, a local
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University-affiliated Medical Center, admitted for acute exacerbation of HF. Penn Presbyterian Medical Center is a regional referral center for cardiac care, drawing patients from across southern New Jersey, as well as from the surrounding community in Philadelphia. The Inclusion/Exclusion criteria were defined as the following:

**Inclusion Criteria:**

1. The participants had to be hospitalized with a diagnosis of acute exacerbation of HF with systolic dysfunction (HFrEF).
2. The Left Ventricular Ejection Fraction had to be $\leq 40\%$ within the previous twelve months.
3. The participants had to speak and read English and had to sign an Informed Consent prior to any study procedures being performed.

**Exclusion Criteria:**

1. The participants could not be receiving dialysis at the time of potential enrollment because the electrolyte shifts and varying fluid balances are known to alter cognitive functioning (Muwaswes, 1993)
2. The participants could not have a history of severely diminished functional capacity or severe dementia necessitating full-time care, including nursing home patients admitted to the hospital as the care provider would have been providing all prescribed therapies or would have been ensuring that all medical therapies were followed.
3. The participants could not have had a diagnosis of active psychosis because the responses to the study tests may not have been reliable and valid (Muwaswes, 1993).
4. The participants could not have been pregnant due to the increase in baseline volume status associated with pregnancy which would result in exacerbation of HF (Elkayam & Gleicher, 1998).

5. The participants could not have had an MI within the last 6 months due to the altered cardiac and psychologic function after the MI which could have impaired cognitive functioning (Thombs et al., 2010; Watkins et al., 2003).

6. The participants could not have been using street or recreational drugs, or drink more than 4 alcoholic beverages per day per patient report due to the known impact that such substances have on cognitive functioning (Muwaswes, 1993).

7. There were no racial, ethnic, or gender exclusion criteria in order to ensure an ethically just inclusion of a wide variety of people with HF, more representative of the larger population of people with HF.

**Sample Size Estimation**

Originally, a power analysis for a regression analysis was anticipated based on an alpha of .05, a Power of 0.80 and a moderate effect size $R^2 = 0.13$, which resulted in the need for 77 participants (Munro, 2005). However, after 12 months of almost daily screening, only 30 participants signed consent forms and only 21 were suitable for data analysis due to deaths, withdrawal of consent, lost to follow-up, and meeting exclusion criteria. Therefore, as a result of the sample size, it was decided to examine the difference between baseline mean cognitive function MoCA scores and mean change in weight between $T_1$ to $T_2$.

An Independent t-test was considered, but we realized an a priori T-test requires 64 participants in each group for a two-tailed test with an alpha of 0.05, a moderate effect
size of .50 and a power of .80 (Munro, 2005). Since there were only 21 participants in the entire sample, the study was underpowered to detect statistical significance. Instead, the results of this pilot study will inform future research in this area.

**Measures**

**Cognitive Function:** In order to screen for a variety of cognitive domains, including those domains operational in Executive Function, the Montreal Cognitive Assessment tool (MoCA) was used (Dong et al., 2010; McLennan et al., 2010; Nasreddine et al., 2005). The MoCA was used to measure cognitive function in short-term memory (noun recall), Visuospatial abilities (clock-drawing task and 3-dimensional cube drawing), mental agility, organizing, planning, and sequencing (a short version of the Trail-making B task), ability to speak consonants clearly and repeat two complete sentences (phonetics), and a two-item verbal abstraction (Nasreddine et al., 2005). Attention, concentration, and working memory were evaluated using a sustained attention task with finger tapping, serial subtraction, picture naming, recalling words that begin with an “f,” and including orientation to time and place. The tool scores range from 0 to 30, with a cut-off of 26 indicating possible cognitive impairment in non-cardiac patients (Nasreddine, et al., 2005).

When the MoCA was developed, Nasreddine et al. (2005) compared the MMSE with the MoCA, and used a cutoff score of 26 for both tests. The MoCA demonstrated 90% sensitivity in the participants with mild cognitive impairment and 100% in the participants with Alzheimer’s disease. However, the MMSE demonstrated a sensitivity of 18% in the participants with mild cognitive impairment and 78% in the participants with Alzheimer’s Disease. Specificity was 100% with the MMSE and 87% for the MoCA.
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Test-retest reliability data demonstrated a correlation of 0.92, (p < .001). The internal consistency of the MoCA yielded a Cronbach alpha of 0.83. It was found that the 73% of the patients with mild cognitive impairment scored in the normal range on the MMSE, but in the abnormal range on the MoCA. In other words, the MoCA was measuring executive dysfunction which the MMSE was missing.

The MoCA was cross-validated between participants with Alzheimer’s disease and participants with mild cognitive impairment in a study by Luis, et al. (2009) in order to test sensitivity and specificity of the tool. One hundred eighteen adults in the southeastern US were tested using a cut-off score of < 25. This cut-off score demonstrated that the MoCA was not specific to cognitive impairment at that cut point. Using the recommended cut-off score of 26, the MoCA detected 97% of those with cognitive impairment, but the specificity was only fair at 35%. When the cut-off score was set at ≤ 23, the MoCA demonstrated improved sensitivity (96%) and specificity (95%) (Luis, Keegan, and Mullan, 2009).

The above review of the comparisons of the MoCA and MMSE demonstrates better specificity on the part of the MoCA to visuospatial, executive function, and abstract reasoning. The addition of the trail-making test or digit symbol test was recommended to supplement the MMSE to improve its sensitivity to those domains (Dong, et al., 2010). The MoCA has the Trail-making and digit symbol test already incorporated, along with a Clock Drawing test and cube-copying drawing test, both of which test visuospatial and planning skills. The ability of patients to be able to perform self-care requires the above cognitive skills. In order to do math calculations related to a 2 Liter fluid restriction, in order to remember to perform daily weights, in order to
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problem-solve the meaning of a 2 lb. weight gain and know to call their cardiologist, the
patients must have intact cognitive functioning. Therefore, the MoCA was used as a
cognitive function measurement tool in this study with a score of 24 as the cut-off point
to determine the presence or absence of cognitive impairment in HF patients (Cameron,
Worrall-Carter, Riegel, Lo, and Stewart, 2009; Lee et al., 2013).

In order to perform the MoCA test, the participant was asked to draw the dot-to-
dot, the cube, and the clock drawing directly on the paper form with a pencil, while the
bottom half of the paper was covered up. Then the participant was shown the pictures of
the animals and asked to name them. Afterward, the page was removed from the table
and the rest of the testing was administered verbally by the researcher. The form was
scored out of patient’s presence.

**Body Weight:** The patient was weighed during the research study visit, prior to
discharge (T1), using an Electronic 7544BL Cal-Max wide body, Glass Scale by Taylor
(China) bathroom scale. The scale could weigh up to 440 pound in 0.2 pound increments
and had a 15 inch wide 8 mm safety glass platform, wide enough for patient stability. The
scale was calibrated prior to use by tapping quickly on the platform which had been
placed on a hard surface. After the display turned on and off, the scale became ready for
use. The scale was transported to the patient in a brief case with shock absorbing
padding to promote reliability in measurements among the patients.

Change in weight was calculated from weights at T1 to weights at T2 on the
dedicated research bathroom scales. Participants were divided into three groups based on
change in weight: participants who lost more than two pounds by T2, participants who
maintained ± 2 lbs. from their T1 weight, and participants who gained more than two
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pounds by T2. The change in weight between the two time points was examined to see if the participant gained weight while in the home environment.

**Activities of Daily Living Tool.**

The Activities of Daily Living Tool (ADL) (Katz et al., 1970) was used to quantify the ability of individuals to care for themselves in the domains of bathing, dressing, toileting, transferring, continence, and feeding (Katz et al., 1970). The maximum score was 6 (one point for each area), where 4 indicated moderate impairment and 2 indicated severe impairment in function. Administration time was about five minutes. Reliability and Validity statistics could not be found in a literature search, but this tool has been the gold standard over the last forty years for these specific measurements (Graf, 2006; Wallace & Shelkey, 2007).

**Instrumental of Activities of Daily Living Tool.**

The Instrumental Activities of Daily Living Scale (IADL) (Lawton & Brody, 1969) was used to quantify the ability of individuals to care for themselves in the domains of telephoning, shopping, food preparation, housekeeping, laundry, transportation, self-medication, and handling finances (Graf, 2006, 2007; Lawton & Brody, 1969). The maximum score is 8 with 8 considered to be high functioning for women and 5 considered to be high functioning for men due to the fact that culturally speaking, most men do not do food preparation, housekeeping and laundering even if they are able (Graf, 2007). A score of zero is considered to be the lowest level of functioning and is consistent with total dependency. Administration time is about 10-15 minutes (Graf, 2007). This tool has been used for four decades to quantify functional status and has proven reliability and validity.
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Reliability was tested originally with the Physical Self-Maintenance Scale (PSMS) and was .96 with an inter-rater reliability of .87-.91 (Lawton & Brody, 1969). The validity was established by correlation with the Physical Classification of physical health scale, the Mental Status Questionnaire, the Behavior and Adjustment scale and the PSMS. All correlations were significant at the .01 or .05 level (Lawton & Brody, 1969). Administration time was about 10-15 minutes (Graf, 2007).

**Depression: Beck Depression Inventory II.**

The Beck Depression Inventory II (BDI-II) was chosen for this study, because it has proven to reliably screen for the presence of depression in cardiovascular patients (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; Frasure-Smith et al., 2009; Nabi et al., 2010; Stewart et al., 2010; Tang et al., 2010; Thombs et al., 2010; Watkins, et al., 2003). The BDI is an easily administered twenty-one-question Likert Scale tool. The scores range from zero to 63, with the higher score indicative of depressive symptoms. Scores ranging from 0-13 indicate minimal depression. Scores greater than 14 indicate mild to severe depression (Beck, Steer, & Brown, 1996).

The reliability testing at its inception, using Kruskal-Wallis Non-parametric Analysis of Variance by Ranks, revealed a very high correlation at the .001 level for every category tested except for the weight loss category, which was significant at the .01 level (Beck, Ward, Mendelson, Mock, and Erbaugh, 1961). Its reliability was measured by Reynolds and Gould (1981) and found to be .85. Reliability was tested by Kinsinger, et al. (2010) and found to highly correlate with the Hamilton Rating Scale for Depression (r = .71, p < .001). Validity of the instrument was established by its developers using the Kruskal-Wallis One-way Analysis of Variance by Ranks. For both the original group and
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the replication group, the p-value of the differences between the means was < 0.001 (Beck, et al., 1961). In using this tool, it must be kept in mind that it may test falsely positive for depression. For example, a positive reply on the “fatigue” item may be due only to the fatigue present in HF, not due to depression (Alosco et al., 2013; Heo et al., 2014), although one study was found that found that removing the fatigue question from the BDI-II did not bias the association between depression and fatigue in patients with coronary artery disease (Bunevicius, Brozaitiene, Stankus, Bunevicius, 2011).

**Fluid Management Questions.**

An important attribute of self-care management is the ability to know and follow a prescribed fluid restriction prescription provided by the cardiologist or nurse practitioner. To document that data, participants were asked questions about the amount of fluid they were allowed to have, whether they followed the fluid prescription, and how much they consumed (Appendix E). In addition, they were asked whether they weighed themselves daily, and to describe how they kept track of how much fluid they consumed. Additionally, the participant was asked to report whether they had a fluid restriction prior to being admitted to the hospital and how much it was, their best estimate of whether they followed the fluid restriction and whether they weighed themselves daily. Also, they were asked to describe how they kept track of the number ounces of fluid they drank during the course of the day in real time (math calculations on paper, pitcher-pouring method, etc.). The participant’s chart was reviewed for the cardiologist’s prescription for the amount of fluid restriction.

It was standard of practice with these HF cardiologists to have a nurse who is educated in the care of HF patients, to call the patients within 72 hours of discharge to
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provide telephone follow-up including adjusting the number and dose of diuretics. This study tracked the number of diuretic dose adjustments that were made between discharge $T_1$ and the clinic visit at $T_2$.

**Demographic and Descriptive Variables.**

Demographic and descriptive data were obtained from the patient’s medical record during hospitalization and at follow up clinic, and through patient self-report. Demographic data included gender, age in years, race, marital status, occupation/retirement status, income, living status (alone or with someone), did a care provider come into the home to help with personal or health care related to the HF, educational level, length of time diagnosed with HF, and age at time of HF diagnosis.

The medical chart was reviewed for clinical data, which included additional co-morbid diseases, concurrent medications, and data from neurological and physical assessments done by the nurses and physicians. Vital signs (heart rate, respiratory rate, temperature, blood pressure, and daily weights) obtained by the nursing staff were recorded upon admission and at discharge. Results of right heart catheter measurements (if obtained) were recorded once daily while the right heart catheter was in place. Results of ordered chest X-rays, echocardiograms, and lab values (metabolic panel, B-natriuretic peptides, CBC, and LFT’s) were documented. NYHA classification (Hunt, et al., 2009, pg. e8) was obtained from the physician or Certified Nurse Practitioner (CRNP) according to the following guidelines:

- patients may have symptoms of HF at rest (class IV),
- on less-than-ordinary exertion (class III),
- on ordinary exertion (class II), or
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- only at levels of exertion that would limit normal individuals (class I).

**Procedures**

The participants were recruited from the clinical practices of three HF physicians at Penn Presbyterian Medical Center. The physicians identified patients from their practice who had been admitted to the hospital with an Acute Exacerbation of Heart Failure, including having no known or previously diagnosed cognitive or psychosocial impediments that would prevent them from participating in this study.

Visit 1 (T1): The identified, eligible patients were approached in their hospital room at Penn Presbyterian Medical Center. After initial introduction to the study by the researcher, potential participants were given verbal and written instructions on the purpose and procedures of the study. Potential participants were reassured that they did not have to participate, would not lose any benefits to which they are otherwise entitled, and could withdraw from the study at any time. After signing an Informed Consent form (ICF), the participants were given their own copy of the ICF and a copy was placed in the participants’ chart.

The study activities took place in the participant’s hospital room to allow the participant to have privacy. The participant was given the questionnaire containing the request for demographic data (or it was read to them and they provided the information verbally). The MoCA was administered as described above. The ADL’s, and the IADL’s were read to the participant. The participant responded to questions for demographic data not found in the chart. The participant then participated in the MoCA and responded to the ADL’s, the IADL’s and Beck Depression Scale (BDI) questionnaires. If the participant needed to, a moment of rest was inserted where needed. The patient was
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weighed during the research study visit using an Electronic 7544BL Cal-Max wide body, Glass Scale by Taylor bathroom scale (Appendix F).

