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Effects of stress, health competence, and social support on depressive symptoms after cardiac hospitalization

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Abstract

Little is known about the role of stress on the psychological well-being of patients after cardiac hospitalization or about factors that protect against or exacerbate the effects of stress. We use prospective data from 1542 patients to investigate the relationship between post-discharge stress and changes in depressive symptoms, and whether the level of prior depressive symptoms, health competence, and perceived social support moderate this relationship. Net of depressive symptoms in the 2 weeks prior to hospitalization, higher levels of post-discharge stress significantly increase depressive symptoms 30 days after discharge. The level of prior depressive symptoms moderates the effect of stress. On the other hand, perceived health competence and social support buffer the negative effects of post-discharge stress. Knowing which patients are particularly vulnerable to experiencing stress and a subsequent increase in depressive symptoms can help trigger interventions prior to discharge and possibly ameliorate the prevalence of depression.

Keywords

Depressive symptoms; Stress; Health competence; Social support; Heart disease

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Compliance with ethical standards

Conflict of interest

Gabriela León-Pérez, Kenneth A. Wallston, Kathryn M. Goggins, Heidi M. Poppendeck, and Sunil Kripalani declare that they have no conflict of interest.

Human and animal rights and informed consent

All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all patients for being included in the study.

Introduction

Someone experiences a coronary event every 34 s, which results in almost one million new or recurrent coronary attacks each year in the United States (Mozaffarian et al., 2015). Noncardiac comorbidities, especially those affecting patients' psychological well-being, are common among patients with coronary heart disease (CHD) and have a great impact on adverse clinical outcomes, hospitalizations, and mortality (van Deursen et al., 2014). Depression is the most common mental health condition—about 35 % of CHD patients meet criteria for clinical depression and even a greater proportion report depressive symptoms (Hemingway & Marmot, 1999; Riegel et al., 2009). Heart disease patients who are depressed tend to experience worse health status, more pronounced symptomatology, recurrent cardiac events, and higher risk of death than those who are not depressed (Lesman-Leegte et al., 2006; Riegel et al., 2009; Tully et al., 2008).

Given the important clinical implications, there is a growing literature in the United States and around the world seeking to better understand the association between depression and CHD. To date, most of the existing studies focus on four main areas of research: depression as a predictor of CHD (Bremmer et al., 2006; Wulsin & Singal, 2003); prevalence and predictors of depression among inpatient and outpatient CHD populations (Bekke-Hansen et al., 2014; Sanjuán et al., 2014; Stafford et al., 2013); depression as a mediating variable between social characteristics and CHD (Hsu et al., 2014; Thurston et al., 2006); and depression and risk of death among CHD patients (Meyer et al., 2014; Surtees et al., 2008). Little is known, however, about changes in depression over time or about the impact of stress on these changes. Moreover, to our knowledge, no studies have explored the role of coping resources in buffering the negative effects of stress in this population.

This paper uses prospective data from over 1500 hospitalized heart disease patients to examine the association between post-discharge stress and changes in depressive symptoms. Specifically, we examine if stress reported during the first few days after hospital discharge is related to depressive symptoms 30 days after discharge, net of depressive symptoms prior to hospitalization. In addition, we examine if and how the level of prior depressive symptoms moderates the effect of post-discharge stress, and whether perceived health competence and social support buffer the association between changes in depressive symptoms and post-discharge stress.

Changes in depressive symptoms

Most research examining depression in CHD patients is cross-sectional and uses correlational designs (Graven & Grant, 2013). Few studies have examined changes in depression in heart disease patients. One study of over 800 patients hospitalized for an acute myocardial infarction found that 30 % were depressed during hospitalization; 1 year later, the rate of depression decreased significantly but was still high at 26 % (Frasure-Smith et al., 2000). Changes in depression were not related to age, sex, education, or measures of cardiac risk or history (Frasure-Smith et al., 2000). Another longitudinal study followed 100 outpatients who received implantable cardioverter defibrillators (ICD). Results were similar, with the overall prevalence of depression decreasing from 35 % at baseline to 26 % two years later (Thomas et al., 2009). Severity of the disease did not influence changes in

depression over time, but the trajectory of change did vary depending on whether patients received ICD shocks or not (Friedmann et al., 2014; Thomas et al., 2009). In another study, Shnek and associates (2001) found that, net of prior depressive symptoms, higher levels of dispositional optimism one month after discharge predicted a decrease in depressive symptoms one year later; helplessness, cognitive disorders, and self-efficacy were not significant predictors of change. In sum, prior research has found that depression or depressive symptoms decrease after hospitalization, yet there is no consensus as to what factors predict these changes.

