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## Depressive Symptoms and Poor Social Support Have a Synergistic Effect on Event-Free Survival in Patients with Heart Failure

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### Abstract

**Background**—Depressive symptoms and poor social support are predictors of increased morbidity and mortality in patients with heart failure (HF). However, the combined contribution of depressive symptoms and social support event-free survival of patients with HF has not been examined.

**Objective**—To compare event-free survival in four groups of patients with HF stratified by depressive symptoms and perceived social support.

**Method**—A total of 220 patients completed the Beck Depression Inventory-II and the Multidimensional Perceived Social Support Scale and were followed for up to 4 years to collect data on death and hospitalizations.

**Results**—Depressive symptoms (HR=1.73,  $P=.008$ ) and perceived social support (PSS) (HR=1.51,  $P=.048$ ) were independent predictors of event-free survival. Depressed patients with low PSS had 2.1 times higher risk of events than non-depressed patients with high PSS ( $P=.003$ ).

**Conclusion**—Depressive symptoms and poor social support had a negative additive effect on event-free survival in patients with HF.

### Keywords

Chronic Heart Failure; Depression; Social support; Outcomes

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## Introduction

More than 5.8 million Americans currently suffer from heart failure (HF).<sup>1</sup> Life expectancy of patients with HF is short, and morbidity and mortality rates are increasing.<sup>2–3</sup> In the last two decades, hospitalization rates due to worsening HF symptoms increased 26%.<sup>1</sup> Mortality rates within 5 years of initial HF diagnosis are 59% and 45% for male and female patients aged between 65 to 75 years, respectively.<sup>1</sup>

Depression is a state of low mood characterized by sad feelings, despair, and discouragement.<sup>4</sup> Depressive symptoms are a common psychological problem in patients with HF. Almost two-thirds to three-quarters of patients with HF suffer from some degree of depressive symptoms. Of these, up to 35% of patients report the highest levels of depression,<sup>5–7</sup> while another 27% to 35% of patients report at least mild depressive symptoms.<sup>5–6</sup> A meta analysis that examined at 27 HF studies found that prevalence of depressive symptoms in patients with HF ranges from 9 to 60% and overall prevalence was 20.1%.<sup>8</sup>

Most patients with HF need family member support or care to effectively manage their condition. Thus, millions of family members, friends and significant others are expected to be the core support system in the long-term care of patients with HF. Social support can be defined as the quality and functional content of social relationships—this consists of supportive behaviors that provide emotional, instrumental, informational and appraisal support.<sup>9</sup> Researchers have found that poor social support from family, friends, significant others and formal care providers may be a factor in worsening health outcomes and quality of life in patients with HF.<sup>10–13</sup>

Evidence from major studies demonstrates that both depressive symptoms and lack of (or poor) social support are independent predictors of poor outcomes in patients with coronary heart disease when depressive symptoms and social support are investigated individually.<sup>5, 8, 14–16</sup> Among patients with HF, patients with depressive symptoms had two to three times greater risk of death and rehospitalization than patients without depressive symptoms.<sup>8</sup> Similarly, unmarried patients with HF had two times higher risk of mortality and morbidity than married patients.<sup>15</sup> Furthermore, it is estimated that one-fifth of HF hospitalizations are due to poor social support.<sup>16</sup>

The occurrence of both poor social support and depressive symptoms may have an additive effect on morbidity and mortality. In two studies,<sup>15,16</sup> both depressive symptoms and social support were independent predictors of mortality in patients with HF. However, further examination of these two risk factors is needed to clarify the combined contribution of depressive symptoms and social support on health outcomes of patients with heart failure. The purpose of this study was to compare event-free survival in patients with HF who were stratified into four groups: (a) depressive symptoms with low perceived social support (PSS), (b) depressive symptoms with high PSS, (c) no-depressive symptoms with low PSS, and (d) no-depressive symptoms with high PSS.

