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Stress, Cognitive Appraisal, Coping, and Event Free Survival in Patients with Heart Failure

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Abstract

Objectives—To describe self-reported stress level, cognitive appraisal and coping among patients with heart failure (HF), and to examine the association of cognitive appraisal and coping strategies with event-free survival.

Methods—This was a prospective, longitudinal, descriptive study of patients with chronic HF. Assessment of stress, cognitive appraisal, and coping was performed using Perceived Stress Scale, Cognitive Appraisal Health Scale, and Brief COPE scale, respectively. The event-free survival was defined as cardiac rehospitalization and all-cause death.

Results—A total of 88 HF patients (mean age 58 ± 13 years and 53.4% male) participated. Linear and cox regression showed that harm/loss cognitive appraisal was associated with avoidant emotional coping ($\beta = -0.28$; 95% CI: $-0.21 - 0.02$; $p = 0.02$) and event free survival ($HR = 0.53$; 95% CI: $0.28 - 1.02$; $p = 0.05$).

Conclusions—The cognitive appraisal of the stressors related to HF may lead to negative coping strategies that are associated with worse event-free survival.

Keywords

Stress; Cognitive Appraisal; Coping; Heart Failure; Event-Free Survival

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Introduction

Heart failure (HF) is a costly condition with high mortality and morbidity rates.^{1,2} In 2012, the total costs for HF in the United States were approximately \$31 billion, and this amount will rise to approximately \$70 billion by 2030.³ Although biological factors contribute to the high morbidity and mortality in HF, there are many unexplored psychosocial factors that potentially contribute to poor prognosis.^{4,5}

Heart failure is commonly perceived with considerable psychological distress.^{6–10} Based on the work Lazarus and Folkman as well as others' in the literature,^{4,6–22} we developed a model of HF patients' response to stressors (Figure 1). In this model, HF is the stressor. Stressors have been defined as environmental circumstances or chronic conditions that are appraised in a primary appraisal process, and then are seen as either benign or a threat to physical and/or psychological health or well-being.²³ In those with HF, cognitive appraisal is the patient's perception of an event or situation, their assessment of the degree to which the event is stressful, and their perception of the potential impact of the event on personal goals and resources.^{22,24} People have considerable differences in their appraisal of and response to stressors.²⁵ Thus, cognitive appraisal is a core component of this as well as other stress models.^{22,26} Stressors can be appraised primarily as: (1) irrelevant when the situation has no effect on the individual, (2) benign positive when the situation is evaluated as positive, or (3) or stressful.²² When appraised as stressful, the stressor can be further appraised (secondary appraisal) as: (1) harm/loss resulting in damage to self or social esteem; (2) threat, which refers to a suspected pain; or (3) challenge, which allows for the opportunity for gain and growth.²² Cognitive appraisal has been shown to play an important role in determining the impact of the stress response.¹⁵ Specifically, appraisal of a stressor in the harm/loss or threat categories result in poor health outcomes, impaired performance and lower quality of life.^{14,16} In contrast, appraisal as a challenge has been associated with positive effects on cardiovascular reactivity and task engagement.^{14,16}

Cognitive appraisal of HF can predict psychological and physical coping responses.²⁷ Lazarus and Folkman (1984) defined coping as “*Constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person*” while attempting to manage, master, or alter the stressful situation by reducing or tolerating it.^{21,28} The following two major types of coping have been suggested: emotion-focused and problem focused.²²

Emotion-focused coping is an attempt to control emotional response to a stressful situation when individuals believe they cannot change the situation.²⁹ These strategies can be divided into active emotional coping and avoidant emotional coping.^{17,18} Active emotional coping includes venting, positive reframing, humor, acceptance, and emotional support strategies. Avoidant emotional coping includes self-distraction, denial, behavioral disengagement, self-blame, and substance use.^{19,20} The predominant view of emotion-focused coping is that it is a maladaptive form of coping associated with impaired health outcomes. Emotion-focused coping is associated with unhealthy lifestyle practices such as smoking, lack of exercise, drinking, non-compliance with medical regimen, and drug use that may lead to frequent hospitalization and even higher mortality rate.^{30,31} In contrast, problem-focused coping

consists of cognitive and behavioral strategies to alter or manage the stressor, such as planning, reaching out for instrumental support, and religion.^{19,20} These are positively associated with better adjustment and health outcomes such as longer survival and fewer hospitalization compared to those with emotion-focused coping.³¹