Finally, the participant was queried regarding their fluid intake by using the Fluid Management questions (Appendix E). In order to document the number of ounces of fluid that the participant was restricted to, the chart was reviewed for the number of ounces of fluid restriction prescribed by the cardiologist. The participant’s New York Heart Association Classification was obtained from a review of the chart. The chart was reviewed for the patient’s daily weights, vital signs, right heart catheter readings (if applicable) and laboratory values as described above.

Visit 2 (T2): The participant completed the T2 visit at 6 weeks (+/- 2 weeks) in the clinic at either Penn Presbyterian Medical Center or at a community-based outpatient clinic, Penn Cardiology in Cherry Hill. The study activities took place in an examination room in the clinic to allow the participant to have privacy. The participants were asked if there had been any adverse events, Emergency Room visits, or hospitalizations, since discharge. The remaining activities concerned the administration of the same questionnaires, weight, and review of the chart as at T1.

Data Management

The results of the tests and questionnaires were placed in an envelope marked with the participant’s code and then sealed. The data were placed in a locked file until entered into the data base and analyzed away from the clinical area. Data were coded and entered into Statistical Package for the Social Sciences 22.0 (IBM/SPSS). The database was maintained on a password protected computer. All identifiers were removed from the
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questionnaires and will be kept in a locked file for six years after data were analysis and manuscripts submitted for publication.

**Data analysis**

Descriptive statistics for the characteristics of the HF population under study were performed. Alpha was set at 0.05. Variability was calculated for all variables. For categorical data, frequencies were calculated; for continuous variables, means were calculated. Paired T-tests were performed to examine for differences among of the main variables (MoCA, ADL’s, IADL’s, and BDI’s) at T1 and T2.

The primary aim of this study was to explore whether weight changes differed based on the presence or absence of cognitive impairment at baseline in HF participants who were followed in the clinic one to two months after discharge from the hospital for an acute exacerbation of HF admission. In order to answer the **Primary Research Question**: Is there a difference in weight change over time in those HF patients with and without cognitive impairment?, an Independent T-test was performed using SPSS to analyze the difference between cognitive functioning at T1 (low versus high scores) and change in weight over time. The independent variable was cognition as measured by MoCA, and the dependent variable was change in weight from T1 to T2.

The second aim was to explore whether functional status, depression, or NYHA Class in HF participants followed in the clinic one to two months after discharge from the hospital for an acute exacerbated HF admission differed according to baseline cognitive impairment. In order to examine the secondary research question: Is there a difference in functional status, depression, or NYHA Class at follow-up in those HF patients with and
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without baseline cognitive impairment, the variables were examined for any differences between T₁ and T₂ using Independent T tests.

The third aim of this study was to explore whether there was a difference in weight or baseline cognitive function in HF participants who received a high number or low number of diuretic dose adjustments one to two months after discharge from the hospital for an acute exacerbated HF admission. In order to answer the research question, Is there a difference in weight change over time in those HF patients who had a low number of diuretic dose adjustments versus a high number of diuretic dose adjustments when followed in the clinic one to two months after discharge from the hospital for an acute exacerbated HF admission? the variables were examined for any differences at T₁ and at T₂ using Independent T-Tests. This was accomplished by comparing the mean scores of the dependent variable, weight change, for two different groups of participants: those who had low or high numbers of diuretic dose adjustments. In order to answer the research question Is there a difference in baseline cognitive status in those HF patients who had a low number of diuretic dose adjustments versus a high number of diuretic dose adjustments when followed in clinic one to two months after discharge? the variables were examined for any differences at T₁ and T₂ using Independent T-tests. This was accomplished by comparing the mean scores of the dependent variable, baseline cognitive function, for two different groups of participants: those who had low or high diuretic dose adjustments. Finally, the research scales and clinic scales were examined for correlation.

**Limitations**

There were several limitations to the study.
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- Not enough participants were recruited to perform a regression analysis, but the difference in weight from T₁ to T₂ based on cognitive function using an Independent T-test was performed.

- The population to be studied was recruited from one acute-care hospital leading to a homogenous mix of patients that may not be representative of the general population of HF patients.

- The patients were managed by three HF cardiology specialists whose standard of practice may be different from the general population of cardiologists around the country. In the patient population seen at Penn Presbyterian Medical Center, a nurse called the patients within 72 hours after discharge to make phone assessments of the patients’ statuses, to educate the patients about meds, diet and daily weights, and to adjust diuretics and dosing. The presence of a specially educated HF nurse who managed the patients after discharge may not be typical for all HF practices.

- Attempting to measure cognitive function, even with a valid screening too, was a limitation due to the multiple factors that influence cognition.

- Accurately measuring body weight was a challenge, even with a dedicated bathroom scale due to the refusal by most patients to change out of their street clothes to wear a patient gown.

- One participant was too exhausted to get on the scales and refused.
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• One participant was so weak that assistance from another staff member and the participant’s walker was required to transition from the examination table to the scale.

• The BDI-II measures fatigue as an attribute of depression, but fatigue is an attribute of heart failure, which may have biased the results of that tool.

• Some patients declined to be in the study due to the use of questionnaires, of multiple questionnaires, waiting for a call from the spouse, wanting to visit with relatives, and not wanting to participate in research of any kind.

• Some patients were too sick or overwhelmed with their diagnosis to consider being in a research study.

Human Participants

Risks.

The risks to the patient who participated in this study included the possibility of psychological distress at being approached by a stranger to participate in a study. There was the psychological risk of answering a number of questions related to demographic information followed by having to describe whether they follow a prescribed fluid management plan, and whether they weigh themselves daily. Finally, there may have been psychological distress while doing the MoCA examination due to not knowing if they were doing the test correctly and imagining that the researcher would pass judgment on them if not.

Benefits.

There were no direct benefits to the participant for participating in this study. The participant may have had an indirect benefit of feeling that they were helping other
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people or of research in general to discover new information by participating in this study. There was the slight possibility that the participant may have inferred that if fluid management was important enough to do research on, then it must be very important, possibly resulting in a change in behavior at home.

Risk/Benefit Ratio.

The psychological distress that may have been experienced was not expected to be extreme or harmful to the participant in any way. The benefit to the future management of patients with HF and cognitive decline may be significant as a result of the study. Therefore, the Risk/Benefit Ratio was not expected to interfere with participant enrollment or the conduct of the study.

Compensation.

The patients were offered a $25.00 Visa gift card upon completion of both study visits.
Chapter 4: Results

Overview of the Study

The impact of baseline cognitive function on change in weight over time in HF (HF) patients was investigated using an observational, longitudinal, descriptive design. The main research variables in this study were cognitive function and change in weight. Cognitive function was measured using The Montreal Cognitive Assessment (MoCA) test (McLennan et al., 2010; Nasreddine et al., 2005). The change in weight between enrollment at T1 and follow-up with the participant’s HF specialist at T2 was calculated from participant weights taken on research scales that were dedicated to the study.

Secondary variables known to be associated with cognitive function were measured in this study and included functional status (Katz Activities of Daily Living and Lawson’s Instrumental Activities of Daily Living) and depression (the Beck Depression Inventory II). The number of times diuretic doses were adjusted was also tracked from the participant’s medical record (Epic).

Demographic characteristics at enrollment into the study

A total of 380 patients were screened for enrollment from December, 2011 to January, 2013. Most participants eligible for screening did not fit the inclusion/exclusion criteria due to dialysis or admission for valve repair, etc. From this group, only 66 qualified for enrollment and were approached to be in the study. Only 30 patients consented to be in the study for an enrollment rate of 45.45%. Refusals included mostly personal reasons or living too far away to return to the clinic. From this group of 30 participants who signed consents, one person was dropped due to meeting exclusion criteria, two participants withdrew consent, two died of HF related complications, and
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three were lost to follow-up. One person was treated as an outlier due to losing a large amount of weight in order to prepare for a possible transplant, leaving only 21 participants for statistical analysis (Figure 1).

Figure 4 Consort Diagram
Demographic characteristics of the study sample at enrollment (N=21) are provided in Table 1. The average age of the sample was 67.10 years (SD 12.2; median 68.00 ± 12.2), though participants ranged in age from 43-88 years. The sample was English-speaking, primarily male (76.2%), married (52.4%), Caucasian (81%), retired (47.6%), had at least a high school education (85.7%), and reported living with someone (71.4%).

Table 1 Characteristics of Study Participants at Enrollment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics @ enrollment</strong></td>
<td></td>
</tr>
<tr>
<td>Age, Mean ± SD</td>
<td>67.1 ± 12.2</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>16 (76.2%)</td>
</tr>
<tr>
<td>Caucasian, n (%)</td>
<td>17 (81.0%)</td>
</tr>
<tr>
<td>Married, n (%)</td>
<td>11 (52.4%)</td>
</tr>
<tr>
<td>Lives alone, n (%)</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td><strong>Education, years, M ± SD @ enrollment</strong></td>
<td>13.38 ± 3.2</td>
</tr>
<tr>
<td>&lt;12, n (%)</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td>12, n (%)</td>
<td>9 (42.9%)</td>
</tr>
<tr>
<td>&gt;12, n (%)</td>
<td>9 (42.8%)</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
</tr>
<tr>
<td>Retired, n (%)</td>
<td>10 (47.6%)</td>
</tr>
<tr>
<td>Employed/self-employed, n (%)</td>
<td>8 (38.1%)</td>
</tr>
<tr>
<td>Disabled due to HF, n (%)</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td><strong>Financial status, M ± SD @ enrollment</strong></td>
<td>$40,800 ± 28,659.40</td>
</tr>
<tr>
<td>$0 to $25,000, n (%)</td>
<td>8 (44.4%)</td>
</tr>
<tr>
<td>$26,000 to $50,000, n (%)</td>
<td>6 (33.4%)</td>
</tr>
<tr>
<td>$51,000 to $100,000, n (%)</td>
<td>4 (22.2%)</td>
</tr>
</tbody>
</table>

At the follow-up visit, more participants reported having a caregiver at T2 (Table 2) than at T1. Two participants reported that caregiver was a child (9.5%), one reported having some unpaid help (unspecified), eight participants reported having paid help (38.1%), which was for the purpose of assistance with bathing or with changing dressings due to having Milrinone infusions. The number of paid health caregivers was
Cognitive function and weight in HF patients significantly different from T₁ to T₂ (p = .04) as participants who had paid help were also on Milrinone infusions at home.

Table 2 Characteristics of Study Patients: Caregivers, T₁ to T₂

<table>
<thead>
<tr>
<th>Variable</th>
<th>T₁</th>
<th>T₂</th>
<th>Fisher’s Exact X² 2-sided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caregiver</td>
<td>4 (19.04%)</td>
<td>10 (47.61%)</td>
<td>.04</td>
</tr>
<tr>
<td>Child, n (%)</td>
<td>1 (4.8%)</td>
<td>2 (9.5%)</td>
<td>.10</td>
</tr>
<tr>
<td>Unpaid Help, n (%)</td>
<td>1 (4.8%)</td>
<td>1 (4.8%)</td>
<td>.05</td>
</tr>
<tr>
<td>Paid Help, n (%)</td>
<td>3 (14.3%)</td>
<td>8 (38.1%)</td>
<td>.04</td>
</tr>
</tbody>
</table>

Clinical Characteristics

Clinical characteristics of the study sample (n = 21) are displayed in Table 3. The mean length of time since diagnosis with HF was 12.4 years (SD 10.47; median 10.00 ± 10.47 years) where the range was 0.03 years (new diagnosis 11 days prior to enrollment) to 43 years. The age of the participants at time of dx with HF was 0 years (newborn congenital heart disease) to 78 years of age (M 54.57 years of age, SD 16.34). More than half of the participants (71.4%, n=15) had ejection fractions between 10 and 20%. All of the participants in this sample had a diagnosis of cardiomyopathy (see Table 3).

Table 3 Heart Failure Clinical Characteristics of Study Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value, n(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at time of dx with HF, M ± SD</td>
<td>54.57 ± 16.34</td>
</tr>
<tr>
<td>Time diagnosed with HF, years, Mean ± SD</td>
<td>12.40 ± 10.47</td>
</tr>
<tr>
<td>0 to 5 years, n (%)</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>6 to 10 years, n (%)</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>11 to 20 years, n (%)</td>
<td>5 (23.6%)</td>
</tr>
<tr>
<td>&gt; 20 years, n (%)</td>
<td>4 (19.0%)</td>
</tr>
<tr>
<td>Ejection Fraction @ enrollment</td>
<td></td>
</tr>
<tr>
<td>10 to 25%, n (%)</td>
<td>18 (85.7%)</td>
</tr>
<tr>
<td>30 to 40 %, n (%)</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td>Type of Cardiomyopathy</td>
<td></td>
</tr>
<tr>
<td>Ischemic Cardiomyopathy, n (%)</td>
<td>12 (57.1%)</td>
</tr>
<tr>
<td>Non-ischemic Cardiomyopathy, n (%)</td>
<td>5 (23.80%)</td>
</tr>
<tr>
<td>Congenital Heart Disease, n (%)</td>
<td>1 (4.8%)</td>
</tr>
<tr>
<td>Hypertensive CM/Dilated, n (%)</td>
<td>1 (4.8%)</td>
</tr>
<tr>
<td>No mention of etiology, n (%)</td>
<td>2 (9.5%)</td>
</tr>
</tbody>
</table>
Cognitive function and weight in HF patients

The participants in this study were admitted to the hospital for acute exacerbation of HF. Of the 21 participants who completed visit 2, only 20 participants had their NYHA Classification documented. Therefore, the discussion in this paragraph of NYHA Class is based on 20 participants who completed both Visit 1 and Visit 2. At admission to the hospital, 15.0% (n = 3) were classified as New York Heart Association Class II, 40.0% (n = 8) were Class III, and 45.0% (n = 9) were Class IV based on presenting symptoms.

Table 4 shows that the change in NYHA Classification from Visit 1 to Visit 2 was significantly different; none of the participants had a worsening of their HF classification from T1 to T2 (Fisher’s Exact Test = 12.8, p = .003). In this sample, there were nine participants who were classified as NYHA Class IV on admission to the hospital. Two of those nine dropped to Class III and one dropped to Class II. Additionally, there were eight participants who were classified as NYHA Class III during their hospitalization, and three dropped to Class II by Visit 2.

<table>
<thead>
<tr>
<th>NYHA Classification on admission T1</th>
<th>NYHA Classification at visit T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>II</td>
</tr>
<tr>
<td>III</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>1</td>
</tr>
</tbody>
</table>

Fisher’s Exact Test = 12.8, p = .003

Comorbid conditions at baseline are displayed in Table 5. The five most common comorbid conditions were chronic renal failure (76.2%), hypertension (71.4%), pulmonary hypertension (57.1%), hyperlipidemia (52.4%) and diabetes mellitus (52.4%). More than half of the participants presented with shortness of breath (57.1%), or dyspnea.
Cognitive function and weight in HF patients on exertion (DOE) (57.6%), see Table 5 for the variety of clinical presentations on admission to the hospital.