Stress and depression

Experiencing a cardiac event and a subsequent hospitalization are stressful situations for patients. Kendler and colleagues (1999, 2010) studied twin pairs and found that experiencing a serious illness or injury doubled the risk for the onset of a depressive episode. Indeed, there is ample and compelling evidence for the association between stressful life events and depression (Caspi et al. 2003; Hammen 2005; Kendler and Gardner 2010; Kessler 1997; Mazure 1998). However, not everyone who experiences negative life events becomes depressed (Aneshensel, 1992; Kuiper et al., 1986; Thoits, 2010). Some researchers suggest that it is the level of perceived stress—not the actual occurrence of the event—that likely determines a person's response to a stressor and the subsequent mental health consequences (Cohen et al., 1983; Kuiper et al., 1986). Stress arises when a person perceives a situation to be demanding or threatening to their well-being but does not have an adequate coping response (Lazarus, 1966). In the absence of coping resources, high levels of stress are related to an increased risk of depression, a longer duration, exacerbated symptoms, and relapse (Hammen, 2005; Mazure, 1998).

History of depression modifies the effect of stress. For example, stressful life events have a significant, negative effect on the self-esteem of individuals with prior depressive symptoms, but not on those without prior symptoms (Maciejewski et al., 2000). Similarly, there is a stronger association between stressful life events and first onset of depression among adults with no history of mental illness, compared to those without a prior history (Hammen, 2005; Kessler & Magee, 1994). There is also evidence that history of depression interacts with changes in stress to predict pain in patients with rheumatoid arthritis (Zautra et al., 2007). Among heart disease patients, prior history of mental illness significantly predicts prevalence of depression and anxiety, as well as a poorer quality of life (Haworth et al., 2005; Stafford et al., 2013). Prior depressive symptoms are also an indicator of greater vulnerability to other risk factors, such as lack of adequate coping resources (Kessler & Magee, 1994). In light of these findings, failing to control for history of depression can lead to biased conclusions regarding the importance of risk factors (Hammen, 2005; Kessler & Magee, 1994).

Coping resources

Over the last 40 years, stress researchers have consistently confirmed that the negative psychological impacts of stress exposure are buffered or weakened through the effective use of personal and social coping resources (Thoits, 2010; Uchino, 2006). Coping resources help individuals manage or reduce the magnitude of the effect of stressful internal and external

demands and conflicts (Folkman et al., 1986). Social support is a key coping resource involving emotional, informational, and/or practical assistance from an individual's primary social group (Cassel, 1976; Cohen & Wills, 1985; Turner & Brown, 2010; Umberson et al. 2010). The benefits of social support are mostly evident in situations with high levels of stress exposure. According to Cohen and Wills (1985, p. 310), social support protects individuals from "the potentially pathogenic influence of stressful events;" alternatively, the negative impact of stress is augmented in individuals lacking support. Social support is the coping resource that has received the most attention in the CHD literature (Chung et al., 2013; Friedmann et al., 2014; Graven & Grant, 2013; Heo et al., 2014; Lett et al., 2005, 2007). Recent studies have examined the effects of social support on changes in depression in CHD inpatients and outpatients, yet none have assessed its stress-buffering role. Friedman et al. (2014) found that baseline social support significantly predicted changes in depressive symptoms: patients with lower baseline social support experienced a greater increase in depressive symptoms over time; in contrast, depression did not increase for those with high baseline support. In another study, social support was only related to changes in depression among patients who were depressed during hospitalization (Frasure-Smith et al., 2000).