## Methods

### Sample

The Research and Intervention for Cardiopulmonary Health Heart Program at the College of Nursing, University of Kentucky, simultaneously conducted three prospective, longitudinal studies in outpatient clinics and a private hospital in Central Kentucky. The first study focused on exploring potential mechanisms for the association between depression, increased morbidity and mortality in HF.<sup>17</sup> The second study examined relationships among nutritional intake, inflammation, and outcomes in patients with HF.<sup>18</sup> The third study tested

the effectiveness of biofeedback-relaxation training on outcomes in patients with HF; we used baseline data from this study and excluded patients who received the intervention.

Patients in all three studies were recruited using the same inclusion and exclusion criteria, although each study had unique primary research questions. After physician and nurse practitioner referral, patient eligibility was confirmed by reviewing medical charts with standardized screening criteria. Patients were eligible to participate if they had a confirmed diagnosis of chronic HF, were in a stable HF condition, and had not experienced an acute myocardial infarction in the past 3 months. Patients were excluded if they had valvular or peripartum HF etiology, were referred for heart transplantation, or end-stage cancer, liver or renal disease. Of the screened eligible patients, 32% participated in one of the three studies from January 2004 to December 2006. For this study, we included only 220 unique patients who (1) participated in only one study, (2) completed questionnaires of depressive symptoms and perceived social support at baseline and (3) were followed for up to four years to collect data on death and hospitalization.

## Measures

**Depressive symptoms**—An inclusive approach was used to measure depressive symptoms, (i.e. patients were considered to have depressive symptoms, even if the patient had depressive somatic symptoms that could be attributed to HF).<sup>19</sup> Other researchers have found that this inclusive method is sensitive, reliable, and predicts long-lasting depression in the medically ill.<sup>20</sup> Depressive symptoms were assessed with the Beck Depression Inventory-II (BDI-II), a valid and reliable instrument for the measurement of depressive symptoms.<sup>21–22</sup> The BDI-II measures the presence and severity of depressive symptoms corresponding to criteria for depressive disorders listed in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorder (Fourth Edition); however, this instrument is not used to diagnose clinical depression.<sup>23</sup> The BDI-II predicts outcomes of mortality and hospitalizations in coronary heart disease patients and patients with HF.<sup>14, 24–26</sup> The BDI-II has a total of 21 items rated on a likert scale from 0 to 3 and the total score can range from 0 to 63.<sup>22–23, 27–28</sup> Patients who score 14 or above are considered to have clinically significant depressive symptoms.<sup>23</sup> Cronbach's alpha was .88 in our sample.

**Social support**—Social support was defined as self-reported perceived social support from family, friends, or others and was assessed using the Multidimensional Perceived Social Support Scale (MPSS).<sup>29</sup> The MPSS includes 12 items and is rated on a 7-point Likert scale from 1 (very strongly disagree) to 7 (very strongly agree). The total score is a sum of 12 items that ranges from 12 to 84; higher total scores indicate higher levels of perceived social support from family, friends, or significant others. Researchers have found evidence for reliability of this instrument, with Cronbach's alphas ranging from .85 to .91.<sup>29</sup> In our study the Cronbach's alpha was .94.

**Event-free survival**—The primary outcome in our study was event-free survival, defined as time to a combined end point of all cause hospitalization or death. Event-free survival—which reflects both mortality and hospitalizations—was chosen as the primary end point to capture a more complete picture of disease progress rather than mortality alone.<sup>30–32</sup> Monthly follow-up phone calls and hospital administrative databases were reviewed to identify events. Hospitalizations were verified with hospital records; dates and causes of death were determined by hospital records, family interview, and death certificates. A written protocol for event coding was developed by the investigators. The events were coded independently by two Master's-prepared cardiac nurses who were blinded to depressive symptoms and social support scores. The data codes were compared for agreement; any

discrepancies or disagreements were reviewed with the principal investigators of the three studies, who together made the final coding decision.