**Table 5 Comorbid Conditions at Baseline of Study Participants**

<table>
<thead>
<tr>
<th>Comorbid Condition, T1</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Renal Insufficiency</td>
<td>16 (76.2%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>15 (71.4%)</td>
</tr>
<tr>
<td>Pulmonary Hypertension</td>
<td>12 (57.1%)</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>11 (52.4%)</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>11 (52.4%)</td>
</tr>
<tr>
<td>Sleep Apnea/Obstructive Sleep Apnea</td>
<td>8 (38.1%)</td>
</tr>
<tr>
<td>Gout</td>
<td>8 (38.1%)</td>
</tr>
<tr>
<td>Anemia</td>
<td>7 (33.3%)</td>
</tr>
<tr>
<td>CABG</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>Coronary Artery Stent</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>Obesity</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>Depression (under treatment)</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>Cancer of any kind</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>COPD</td>
<td>5 (23.80%)</td>
</tr>
<tr>
<td>History of MI</td>
<td>4 (19.0%)</td>
</tr>
<tr>
<td>CVA/TIA History</td>
<td>4 (19.0%)</td>
</tr>
<tr>
<td>GERD</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td>Interstitial Lung Disease</td>
<td>1 (4.8%)</td>
</tr>
<tr>
<td>Arthritis</td>
<td>1 (4.8%)</td>
</tr>
<tr>
<td>Autoimmune Disorders</td>
<td>1 (4.8%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospitalization Admitting Symptoms, T1</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortness of Breath (SOB)</td>
<td>12 (57.1%)</td>
</tr>
<tr>
<td>Dyspnea on Exertion (DOE)</td>
<td>10 (47.6%)</td>
</tr>
<tr>
<td>Swelling/Edema</td>
<td>9 (42.9%)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>9 (42.9%)</td>
</tr>
<tr>
<td>Paroxysmal Nocturnal Dyspnea (PND)</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>Weight Gain</td>
<td>6 (28.6%)</td>
</tr>
<tr>
<td>Ascites/Bloating</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td>Orthopnea</td>
<td>2 (9.5%)</td>
</tr>
<tr>
<td>Angina</td>
<td>1 (4.8%)</td>
</tr>
</tbody>
</table>

Outcomes for these participants by Visit 2 (Table 6) included insertion of a ventricular assist device (VAD) (n = 3) and re-hospitalization for HF (n = 5). In this sample of 21 HF patients, five participants (23.80%) were re-hospitalized prior to Visit #2. Four were re-hospitalized for treatment of HF and one for treatment of dysrhythmias.
Cognitive function and weight in HF patients

One person was treated in the Emergency Room for a gouty attack. Of the five people who were hospitalized, four were African American (MoCA < 24); the remaining participant scored ≥ 24 on the MoCA. While four scored < 24 on the MoCA, it was not statistically significant (not rehospitalized: n = 16, MoCA score, M = 24.88, SD 3.7; rehospitalized: n = 5, MoCA score, M = 21.60, SD 2.97; t(df19) = 1.80, p = .09).

Table 6 Participant Outcomes: Re-hospitalizations and VAD insertions

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-hospitalizations for HF from retained 21 participants</td>
<td>5 (23.80%)</td>
</tr>
<tr>
<td>Treatment of HF</td>
<td>4 (80.00%)</td>
</tr>
<tr>
<td>Treatment for Dysrhythmias</td>
<td>1 (20.00%)</td>
</tr>
<tr>
<td>Treatment for non-HF diagnosis</td>
<td>1 (20.00%)</td>
</tr>
<tr>
<td>VAD insertions, between T1 to T2, from original 21 participants</td>
<td>1 (4.76%)</td>
</tr>
</tbody>
</table>

VAD = Ventricular Assist Device

The time to follow-up in the clinic for visit 2 from the hospitalization discharge ranged from 30 days to 123 days with a mean of 59.05 days (SD = 23.42) a median of 54 days and a mode of 42, 48 and 68 days (2 participants each). The skewness was + 1.38 and the kurtosis was + 1.97, demonstrating near symmetry and normalcy. The window for the follow-up was planned in the protocol to be 28 to 56 days in order to capture those participants who may have been re-hospitalized for HF within < 30 days.

Some of the reasons for the time frame > 56 days included the fact that participants were re-hospitalized before T2, participants changed their appointment with their cardiologist to an earlier or later date, one participant was taken from the T2 visit to the hospital for re-hospitalization, thus preventing the T2 research visit, and VAD insertion between T1 and T2, thus prolonging the time for the follow-up visit with the cardiologist. Participants returning to the HF clinic to see their Cardiologist and to complete Visit 2 had various clinical complaints related to their HF status.
Upon return to the clinic, most participants had a slight improvement in their clinical symptoms of HF. However, because the sample was so small and the improvements in clinical symptoms were so slight, a significant difference could only be found in the clinical complaints of shortness of breath (SOB). Four (19%) continued to complain of shortness of breath (SOB), but that was a significantly smaller number of participants than complained of SOB on admission to the hospital (p = .02). Table 7 details the lack of statistically different symptom complaints between the two visits. Six participants (28.6%) complained of water weight gain on admission to the hospital, but no one complained of water weight gain at T2 (n = 20), so a statistical difference could not be computed. It is worth noting that even though no one complained of water weight gain at T2, 60% of the 20 participants with weights at T2 did gain water weight (M: 7.07; range: 0.20 - 22 lbs.).

Table 7. Differences in Participants’ Clinical Complaints, Signs and Symptoms between T1 and T2

<table>
<thead>
<tr>
<th>Clinical complaint, sign, or symptom</th>
<th>T1</th>
<th>T2</th>
<th>N</th>
<th>Pearson $\chi^2$ value</th>
<th>Fishers Exact test, 2-sided</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOB</td>
<td>12 (57.1%)</td>
<td>4 (19.00%)</td>
<td>21</td>
<td>6.59</td>
<td>.02</td>
</tr>
<tr>
<td>DOE</td>
<td>10 (47.6%)</td>
<td>11 (52.40%)</td>
<td>21</td>
<td>2.38</td>
<td>.20</td>
</tr>
<tr>
<td>Swelling/edema</td>
<td>9 (42.8%)</td>
<td>1 (  4.76%)</td>
<td>21</td>
<td>1.40</td>
<td>.14</td>
</tr>
<tr>
<td>Fatigue</td>
<td>9 (42.9%)</td>
<td>9 (42.90%)</td>
<td>21</td>
<td>1.04</td>
<td>.40</td>
</tr>
<tr>
<td>PND</td>
<td>6 (28.6%)</td>
<td>1 (  4.76%)</td>
<td>21</td>
<td>.42</td>
<td>1.00</td>
</tr>
<tr>
<td>Ascites/bloating</td>
<td>3 (14.3%)</td>
<td>1 (  4.76%)</td>
<td>21</td>
<td>6.30</td>
<td>.14</td>
</tr>
<tr>
<td>Orthopnea</td>
<td>2 ( 9.5%)</td>
<td>2 ( 9.50%)</td>
<td>21</td>
<td>1.66</td>
<td>.69</td>
</tr>
</tbody>
</table>

Aim 1: Cognitive Impairment and Weight Change

The primary aim of this study was to explore whether weight changes differed based on the presence or absence of cognitive impairment in HF participants who were followed in the clinic one to two months after discharge from the hospital for an acute
Cognitive function and weight in HF patients

exacerbated HF admission. The Montreal Cognitive Assessment (MoCA) tool was used to establish baseline cognitive function at T1 enrollment into the study and the participants were weighed on dedicated research scales at T1 and in follow-up in the clinic at T2. The results of the data analysis will be discussed in order, beginning with the data analysis of the MoCA, then the weights on the research scales, and then the interaction of the data from these two variables.

**The Montreal Cognitive Assessment tool.**

The MoCA has a maximum score of 30. The scores on this tool at T1 ranged from 15 to 29 with a mean of 24.10 and median of 24.00. The distribution of the MoCA scores was not symmetrical, being negatively skewed (-0.58). Since the measurement of kurtosis was +0.12, the MoCA scores are considered to have a close to normal peak and nearly normal distribution (Munro, 2005). In this sample, 42.9% (n = 21) of the participants scored < 24 at T1, which is evidence of cognitive impairment in adults with cardiovascular disease (Lee et al., 2013; Cameron et al., 2009). Low MoCA scores correlated with African American race (n = 4) (r = -.56, p = .01). High and low MoCA scores demonstrated a significant difference when examined with length of time diagnosed with HF at T1, t(df 19) = -2.33, p = .03. The educational level of the participants did not correlate with low or high MoCA scores (T1) (r = .41, p = .06). Gender, age, marital status, income, living status (married or single), and having a care provider in the home did not correlate with the MoCA score, either low or high.

**Change in Weight over time.**

Participants were weighed on the research scales on the same day as enrollment. Due to delays in discharges, the enrollment weight was not the same as the discharge...
Cognitive function and weight in HF patients

weight in six cases as the participants either gained weight (0.3 and 1.6 lbs.) or lost additional weight (0.7 lbs. to 8.6 lbs.). Other participants who were discharged within the planned 48 hours from enrollment, also gained or lost weight prior to discharge. The mean change in weight for the entire sample of 20 participants from enrollment to discharge was -2.4 lbs. (m = 193.41, SD 9.2; m = 1.91, SD 42.44). However, the calculations for the variable of change in weight were made from the enrollment weight per study protocol.

Participants were considered to have maintained their weight if their weight did not vary by more than ±2 lbs. of their weight upon enrollment into the study (T1) to the clinic visit (T2). If they gained or lost more than 2 lbs. then they were considered to have had a weight change. Table 8 shows the mean weights of the 20 study participants from the time they were enrolled in the research study at T1 to the time they were seen in the clinic at T2 with the mean change in their weight at T2. One of the final 21 participants did not want to get weighed on the research scales at T2. A paired T-test revealed there was no statistically significant difference in mean weights from T1 (M = 192.88, SD = 43.24) to T2 (M = 192.45, SD 40.49), t(19) = .44, p = .84 (two-tailed). The mean change in weight was 0.43 (SD 9.64) with a 95% confidence interval ranging from -4.08 to 4.94.

Table 8 Mean weights of the study participants at T1 and T2, N = 20

<table>
<thead>
<tr>
<th>Weight Lbs.</th>
<th>Enrollment Research Scale</th>
<th>Clinic F/U Research Scale</th>
<th>Mean Change Score</th>
<th>Paired T-Test</th>
<th>95% Confidence Interval</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>192.88</td>
<td>192.45</td>
<td>0.43</td>
<td>t = .20</td>
<td>-4.08 to 4.94</td>
<td>.84</td>
</tr>
<tr>
<td></td>
<td>SD 43.24 (n = 20)</td>
<td>SD 40.49 (n = 20)</td>
<td>SD 9.63</td>
<td>df 19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cognitive function and weight in HF patients

In this study, the range of weight lost to weight gained from enrollment at T1 to the Clinic Visit at T2 for 20 participants was -22.0 lbs. to 20.20 lbs. Fifty percent of the participants (n = 10) lost weight by T2, 10% (2 participants) maintained their weight (weight change 0.40 to -0.20), and 40% (n = 8) gained weight.

**Research Question**

1. **Primary Research Question**: Is there a difference in weight change over time in those HF patients with and without cognitive impairment?

   In this study, participants were divided into three groups based on their change in weight: participants who lost more than two pounds by T2, participants who maintained weight between ± 2 lbs. of their T1 weight, and participant who gained more than two pounds by T2. An Independent T test was performed to examine the difference in weight change over time from enrollment at T1 to the clinic visit at T2 in HF patients with high and low scores on the MoCA at T1. The mean change in weight for participants who scored higher on the MoCA (≥ 24) was +.62 lbs. (SD 11.22) while the mean change in weight for participants who scored lower on the MoCA (< 24) was +.20 lbs. (SD 7.94). There was no statistically significant difference between the change in weight on the research scales from T1 to T2 in those with high (M = .62, SD 11.22) or low MoCA scores (M = .20, SD 7.94; t(df 18) = -.09, p = .93) at T1.

**Aim 2: Cognitive Impairment and Functional Status, Depression, or NYHA Class**

A secondary aim was to explore whether functional status, depression, or NYHA Class in HF patients followed in the clinic one to two month after discharge from the hospital for an acute exacerbated HF admission differed according to baseline cognitive impairment.
Cognitive function and weight in HF patients


Activities of Daily Living.

The Katz ADL and the Lawton IADL tools were used to assess functional status. All of these participants possessed basic, self-care skills at T₁ as evidenced by the T₁ scores of 5 and 6 (Katz, et al., 1970). The Instrumental Activities of Daily Living Scale (IADL) (Lawton & Brody, 1969) picked up on more deficits with self-care skills at enrollment. Out of a possible eight points, only 38.1% of the participants reported competence in every domain (M = 6.14, SD 1.88). The mean score for this sample at T₂ was 6.19 (SD 2.02). The change in IADL total scores from T₁ to T₂ was not statistically significant (p = .86). Table 9 shows the percentages of participants in each category.

Table 9 Percentages of participants in each category of the IADL

<table>
<thead>
<tr>
<th>IADL items</th>
<th>T₁ N = 21</th>
<th>T₂ N = 21</th>
<th>Paired T test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.14</td>
<td>6.19</td>
<td>.86</td>
</tr>
<tr>
<td>Shopping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never Shop</td>
<td>8 (38.1%)</td>
<td>6 (28.6%)</td>
<td></td>
</tr>
<tr>
<td>Shops</td>
<td>13 (61.9%)</td>
<td>15 (71.4%)</td>
<td></td>
</tr>
<tr>
<td>Food Prep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never prepares food</td>
<td>9 (42.9%)</td>
<td>10 (47.6%)</td>
<td></td>
</tr>
<tr>
<td>Prepares food</td>
<td>12 (57.1%)</td>
<td>11 (52.4%)</td>
<td></td>
</tr>
<tr>
<td>Indoor or Outdoor House Keeping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does neither housekeeping chores</td>
<td>4 (19.0%)</td>
<td>15 (71.4%)</td>
<td></td>
</tr>
<tr>
<td>Does either housekeeping chores</td>
<td>17 (81.0%)</td>
<td>6 (28.6%)</td>
<td></td>
</tr>
<tr>
<td>Laundry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does no laundry</td>
<td>8 (28.1%)</td>
<td>7 (33.3%)</td>
<td></td>
</tr>
<tr>
<td>Does laundry</td>
<td>13 (61.9%)</td>
<td>14 (66.7%)</td>
<td></td>
</tr>
<tr>
<td>Mode of transportation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Must be taken everywhere</td>
<td>5 (23.80%)</td>
<td>3 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Can drive, take bus, etc.</td>
<td>16 (76.2%)</td>
<td>18 (85.7%)</td>
<td></td>
</tr>
<tr>
<td>Medication Responsibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is not independent with medications</td>
<td>3 (14.3%)</td>
<td>3 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Prepares and takes meds independently</td>
<td>18 (85.7%)</td>
<td>18 (85.7%)</td>
<td></td>
</tr>
<tr>
<td>Finances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is not independent with finances</td>
<td>2 (9.5%)</td>
<td>3 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Is independent with finances</td>
<td>19 (90.5%)</td>
<td>18 (85.7%)</td>
<td></td>
</tr>
</tbody>
</table>
Cognitive function and weight in HF patients

A cross tabs was performed on IADL items at baseline to determine differences that were explained by gender Table 10 demonstrates that more men reported inability to shop (5 of 16 males vs. 1 of 5 females), prepare food (9 of 16 males vs. 1 of 5 females), and do laundry (6 of 16 males vs. 1 of 5 females).