Understanding factors that affect survival in patients with HF is important to design future interventions to reduce the stress from HF and change how HF patients appraise their condition and cope with it. The purposes of this study were to describe self-reported stress level, cognitive appraisal and coping among patients with HF, and to examine the association of cognitive appraisal and coping strategies with event-free survival.

Methods

Design, sample, and setting

A prospective, longitudinal, descriptive design was used in which patients' follow up were performed for 6 months to determine the occurrence of the endpoint of time to re-hospitalization for cardiac causes or death from any cause. The study was approved by the local Institutional Review Board. A convenience sample of 88 patients with HF who were hospitalized for cardiac reasons at an academic health care center and a level 1 trauma medical center in Kentucky, USA was used in this study.

Patients with a diagnosis of chronic HF were eligible for participation in the study if they were: 1) admitted to the hospital with a primary or secondary diagnosis of exacerbation of chronic HF or any other cardiac diagnosis; 2) 21 years or older; 3) able to read and speak English; and 4) not obviously cognitively impaired. Cognitive impairment was defined as the presence of a diagnosis of dementia or cognitive impairment, the inability of the patient to provide informed consent, or to provide an accurate description of what was expected in the study after the study was explained by research staff. Chronic HF was defined as an existing and confirmed diagnosis of HF from a cardiologist. Only patients with existing HF (versus new onset) were considered to have chronic HF. Patients were excluded from the study for: 1) co-existing terminal illness likely to be fatal within 6 months; 2) presence of a left ventricular assist device, continuous inotropic infusion, or hospice care; 3) active suicidality (defined as choosing option 2 or 3 on item 9 of the Beck Depression Inventory-II); 4) history of the death of a spouse or child within the past month; 5) history of psychotic illness or bipolar illness; or 6) current alcohol dependence or other substance abuse.

Power analysis was performed using G-Power 3.1 with power level of 0.80, level of significance of 0.05, the medium effect size of 0.15, and seven predictors. A minimum sample size of 103 was recommended based on the G-Power analysis.

Variables and Measures

Stress—Stress was measured using the brief version of the Perceived Stress Scale.³² This version consists of a four-item scale that has been demonstrated to be reliable and valid,³² in a variety of countries and in multiple populations including those with chronic illness.^{33,34} Each item was rated by patients on a scale ranging from 0 (never) to 5 (very often). Higher scores indicate greater levels of stress. Cronbach's alpha for this instrument in the current

study was 0.71. The four items were: (1) how often have you felt that you were unable to control the important things in your life?, (2) how often have you felt confident about your ability to handle your personal problems?, (3) how often have you felt that things were going your way?, and (4) how often have you felt difficulties were piling up so high that you could not overcome them?

Cognitive Appraisal—Cognitive appraisal types (Challenge, Threat, and Harm/Loss) were measured using the brief version of the Cognitive Appraisal Health Scale.^{35,36} This version contains 13 items derived from Kessler's scale, which is one of the most commonly used measures of cognitive appraisal of stressful and non-stressful events.²⁴ Validity was supported by component factor analysis and reliability has been shown in previous studies.^{35,36} The responses in this scale range from 0 (strongly agree) to 5 (strongly disagree). Higher scores indicate that the patient does not commonly use that type of appraisal. Cronbach's alpha in this study was 0.78.

Coping—Coping was measured using the Brief COPE scale.³⁷ This 28-item scale is an abbreviated version of the COPE Inventory.³⁷ The reliability and validity of the brief COPE have been demonstrated in multiple patient populations, and used in those with chronic conditions and with HF.^{37,38} The responses to items on this scale range from 1 (I haven't been doing this at all) to 4 (I have been doing this a lot). Based on conceptual and empirical literature the 14-subscales were grouped in three coping strategies which are active emotional coping, avoidant emotional coping, and problem focused coping.^{12,22,39} Higher scores on the subscales indicate that the patient commonly used that coping strategy. The Cronbach's alpha for the COPE in this study was 0.78.