Health competence refers to the degree to which a person feels able to manage his or her health outcomes (Smith et al., 1995). In other words, it reflects perceptions of self-efficacy in health-related situations. Health competence is significantly related to higher emotional, functional, and social well-being (Arora et al., 2002) and is a significant predictor of health behaviors (Bellizzi et al., 2009; Marks & Lutgendorf, 1999). Individuals with low perceived health competence tend to report more depressive symptoms (Bane et al., 2006; Smith et al., 1995). Among heart disease patients, health competence is associated with better physical functioning and general health perceptions (Arnold et al., 2005). To our knowledge, no studies have assessed the relationship between health competence and changes in depression or whether health competence buffers the negative effects of stress.

Drawing from the existing literature, in this study we test the following three hypotheses:

- H1** Net of covariates, stress in the days immediately after hospital discharge is positively associated with higher depressive symptoms one month after discharge.
- H2** Depressive symptoms in the two weeks prior to hospitalization moderate the effect of post-discharge stress on depressive symptoms one month after hospital discharge.
- H3** Health competence and perceived social support buffer the effect of post-discharge stress on depressive symptoms one month after hospital discharge.

Methods

Study design and setting

Data for this analysis come from the Vanderbilt Inpatient Cohort Study (VICS). VICS is a prospective cohort study that collects data from hospitalized heart disease patients admitted to Vanderbilt University Hospital and follows them after discharge. The goal is to examine

how health literacy and sociodemographic factors are related to post-discharge health outcomes such as medication adherence and safety, readmission, functional status, quality of life, and mortality. The study was approved by the Institutional Review Board at Vanderbilt University. Details about the aims, sampling design, and data collection methods are described elsewhere (Meyers et al., 2014).

In brief, VICS consists of one enrollment interview conducted at the hospital and three follow-up telephone interviews. We recruited hospitalized patients over the age of 17 who met clinical criteria suggestive of acute coronary syndrome (ACS), acute decompensated heart failure (ADHF), or both. Eligibility was confirmed by a physician's review of the patient's medical record. After consenting to participate, patients completed a baseline interview, which was verbally administered at the bedside by trained research assistants. Follow-up telephone interviews were conducted 2–3, 30, and 90 days after discharge, with completion rates of 88–89 % at each time point.

Measures

Depressive symptoms—The presence and severity of depressive symptoms were assessed at baseline and during the 30-day follow-up interview using the eight items from the Patient Health Questionnaire (PHQ-8) (Kroenke et al., 2010). The items in the PHQ-8 measure depressive symptoms over the last 2 weeks. Thus, at baseline, it assesses depressive symptoms prior to hospitalization; at 30-days, it captures post-discharge depressive symptoms. Each item of the PHQ-8 is scored on a scale ranging from 0 = not at all to 3 = nearly every day. Summed scores range from 0 to 24, with higher scores indicating more severe depressive symptoms. Studies have confirmed the reliability and validity of this measure among heart disease patients (Hammash et al., 2012).

Post-discharge stress—During the 2–3 day post-discharge follow-up interview, patients were asked how much stress they had experienced since leaving the hospital; thus, it represents patients' perceived level of stress. Responses ranged from 0 = no stress to 10 = extreme stress. This item is based on the distress thermometer recommended by the National Institutes of Health and the Society of Behavioral Medicine to assess stress in patients (Boyle, 2011).

Health competence—Perceived health competence was measured at baseline using a 2-item version of the Perceived Health Competence Scale (Smith et al., 1995). Patients were asked two statements about how they handle their health: "I am able to do things for my health as well as most other people" and "It is difficult for me to find effective solutions for my health problems". Response options range from 1 = strongly disagree to 5 = strongly agree. Responses for the second statement were reverse coded and summed with responses for the first statement. Total scores range from 2 to 10, with higher scores indicating more health competence.