Table 10 Chi Square of significant gender differences in IADL’s

<table>
<thead>
<tr>
<th>IADL item</th>
<th>Males, unable to perform</th>
<th>Females, unable to perform</th>
<th>Chi Square, Fisher’s Exact, Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shopping</td>
<td>5 of 16 (31.25%)</td>
<td>1 of 5 (20%)</td>
<td>.001</td>
</tr>
<tr>
<td>Food Prep</td>
<td>9 of 16 (56.25%)</td>
<td>1 of 5 (20%)</td>
<td>.002</td>
</tr>
<tr>
<td>Laundry</td>
<td>6 of 16 (37.5%)</td>
<td>1 of 5 (20%)</td>
<td>.003</td>
</tr>
</tbody>
</table>

2. **Secondary Research Question:** Is there a difference in functional status, depression, or NYHA Class at follow-up in those HF patients with and without baseline cognitive impairment?

Table 11 shows Paired T tests of differences between Katz ADL total scores at enrollment and at T2, as well as Lawton IADL total scores, BDI’s and MoCA total scores between T1 and T2. The paired sample differences were not significantly different for the Katz ADL, Lawton IADL’s, and the MoCA total scores between T1 and T2. The BDI scores were the only ones that showed a statistically significant difference in the BDI scores by the T2 clinic visit.

Table 11 Differences in Mean scores of the main variables, T1 to T2

<table>
<thead>
<tr>
<th>Variables, Means</th>
<th>Visit 1, mean score, ±SD</th>
<th>Visit 2, mean score, ±SD</th>
<th>Range of scores</th>
<th>Paired Samples T test, Sig. (2 tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katz Score, M</td>
<td>5.76, SD ± .44</td>
<td>5.86, SD ± .48</td>
<td>0-6</td>
<td>.49</td>
</tr>
<tr>
<td>Lawton Score, M</td>
<td>6.14, SD ± 1.88</td>
<td>6.19, SD ± 2.02</td>
<td>0-8</td>
<td>.86</td>
</tr>
<tr>
<td>BDI Score, M</td>
<td>13.75, SD ± 8.47</td>
<td>9.65, SD ± 5.91</td>
<td>0-63</td>
<td>.01</td>
</tr>
<tr>
<td>MoCA Score, M</td>
<td>24.10, SD ± 3.75</td>
<td>23.67, SD ± 4.94</td>
<td>0-30</td>
<td>.52</td>
</tr>
<tr>
<td>Weights, M</td>
<td>192.88, SD ± 43.24</td>
<td>192.45, SD ± 40.49</td>
<td>N/A</td>
<td>.43</td>
</tr>
</tbody>
</table>
An Independent T-test was performed to examine the difference between low and high MoCA scores at T1 and functional status at T2 as measured by the Katz ADL (p = .12) and Lawton’s IADL (p = .95), however, there was no statistically significant difference in this small sample.

**Cognitive Function and Depression Assessments, T1 – T2.**

*Beck Depression Inventory II.*

A Beck Depression Index-II (BDI-II) was used to assess depression in this population of HF participants. A score of 1-13 on the BDI-II correlates with minimal depression, while mild depression correlates with a score of 14-19 (Beck, et al., 1996; Beck, et al., 1961). A score of 20-28 correlates with moderate depression and a score of 29-63 correlates with severe depression. In this population of participants, the BDI scores at enrollment ranged from 3 (9.5%) to 34 (4.8%) with a mean of 14.05 (SD 8.37), median of 13.00 and a mode of 13 (n = 4, 19.0%). In this population, 38.1% of the participants scored ≥ 14 on the BDI. The scores were skewed slightly to the right (.737), but represented nearly normal symmetry. The kurtosis score of .079 indicates nearly normal distribution. The left tail is thick due to the predominance of scores less than 20 resulting in the mean of only 14.05.

*Depression Assessment follow-up – Beck Depression Inventory II.*

The BDI-II was completed by 20 out of 21 participants at follow-up. One participant declined to fill out anymore forms due to extreme fatigue. Of the 20 who completed the BDI-II, the mean score was 9.65 (SD 5.90), with scores ranging from zero to 21, where scores < 14 indicate clinically insignificant depression and scores ≥ 14 indicate mild (14 - 19), moderate (20 – 28), and severe (29 - 63) depression (Beck, et al.,
Cognitive function and weight in HF patients

1996; Beck, et al., 1961). In this population, 38.1% of the participants scored ≥ 14 on the BDI-II. The Skewness was .10 and the Kurtosis was -.87, indicating near normal symmetry and distribution. The Paired T-test for the mean BDI scores from T1 to T2 were significantly different (p = .01). Table 12 shows the percentages of participants with responses for each item between T1 and T2.

Table 12: Percentages of participants with responses for each BDI item between T1 and T2.

<table>
<thead>
<tr>
<th>BDI items</th>
<th>T1 N = 21</th>
<th>T2 N = 20</th>
<th>Paired T Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean BDI scores</td>
<td>13.75 (SD 8.47)</td>
<td>9.65 (SD 5.91)</td>
<td>.01</td>
</tr>
<tr>
<td><strong>Sadness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not feel sad</td>
<td>14 (66.7%)</td>
<td>14 (70.0%)</td>
<td></td>
</tr>
<tr>
<td>I feel sad much of the time</td>
<td>7 (33.3%)</td>
<td>6 (30.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Pessimism</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am not discouraged</td>
<td>9 (42.9%)</td>
<td>10 (50.0%)</td>
<td></td>
</tr>
<tr>
<td>I feel more discouraged</td>
<td>12 (57.2%)</td>
<td>10 (50.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Past failure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not feel like a failure</td>
<td>14 (66.7%)</td>
<td>15 (75.0%)</td>
<td></td>
</tr>
<tr>
<td>I have failed more than I should have</td>
<td>7 (33.3%)</td>
<td>5 (25.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Loss of pleasure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get as much pleasure as ever</td>
<td>8 (38.1%)</td>
<td>9 (45.0%)</td>
<td></td>
</tr>
<tr>
<td>I don’t enjoy things like I used to</td>
<td>10 (47.6%)</td>
<td>10 (50.0%)</td>
<td></td>
</tr>
<tr>
<td>I get very little (or no) pleasure</td>
<td>3 (14.3%)</td>
<td>1 ( 5.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Guilty feelings</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don’t feel guilty</td>
<td>18 (85.7%)</td>
<td>17 (85.0%)</td>
<td></td>
</tr>
<tr>
<td>I feel guilty over many things</td>
<td>3 (14.3%)</td>
<td>3 (15.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Punishment feelings</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don’t feel I am being punished</td>
<td>19 (90.5%)</td>
<td>17 (85.0%)</td>
<td></td>
</tr>
<tr>
<td>I do feel I am being punished</td>
<td>2 ( 9.5%)</td>
<td>3 (15.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Self-dislike</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel the same about myself as ever</td>
<td>13 (61.9%)</td>
<td>17 (85.0%)</td>
<td></td>
</tr>
<tr>
<td>I have lost confidence in myself</td>
<td>6 (28.6%)</td>
<td>2 (10.0%)</td>
<td></td>
</tr>
<tr>
<td>I am disappointed in myself</td>
<td>2 ( 9.5%)</td>
<td>1 ( 5.0%)</td>
<td></td>
</tr>
</tbody>
</table>

Table continues on next page
Cognitive function and weight in HF patients

<table>
<thead>
<tr>
<th>BDI items</th>
<th>T1 N = 21</th>
<th>T2 N = 20</th>
<th>Paired T Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-criticalness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don’t criticize myself more than usual</td>
<td>13 (61.9%)</td>
<td>12 (60.0%)</td>
<td></td>
</tr>
<tr>
<td>I am more critical of myself than I used to be</td>
<td>6 (38.1%)</td>
<td>8 (40.0%)</td>
<td></td>
</tr>
<tr>
<td>Suicidal thoughts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don’t have thoughts of killing myself</td>
<td>18 (85.6%)</td>
<td>20 (100.0%)</td>
<td></td>
</tr>
<tr>
<td>I have thoughts of killing myself, but wouldn’t carry it out</td>
<td>2 ( 9.5%)</td>
<td>0 ( 0.00%)</td>
<td></td>
</tr>
<tr>
<td>I would like to kill myself</td>
<td>1 ( 4.8%)</td>
<td>0 ( 0.00%)</td>
<td></td>
</tr>
<tr>
<td>Crying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don’t cry any more than I used to</td>
<td>13 (61.9%)</td>
<td>16 (80.0%)</td>
<td></td>
</tr>
<tr>
<td>I cry more than I used to</td>
<td>8 (38.1%)</td>
<td>4 (20.0%)</td>
<td></td>
</tr>
<tr>
<td>Agitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am no more restless than usual</td>
<td>10 (47.6%)</td>
<td>15 (75.0%)</td>
<td></td>
</tr>
<tr>
<td>I am more restless than usual</td>
<td>11 (52.4%)</td>
<td>5 (25.0%)</td>
<td></td>
</tr>
<tr>
<td>Loss of interest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have not lost interest in people or activities</td>
<td>11 (52.4%)</td>
<td>14 (70.0%)</td>
<td></td>
</tr>
<tr>
<td>I have lost interest in people or activities</td>
<td>10 (47.6%)</td>
<td>6 (30.0%)</td>
<td></td>
</tr>
<tr>
<td>Indecisiveness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I make decisions about as well as ever</td>
<td>14 (66.7%)</td>
<td>17 (85.0%)</td>
<td></td>
</tr>
<tr>
<td>It is more difficult to make decisions</td>
<td>7 (33.3%)</td>
<td>3 ( 15.0%)</td>
<td></td>
</tr>
<tr>
<td>Worthlessness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not feel I am worthless</td>
<td>15 (76.20%)</td>
<td>17 (85.0%)</td>
<td></td>
</tr>
<tr>
<td>I feel I am worthless</td>
<td>6 (28.60%)</td>
<td>3 (15.0%)</td>
<td></td>
</tr>
<tr>
<td>Loss of energy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have as much energy as ever</td>
<td>0 ( 0.00%)</td>
<td>5 (25.0%)</td>
<td></td>
</tr>
<tr>
<td>I have less energy than I used to</td>
<td>13 (61.9%)</td>
<td>13 (65.0%)</td>
<td></td>
</tr>
<tr>
<td>I don’t have enough energy to do very much</td>
<td>8 (38.1%)</td>
<td>2 (10.0%)</td>
<td></td>
</tr>
</tbody>
</table>

Table continues on next page
Cognitive function and weight in HF patients

<table>
<thead>
<tr>
<th>BDI items</th>
<th>T₁ N = 21</th>
<th>T₂ N = 20</th>
<th>Paired T Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sleep Patterns</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have not experienced any change</td>
<td>3 (14.3%)</td>
<td>5 (25.0%)</td>
<td></td>
</tr>
<tr>
<td>I sleep somewhat more or less than usual</td>
<td>13 (61.9%)</td>
<td>10 (50.0%)</td>
<td></td>
</tr>
<tr>
<td>I sleep a lot more or a lot less than usual</td>
<td>5 (23.80%)</td>
<td>5 (25.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Irritability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am no more irritable than usual</td>
<td>13 (61.9%)</td>
<td>14 (70.0%)</td>
<td></td>
</tr>
<tr>
<td>I am more irritable than usual</td>
<td>8 (38.1%)</td>
<td>6 (30.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Appetite</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have not experienced any change in my appetite</td>
<td>3 (14.3%)</td>
<td>6 (30.0%)</td>
<td></td>
</tr>
<tr>
<td>My appetite is somewhat more or less than usual</td>
<td>12 (57.1%)</td>
<td>7 (35.0%)</td>
<td></td>
</tr>
<tr>
<td>My appetite is much more or less than usual</td>
<td>6 (28.6%)</td>
<td>7 (35.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Concentration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can concentrate as well as ever</td>
<td>8 (38.1%)</td>
<td>13 (65.0%)</td>
<td></td>
</tr>
<tr>
<td>I can’t concentrate as well as usual</td>
<td>13 (57.9%)</td>
<td>7 (35.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Fatigue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am no more tired than usual</td>
<td>4 (19.0%)</td>
<td>7 (35.0%)</td>
<td></td>
</tr>
<tr>
<td>I get more tired than usual</td>
<td>9 (42.9%)</td>
<td>9 (45.0%)</td>
<td></td>
</tr>
<tr>
<td>I am too tired to do what I like to do</td>
<td>8 (38.1%)</td>
<td>4 (20.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My interest in sex has not changed</td>
<td>7 (33.3%)</td>
<td>10 (50.0%)</td>
<td></td>
</tr>
<tr>
<td>I am less interested in sex than I used to</td>
<td>14 (66.7%)</td>
<td>10 (50.0%)</td>
<td></td>
</tr>
</tbody>
</table>

**Research Question:** Is there a difference between low and high MoCA scores at T₁ with scores on the BDI-II at T₂?

An Independent T-test was used to examine the difference between low (n = 9, M = 6.22, SD 2.33) and high (n = 12, M = 6.17, SD 1.85) MoCA scores at T₁ and depression at T₂ as measured by the BDI-II; t(df 19) = .06, p = .95. There was no statistically significant difference.
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**Research Question:** Do MoCA scores at T1 correlate with NYHA Class at T1 and T2?

The MoCA score at T1 correlated inversely with the NYHA Classification at both T1 (r = -0.53, p = .01) and T2 (r = -0.50, p = .02).