Event-free survival—Event-free survival was defined as the combined endpoint of cardiac hospitalization or all-cause death. Hospitalization data were determined through a combination of patient and family interviews and a review of medical records. Hospitalizations were verified and documented by trained research assistants who reviewed medical records and clinic notes on a weekly basis. Given the possibility that patients could have been hospitalized at different facilities, trained research assistants carefully questioned the patients or family members by phone to determine if hospitalization had occurred elsewhere.

All-cause death was determined by reviewing medical records and contacting the patient's family. At enrollment, the patient was asked for contact information for a close friend or family member in case the patient could not be contacted. At follow-up if a patient could not be reached by phone, hospital records were searched. When information regarding the patient was not available, family members or friends were contacted.

Demographic and clinical variables—These variables included age, gender, ethnicity, and New York Heart Association (NYHA) class. NYHA class indicated the level of functional impairment reported by patients as a result of symptoms. These variables were selected because of their effects on the outcome as suggested in the literature.^{40,41}

Procedure—Hospitalized patients were identified by clinicians and referred to research staff who determined each patient's eligibility. The study and its voluntary nature were thoroughly explained to each patient and signed informed consent was obtained after answering any questions patients had about the study. The research staff met with the patients to administer study questionnaires via the web based Survey Monkey. The questionnaires took approximately 20 minutes to complete. A paper copy was offered to the patient if they did not feel comfortable with the web based survey.

Patients were contacted by phone at two weeks, three months, and six months from hospital discharge. At each telephone contact, the research staff asked the patient whether he or she has been hospitalized or visited the emergency unit. At the end of the study period, hospital records were reviewed to confirm deaths, re-hospitalizations or emergency department visits.

Statistical Analyses—Data were analyzed using SPSS software, version 20.0 (SPSS Inc., Chicago, IL). Descriptive statistics, including means, standard deviations and frequency distributions, were used to describe sample characteristics. Two tailed Pearson correlation coefficients were used to determine bivariate relationship among the variables. Multiple linear regressions were used to determine the association between stress and cognitive appraisal type, stress and coping style, and cognitive appraisal and coping style. Age, gender, and NYHA class were controlled in those three multiple linear regressions. Two groups, low and high perceived stress level, were created based on the median of perceived stress level and used in this analysis. The median was used to create the groups because there are no published cut-points to define high and low stress levels.

To examine the association of cognitive appraisal and coping strategies with event-free survival (cardiac hospitalization or all-cause death), adjusted Cox regression analysis (survival analysis) was used to determine whether different types of cognitive appraisal and coping styles, independently predict event-free survival. Each type of cognitive appraisal (Challenge, Threat, and Harm/Loss) and each style of coping (Problem focused coping, Active emotional coping, and Avoidant emotional coping) was entered in separate Cox regression analysis to predict event-free survival. The following covariates were considered in the adjusted analyses: age, gender, and NYHA class. The assumptions of all Cox regressions and multiple linear regressions were tested for violations, and none were noted. A p-value of 0.05 was considered statistically significant.

Results

Demographic and clinical characteristics of patients (N = 88) are summarized in Table 1. The average stress score in this sample was 9.44 ± 3.86 , with a range of 4 to 20. The average cognitive appraisals scores were as following: threat appraisal 2.46 ± 0.87 , challenge appraisal 2.47 ± 0.77 , and harm/loss appraisal 2.65 ± 0.88 . The average coping styles scores were as follows: problem-focused coping 2.82 ± 0.66 , active-emotional coping 2.57 ± 0.56 , and avoidant-emotional coping 1.56 ± 0.38 . A total of 29 (32.9%) patients had an event: seven (7.9%) died and 22 (25%) were hospitalized for cardiac reasons.