Perceived social support—Perceived social support at baseline was measured using six items from the ENRICH Social Support Inventory (ESSI) (Mitchell et al., 2003).¹ Patients were asked how often there was someone available to listen when they need to talk,

to give good advice about a problem, to show them love and affection, to help with daily chores, to provide emotional support, and how often they were in contact with someone they can trust and confide in.² Responses ranged from 1 = none of the time to 5 = all of the time and were summed, creating a scale that ranged from 6 to 30. Higher scores indicate higher perceived social support.

Covariates—Models adjust for the effects of demographic attributes, socioeconomic status, and health status. Demographic attributes include sex (1 = female), age (measured in continuous years), race (1 = nonwhite), and marital status (1 = married/partnered). Socioeconomic status variables include dummy variables for level of educational attainment (less than high school, high school graduate, and some college or more), annual household income (less than \$25,000, \$25,000–\$49,999, and \$50,000 or more), and employment status (1 = employed). To control for health status, we include dummy variables for the type of diagnosis (ACS, ADHF, or both); the sum of the number of hospitalizations and emergency rooms visits during the previous 12 months (excluding the hospitalization when they were recruited); and self-rated health (ranging from 1 = poor to 5 = excellent). All covariates were measured at baseline.

Analyses

First, we compute descriptive statistics for the variables used in the analyses. Next, we conduct a series of change models using ordinary least squares regression. By controlling for the dependent variable at baseline, change models are able to adjust for prior levels of the outcome as well as for the effects of omitted variables (Rao & Miller, 1971). Thus, they allow for more stringent tests of effects than cross-sectional models. In a first set of multivariate analyses, we examine the effects of post-discharge stress on depressive symptoms 30 days after hospitalization, adjusting for prior depressive symptoms. We follow a hierarchical modeling strategy, starting with a baseline equation that includes prior depressive symptoms as well as the demographic, socioeconomic, and health covariates. We then add post-discharge stress to assess whether it makes a significant and independent contribution to the model. Next, we include an interaction term to examine if and how prior depressive symptoms moderate the effect of post-discharge stress. To reduce issues of multicollinearity between the interactions and their component variables, we centered the component variables and then computed the interaction terms (Aiken & West, 1991).

A second set of multivariate analyses assess whether health competence and perceived social support buffer the effect of post-discharge stress on 30-day depressive symptoms, net of prior depressive symptoms. The baseline model includes prior depressive symptoms, post-discharge stress, health competence, perceived social support, and all covariates. Then, in separate models, we include interaction terms between stress and each moderator. Significant interaction effects are plotted for ease of interpretation. All analyses were conducted using SAS software version 9.4 (SAS Institute, Cary, NC).

¹Perceived social support was also measured at the 30-day interview. This is the only variable used in the analysis, other than depressive symptoms, that was measured at another time point.

²We excluded marital status (item 7 in the ESSi) because we wanted to assess the independent effects of being married or living with a partner.

Results

Sample characteristics

The sample used in this analysis includes data from 1542 patients interviewed at baseline and who had completed follow-up interviews 2–3 and 30 days after discharge.³ Table 1 presents descriptive statistics for all study variables. Patients reported mild depressive symptoms both at baseline and 30-days. Mean prior depressive symptoms ($\bar{x}=7.8$; $SD=5.4$) were higher than post-discharge symptoms ($\bar{x}=5.8$; $SD=5.4$), and this difference is statistically significant ($p<.001$; analysis not shown). Out of a scale from 0 to 10, respondents reported a mean level of post-discharge stress of 2.9 ($SD=2.9$). Mean health competence was 7.6 ($SD=2.2$) and the average perceived social support score was 25.9 ($SD=4.5$).

Forty-three percent of the sample was female and had an average age of 60. Sixteen percent of respondents were nonwhite and almost two-thirds were married or partnered. With regards to socioeconomic status, 87 % of respondents had a high school degree or more; respondents were evenly distributed along the three household income categories; and a third of the sample was employed. In terms of health status, 65 % of respondents were diagnosed with ACS, 28 % with ADHF, and 7 % with both conditions. On average, respondents rated their health between fair and good ($\bar{x}=2.5$; $SD=1.1$) and had 2.6 ($SD=4$) hospitalizations and emergency room visits in the previous 12 months.