**Other variables of interest**—In order to describe sample demographic and clinical variables, we also collected demographics (i.e., age, gender, education, ethnicity, marital status) and clinical characteristics (etiology, left ventricular ejection fraction, prescribed medications, comorbidities).

We measured subjective functional status using New York Heart Association (NYHA) class and the Duke Activity Status Index (DASI).<sup>33</sup> NYHA functional class was determined by careful patient interview. Based on patient's report of how able they were to perform their usual activities, they were assigned a NYHA classification of I (ordinary physical activity causes no symptoms of fatigue, dyspnea, angina or palpitations), II (symptoms with ordinary physical activity that slightly limit physical activity), III (symptoms occur with less than ordinary physical and markedly limit activity), or IV (symptoms occur even at rest).<sup>34</sup> All research nurses completed a standard training protocol to meet 100% inter-rater reliability and intra-rater reliability.

The DASI is widely used to assess cardiovascular patients' functional capabilities for activities of daily living. The 12 items of the DASI have three response categories (i.e., 'not done because of health reason', 'done with difficulty', and 'done without difficulty') to assess the difficulty of each activity. The total score is calculated based on a weighted score for each activity and ranges from 0 to 58.2. Higher total scores indicate better functional status. Cronbach's alpha coefficient for the DASI was .84 in this study.

## Procedure

After approval of the Institutional Review Board for each study, trained research nurses screened medical charts (in compliance with the Health Insurance Portability and Accountability Act) to find potential eligible patients who were referred to the study by doctors or nurse practitioners. Trained nurse researchers contacted eligible patients at a clinic visit and obtained signed informed consent. Demographic and clinical characteristics were collected by patient interview and by reviewing patients' medical charts using a structured questionnaire. All participating patients completed questionnaires and were asked to record their hospitalization history in a log book. We followed up with monthly phone calls to collect death or hospitalization histories and confirmed all dates and causes of death and hospitalization by reviewing medical charts. We obtained death certificates and reviewed county death records if necessary.

## Data analysis

Data analysis took place in two main steps. In the first step, we confirmed that depressive symptoms and PSS were independent predictors of event-free survival. Patients were grouped into two groups—presence or absence of depressive symptoms—using the standard cut-point of 14 on the BDI-II. We also grouped patients into high and low perceived social support (PSS) groups using a median MPSSS score of 73; the median score was used because there is no recommended cut point for this scale. Kaplan-Meier survival curves, the log-rank test, and Cox proportional hazards models were used to examine the prediction of event-free survival for depressive symptoms alone and social support alone, without controlling for possible confounding variables. A *p* value of .05 was considered significant for all analyses.

In the second step, patients were divided into 4 groups using the cut-points described above: 1) depressive symptoms with high PSS, 2) depressive symptoms with low PSS, 3) no

depressive symptoms with high PSS, and 4) no depressive symptoms with low PSS. We evaluated differences between the four groups with independent sample t-tests, Chi-square, and Pearson correlations. We then obtained hazard ratios for each of the four groups using Cox proportional hazards modeling with and without controlling for age, gender, NYHA class, and DASI scores. The proportional assumption of the Cox proportional hazard model for variables was examined using log-minus-log survival plots and scatterplots of Schoenfeld residuals plots.<sup>35</sup> The proportionality assumptions for all Cox proportional hazard models in this study were not violated because there was a steady increasing difference between the two curves without crossed curves in the log-minus-log survival plots and because Schoenfeld residual plots appeared as a systemic trend over time.<sup>35</sup>