The two tailed Pearson correlations showed that harm/loss cognitive appraisal was significantly correlated with stress level ($r = -0.342$, $p = 0.005$). Specifically, higher levels of stress were associated with the more common use of harm/loss appraisal. Stress level was also significantly correlated with avoidant emotional coping ($r = 0.429$, $p < 0.001$). The avoidant emotional coping style was associated with higher levels of stress. In addition, threat cognitive appraisal was significantly correlated with avoidant emotional coping ($r = -0.372$, $p = 0.002$). Furthermore, harm/loss cognitive appraisal was significantly correlated with the avoidant emotional coping ($r = -0.433$, $p < 0.001$).

In adjusted analyses, and with regard to prediction of cognitive appraisal, multiple linear regressions showed that none of the demographic, clinical, or stress variables was a significant predictor of challenge (Table 2). The only significant predictors of cognitive appraisal as threat were age (β 0.39; 95% CI: 0.01 – 0.04; $p = 0.01$) and gender (β -0.23; 95% CI: -0.81–0.01; $p = 0.05$). Specifically, older age and female gender were associated with cognitive appraisal as a threat. Finally, age (β 0.06; 95% CI: -0.01 – 0.02; $p = 0.05$) and stress (β -0.37; 95% CI: -1.11 – 0.23; $p < 0.001$) were the only significant predictors of cognitive appraisal as harm/loss. Specifically, older age and higher stress level were associated with harm/loss cognitive appraisal.

Significant predictors of avoidant emotional coping included harm/loss cognitive appraisal (β -0.28; 95% CI: -0.21 – -0.02; $p = 0.02$) and stress level (β 0.30; 95% CI: 0.04 – 0.38; $p = 0.02$); controlling for age, gender, and NYHA class (Table 3). Higher levels of stress and greater use of harm/loss cognitive appraisal were associated with avoidant emotional coping style.

In analyses adjusted for age, gender and NYHA class, where cognitive appraisal types were the independent variables, none of the demographics, clinical characteristics, or cognitive appraisal variables was significant predictors of event-free survival (Table 4). Where coping styles were the independent variables, none of the demographics, clinical characteristics or coping styles were significant predictors (Table 5).

Discussion

Despite the medical and surgical advances in HF treatment, mortality and morbidity rates are still substantial even in comparison to some aggressive types of cancer.^{42–45} We hypothesized the relationships among the study variables (stress, cognitive appraisal, and coping) depicted in the model (Figure 1) that was developed based on the literature to date.

In this study, we investigated whether cognitive appraisal type predicted 6-month event-free survival. Our findings suggest that greater use of harm/loss cognitive appraisal predicted shorter event-free survival in HF. None of the other cognitive appraisal types were significant predictors. These findings suggest that threat and harm/loss cognitive appraisals may lead to negative coping styles such as avoidant emotional coping that also predicted shorter event-free survival in the unadjusted model. This result can be explained by the association of the harm/loss cognitive appraisal with other negative psychosocial factors such as depression and anxiety that been found to short event free survival among HF

patients.^{46,47} Healthcare providers must assist patients to learn and use more positive types of appraisal and coping in response to stress. Cognitive behavioral therapy is effective in assisting patients assume healthier appraisal and coping strategies, which are associated with better health outcomes, greater self-efficacy, and less depression and anxiety.^{48,49}

We found also that higher stress levels were associated with greater use of harm/loss cognitive appraisal. This finding suggests that patients with HF respond negatively to higher stress levels with an appraisal type that is associated with negative health outcomes, and are unable to marshal a positive coping response to stress. Other healthy and chronically ill subjects have demonstrated the ability to respond to the stress imposed by their condition with a healthier type of cognitive appraisal, challenge, which is associated with better adherence and outcomes.^{14,15}

In a study conducted among patients with the human immunodeficiency virus, psychological stress was associated with threat cognitive appraisal.⁵⁰ Our findings suggest that HF patients may have a different appraisal for the stressful situation since a higher level of stress was associated with harm/loss cognitive appraisal. However, these findings demonstrate that cognitive appraisal plays a role in the stress response.¹⁵