Effects of post-discharge stress on change in depressive symptoms

Table 2 shows the results from multivariate regression analyses examining the effects of perceived stress 2–3 days after hospital discharge on depressive symptoms 30 days after discharge, net of prior depressive symptoms. Model 1 regresses 30-day depressive symptoms on prior depressive symptoms and all covariates. This model explains 36 % of the variance. As would be expected, prior depressive symptoms significantly increase depressive symptoms after hospitalization, such that a 1-unit increase in baseline PHQ-8 is related to a .455 increase in the 30-day PHQ-8. Age is the only demographic attribute that has a significant effect on depressive symptoms—older patients report less depressive symptoms after hospitalization than younger patients. In terms of socioeconomic status, level of education is not significantly related to depressive symptoms, but both household income and employment status have significant effects. Compared to respondents with incomes of \$50,000 or more, those with incomes of \$49,999 or less experience higher levels of depressive symptoms. Being employed at the time of baseline interview significantly reduces depressive symptoms 30-days after discharge. Health status variables are also significant predictors. Patients diagnosed with ADHF experience significantly less depressive symptoms than ACS patients; there is no significant difference between those diagnosed with ACS and both ADHF and ACS. Better self-rated health at baseline significantly decreases depressive symptoms, whereas more hospitalizations and emergency room visits during the previous year increase symptoms.

³We had data for a total of 1576 participants who had completed all three interviews between October 2011 and January 2015. We excluded observations with missing data in any of the variables used in the analysis ($N=35$).

Next, we add post-discharge stress to examine if it is significantly related to 30-day depressive symptoms, net of prior depressive symptoms and demographic, socioeconomic, and health status covariates. Model 2 in Table 2 shows the results of this equation. As expected in Hypothesis 1, the level of stress experienced 2–3 days after discharge is a significant and independent predictor of depressive symptoms 30-days after discharge. Specifically, a 1-unit increase in the level of stress predicts a .307 increase in depressive symptoms. Adding this variable to the equation increases the variance explained from 36 to 39 %. The effects of prior depressive symptoms and covariates remain the same, except for age and ADHF, which lose statistical significance.

Is the effect of post-discharge stress moderated by prior depressive symptoms?

We examined the moderating effects of prior history of depression by entering into the model an interaction term between post-discharge stress and prior depressive symptoms. As mentioned previously, the variable prior depressive symptoms captures the presence and severity of depressive symptoms in the two weeks prior to hospitalization; the outcome variable captures depressive symptoms 30-days after hospital discharge. Model 3 in Table 2 shows the results of this equation. Consistent with our expectations in Hypothesis 2, the interaction between post-discharge stress and prior depressive symptoms is statistically significant. This suggests that the effect of stress on 30-day depressive symptoms depends on the level of prior depressive symptoms. The significance and direction of all of the covariates remain similar to the previous models.

To facilitate interpretation of the interaction effects, we tested and plotted simple slopes for low (1 *SD* below the mean) and high (1 *SD* above the mean) prior depressive symptoms. Both of the simple slopes are statistically significant at $p < .0001$. Figure 1 shows that 30-day depressive symptoms increase substantially in the presence of stress, particularly in patients with high prior depressive symptoms. At low levels of post-discharge stress, individuals with high depressive symptoms prior to hospitalization report significantly more depressive symptoms 30 days after discharge than those with low prior symptoms. As the level of post-discharge stress increases, all individuals experience an increase in 30-day depressive symptoms, but those with high prior symptoms experience the steepest increase and the gap between low and high becomes wider.

Do health competence and perceived social support buffer the effect of post-discharge stress?

We examined the association between health competence and perceived social support (both measured at baseline) and 30-day depressive symptoms, and whether they buffer the negative effects of post-discharge stress. Model 1 in Table 3 shows the results of the main effects equation, which includes prior depressive symptoms, all the covariates, post-discharge stress, health competence, and perceived social support (this model builds on Model 2 in Table 2). Results indicate that higher levels of health competence and perceived social support at baseline significantly decrease 30-day depressive symptoms, net of prior depressive symptoms, stress, and demographic, socioeconomic, and health covariates. Models 2 and 3 include interaction terms between stress and health competence and stress and perceived social support, respectively. As expected in Hypothesis 3, both interaction

terms are significant, indicating that health competence and perceived social support moderate the effect of post-discharge stress.