We conducted a power analysis prior to data collection with NQuery Advisor.<sup>36</sup> With a significance level of 0.05 and at least 90 subjects in each group (ie ‘with depressive symptoms’ and ‘without depressive symptom’), the power of the log rank test to detect a significant difference in the combined endpoint distribution between the two subgroups was estimated to be at least 74% if the ‘with depressive symptoms’ group had a 25% reduction in the combined endpoint relative to the ‘without depressive symptoms’ group. With addition of covariates in the Cox proportional hazards model, the power of the regression to detect significant group difference would be even greater than the corresponding log-rank test given above. Although we included more than 90 per group in this study (leading to an increase in estimated power relative to the initial estimate), we are not able to reassess the power analysis estimates in the light of this sample size increase since post-hoc power analysis is not statistically valid.<sup>37</sup>

## Results

Sample characteristics are displayed in Table 1. The mean age of the 220 participating patients was 61 years (SD = 11), similar to other studies of patients with HF.<sup>38</sup> The majority of patients were Caucasian (80%), half were married (56%), and 66% were male. The mean left ventricular ejection fraction was 34.5%, and 60% of patients were NYHA class level III or IV, indicating that the majority of the sample had poor functional status. During the follow-up period, 22 patients (10%) died and 96 patients (44%) were hospitalized. Of the 96 hospitalized patients, 62 patients were readmitted due to HF or other cardiovascular-related diagnoses.

### Depressive symptoms

The mean BDI-II level was  $11.5 \pm 8.9$ . Seventy-one patients (32%) had clinically significant depressive symptoms (BDI-II > 13), and 23% of patients were taking antidepressants at baseline. As shown in Table 2, patients with depressive symptoms were younger ( $P < .001$ ), had lower levels of perceived social support ( $P < .001$ ), and poorer functional status ( $P < .001$ ) than patients without depressive symptoms (Table 2). Patients with depressive symptoms were more likely to take antidepressants than patients without depressive symptoms ( $P < .001$ ). Male and female patients had similar levels of depressive symptoms.

### Perceived social support

The mean of the MPSSS was  $67.3 \pm 17.7$  and the median was 73, indicating a moderately high level of perceived social support. Patients with high perceived social support were older, married, and had lower levels of depressive symptoms than patients with low levels of perceived social support (Table 2). The number of patients taking prescribed antidepressants was similar between patients with high and low social support.

### Depressive symptoms and perceived social support

When we compared the characteristics of the four patient groups stratified by depressive symptoms and perceived social support, there were differences in age, marital status, NYHA class and functional status among groups (Table 3). Patients who had no depressive symptoms and high social support were older compared to the other groups. Regardless of depressive symptoms, patients with high social support were more likely to be married and have higher functional status than patients with low social support. Regardless of social support, patients with depressive symptoms were more likely to be NYHA class level III or IV patients than patients without depressive symptoms. Depressive symptoms were negatively correlated with perceived social support; higher depressive symptom levels were associated with low perceived social support levels ( $r = -.309, P < .001$ ).

### Individual variables and event-free survival

As demonstrated by the Kaplan-Meier survival analyses, patients with depressive symptoms had shorter event-free survival than patients without depressive symptoms ( $P = .008$ , Figure 1). The Cox proportional hazards model results indicated that patients with depressive symptoms had a 73% higher risk of events than patients without depressive symptoms (HR = 1.73; 95% CI: 1.15 – 2.61; Table 4). Patients with high PSS had longer event-free survival than patients with low PSS ( $P = .046$ , Figure 2). Patients with low PSS had a 50% higher risk of events compared to patients with high PSS (HR = 1.5; 95% CI: 1.00 – 2.26; Table 4).

### Combined effects of depressive symptoms and poor social support

Patients with depressive symptoms and low perceived social support experienced the shortest event-free survival among all groups ( $P = .04$ ). In the Cox proportional hazards model (Figure 3), patients with depressive symptoms and low PSS had 2.1 times higher risk of events compared to the patients with no depressive symptoms and high PSS (Table 4). When we controlled for age, gender, NYHA class, and functional status, patients with depressive symptoms and low PSS had 1.8 times higher risk of events than patients with no depressive symptoms and high PSS (Table 5). Patients with no depressive symptoms and low perceived social support and patients with depressive symptoms and high perceived social support experienced similar hazard ratios for event-free survival (Table 4 and 5). Together, the survival curve (Figure 3) and hazard ratios (Table 4 and 5) indicate a synergistic effect of depressive symptoms and low perceived social support on event-free survival.