In our study, only stress and harm/loss cognitive appraisal were predictors of avoidant emotional coping style. Our findings suggest that higher levels of stress and greater use of harm/loss cognitive appraisal were associated with the avoidant emotional coping style. Thus, the dominant type of cognitive appraisal in our sample of patients with HF is associated with a coping style that has negative health outcomes and a negative impact on emotional well-being. Similar findings have been reported in the literature.^{51–55}

Our study was the first to investigate stress, cognitive appraisal, coping, and event-free survival in HF patients. Many of our findings were consistent with other investigations conducted on different groups of healthy and ill subjects.^{50,56–58} However, our findings did not support all the relationship in the hypothesized model. A potential explanation is that the measures did not adequately capture stress and coping styles. We used brief stress and coping scales that contains 4 and 28 items respectively. Both shortened measures have been demonstrated to be valid and reliable; nonetheless, the full instruments may have provided more complete information about stress level, and coping styles than the shorter versions.^{32,37,59,60} Another potential explanation is that the 6 month follow up period may have been too short to capture the effect of coping styles on the health outcomes in patients with HF. Also, the role of the culture in response to stress and coping style may have affected our results. The sample was recruited from a large city in Kentucky, USA called Lexington. However, this city is in the heart of Appalachia. The Appalachians are well known for their unhealthy lifestyle that may consider as a way of coping with the stressors. We recommend to include the cultural factor in the future studies. A final possible explanation is that there is no relationship between the variables and outcomes in patients with HF.

The strengths of our study include the use of valid and reliable instruments to measure stress, cognitive appraisal, coping, and other covariates. Furthermore, we investigated multiple associations among the variables of this study and our findings form a foundation

for future studies of stress, cognitive appraisal, coping, and health outcomes in HF patients. The small sample size is one of the limitations of this study that may affect our ability to find significant association similar to those that were presented in the literature. We also did not adjust the analysis for the length of time from diagnosis which may have affected the perception of HF in this population. Including this variable in the analysis could have provided more insights into our finding. Furthermore, choosing the unhealthy style of coping to manage the stressors associated with HF, it can be a chance to develop anxiety and depression among those patients which may affect their survival. Thus, not including anxiety and depression as variables may consider a limitation in this study.

Conclusion

Our findings suggest that there is an association between stress level and harm/loss cognitive appraisal that is associated with shorter event free survival among HF patients. In addition, harm /loss cognitive appraisal is associated with avoidant emotional coping that is associated with negative health outcomes and shorter event-free survival. Thus, to improve health outcomes in patients with HF, interventions are needed to reduce the stress from HF and change how HF patients appraise their condition and cope with it. Cognitive restructuring may be useful among patients with HF who negatively appraise the stress of HF as such appraisal leads to negative coping strategies that are associated with worse event-free survival.

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Abbreviations

HF	Heart failure
NYHA	New York Heart Association

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Figure 1.
Heart Failure Patients' Response to stressors

Table 1

Sample Characteristics (N = 88)

Characteristic	N (%) OR MEAN $\pm$ SD
Age, years	58.13 $\pm$ 12.64
Stress Score	9.44 $\pm$ 3.86
Cognitive appraisal	
Threat Score	2.46 $\pm$ 0.87
Challenge Score	2.47 $\pm$ 0.77
Harm/Loss Score	2.65 $\pm$ 0.88
Coping Style	
Problem Focused Coping Score	2.82 $\pm$ 0.66
Active Emotional Coping Score	2.57 $\pm$ 0.56
Avoidant Emotional Coping Score	1.56 $\pm$ 0.38
Gender	
Male	47 (53.4)
Female	41 (46.6)
Ethnicity	
White	68 (77.3)
African American	20 (22.7)
Marital Status	
Single/divorced/widowed	47 (53.4)
Married or cohabitate	41 (46.6)
Education Level	
High school or under	50 (56.8)
Higher than high school	38 (43.2)
Employment Status	59 (67.0)
Unemployed	29 (33.0)
Employed	
NYHA class	
I/II	40 (45.5)
III/IV	48 (54.5)
Stress	
Not Stressed	47 (53.4)
Stressed	41 (46.6)

Note: NYHA = New York Heart Association, SD = standard deviation.