Figure 2 shows that at low levels of post-discharge stress, individuals with low health competence (1 *SD* below the mean) and those with high health competence (1 *SD* above the mean) have similar levels of 30-day depressive symptoms; however, as post-discharge stress increases, they experience different trajectories. Individuals with low health competence report higher levels of 30-day depressive symptoms as stress increases from low to high. This slope is statistically significant at $p < .001$. Even though it seems that individuals with high competence experience a slight decrease in symptoms, a test of simple slopes reveals that the slope is not statistically significant ($p = .68$). This indicates that depressive symptoms do not change for individuals with high health competence and who experience high levels of stress post-discharge, suggesting that health competence protects against the negative effects of stress. We find a similar pattern in the moderating effects of perceived social support. As Fig. 3 shows, an increase in post-discharge stress predicts a significant increase in 30-day depressive symptoms for individuals with low social support. The slope for high social support is not significant ($p = .45$).

Discussion

This study demonstrates that post-discharge stress plays an important role in the psychological well-being of patients who have suffered a cardiac event, particularly those with prior depressive symptoms, and that the presence of coping resources significantly buffers the negative effects of stress. First, similar to previous studies that found declines in depressive symptoms over time (e.g., Frasure-Smith et al., 2000; Thomas et al., 2009), our descriptive analyses show that, for the sample as a whole, mean depressive symptoms decrease significantly at 30 days after discharge compared to the two weeks prior to hospitalization. However, multivariate regression analyses reveal that post-discharge stress significantly influences changes in depressive symptoms. Indeed, we find that, net of prior depressive symptoms, higher levels of stress during the first few days after hospitalization significantly increase depressive symptoms 30 days after discharge. In addition, income, employment status, self-reported health, and the number of hospitalizations and ER visits during the previous year are significantly related to change in depressive symptoms. Consistent with Frasure-Smith et al.'s (2000) findings, change in depressive symptoms was not related to any demographic attributes or to education.

Second, the level of prior depressive symptoms moderates the effect of stress: while more stress predicts an increase in depressive symptoms in all patients, those with higher depressive symptoms prior to hospitalization experience the most negative impact. Previous studies found that a history of mental illness increases the risk of depression among heart disease patients (Haworth et al., 2005; Stafford et al., 2013). This study adds to the literature by confirming that the relationship between a history of mental illness and subsequent depressive symptoms is heightened by the presence of stress.

Third, the negative effects of stress on depressive symptoms also vary according to the patients' health competence and perceived social support. Lower levels of both health

competence and perceived social support at baseline worsen the effects of post-discharge stress on changes in depressive symptoms; on the other hand, stress in the first few days after discharge appears to have no effect on changes in depressive symptoms in patients with high health competence or high social support. This latter finding is consistent with Cohen and Wills' (1985) buffering model of social support, which suggests that the negative effects of stressors are eliminated or reduced among persons with high social support and are heightened among those with little or no support.

Our study was not without its limitations. One limitation results from the use of patient self-reports for most of our measures. However, the advantages of self-reports are that they represent individuals' own views and perceptions of themselves and their social environment (Barker et al., 2002). Another limitation is that the measure of post-discharge stress was based on a single item. Our results need to be ratified by future studies using more comprehensive measures of stress; still, the single-item measure used in this study is a valid one used in clinical practice to assess the level of stress in various inpatient and outpatient populations (Donovan et al., 2014; Mitchell et al., 2012; Ransom et al., 2006). A third limitation is related to the unknown clinical significance of our findings. Although our key predictors make statistically significant contributions to explaining depressive symptoms one month after hospital discharge, it is difficult to assess whether the magnitude of the contribution is clinically significant. Ultimately, clinical relevance could be established by subsequent demonstration that identification and intervention with patients with, or at risk for, post-discharge stress improves clinical symptoms and outcomes. Furthermore, the generalizability of our results may be limited as our study was conducted at one site in Middle Tennessee; nevertheless, our sample included patients from 15 different states sent to this referral center. Despite these limitations, our study has important methodological strengths. Most prior studies of depression and heart disease are cross-sectional, have limited sample sizes, and focus on predominantly older populations. This study is based on data collected at three different time points from a diverse sample of over 1500 patients with ages ranging from 20 to 95.