**Aim 3: Cognitive impairment or weight change and diuretic dose adjustments**

The third aim of this study was to explore whether there was a difference in weight or baseline cognitive function in HF participants who received a high number or low number of diuretic dose adjustments one to two months after discharge from the hospital for an acute exacerbated HF admission.

**Diuretic Dose Adjustments and Weight.**

Diuretic dose adjustments by the nurses managing outpatient care included changing the dose of furosemide or Bumex for up to three days, adding metolazone for up to three days, or switching from furosemide to Bumex. The number of different diuretics that a participant could have been on may have been as much as three (furosemide, Bumex, and Metolazone) not counting spironolactone / eplerenone. Of the total sample, 42.9% (n = 9) required no diuretic dose adjustments, leaving 57.1% needing dose adjustments. Of those who had a diuretic dose adjustment (12 participants), 41.7% (n = 5) required only one adjustment, 58.3% (7) required two to 11 dose adjustments.

**Tertiary Research Question:** Is there a difference in weight change over time in those HF patients who have a low number versus a high number of diuretic dose adjustments when followed in the clinic one to two months after discharge from the hospital for an acute exacerbated HF admission?
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To examine whether there is a difference in weight change over time in those HF patients who had one to 11 diuretic dose adjustments, the number of adjustments was divided into two categories, a low number of dose adjustments (1 adjustment) and a high number of dose adjustments (2 – 11). Twelve of the 21 participants in this sample required adjusting their diuretic. Of these 12, five participants (41.7%) had one adjustment in their diuretic dosing during the period from T1 to T2. Seven of the 12 participants (58.3%) had two to 11 adjustments to their diuretic during this period. An Independent T test showed no statistically significant difference in weight change over time between a low number of diuretic dose adjustments (M = -7.36, SD 9.13) and a high number of diuretic dose adjustments (M = 1.71, SD 7.36); t (df 10) = -1.91, p = .09 (two-tailed).

**Research Question:** Is there a difference in baseline cognitive status in those HF patients who had a low number of diuretic dose adjustments versus a high number of diuretic dose adjustments when followed in clinic one to two months after discharge?

An Independent T test was performed to determine if there was a difference in baseline cognitive status in those HF participants who had a low number of diuretic dose adjustments (0 to 2) versus a high number of diuretic dose adjustments (3 – 11) by T2. There was no statistically significant difference in high and low MoCA scores from baseline (M = 24.29, SD 3.55) in participants who had 2 or fewer diuretic dose adjustments compared to participants who had 3, 6, or 11 diuretic dose adjustments (M = 23.25, SD 5.06); t(df 19) = .49, p = .63 (two-tailed).

**Additional Findings**

**Characteristics of fluid management by these participants.**
Cognitive function and weight in HF patients

Participants were queried at T1 and T2 regarding a fluid restriction prescription, whether they followed the prescription and whether they weighed themselves daily. Seventy-five percent of these participants knew they had been prescribed a fluid restriction and that number increased by T2 to 85%. At T1, only 1/3 of participants knew the amount of the fluid restriction, but by T2, 82.3% of the participants knew that their restriction was 64 ounces. At T1, only 23.80% of the participants (n = 5/21) always followed their restriction and 15% said they never weighed themselves. By T2, nearly half (46.7%) reported following the fluid restriction daily, but a Chi Square demonstrated that it was not statistically significant in this small sample (p = .61). Nearly half of the participants weighed themselves daily at T1, and this number increased to 85.7% by T2 and no one reported never weighing themselves.

Clinician reported Neurological and cognitive assessment.

This study documented that cognitive function was not measured or documented in this sample of patients at time of admission to the hospital by the healthcare providers. The minimal assessment for orientation was not performed on every patient (n = 20) during T1 (95.2%) and consisted only of documenting that they were awake, alert, and oriented times three on admission (AAOx3). There was no assessment tool to measure orientation other than the ability to state one’s name, where they were, and the date. Only 33.3% of the participants (n = 21) were documented as being able to move all extremities (MAE’s), while it was not even mentioned on the other 66.7% of these patients. Muscle strength received a comment on four of these 21 patients (19.0%). Mood and affect was not documented on 71.4% of patients (n = 21) and sensorium/sensation was not mentioned on 71.4% of the patients. Many of the patients in this group (52.4%)
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had their cranial nerves II – XII described as being “intact” and reflexes were not mentioned in 95.2% of these patients. The ability to follow commands was not mentioned in 90.5% of these patients. Three patients (14.3%) had their neurological exam described as “grossly non-focal” and the status of memory was not mentioned in 71.4%. Eight of these patients were noted to have normal judgment and insight.

*Neurological Assessment at follow-up.*

All participants were documented as being “Awake, Alert, and Oriented (AAO).” The fact that they “Move All Extremities” was recorded on three (14.3%). “Normal muscle strength” and “normal sensorium” were recorded on four participants (19% on each). Five participants were documented to have their “Cranial Nerves II-XII” to be intact and six to have “normal mood/affect.” “Normal reflexes” and “the ability to follow commands” were not mentioned for any of the 21 participants. Ten of the participants were recorded as being “grossly non-focal” and five were documented has having “memory intact.” Beyond that, there were no reported tools for measuring cognitive function.
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Chapter 5: Discussion, Conclusions, Recommendations

Overview of Study

The purpose of this study was to examine whether weight changes differed based on the presence or absence of cognitive impairment in HF participants who were followed in the clinic one to two months after discharge from the hospital after an exacerbation of HF. Additionally, this study sought to explore whether diuretic dose adjustments influenced weight change from T₁ (enrollment in the hospital) to T₂ during a regularly scheduled clinic visit. Results of this study provide greater understanding of the occurrence of mild cognitive impairment in Class II to IV HF patients admitted to the hospital for acute exacerbation of HF and the relationship of diuretic dose adjustments to change in weight in the first one to two months after discharge. In this small sample, 42.9% of participants at enrollment had MoCA scores < 24, indicating cognitive impairment. However, there was no difference in weight change from enrollment to follow-up based on presence or absence of cognitive impairment or the number of times the diuretic dose was adjusted post-discharge.

Discussion

Primary Aim: Cognitive Function and Weight Changes.

The Montreal Cognitive Assessment Tool (MoCA) was used to measure the following domains of cognitive function: Memory, Executive Function, Visuospatial abilities, Language, Mental Speed and Attention and were assessed using the Montreal Cognitive Assessment Tool (Nasreddine et al., 2005). In this study, 42.9% of the subjects scored ≤ the cutpoint of 24 on the MoCA. Lee et al. (2013) reported a cut point of 24 on the MoCA for participants with cardiovascular disease is a more sensitive measure for
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identifying reductions in self-care agency than the previously published cutpoint of 26 for the general population (Nassredine et al., 2005). Our finding is consistent with previously published reports of cognitive impairment in HF patients using various assessment tools between 22% to 70% (Pressler et al., 2010; Vogels, Oosterman, van Harten, Scheltens, et al., 2007). Research was reported in which 14.2% of Class II-IV HF patients had mild cognitive impairment (Lee et al., 2013). Sixty-six percent of 75 patients with systolic dysfunction in another study demonstrated found cognitive impairment (Bauer & Pozehl, 2010). The MoCA was used for screening in HF outpatients ≥ 65 years of age in which 70% scored <26 (Harkness, Demers, Heckman & Mckelvie, 2011). Four screening measures of cognition were tested in 42 patients with HF, which reported that cognitive impairment was detected in 12 (28.6%) of the participants (Riegel, Bennett, et al., 2002). Vogels, Oosterman, Van Harten, Gouw, et al., (2007) found that 25% of HF patients showed more problems with executive function, memory, language, mental speed and attention compared to healthy controls.

Furthermore, HF patients with cognitive impairment may be at risk for self-care deficits. One of the most important components of a patient’s ability to care for oneself is having the cognitive function to learn about the medical therapies, to understand them, and to implement them (Woo et al., 2009; Wu, Moser, Lennie, & Burkhart, 2008; Zuccalà, et al., 2005). Treatment for acute exacerbated HF is focused on maximizing cardiac function through the use of multiple medications including diuretics (Gheorghiade, Shah, et al., 2013; Mosel & Riegel, 2004). The method for measuring the success of diuresis is daily weights done by the patient in their home (Mosel & Riegel,
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2004). The ability of the patients to remember to take their medications and weigh themselves daily requires intact cognitive function (Woo et al., 2009).

**Weights.**

In this small sample, there was no clear tendency for the group of patients to either gain or lose weight. At follow-up, there was no documentation in the Medical Record of the participants complaining of water weight gain even though 40% did gain 0.4 to 20.20 lbs., which was suggestive of water weight gain. Fifty percent of the participants lost weight, 10% did not change their weight, and 40% of the participants gained weight. It illustrates, if anything, that weight fluctuations in HF patients are varied with a multifactorial causality related to medical and nursing management, patient unique characteristics, and the nature of the disease process in which a patient may gain fluid weight or become cachectic due to deteriorating disease process.

Almost half (n = 9, 42.9%) of the T2 visits did not happen within the four to eight week window. The five participants who were re-hospitalized were seen after discharge from the second hospitalization. The remaining four participants who were seen outside of the window changed their clinic appointments to an earlier or later date than scheduled, so were missed and had to be seen for the T2 visit at a later visit. As a result of these variations in the timing of the T2 clinic visit, the resulting weights could be higher, lower, or the same as if the T2 visit had been completed during the window.

**Cognitive Function and Change in Weight from T1 to T2.**

Findings demonstrated that there was no statistically significant difference in weight change over time with low or high scores on the Montreal Cognitive Assessment tool at T1 (MoCA). The mean change in weight for participants who scored higher on the
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MoCA (≥ 24) was + 0.62 lbs. while the mean change in weight for participants who scored lower on the MoCA (< 24) was +.20, which was not statistically significant. This surprising finding is difficult to explain, but there are several possible factors that may be considered. The first is that the sample size was so small as to prevent the sampling of a wide variety of HF patients who may have demonstrated weight gain at T2, especially if they had cognitive impairment. Another reason has to do with the use of data from enrollment rather than from discharge. An additional factor is that patients who declined to enroll in the study may have been the ones to demonstrate more cognitive impairment at enrollment and/or more weight gain over time. A fourth factor may be that patients who have more serious deterioration of their cardiac function may fail to eat well due to reduced appetite and become nutritionally depleted due to this failure coupled with reduced GI malabsorption thus developing cardiac cachexia (von Haehling, Lainscak, Springer, & Anker, 2009). This failure to maintain a healthy nutritional status may mask the insidious development of fluid accumulation. Finally, medical and nursing management of advanced stage HF patients is focused on maximizing cardiac function resulting in discovering, treating and mitigating weight gain early in its trajectory, thereby preventing patients from having excessive weight gain (Yancy et al., 2013).

Secondary Aim: Cognitive Function, Functional Status, Depression, and NYHA Classification.

A secondary aim was to explore whether functional status, depression, or NYHA Class in HF patients followed in the clinic one to two month after discharge from the hospital for an acute exacerbated HF admission differed according to baseline cognitive impairment. Previous research has shown that there is a correlation between cognitive
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function and functional scores, depression, and NYHA class (Alosco et al., 2012; Faller et al., 2009; Heo et al., 2014; Katz, S., 1983, McLennan et al., 2010; Nabi et al., 2010; Tousoulis et al., 2010).

Two tools were used to analyze functional status, the Katz ADL and the Lawton Instrumental Activities of Daily Living Scale (IADL) screening tools. The Katz ADL documented that all of these participants possessed basic, self-care skills at T₁ as evidenced by the scores of 5 and 6 out of a maximum of 6 (Katz, et al., 1970). Since 42.9% of the participants in this study scored below 24 on the MoCA, one would expect to see lower scores on the Katz ADL in order to be more in line with international statistics (Mutai, Furukawa, Araki, Misawa, & Hanihara, 2012). Mutai et al. (2012), found that in 174 stroke patients (mean age 73.0 ± 10.8; 51.12% male), cognitive functional independence measured at admission (22.4 ± 8.3) was a statistically significant predictor of functional recovery by discharge (OR = 1.12; 95% CI 1.03 – 1.22; p < .001).

The IADL (Lawton & Brody, 1969) picked up on more deficits with self-care skills at enrollment into this study. Out of a possible eight points, only 38.1% of the participants reported competence in every domain. Another research team had similar findings, in which their population of HF patients (n = 122) completed a neuropsychological battery including the Mini-Mental State Examination and Trail Making Tests A & B, the Lawton IADL along with a 2-minute step test to estimate fitness, (Alosco et al., 2012) They found that scores were high on basic ADL skills, but the IADL scores showed that 37.7% needed assistance with laundry (p = <.001), 34.4% with housekeeping (p < .05), and 31.1% with food preparation (p < .05) (Alosco et al., 2012).
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At follow-up at T2, items on the IADL in which differences were noted were Mode of Transportation, in which two of 16 males and one of five females reported had lost their independence. Medication Responsibility, in which three of 16 males and zero females reported dependency, and Finances, in which two of 16 males and one of five females reported losing their independence also demonstrated lower IADL scores. Independence in Mode of Transportation and being in charge of finances may have importance for both genders across the life span. The change in IADL total scores from T1 to T2 was statistically insignificant (p = .86). In this study, there was no statistically significant difference between low and high MoCA scores at T1 and functional status at T2 as measured by the Katz Activities of Daily Living (ADL) and Lawton’s Index of Activities of Daily Living (IADL). There was a statistically significant difference between males and females on certain activities of daily living as measured by the Lawton IADL such as laundry, cooking, and housekeeping measures.

More men reported inability to shop (5 of 16 males vs. 1 of 5 females), prepare food (9 of 16 males vs. 1 of 5 females), and do laundry (6 of 16 males vs. 1 of 5 females). The extent to which IADL items varied by gender was based on culturally derived norms, several decades of depending on wives to do chores that the husbands never did in the first place. Eight participants (38.1%) reported needing help with shopping, or that their wives routinely did the shopping. Nine (42.9%) reported that they needed help with food preparation or that their wives routinely did all the food preparation so they really did not know how to in her absence. Four participants (19.0%) reported that they needed help with or never did any housekeeping. Cultural norms for these activities need to be considered before assigning significance to these responses, although keeping house
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included outdoor work such as mowing the lawn, which several men said they could no
longer do. The maximum score was 8 with 8 considered to be high functioning for
women and 5 considered to be high functioning for men due to the fact that culturally
speaking, most men do not do food preparation, housekeeping and laundering even if
they are able (Graf, 2007).