Table 2

Predictors of the Cognitive Appraisal Type Based on the Stress Level (Multiple Linear Regression)

Variable	β	95% CI	P
Challenge Cognitive Appraisal			
Age	0.06	-0.01 – 0.02	0.68
Female Gender	0.08	-0.29 – 0.52	0.57
NYHA class III/IV compared to I/II	-0.18	-0.70 – 0.13	0.18
High stress level compared to low stress level	0.13	-0.21 – 0.62	0.32
Overall Model (Adjusted R² = -0.02, F=0.665; P= 0.619)			
Threat Cognitive Appraisal			
Age	0.39	0.01 – 0.04	0.01
Female Gender	-0.23	-0.81 – 0.01	0.05
NYHA class III/IV compared to I/II	0.24	0.01 – 0.83	0.46
High stress level compared to low stress level	-0.06	-0.52 – 0.31	0.61
Overall Model (Adjusted R² = 0.215, F=5.173; P= 0.001)			
Harm/loss Cognitive Appraisal			
Age	0.06	-0.01 – 0.02	0.05
Female Gender	0.01	-0.42 – 0.46	0.91
NYHA class III/IV compared to I/II	0.20	-0.09 – 0.81	0.12
High stress level compared to low stress level	-0.37	-1.11 – -0.23	<0.001
Overall Model (Adjusted R² = 0.126, F=3.190; P= 0.020)			

Note: CI = confidence interval, β = adjusted regression slope coefficient, NYHA = New York Heart Association

Table 3

Predictors of the Avoidant Emotional Coping of Patients with Heart Failure Based on the Cognitive Appraisal Type (Multiple Linear Regression)

Variable	β	95% CI	P
Age	-0.15	-0.01 – 0.00	0.20
Female Gender	0.13	-0.10 – 0.25	0.25
NYHA class III/IV compared to I/II	-0.15	-0.27 – 0.06	0.19
High stress level compared to low stress level	0.30	0.04 – 0.38	0.02
Harm/loss cognitive appraisal	-0.28	-0.21 – 0.02	0.02
Threat cognitive appraisal	-0.15	-0.12 – 0.06	0.30
Challenge cognitive appraisal	-0.05	-0.14 – 0.10	0.72
Overall Model (Adjusted $R^2 = 0.26$, $F=5.425$; $P<0.001$)			

Note: CI = confidence interval, β = adjusted regression slope coefficient, NYHA = New York Heart Association

Table 4

Predictors of the Cardiac Event-free Survival Based on the Cognitive Appraisal Type (Adjusted Cox Proportional Hazards Regression)

Predictor Variables	Hazard Ratio	95% CI	P
Age	1.02	0.98 – 1.06	0.35
Female Gender	0.84	0.32 – 2.24	0.73
NYHA class III/IV compared to I/II	0.86	0.33 – 2.23	0.76
Harm/loss cognitive appraisal	0.53	0.28 – 1.02	0.05
Threat cognitive appraisal	0.89	0.49 – 1.60	0.69
Challenge cognitive appraisal	1.14	0.59 – 2.18	0.70
Overall Model ($\chi^2 = 7.56$, df = 7; p = 0.48)			

Note: CI = confidence interval, NYHA = New York Heart Association

Table 5

Predictors of the Cardiac Event-free Survival Based on the Coping Style (Adjusted Cox Proportional Hazards Regression)

Predictor Variables	Hazard Ratio	95% CI	P
Age	1.02	0.98 – 1.07	0.37
Female Gender	0.76	0.31 – 1.83	0.54
NYHA class III/IV compared to I/II	0.74	0.29 – 1.87	0.52
Problem Focused Coping	1.98	0.92 – 4.25	0.08
Active Emotional Coping	0.91	0.39 – 2.11	0.83
Avoidant Emotional Coping	3.23	1.14 – 9.16	0.03
Overall Model ($\chi^2 = 7.97$, df = 6; p = 0.24)			

Note: CI = confidence interval, NYHA = New York Heart Association