Our findings have important clinical implications. On average, patients in our study experienced a decrease in depressive symptoms one month after hospital discharge compared to the two weeks prior to hospitalization; however, patients with high levels of stress during the first few days after returning home and who lacked either internal or external coping resources experienced an increase in depressive symptoms as time went on. Higher levels of depressive symptoms have negative consequences not only for patients' mental health but also for their physical health, including a more pronounced symptomatology and a higher likelihood of readmission and mortality (Lesman-Leegte et al., 2006; Riegel et al., 2009; Tully et al., 2008). Knowing which patients are particularly vulnerable to experiencing post-discharge stress and an increase in depressive symptoms as a result of this intensified stress can possibly trigger interventions prior to discharge for the patients and their caregivers that might ameliorate the prevalence of depression. Specifically, discussing with patients their potential stressors in the context of the acute cardiovascular event, helping them problem-solve by mobilizing supportive resources, and providing additional guidance for stress management may be helpful, particularly for patients with poor coping skills. In addition, primary care physician follow-up, ideally with case

management support for psychological and behavioral counseling, may be important to monitor stress and depression after patients leave the hospital.

Future research

Additional research is needed to determine if interventions prior to hospital discharge are effective. For example, future studies should examine if interventions to improve levels of patients' health competence in the hospital could help reduce stress and depression after discharge. One possible intervention could be improving patients' access to health information prior to being released from the hospital. In their study of breast cancer patients, Arora et al. (2002) found that patients who had problems accessing information about their health had lower perceptions of health competence and, subsequently, experienced poorer psychosocial health. Future research should investigate if giving heart disease patients more information about their condition and their health before leaving the hospital can help increase their perceived health competence and ameliorate post-discharge stress and depressive symptoms. Screening and referral programs should also be tested, so that patients who report higher levels of stress around the time of discharge are referred for additional psychological or social support. Such research should examine not only the effect on depressive symptoms, but also on subsequent readmissions or emergency room visits.

Future research should also monitor the presence of stress over time, its long-term impact on coping resources, and whether it is related to patients' morbidity and mortality outcomes. Levels of perceived stress are expected to decline after several weeks since the appraisal of stress is usually influenced by daily hassles, major events, and shifts in coping resources (Cohen et al., 1983). Consequently, perceptions of stress after hospital discharge may decrease as time goes by. If stress continues to be present over longer periods of time, it may have more detrimental and longer-term effects on mental and physical health. In addition, continued exposure to stress may erode coping resources and further impact patients' well-being.

Our study is the first to use prospective data to assess the effects of post-discharge stress and coping resources on post-discharge depressive symptoms among heart disease patients, accounting for the presence of prior depressive symptoms. Consistent with stress research, we found that higher levels of post-discharge stress significantly increased depressive symptoms one month after discharge. Further, the level of prior depressive symptoms moderated this relationship—the effect of stress on 30-day depressive symptoms was more pronounced among patients who reported high depressive symptoms in the two weeks prior to hospitalization. In addition, we found that perceived health competence and social support during hospitalization buffer the negative effects of post-discharge stress—specifically, low health competence and low perceived social support in the context of high perceived stress in the days after hospital discharge predict higher depressive symptoms one month post discharge.