**Cognitive Function and Depression.**

The impact of MoCA scores on the difference in BDI-II scores between T₁ and T₂
was also examined. Depression in the cardiovascular population has been variously
reported to be between 10% (de Jonge et al., 2006) to 42% (Rutledge et al., 2006). In this
sample, 28.6% had a history of depression documented in the medical record on
admission to the hospital, yet 14.3% of the sample scored between 14-19 and 24% of the
sample had a score of ≥ 20 on the BDI upon enrollment into the study. Collectively,
therefore, 38.3% of the sample had mild, moderate, or severe depression at T₁, so this
cohort of participants were representative of other HF patients in the United States (US)
(Go, et al., 2014; Orgen et al., 2014).

There was no statistically significant difference (p = .95) between low and high
MoCA scores at T₁ and depression at T₂. One participant was too tired to do the BDI at
T₂, so only 20 pairs were examined. There is a difference of the occurrence of depression
between that documented in the medical record and that elicited by patient report through
the BDI-II of their feelings of depression by six percentage points. Therefore, eight of
these 21 participants needed to be further screened for depression associated with their
admission to the hospital for acute exacerbated HF. While most people in this sample did
not have thoughts of suicide (85.7%) at T₁, one person from the sample circled the item
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“I would like to kill myself.” This result was not reported to the PI as this issue was already known to the PI.

Of note, the BDI-II scores improved between T1 and T2. At follow-up, these participants reported problems with energy, fatigue, and altered sleep patterns, as would be expected with HF patients (Go, et al., 2014; Lee et al., 2013, Ogren et al., 2014). The mean results of the BDI-II tool at T2 (9.65, SD ± 5.91) did not support the presence of depression generally in this HF population. Published studies have found that depression interferes with patients’ abilities to engage in self-care. Both the Katz and Lawton mean scores were compared to the BDI-II at T2, but in this small highly functional sample and a mean BDI-II score of 9.65, there was not enough depression to demonstrate an impact on functional status.

**Cognitive function and New York Heart Class.**

The correlation between cognitive function as measured by the MoCA screening tool and New York Heart Class was examined. A moderate statistically significant inverse relationship was observed between MoCA scores at T1 and NYHA at T1 and MoCA at T1 and NYHA at T2, even though the NYHA classifications had improved across the group of participants by T2. This finding is consistent with other studies which demonstrated that as NYHA class increases, cognitive function decreases (Go, et al., 2014, Ogren et al., 2014). Additionally, it was found that the MoCA scores were lower for participants with higher NYHA class. This finding is similar to national statistics (Yancy et al., 2013). However, the impact of MoCA scores at T1 on the difference in the mean BDI-II scores between T1 and T2 was not statistically significant.
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**Tertiary Aim: Diuretic Dose Adjustments, Weight Change, and Cognitive Function.**

The third aim of this study was to explore whether there was a difference in weight or baseline cognitive function in HF participants who received a high number or low number of diuretic dose adjustments one to two months after discharge from the hospital for an acute exacerbated HF admission. Diuretic dose adjustments after discharge included changing the dose of furosemide or Bumex or adding metolazone. The number of diuretic dose adjustments ranged from zero for nine participants to 11 for one participant. Other dose or diuretic adjustments were one adjustment for five participants, two adjustments for three participants, three adjustments for two participants and six diuretic dose adjustments for one participant. There was no statistically significant difference in weight change over time between a low number of diuretic dose adjustments and a high number of diuretic dose adjustments ($p = .09$) although it was approaching statistical significance and deserves to be restudied with a larger sample. Possible explanations for this finding include that participants who had nearly stable weights needed less diuretic dose adjustments and those who received more diuretic dose adjustments achieved a more stable weight. Additionally, the sample size was too small to demonstrate any measurable trends on these variables. There was no statistically significant difference in MoCA scores from baseline in participants who had 2 or fewer diuretic dose adjustments compared to participants who had 3, 6, or 11 diuretic dose adjustments. The importance of this concept rests with the thought that if a HF patient is fluid overloaded, the cardiac performance worsens, possibly reducing cerebral perfusion...
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pressure resulting in reduced cognitive function. However, the findings in this study did not support that, possibly due to the low numbers of participants in this study.

**Additional Findings**

**Heart Failure.**

Since emergency room visits and repeat hospitalizations for HF cost up to $44 billion per year (Shah, et al, 2013; Gheorghiade, Vaduganathan, et al., 2013), it would be important to manage these physiologic relationships at home and prevent hospital readmissions. In this study, 23.80% of the participants were readmitted to the hospital within 30 days for treatment of acute exacerbated HF, which is similar to national statistics (Go et al, 2014; Gheorghiade, Vaduganathan, et al., 2013).

These participants received evidenced based care compared to national statistics. The number of patients on Milrinone, either at home or in the hospital was 28.6%, which is similar to standard of care in the US (Go et al., 2014). Eighteen (85.7%) participants had Automatic Implantable Cardioverter Defibrillators and 42.9% had BiV pacers (or CRT-D’s). The latest statistics from the National Cardiovascular Data Registry’s ICD Registry document that 80.35% to 84.02% of 107,096 patients nationwide had CRT-D’s implanted from 2006-2010 (Eapen et al., 2012). The American Heart Association (AHA) guidelines for the management of HF estimate that only about 30% of Class III-IV HF patients probably meet the criteria of widening QRS morphology to qualify for placement of a CRT-D device (Yancy et al., 2013), but Eapen et al. (2012) note that individual circumstances may influence a physician to place CRT-D’s in patients who do not meet these rigid guidelines, such as some Class II patients.
Characteristics of fluid management.

Participants were queried at T1 and T2 regarding a fluid restriction prescription, whether they followed the prescription and whether they weighed themselves daily. Seventy-five percent of these participants knew they had been prescribed a fluid restriction and that number increased by T2 to 85%. At T1, only 1/3 of participants knew the amount of the fluid restriction, but by T2, 82.3% of the participants new that their restriction was 64 ounces. At T1, only 23.80% of the participants always followed their restriction and 15% said they never weighed themselves. By T2, nearly half reported following the fluid restriction daily.

Nearly half of the participants weighed themselves daily at T1, and this number increased to 85.7% by T2 and no one reported never weighing themselves. Although there was an increase in the percentage of participants who reported that they followed the Fluid Restriction every day at enrollment versus at T2, it was not statistically significant in this small sample (p = .56). The fact that more participants knew that they had a fluid restriction, knew the amount, followed the restriction, and weighed themselves by T2 is a testament to the educational efforts of the nurses caring for these participants.

These findings are similar to other studies. Data from 648 hospitalized HF patients demonstrated that at baseline, adherence to fluid restriction was 72% and improved to 89% after receiving educational support over 18 months, while adherence to daily weighing was 34% and improved to 85% after receiving educational support over 18 months (Nieuwenhuis, Jaarsma, Van Veldhuisen, Postmus, & Van der Wal, 2012). The “Get with the Guidelines-Heart Failure” registry studied data collected from 236 American hospitals and 54,322 patients from 2005 – 2007 (36 months of data).
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(Ambardekar et al., 2009). They found that 2.4% of these patients had dietary non-adherence and an additional 2.35% of patients had both medication and dietary non-adherence. They also found that among their non-adherent patients, there was greater volume overload as evidenced by higher body weight than the adherent group (p > .0001), increased jugular venous distention (p > .0001), crackles in the lung fields (p > .0001), lower extremity edema (p > .0001), and higher brain natriuretic peptide levels (p > .0001).

**Neurological and Cognitive Assessments by Health Care Providers**

Finally, this study documented that cognitive function was not documented in this sample at time of admission to the hospital by the health care providers even though 42.9% of the participants demonstrated cognitive impairment by scoring < 24 on the MoCA. This study also documented that neurological assessments were performed erratically and that little to no cognitive assessments were done beyond asking for orientation to person, place, and time.

The fact that these participants scored well on the Orientation section, calls into question the common practice of assuming that assessing patients for orientation is an adequate assessment of cognitive status. Of these participants 95.2% were documented as being awake, alert, and oriented times three on admission (AAOx3). There was no standard tool to measure orientation other than the ability to state one’s name, where they were, and the date.

Neurological assessments at the follow-up visit were equally sparse. All participants were documented as being “Awake, Alert, and Oriented (AAO).” Beyond that, there were no tools for measuring cognitive function. These data are similar to that
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reported by Dodson et al. (2013) and Pressler et al (2010). Dodson et al. (2013) studied 282 in-patient HF patients (M = 80 years) using the Folstein Mini-Mental State Examination. They found that 46.8% had some degree of cognitive impairment (CI) (mild 25.2%, 21.6% moderate-severe) but only 22.7% had CI documented by the physicians. Those whose impairment was less severe (median MMSE of 22.0 vs 18.0, p < .01) tended to be the ones not documented. In addition, those whose CI was not documented were significantly more likely to experience 6-month mortality or hospital readmission than patients without CI (adjusted HR 1.53; 95% CI, 1.06-2.20; p = .02) (Dodson et al., 2013). This study supports these results and lays the foundation for developing an argument for dedicated assessments of patients’ cognitive function separate from a neurological assessment.

Cognitive Impairment

No one was enrolled in this study who had a previous diagnosis of dementia or required a personal caregiver to assist with Activities of Daily Living (ADL’s). This study documented that 42.9% of the participants scored < 24 on the MoCA tool, which raised the question of whether these individuals had previously undiagnosed cognitive impairment. Cognitive impairment is increasingly recognized as being associated with HF (Dodson, et al., 2013; Ogren, Fonarow, & Woo, 2014; Pressler, et al., 2010; Wolfe, Worrall-Carter, Foister, Keks, and Howe, 2006) and occurs on a continuum between normal cognitive function and total cognitive disability/dementia. There is evidence of diminished cognitive skills which may include short term memory and attention disorders, and problems with organizing and problem solving which impair patients’ abilities to implement a treatment regime that includes fluid and water restriction (Lee et
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al., 2013:Pressler et al., 2010). Because the sample is so small, it is not statistically sound to do a sub-analysis of the various parts of the MoCA to isolate the particular sub-tests that contributed to the low scores. Therefore, the scores of < 24 identify participants who may need further cognitive evaluation to characterize functional deficits.

Conclusions

Patients with HF may have cognitive impairment which could impact self care management. Cognitive impairment (CI) was documented in 42.9% of this sample and the data also shows that the MoCA scores were lower for participants with higher NYHA Class. While there was no difference between CI and weight change or diuretic dose adjustment, this could be due to the small sample size, and warrants further exploration in other studies. In this study, 23.8% of this small sample were readmitted to the hospital for treatment of acute exacerbated HF, which is very similar to the national average of 20% readmission rate (Go et al., 2014). Additionally, four of the five participants who were rehospitalized had cognitive impairment.

Statistically significant differences found in this study were a decrease in the BDI-II scores between T₁ and T₂, and a significant difference between males and females on certain activities of daily living as measured by the Lawton IADL. Other findings included that there was no statistically significant difference between MoCA scores at T₁ and functional status scores and depression scores between T₁ and T₂ in this small sample of relatively high functioning participants. Due to the small sample size, the extent of impact of any of the findings is not able to be calculated.
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**Significance to Nursing Practice**

This study is significant to nursing practice because it documents a need to incorporate cognitive function assessments into the discharge planning process to better provide needed services to HF patients at home. A patient’s ability to maintain their weight depends on having the cognitive skills to take their medications as prescribed, to follow a fluid restriction, and to weigh themselves daily. They must be able to analyze the significance of variations in their weight and engage in a problem solving process to determine the appropriate action to take when they determine that the weight variation is indicative of fluid overload; and then to make that phone call to their cardiologist or to take the prn diuretic.

When CI is documented, then patients are unable to actively engage in these self care behaviors independently. They are unable to translate the discharge teaching materials from the hospital into the home environment without assistance. The family members may not realize that their loved one has these deficits and may be ill prepared to fill the void. They may be surprised when their loved one does not follow the fluid restriction, does not do daily weights and argues with them when confronted about their nonadherence.

A patient’s ability to manage their weight is directly linked with maintaining euvolemia and maximal cardiac output. Failure to follow a prescribed fluid management program and performance of daily weights can destabilize a patient clinically leading to exacerbation of HF symptoms and increasing frequency of hospital readmissions, (Howlett, 2011; Hunt et al., 2009; Parrinello et al., 2008). Maintaining euvolemic weight is a cornerstone of HF care (Moser & Riegel, 2004). It is imperative that current nursing
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practice in the management of HF patients must change. Nurses should perform cognitive screenings on patients with Class II-IV HF in order to better plan for their discharge needs.

Recently, researchers have focused on the association between cognitive impairment and HF (Go et al., 2014, Lee et al., 2013, Ogren et al., 2014; Pressler et al., 2010; Vogels, Oosterman, Van Harten, Gouw, et al., 2007). These findings show the relationship between cognitive impairment and blunted responses to HF symptoms (Lee et al., 2013) or that executive dysfunction predicts mortality and morbidity at one year (Pressler et al., 2010). HF experts recommend systematic assessment of cognitive function in HF patients (Cameron et al., 2009; Yancy et al., 2013). However, no research was found on the relationship between cognitive impairment and change in weight in HF patients.

Strategies for post discharge contact with heart failure patients.

While there are many studies and recommendations for discharge programs for HF patients, there are no studies to date which highlight the unique needs of cognitively impaired HF patients. There are programs at some health care practices that contact patients after discharge to assess them for dyspnea, fatigue, and lower extremity edema, as well as requesting a report of daily weights, blood pressures, and knowledge of medications (Parrinello et al., 2013). Miller and Schaper (2015) also reported the use of telephone follow-up calls to reduce readmission rates. Telemonitoring is being used more often to monitor HF patients at home, capturing data on weight, blood pressure, and heart rate (Blum & Gottlieb, 2014). The role of the nurse navigator to reduce rehospitalization is being described in the literature to provide education, ensure accurate medication
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reconciliation, to assist the patient with making follow-up appointments and facilitate communications with other care providers (Schell, 2014). Other strategies include reducing caregiver burden and use of cardiac rehabilitation (McClintock, Mose, and Smith, 2014). None of these articles addressed the needs of the cognitively impaired HF patient. Nurse-led outpatient heart failure clinics have a proven track record of reduction of all-cause mortality and should flourish in the health care system (Bdeir et al., 2015).