## Discussion

In this study, the rate of depressive symptoms and the under-treatment of depressive symptoms are consistent with findings from other researchers.<sup>8, 38</sup> We found that both depressive symptoms and perceived social support were independent predictors of hospitalization and death. Our finding that depressive symptoms are an independent predictor of event-free survival of patients with HF is similar to findings from other investigators.<sup>5, 14</sup> Patients with depressive symptoms in this study had a 73% higher risk of hospitalization and death than patients without depressive symptoms. Also consistent with prior investigators,<sup>39</sup> we found that perceived social support from family and friends was an independent predictor of event-free survival. Patients with low perceived social support had a 50% higher risk of hospitalization and death than patients with high perceived social support.

The most compelling finding of this study was the synergistic effect of depressive symptoms and low perceived social support on event-free survival in patients with HF. Patients with only one risk factor—either depressive symptoms or perceived low social support—had a

similar risk of hospitalization or death as patients with neither risk factor. In contrast, patients with both risk factors had double the risk of hospitalization or death compared to patients with neither risk factor. Even when we controlled for possible confounding factors (i.e., age, gender, NYHA class, and functional status), the risk of hospitalization and death for patients with both risk factors was still 1.8 times higher than patients with neither risk factor.

In the context of depression, investigators have not clearly explained how social support improves outcomes; however, two mechanisms have been suggested: a buffer effect or a direct effect on outcomes.<sup>40–42</sup> The buffer effect hypothesizes that positive social support protects patients from potentially distressful experience or depression. In contrast, the direct effect suggests that positive social support has a direct impact on improving outcomes despite the presence of stress or depression. Given that both depressive symptoms and poor social support were independent and synergistic predictors of event-free survival, our findings indicate that social support had a direct effect on outcomes.

To date, only four groups of investigators<sup>25, 43–45</sup> have investigated the effects of both depressive symptoms and social support on mortality outcomes in patients with cardiovascular disease. Two research teams investigated the effects in acute myocardial infarction patients<sup>25, 45</sup> and the other two groups of investigators described effects in patients with HF.<sup>43–44</sup> Depressive symptoms had a consistently negative impact on outcomes in all four studies, whereas social support did not have a consistent impact.

Social support failed to predict mortality in patients with acute myocardial infarction<sup>25, 45</sup> but did predict mortality in patients with HF.<sup>43–44</sup> Frasure-Smith et al.<sup>25</sup> conducted a prospective study in 877 post myocardial infarction patients for one year. They found that patients with depressive symptoms had 3.3 times higher risk of mortality than patients without depressive symptoms while perceived social support failed to predict mortality outcomes independently. In the Enhancing Recovery in Coronary Heart Disease (ENRICHD) study, Lett and colleagues<sup>45</sup> enrolled 2481 patients with acute myocardial infarction and found that patients with depressive symptoms had 2.25 times higher risk of mortality than patients without depressive symptoms, but perceived social support did not predict mortality. However, researchers have reported an interaction effect between perceived social support and depressive symptoms. Frasure-Smith and colleagues<sup>25</sup> found that only patients who were depressed with perceived low social support had increased risk of cardiac mortality. Similarly, Lett and colleagues<sup>45</sup> reported that the best survival rate occurred only in patients who had perceived high social support and no depressive symptoms.