**Strategies for discharge transitions.**

An alternative to current practice is to first identify HF patients with mild cognitive impairment and assess the home environment for suitability for discharge to home. A unique transition care model was studied in Australia called Transition Care: Cognitive Assessment and Management Pilot (TC CAMP) because it was recognized that people with cognitive impairment require more time and support beyond the walls of the hospital to optimize their functional capacity in order to reduce hospital readmissions (Renehan, Haralambous, Galvin, Kotis, and Dow, 2013). Among the underpinnings of this program was the understanding that persons with cognitive impairment can become disoriented to time and place resulting in behavioral disruptions. Additionally, persons with cognitive impairment experience memory lapses and cannot remember what they were taught in the hospital (Lee et al., 2013; Pressler, et al., 2010). Using a person and family-centered approach, the staff included a nurse specialist who was the liaison with families, performed cognitive assessments, behavior management and discharge planning. Additionally, there were a geriatrician, occupational therapist and other allied health as required.
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Once identified as having cognitive impairment, hospitalized HF patients need more support in transitioning to home. Similar to the TC CAMP model mentioned above, but not involving transitioning to a residential facility, patients with cognitive impairment need to have a home visiting nurse (HVN) every day, not just 2-3 days per week, along with ancillary personnel to help with ADL’s as indicated. The first home visit should include a home assessment as well as making sure that the weighing scales are available on a hard flat surface, a patient-usable method of keeping track of fluid consumption is available to the patient, that high sodium foods are identified for disposal, and that the medications are reconciled and easily available to the patient in a pill dispenser among many other safety concerns for a home visiting nurse to assess. The first visit should include not only a physical assessment, but re-education about meds, fluids, and diet along with an easily readable chart for medication names, doses, and schedule. These daily visits need to continue until the HVN signs off on the patient. The TC CAMP model above had 60 day renewable options for care (Renehan, et al., 2013), so should home care. Home care is likely to be less expensive even with daily HVN visits, and certainly less expensive that multiple HF re-hospitalizations.

Nurses need to teach patients and families about the possibilities of cognitive impairment with HF so that they can better plan for their future. Additionally, patients need to be able to plan for their day to day safety in order to carry out all of the therapies prescribed for them for the management of their HF. Healthcare providers teach patients a lot of information about their disease processes and expect them to go home and begin to implement everything they learned. But if a patient has injury to the Executive Function area of their brain, they are not able to plan, organize, and sequence well
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enough to carry out all the therapies prescribed. Healthcare providers teach HF patient not to drink more than 64 ounces of fluid per day, but if their Executive Function area of the brain is injured, then they cannot do math. Accusations of non-compliance are useless characterizations in this scenario. Nurses need to know when their patients have mild cognitive impairment in order to be better teachers for our patients and families as well as better discharge planners.

**Limitations of Study**

There were a variety of limitations to the study that have to do with sample size; setting; personal characteristics of the patients who were willing to be in the study versus those who refused; type of HF, natural course of HF over time; fluid management self-report tool; and the cognitive, functional, and depression assessment tools. The main limitation of the study was the small sample size. As a result, there were not enough participants to do reliable statistical analysis. Efforts to increase the sample size included modifying the protocol to add a third cardiologist whose practice specialized in HF patients at the same academic medical center and adding a third clinic to accommodate that practice. This addition did improve enrollment numbers, but only slightly. Because of the small sample size, statistical significance on most measures could not be achieved and on those measures that were statistically significant, the sample was too small to achieve statistical power. Of concern when doing clinical research is the unjustifiable research burden on participants enrolled in a study that is underpowered (Munro, 2005). However, when doing novel research such as this one, unanticipated barriers may arise that confound one’s ability to enroll the numbers required for statistical power. There is an argument to be made that for novel research, a smaller N may be acceptable in order to
investigate the feasibility and scientific justification for investigating the topic (Bacchetti, Deeks, & McCune, 2011; Sauro, 2013).

Recruiting participants from a single medical center resulted in a homogenous sample of patients, mostly male, and mostly Caucasian, thus limiting generalizability of the findings. The study needed to be expanded to include other academic centers to not only increase the sample size, but to also broaden the variety of patients enrolled and to incorporate a wider variety of cardiology practices.

The participants who were willing to be in the study may have been more comfortable with filling out questionnaires and not have been intimidated by the fact that one of them was a screening tool for cognition. The study is only applicable to patients with systolic HF and left ventricular ejection fraction (LVEF) \( \leq 40\% \). The LVEF was measured as much as 12 months prior to enrollment in the study, which is a limitation, however, it was only used to document the presence of left ventricular impairment.

Management of patients with HF is very complex. An inaccurate, simplistic understanding of outpatient management of patients with HF is that they gain weight in Class IV HF as their myocardium deteriorates. In actuality, some patients gain weight, but some patients become cachectic due to loss of appetite mediated by reduced blood flow to the GI tract and malabsorption of nutrients among other factors. As a result they lose weight, while still demonstrating physical signs of fluid overload.

The patient who needed the most diuretic dose adjustments (11) scored 29/30 on the MoCA, 8/8 on the Lawton IADL, and still gained 6.8 lbs. Another patient who scored 27/30 on the MoCA gained 20 lbs. and somehow received no diuretic dose adjustments, while demonstrating a Lawton IADL score of 3/8. The patient who lost 22
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lbs. scored only 24/30 on the MoCA, 5/8 on the Lawton IADL (normal for a male) and only had 1 diuretic dose adjustment. These three examples are provided here to illustrate that in this small sample, outliers skewed the expectations that highly functional patients with a higher cognitive score would need fewer diuretic dose adjustments while still being able to maintain one’s study enrollment weight. This study is not able to demonstrate that higher cognitive scores impact on self-care, assuming that no change in weight is a surrogate for self-care. What is not known is whether any of these patients who lost weight were seasoned patients who knew when to call the HF nurse for diuretic dose adjustments. Additionally, the patients may have not understood the importance of following their fluid restriction prior to their baseline hospitalization, indeed some denied knowing that they were on a fluid restriction. However, due to the hospitalization and teaching by the nurses both during the hospitalization and afterward, they became more aware of the need to follow a fluid restriction. It is not possible in this study to distinguish whether a change in behavior due to education by the nurses or any possible improvement in cognitive performance resulted in less weight gain in the overall sample.

Additionally, some participants with Class IV HF scored very high on the MoCA, while other Class IV patients scored low and vice versa. A larger sample size may have resulted in a more reliable distribution of the MoCA scores with less deviation around the mean. The MoCA tool is in itself a limitation, as it is merely a screening tool. The results do not necessarily indicate that someone does or does not have cognitive impairment, but merely that someone needs to be further evaluated. Additionally, some potential participants may have been intimidated by the fact that the study involved a thinking skills questionnaire and thus declined to participate.
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The fluid restriction self-report is fraught with limitations due to the problems with patients recalling accurately if they drink no more than the number of ounces per day prescribed by their health care provider and weigh themselves daily. Furthermore, their routine may vary from day to day and their ability to remember whether they do or do not follow the fluid restriction may be limited in the presence of cognitive impairment. Emotionally, they may want to please the researcher or appear desirable, as well as experience the emotional trauma of admitting that they do not follow these prescriptions. So they may report what they think the researcher wants to hear. Documentation of a written prescription for a fluid restriction by the physician or nurse practitioner was fragmented.

The IADL is difficult to analyze as it measures functioning in areas such as cooking and housekeeping which may be culturally determined (Graf, 2007). Both fatigue and depression have a negative effect on one’s ability to perform IADL’s, however this study was not able to demonstrate that depression changed the IADL scores between T₁ and T₂.

The Beck Depression Inventory II measures several somatic complaints, such as fatigue, appetite, and interest in sex. Low scores on these measures may falsely indicate depression in a HF patient, when, in fact, the patient has these symptoms due to their HF pathophysiology (Ogren et al., 2014).

Recommendations for Future Research

There are many areas of future research. First, this study needs to be modified and repeated in order to reach statistical significance so as to add to the beginning evidence of cognitive impairment in patients with HF. It definitely needs to be done, since there are
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still no studies examining the impact of cognitive impairment on change in weight. One way to modify the study would be to involve more academic medical centers and more staff so as to enroll the required number of participants within one year.

In the outpatient setting, there needs to be more research on the value and role of nurse-led clinics while even expanding the role of these clinics to include biometric measurements and outpatient administration of intravenous Lasix if indicated. Other research needs to be done on transitions of care from hospital to home. It is possible to increase the amount of assistance in the home environment for HF patients with cognitive impairment in order to prevent the more expensive hospital readmissions.

Another area for potential research is to examine the state of practice of nurses as well as physicians in doing cognitive assessments. The US Preventative Task Force (Moyer, 2014) recommends that there is no significant value to doing routine cognitive screening on older Americans. The key word here is “routine.” There is an imperative to screen high risk individuals and the data needs to be developed to demonstrate that cognitive screening is not being done and whether Americans have worse outcomes when no screening is done to support discharge planning.
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Cognitive function and weight in HF patients

Zile, M. R., Adamson, P. B., Cho, Y. K., Bennett, T. D., Bourge, R. C., Aaron, M. F., ...


Appendix A

Katz Index of Independence in Activities of Daily Living

<table>
<thead>
<tr>
<th>Activities</th>
<th>Independence: (1 point)</th>
<th>Dependence: (0 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No supervision, direction or personal assistance</td>
<td>With supervision, direction, personal assistance or total care</td>
</tr>
<tr>
<td>Bathing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points_________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 Point)</td>
<td>BATHES self completely or needs help in bathing only a single part of the body such as the back, genital area or disabled extremity.</td>
<td>(0 Points) Needs help with bathing more than one part of the body, getting in or out of the tub or shower. Requires total bathing.</td>
</tr>
<tr>
<td>Dressing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points_________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 Point)</td>
<td>GETS clothes from closets and drawers and puts on clothes and outer garments complete with fasteners. May have help tying shoes.</td>
<td>(0 Points) Needs help with dressing self or needs to be completely dressed.</td>
</tr>
<tr>
<td>Toileting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points_________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 Point)</td>
<td>GOES to toilet, gets on and off, arranges clothes, cleans genital area without help.</td>
<td>(0 Points) Needs help transferring to the toilet, cleaning self or uses bedpan or commode</td>
</tr>
<tr>
<td>Transferring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points_________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 Point)</td>
<td>MOVES in and out of bed or chair unassisted. Mechanical transferring aides are acceptable.</td>
<td>(0 Points) Needs help in moving from bed to chair or requires a complete transfer.</td>
</tr>
<tr>
<td>Continence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points_________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 Point)</td>
<td>EXERCISES complete self control over urination and defecation.</td>
<td>(0 Points) Is partially or totally incontinent of bowel or bladder.</td>
</tr>
<tr>
<td>Feeding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points_________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 Point)</td>
<td>GETS food from plate into mouth without help. Preparation of food may be done by another person.</td>
<td>(0 Points) Needs partial or total help with feeding or requires parenteral feeding.</td>
</tr>
</tbody>
</table>

Total Points = ____________ 6 = High (patient independent) 0 = low (patient very dependent)

### Appendix B

#### INSTRUMENTAL ACTIVITIES OF DAILY LIVING SCALE (IADL)

**M.P. Lawton & E.M. Brody**

**A. Ability to use telephone**
- 1. Operates telephone on own initiative; looks up and dials numbers, etc.   1
- 2. Dials a few well-known numbers   1
- 3. Answers telephone but does not dial   1
- 4. Does not use telephone at all.   0

**B. Shopping**
- 1. Takes care of all shopping needs independently   1
- 2. Shops independently for small purchases   0
- 3. Needs to be accompanied on any shopping trip.   0
- 4. Completely unable to shop.   0

**C. Food Preparation**
- 1. Plans, prepares and serves adequate meals independently   1
- 2. Prepares adequate meals if supplied with ingredients   0
- 3. Heats, serves, prepares meals or prepares meals but does not maintain adequate diet.   0
- 4. Needs to have meals prepared and served.   0

**D. Housekeeping**
- 1. Maintains house alone or with assistance (e.g. “heavy work domestic help”)   1
- 2. Performs light daily tasks such as dishwashing, bed making   1
- 3. Performs light daily tasks but cannot maintain acceptable level of cleanliness.   1
- 4. Needs help with all home maintenance tasks.   1
- 5. Does not participate in any housekeeping tasks.   0

**E. Laundry**
- 1. Does personal laundry completely   1
- 2. Launders small items; rinses stockings, etc.   1
- 3. All laundry must be done by others.   0

**F. Mode of Transportation**
- 1. Travels independently on public transportation or drives own car.   1
- 2. Arranges own travel via taxi, but does not otherwise use public transportation.   1
- 3. Travels on public transportation when accompanied by another.   1
- 4. Travel limited to taxi or automobile with assistance of another.   0
- 5. Does not travel at all.   0

**G. Responsibility for own medications**
- 1. Is responsible for taking medication in correct dosages at correct time.   1
- 2. Takes responsibility if medication is prepared in advance in separate dosage.   0
- 3. Is not capable of dispensing own medication.   0

**H. Ability to Handle Finances**
- 1. Manages financial matters independently (budgets, writes checks, pays rent, bills goes to bank), collects and keeps track of income.   1
- 2. Manages day-to-day purchases, but needs help with banking, major purchases, etc.   1
- 3. Incapable of handling money.   0


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Appendix C

MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Original Version

VISUOSPATIAL / EXECUTIVE

- Copy cube
- Draw CIRCLE (Ten past eleven)
  (3 points)
- Contour
- Numbers
- Hands
  
- Points

NAMING

- Rhinoceros
- Kangaroo

MEMORY

- Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.
- 1st trial
- 2nd trial
- Points

ATTENTION

- Read list of digits (1 digit/ sec.).
  Subject has to repeat them in the forward order
  Subject has to repeat them in the backward order
  Points

- Serial 7 subtraction starting at 100
  93 - 7 = 86 - 7 = 79 - 7 = 72 - 7 = 65
  4 or 5 correct subtractions: 3 pts, 2 or 3 correct: 2 pts, 1 correct: 1 pt, 0 correct: 0 pt
  Points

LANGUAGE

- Repeat: I only know that John is the one to help today.
- The cat always hid under the couch when dogs were in the room.
- Fluency / Name maximum number of words in one minute that begin with the letter F
  Points

ABSTRACTION

- Similarity between e.g. banana - orange = fruit
  [ ] train - bicycle
  [ ] watch - ruler
  Points

DELAYED RECALL

- Has to recall words
  WITH NO CUE
- Points

Optional

- Category cue
- Multiple choice cue

ORIENTATION

- [ ] Date
- [ ] Month
- [ ] Year
- [ ] Day
- [ ] Place
- [ ] City
  Points

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www.mocatest.org
Normal ≥ 26 / 30
TOTAL ≥ 30
Add 1 point if ≤ 12 yr edu
Montreal Cognitive Assessment (MoCA)  
Instructions  

MoCA Version August 18, 2010  © Z. Nasreddine MD  
www.mocatest.org  

Administration and Scoring Instructions  

The Montreal Cognitive Assessment (MoCA) was designed as a rapid screening instrument for mild cognitive dysfunction. It assesses different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation. Time to administer the MoCA is approximately 10 minutes. The total possible score is 30 points; a score of 26 or above is considered normal.  

1. Alternating Trail Making:  

Administration: The examiner instructs the subject: "Please draw a line, going from a number to a letter in ascending order. Begin here [point to (1)] and draw a line from 1 then to A then to 2 and so on. End here [point to (E)]."  

Scoring: Allocate one point if the subject successfully draws the following pattern: 1 −A- 2- B- 3- C- 4- D- 5- E, without drawing any lines that cross. Any error that is not immediately self-corrected earns a score of 0.  

2. Visuoconstructional Skills (Cube):  

Administration: The examiner gives the following instructions, pointing to the cube: “Copy this drawing as accurately as you can, in the space below”.  

Scoring: One point is allocated for a correctly executed drawing.  
• Drawing must be three-dimensional  
• All lines are drawn  
• No line is added  
• Lines are relatively parallel and their length is similar (rectangular prisms are accepted)  
A point is not assigned if any of the above-criteria are not met.  

3. Visuoconstructional Skills (Clock):  

Administration: Indicate the right third of the space and give the following instructions: “Draw a clock. Put in all the numbers and set the time to 10 past 11”.  

Scoring: One point is allocated for each of the following three criteria:
Cognitive function and weight in HF patients

- Contour (1 pt.): the clock face must be a circle with only minor distortion acceptable (e.g., slight imperfection on closing the circle);
- Numbers (1 pt.): all clock numbers must be present with no additional numbers; numbers must be in the correct order and placed in the approximate quadrants on the clock face; Roman numerals are acceptable; numbers can be placed outside the circle contour;
- Hands (1 pt.): there must be two hands jointly indicating the correct time; the hour hand must be clearly shorter than the minute hand; hands must be centred within the clock face with their junction close to the clock centre.

A point is not assigned for a given element if any of the above-criteria are not met.

4. Naming:

Administration: Beginning on the left, point to each figure and say: “Tell me the name of this animal”.

Scoring: One point each is given for the following responses: (1) lion (2) rhinoceros or rhino (3) camel or dromedary.

5. Memory:

Administration: The examiner reads a list of 5 words at a rate of one per second, giving the following instructions: “This is a memory test. I am going to read a list of words that you will have to remember now and later on. Listen carefully. When I am through, tell me as many words as you can remember. It doesn’t matter in what order you say them”.

Mark a check in the allocated space for each word the subject produces on this first trial. When the subject indicates that (s)he has finished (has recalled all words), or can recall no more words, read the list a second time with the following instructions: “I am going to read the same list for a second time. Try to remember and tell me as many words as you can, including words you said the first time.” Put a check in the allocated space for each word the subject recalls after the second trial.

At the end of the second trial, inform the subject that (s)he will be asked to recall these words again by saying, “I will ask you to recall those words again at the end of the test.”

Scoring: No points are given for Trials One and Two.

6. Attention:
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Forward Digit Span: Administration: Give the following instruction: “I am going to say some numbers and when I am through, repeat them to me exactly as I said them”. Read the five number sequence at a rate of one digit per second.

Backward Digit Span: Administration: Give the following instruction: “Now I am going to say some more numbers, but when I am through you must repeat them to me in the backwards order.” Read the three number sequence at a rate of one digit per second.

Scoring: Allocate one point for each sequence correctly repeated, (N.B.: the correct response for the backwards trial is 2-4-7).

Vigilance: Administration: The examiner reads the list of letters at a rate of one per second, after giving the following instruction: “I am going to read a sequence of letters. Every time I say the letter A, tap your hand once. If I say a different letter, do not tap your hand”.

Scoring: Give one point if there is zero to one errors (an error is a tap on a wrong letter or a failure to tap on letter A).

Serial 7s: Administration: The examiner gives the following instruction: “Now, I will ask you to count by subtracting seven from 100, and then, keep subtracting seven from your answer until I tell you to stop.” Give this instruction twice if necessary.

Scoring: This item is scored out of 3 points. Give no (0) points for no correct subtractions, 1 point for one correction subtraction, 2 points for two-to-three correct subtractions, and 3 points if the participant successfully makes four or five correct subtractions. Count each correct subtraction of 7 beginning at 100. Each subtraction is evaluated independently; that is, if the participant responds with an incorrect number but continues to correctly subtract 7 from it, give a point for each correct subtraction. For example, a participant may respond “92 – 85 – 78 – 71 – 64” where the “92” is incorrect, but all subsequent numbers are subtracted correctly. This is one error and the item would be given a score of 3.

7. Sentence repetition:

Administration: The examiner gives the following instructions: “I am going to read you a sentence. Repeat it after me, exactly as I say it [pause]: I only know that John is the one to help today.” Following the response, say: “Now I am going to read you another sentence. Repeat it after me, exactly as I say it [pause]: The cat always hid under the couch when dogs were in the room.”

Scoring: Allocate 1 point for each sentence correctly repeated. Repetition must be exact. Be alert for errors that are omissions (e.g., omitting "only", "always") and
substitutions/additions (e.g., "John is the one who helped today;" substituting "hides" for "hid", altering plurals, etc.).

8. Verbal fluency:
Administration: The examiner gives the following instruction: "Tell me as many words as you can think of that begin with a certain letter of the alphabet that I will tell you in a moment. You can say any kind of word you want, except for proper nouns (like Bob or Boston), numbers, or words that begin with the same sound but have a different suffix, for example, love, lover, loving. I will tell you to stop after one minute. Are you ready? [Pause] Now, tell me as many words as you can think of that begin with the letter F. [time for 60 sec]. Stop."

Scoring: Allocate one point if the subject generates 11 words or more in 60 sec. Record the subject’s response in the bottom or side margins.

9. Abstraction:
Administration: The examiner asks the subject to explain what each pair of words has in common, starting with the example: “Tell me how an orange and a banana are alike”. If the subject answers in a concrete manner, then say only one additional time: “Tell me another way in which those items are alike”. If the subject does not give the appropriate response (fruit), say, “Yes, and they are also both fruit.” Do not give any additional instructions or clarification. After the practice trial, say: “Now, tell me how a train and a bicycle are alike”. Following the response, administer the second trial, saying: “Now tell me how a ruler and a watch are alike”. Do not give any additional instructions or prompts.

Scoring: Only the last two item pairs are scored. Give 1 point to each item pair correctly answered. The following responses are acceptable:
   Train-bicycle = means of transportation, means of travelling, you take trips in both;
   Ruler-watch = measuring instruments, used to measure.
   The following responses are not acceptable:
   Train-bicycle = they have wheels; Ruler-watch = they have numbers.

10. Delayed recall:
Administration: The examiner gives the following instruction: “I read some words to you earlier, which I asked you to remember. Tell me as many of those words as you can remember.” Make a check mark (✓) for each of the words correctly recalled spontaneously without any cues, in the allocated space.

Scoring: Allocate 1 point for each word recalled freely without any cues.
Optional:
Following the delayed free recall trial, prompt the subject with the semantic category cue provided below for any word not recalled. Make a check mark (√) in the allocated space if the subject remembered the word with the help of a category or multiple-choice cue. Prompt all non-recalled words in this manner. If the subject does not recall the word after the category cue, give him/her a multiple choice trial, using the following example instruction, “Which of the following words do you think it was, NOSE, FACE, or HAND?”

Use the following category and/or multiple-choice cues for each word, when appropriate:
FACE: category cue: part of the body multiple choice: nose, face, hand
VELVET: category cue: type of fabric multiple choice: denim, cotton, velvet
CHURCH: category cue: type of building multiple choice: church, school, hospital
DAISY: category cue: type of flower multiple choice: rose, daisy, tulip
RED: category cue: a colour multiple choice: red, blue, green

Scoring: No points are allocated for words recalled with a cue. A cue is used for clinical information purposes only and can give the test interpreter additional information about the type of memory disorder. For memory deficits due to retrieval failures, performance can be improved with a cue. For memory deficits due to encoding failures, performance does not improve with a cue.

11. Orientation:

Administration: The examiner gives the following instructions: “Tell me the date today”. If the subject does not give a complete answer, then prompt accordingly by saying: “Tell me the [year, month, exact date, and day of the week].” Then say: “Now, tell me the name of this place, and which city it is in.”

Scoring: Give one point for each item correctly answered. The subject must tell the exact date and the exact place (name of hospital, clinic, office). No points are allocated if subject makes an error of one day for the day and date.

TOTAL SCORE: Sum all subscores listed on the right-hand side. Add one point for an individual who has 12 years or fewer of formal education, for a possible maximum of 30 points.

A final total score of 26 and above is considered normal.
Appendix D

Beck Depression Inventory

<table>
<thead>
<tr>
<th>Item</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Agitation</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I am no more bothered or worried than usual.</td>
</tr>
<tr>
<td>2</td>
<td>I feel more anxious or worried than usual.</td>
</tr>
<tr>
<td>3</td>
<td>I am so worried or anxious that I can’t help it stay still.</td>
</tr>
<tr>
<td>4</td>
<td>I am so worried or anxious that I have to keep moving or doing something.</td>
</tr>
<tr>
<td>12. Loss of Interest</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I have not lost interest in other people or activities.</td>
</tr>
<tr>
<td>2</td>
<td>I am less interested in other people or things than before.</td>
</tr>
<tr>
<td>3</td>
<td>I have lost most of my interest in other people or things.</td>
</tr>
<tr>
<td>4</td>
<td>It’s hard to get interested in anything.</td>
</tr>
<tr>
<td>13. Irritability</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I make decisions about as well as usual.</td>
</tr>
<tr>
<td>2</td>
<td>I find it more difficult to make decisions than usual.</td>
</tr>
<tr>
<td>3</td>
<td>I have much greater difficulty in making decisions than I used to.</td>
</tr>
<tr>
<td>4</td>
<td>I have trouble making my decisions.</td>
</tr>
<tr>
<td>14. Worthlessness</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I do not feel I am worthwhile.</td>
</tr>
<tr>
<td>2</td>
<td>I don’t consider myself as worthwhile and useful as I used to.</td>
</tr>
<tr>
<td>3</td>
<td>I feel more worthless as compared to other people.</td>
</tr>
<tr>
<td>4</td>
<td>I feel extremely worthless.</td>
</tr>
<tr>
<td>15. Loss of Energy</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I have as much energy as usual.</td>
</tr>
<tr>
<td>2</td>
<td>I have less energy than I used to have.</td>
</tr>
<tr>
<td>3</td>
<td>I don’t have enough energy to do very much.</td>
</tr>
<tr>
<td>4</td>
<td>I don’t have enough energy to do anything.</td>
</tr>
<tr>
<td>16. Change in Sleeping Pattern</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I have not experienced any change in my sleeping pattern.</td>
</tr>
<tr>
<td>2</td>
<td>I sleep somewhat more than usual.</td>
</tr>
<tr>
<td>3</td>
<td>I sleep somewhat less than usual.</td>
</tr>
<tr>
<td>4</td>
<td>I sleep a lot more than usual.</td>
</tr>
<tr>
<td>5</td>
<td>I sleep a lot less than usual.</td>
</tr>
<tr>
<td>6</td>
<td>I sleep most of the day.</td>
</tr>
<tr>
<td>7</td>
<td>I wake up 1-2 hours early and can’t get back to sleep.</td>
</tr>
</tbody>
</table>

17. Somnolence
<table>
<thead>
<tr>
<th>Item</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I am no more irritable than usual.</td>
</tr>
<tr>
<td>2</td>
<td>I am more irritable than usual.</td>
</tr>
<tr>
<td>3</td>
<td>I am much more irritable than usual.</td>
</tr>
<tr>
<td>4</td>
<td>I am irritable all the time.</td>
</tr>
<tr>
<td>18. Changes in Appetite</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I have not experienced any change in my appetite.</td>
</tr>
<tr>
<td>2</td>
<td>My appetite is somewhat less than usual.</td>
</tr>
<tr>
<td>3</td>
<td>My appetite is somewhat greater than usual.</td>
</tr>
<tr>
<td>4</td>
<td>My appetite is much less than before.</td>
</tr>
<tr>
<td>5</td>
<td>My appetite is much greater than usual.</td>
</tr>
<tr>
<td>6</td>
<td>I have no appetite at all.</td>
</tr>
<tr>
<td>7</td>
<td>I never feel hungry.</td>
</tr>
</tbody>
</table>

19. Concentration Difficulty
<table>
<thead>
<tr>
<th>Item</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I can concentrate as well as usual.</td>
</tr>
<tr>
<td>2</td>
<td>I can’t concentrate as well as usual.</td>
</tr>
<tr>
<td>3</td>
<td>It’s hard to keep my mind on anything for very long.</td>
</tr>
<tr>
<td>4</td>
<td>I find I can’t concentrate on anything.</td>
</tr>
<tr>
<td>20. Tiredness or Fatigue</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I am not more tired or fatigued than usual.</td>
</tr>
<tr>
<td>2</td>
<td>I get more tired or fatigued more easily than usual.</td>
</tr>
<tr>
<td>3</td>
<td>I am too tired or fatigued to do a lot of the things I used to do.</td>
</tr>
<tr>
<td>4</td>
<td>I am not too tired or fatigued to do most of the things I used to do.</td>
</tr>
<tr>
<td>21. Loss of Interest in Sex</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>I have not noticed any recent change in my interest in sex.</td>
</tr>
<tr>
<td>2</td>
<td>I am less interested in sex than I used to be.</td>
</tr>
<tr>
<td>3</td>
<td>I am much less interested in sex now.</td>
</tr>
<tr>
<td>4</td>
<td>I have lost interest in sex completely.</td>
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Appendix E

Fluid Management

Did your doctor or nurse practitioner prescribe a fluid restriction for you?  Yes  No

Do you follow the fluid restriction?  Always  Sometimes  Never  Uncertain

Do you weigh yourself daily?  Always  Sometimes  Never  Uncertain

How much is the fluid restriction?  

How much fluid do you think you drink per day?  

Describe how you keep track of how much fluid you have consumed and how much fluid can still be consumed for the rest of the day.

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Appendix F

Taylor Body fat Scales-Biggest Loser 7544bl Cal-max by Taylor Wide Body Scale, 440-Pound capability

- Extra wide 15 inch platform
- Weighs to 440 lbs/200kgs
- Cal-max indicates maximum calories you can consume to maintain weight
- 5 year warranty

Counting calories has never been easier! cal-max calculates your minimum calorie intake to maintain your current weight. eat fewer calories, start losing weight. super wide 15 inch tempered glass platform for extra comfort, large 2.2 inch display with 2 inch lcd digits and extremely high capacity of 440 lb / 200 kg in 0.2 lb / 0.1 kg increments. scale uses 1 long life lithium battery (included) 5 year warranty.
Cognitive function and weight in HF patients

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