On the other hand, in patients with HF, two groups of investigators have found that social support independently predicted mortality outcomes, as did depressive symptoms. Friedmann and colleagues<sup>44</sup> found that both depressive symptoms (HR = 2.25) and social isolation (HR = .55) as were independent predictors of mortality in 153 patients with HF. Chung and colleagues<sup>43</sup> found that both depressive symptoms and marital status—one indicator of social support—were strong independent predictors of cardiac event-free survival in patients with HF. Unmarried patients had 3.9 times higher risk of cardiac events than married patients with HF, while depressed patients had 3.7 times higher risk of cardiac events than non-depressed patients.<sup>43</sup>

Although these prior studies have identified social support and depressive symptoms as important predictors of health outcomes in patients with HF, these researchers did not report whether there was a combined effect of both predictors on outcomes. In our study, we advanced the state of the science by determining the combined impact of depressive

symptoms and perceived social support on event-free survival in patients with HF. Importantly, we also found that perceived social support had a similar hazard ratio depressive symptoms for event-free survival similar to what other investigators have found in patients with HF.<sup>43–44</sup>

One of the possible reasons for inconsistent findings on social support and outcomes between acute myocardial infarction patients and patients with HF could be explained by stability of social support in the acute or chronic situation. Myocardial infarction is a potentially life-threatening event, but the experience is often acute and short-term. An acute event may motivate individuals to temporarily enhance social networks. Acute events may also motivate support persons to rally and provide more support for the time being. According to Pedersen and colleagues,<sup>46</sup> patients with a first myocardial infarction experienced a decrease in levels of social support from 4–6 weeks to 9-months. In contrast, HF is a chronic condition that requires long-term support. This chronic nature of HF may erode the strength or quality of social support networks because of the long term commitment involved. It has been reported that caregivers of patients with HF experience severe burden and emotional distress.<sup>47–50</sup> The quality of social support or the size of social networks may also decrease over time as the caregiver's burden increases. In this study, it is not known whether the quality of social support changed because perceived social support was assessed at only one time point. However, patients with HF in this study did not have any hospitalizations within the 3 months prior to participation in this study, thus the perceived social support likely reflect their usual level of social support. Longitudinal studies are needed to determine whether changes in perceived social support affect outcomes of patients with HF and depressive symptoms.

Non-pharmacological interventions such as relaxation therapy and cognitive behavioral therapy have been proposed as possible treatments for depressive symptoms in patients with HF,<sup>8, 51</sup> but few investigators have systemically investigated interventions to improve social support in patients with HF.<sup>52–53</sup> Only one intervention study related to both depressive symptoms and improved social support was found.<sup>54</sup> The ENRICHD investigators reported that cognitive behavioral therapy was effective in improving depressive symptoms and social support in myocardial infarction patients, but the intervention did not reduce the risk of six-month mortality or recurrent infarction outcomes.<sup>54</sup> It is possible that cognitive behavioral therapy, which can focus on improving depressive symptoms and reinforcing social support, may be an intervention that improves long term mortality and morbidity outcomes of patients with HF. However, research on this intervention in patients with HF is still in early stages; further testing is needed before cognitive behavioral therapy can be recommended.<sup>55</sup>

This study contributes to evidence that suggests perceived social support is an independent predictor of mortality and morbidity in patients with HF even when different conceptualizations and measures of social support are used.<sup>44, 56</sup> In this study, we conceptualized social support as the subjective perception of support from family, friends, and significant others (using the MPSS), rather than structured social support, emotional support, functional support or social networks. Although scholars have raised concerns that different conceptualizations of social support may contribute to inconsistent findings, we found that our results appeared to be consistent with previous studies despite the differing definitions of social support. Nevertheless, additional longitudinal investigations are needed to examine the effects of various types of support and the amount of social support needed to influence health outcomes in patients with HF. Interventions that improve current social network connections, develop new social network connections, and utilize community health workers may help provide effective social support. Further research is needed to



assess the efficacy of interventions such as these in patients with HF—especially in those with depressive symptoms.

Several limitations should be noted. First, we did not assess patients' use of antidepressants during the follow up period, and we also do not know whether depressive symptoms improved. Second, we do not know whether patients' support systems or quality of social support were maintained after baseline assessment. Nonetheless, our findings suggest that depressive symptoms and perceived social support as measured at baseline assessment predict event-free survival.

## Conclusions

Depressive symptoms and poor social support had a synergistic, negative effect on event-free survival in patients with HF. These findings emphasize the crucial role of both depressive symptoms and social support on negative outcomes of patients with HF. Interventions to improve clinical outcomes in patients with HF should target both depressive symptoms and perceived poor social support, as the synergistic effects of these factors may lead to greater health risks in this population.

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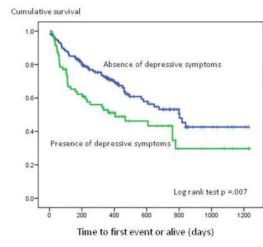
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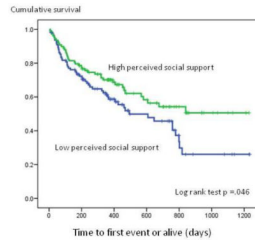
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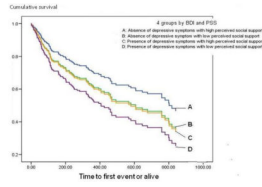
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**Figure 1.** Kaplan-Meier event-free survival curve for depressive symptoms groups



**Figure 2.** Kaplan-Meier event-free survival curve for perceived social support groups



**Figure 3.** Event-free survival for patients who were stratified by depressive symptoms and perceived social support.

**Table 1**

Demographic and clinical characteristics of patients with heart failure (N = 220)

Characteristics	M ± SD/n (%)
Age, years	60.9 ± 11.3
Male, gender	146 (66.4%)
Caucasian	176 (80.0%)
Married	124 (56.3%)
Ischemic etiology	118 (53.6%)
Prior bypass surgery	64 (29.1%)
Co-morbidity of DM	98 (44.5%)
Co-morbidity of hypertension	164 (74.5%)
Prior MI	119 (54.1%)
NYHA Class II	88 (40.0%)
Class III	101 (45.9%)
Class IV	31 (14.1%)
ACEI	166 (75.5%)
ARB	20 (9.1%)
Beta-Blocker	190 (86.4%)
Diuretics	168 (76.4%)
Antidepressant use	51 (23.2%)
ICD	79 (35.9%)
Body mass index	31.5 ± 7.2
Death (%)	22 (10.1%)
Cardiac hospitalization	62 (28.2%)
All cause of hospitalization	96 (43.6%)

DM = Diabetes Mellitus; MI = Myocardial Infarction; NYHA = New York Heart Association; ACEI = Angiotensin-converting enzyme inhibitors; ARB = Angiotensin II Receptor Blockers; ICD = Implantable Cardioverter Defibrillator.



**Table 2**  
Comparison of clinical and demographic characteristics by depressive symptoms and social support group classification

Characteristics	Depressed (n = 71)	Non-depressed (n = 149)	p-value	High PSS (n = 109)	Low PSS (n = 111)	p-value
Age, years (M ± SD)	57.6 ± 9.1	62.4 ± 11.9	.001	63.1 ± 11.8	58.7 ± 10.3	.003
Male, gender (%)	38%	31.5%	.424	67.9%	64.9%	.740
Caucasian, (%)	83.1%	78.5%	.711	81.7%	78.4%	.220
Married (%)	56.3%	56.4%	1.0	68.8%	44.1%	<.001
Depressive symptoms (M ± SD)	21.9 ± 7.5	6.4 ± 3.6	<.001	9.1 ± 7.8	13.8 ± 9.3	<.001
Perceived social support	59.6 ± 19.4	70.9 ± 15.6	<.001	81.2 ± 3.3	53.6 ± 15.2	<.001
Functional status	7.3 ± 7.2	18.1 ± 14.5	<.001	16.2 ± 13.1	13.0 ± 13.2	.078
Ejection Fraction, % (M ± SD)	34.9 ± 15.6	34.3 ± 15.1	.793	35.9 ± 14.9	33.1 ± 15.4	.178
NYHA Class III or IV (%)	80.3%	50.3%	<.001	52.3%	67.6%	.030
Hypertension (%)	81.2%	74.0%	.325	73.4%	79.2%	.313
DM (%)	45.7%	44.3%	.959	52.3%	37.3%	.036
Diuretics (%)	77.1%	78.1%	.763	75.5%	80%	.399
ACEI (%)	72.9%	78.2%	.483	83.2%	70.0%	.022
Beta blocker (%)	88.6%	87.1%	.926	86%	89.1%	.625
Antidepressant use (%)	38.6%	16.3%	<.001	20.6%	26.4%	.397
Body mass index (M ± SD)	31.5 ± 6.9	31.6 ± 7.3	.982	31.5 ± 7.0	31.6 ± 7.3	.917

PSS = Perceived social support; M = Mean; SD = Standard deviation; DM = Diabetes Mellitus; MI = Myocardial Infarction; NYHA = New York Heart Association.

**Table 3**

Comparison of characteristics among four groups stratified by depressive symptoms and perceived social support

Group	Depressive symptoms		No depressive symptoms		p-value	Post hoc test by Tukey
	Low PSS (n=50)	High PSS (n=21)	Low PSS (n = 61)	High PSS (n =88)		
Age	56.4 ± 8.1	60.5 ± 10.8	60.5 ± 11.5	63.7 ± 12.0	.003	A < D
Marital status	48.0%	76.2%	41.0%	67.0%	.002	-
NYHA class III-IV	84.0%	71.4%	54.1%	47.7%	<.001	-
Functional status (DASI)	6.9 ± 7.6	8.2 ± 6.4	18.1 ± 14.8	18.1 ± 13.6	.000	A, B < C, D

PSS = Perceived social support; NYHA = New York Heart Association; DASI = Duke Activity Status Index.

**Table 4**

Cox proportional hazards models for individual risk factors

<u>All cause of death and hospitalization</u>		
	<b>Hazard ratio (95% CI)</b>	<b>P-value</b>
No depressive symptoms (reference)	1.0	-
Depressive symptoms	1.733 (1.153 – 2.607)	.008
High PSS (reference)	1.0	-
Low PSS	1.505 (1.004 – 2.258)	.048
No depressive symptoms with high PSS (reference)	1.0	-
No depressive symptoms with low PSS	1.187 (.701 – 2.011)	.524
Depressive symptoms with high PSS	1.281 (.591 – 2.778)	.531
Depressive symptoms with low PSS	2.102 (1.285 – 3.435)	.003

CI = Confidence Interval; PSS= Perceived social support

**Table 5**  
Cox proportional hazards model with statistical control for clinical and demographical variables

Step	Predictors	All cause of death and hospitalization	
		Hazard ratio (95% CI)	p-value
1	Age > 65 (age ≤65 reference)	1.20 (.764 – 1.887)	.428
	Male, gender (female-reference)	1.165 (.770–1.781)	.470
	NYHA class II (reference)	-	-
	III	1.161 (.714 – 1.890)	.547
	IV	1.399 (.732 – 2.673)	.390
	Functional status	.983 (.963 – 1.004)	.108
2	No depressive symptoms with high PSS (reference)	1.0	.235
	No depressive symptoms with low PSS	1.371 (.809 – 2.322)	.241
	Depressive symptoms with high PSS	1.410 (.677 – 2.937)	.358
	Depressive symptoms with low PSS	1.801 (1.027 – 3.158)	.040

Note: This is the final step of the Cox regression (full model p-value = .006); CI = Confidence Interval; NYHA = New York Heart Association; PSS= Perceived social support