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Fig. 1.
Significant interaction effects between post-discharge stress and prior depressive symptoms.
Both slopes are statistically significant at $p < .001$

Fig. 2. Significant interaction effects between post-discharge stress and baseline health competence. The slope for low health competence is significant at $p < .001$; the slope for high health competence is not significant ($p = .68$)

Fig. 3. Significant interaction effects between post-discharge stress and baseline perceived social support. The slope for low health competence is significant at $p < .001$; the slope for high health competence is not significant ($p = .45$)

Table 1

Descriptive statistics for study variables

	Mean/percent	SD
<i>Depressive symptoms</i>		
Prior depressive symptoms	7.8	5.4
30-day depressive symptoms	5.8	5.4
<i>Post-discharge stress</i>		
Level of stress	2.9	2.9
<i>Coping resources</i>		
Health competence	7.6	2.2
Perceived social support	25.9	4.5
<i>Demographic attributes</i>		
Female	42.8 %	–
Age	60.5	12.2
Nonwhite	16.1 %	–
Married/partnered	62.2 %	–
<i>Socioeconomic status</i>		
Education		
Less than high school	12.6 %	–
High school graduate	31.0 %	–
Some college or more	56.4 %	–
Household Income		
Less than \$25,000	31.6 %	–
\$25,000 to \$49,999	32.5 %	–
\$50,000 or more	35.9 %	–
Employed	33.9 %	–
<i>Health status</i>		
Diagnosis		
Acute coronary syndrome (ACS)	65.1 %	–
Acute decompensated heart failure (ADHF)	28.1 %	–
Both ACS and ADHF	6.8 %	–
Self-rated health	2.5	1.1
Number of hospitalizations and ER visits	2.6	4.0

N= 1541

Table 2
Depressive symptoms 30-days after discharge regressed on post-discharge stress and other selected variables

	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
Prior depressive symptoms	.455***	.023	.423***	.023	.425***	.023
<i>Demographic Attributes</i>						
Female	-.001	.233	-.094	.229	-.088	.229
Age	-.022*	.010	-.015	.010	-.015	.010
Nonwhite	-.447	.315	-.310	.309	-.288	.309
Married/Partnered	-.388	.263	-.294	.258	-.286	.258
<i>Socioeconomic Status</i>						
Education (ref = college or more)						
Less than high school	.531	.370	.641	.363	.660	.363
High school graduate	-.012	.256	.056	.251	.050	.251
Household Income (ref = \$50,000 or more)						
Less than \$25,000	1.293***	.356	1.301***	.349	1.309***	.349
\$25,000 to \$49,999	.890**	.291	.875**	.285	.875**	.285
Employed	-.740**	.276	-.702**	.271	-.696*	.271
<i>Health Status</i>						
Diagnosis (ref = ACS)						
ADHF	-.536*	.264	-.436	.259	-.435	.259
Both ADHF and ACS	-.317	.449	-.266	.440	-.247	.440
Self-rated health	-.666***	.120	-.586***	.118	-.596***	.118
Number of hospitalizations and ER visits	.069*	.029	.068*	.029	.069*	.029
<i>Post-discharge stress</i>						
Level of stress			.307***	.039	.295***	.039
<i>Interaction</i>						
Stress × prior depressive symptoms					.013*	.007
Intercept	5.103***	.857	3.641***	.860	3.677***	.859

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	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
R-square	.36 %		.39 %		.40 %	

ACS acute coronary syndrome, *ADHF*-acute decompensated heart failure

N = 1541.

* *p* < .05,

** *p* < .01,

*** *p* < .001 (two-tailed tests)

Table 3
Depressive symptoms 30-days after discharge regressed on health competence, perceived social support, and other selected variables

	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
Prior depressive symptoms	.388***	.024	.389***	.024	.387***	.024
<i>Demographic Attributes</i>						
Female	.058	.228	.064	.228	.078	.228
Age	-.017	.010	-.017	.010	-.016	.010
Nonwhite	-.408	.306	-.404	.306	-.393	.306
Married/Partnered	-.171	.260	-.175	.260	-.155	.260
<i>Socioeconomic Status</i>						
Education (ref = college or more)						
Less than high school	.516	.361	.512	.361	.499	.361
High school graduate	-.021	.249	-.016	.248	-.003	.249
Household Income (ref = \$50,000 or more)						
Less than \$25,000	1.155***	.346	1.158***	.345	1.162***	.346
\$25,000 to \$49,999	.803**	.282	.787**	.282	.801**	.282
Employed	-.546*	.269	-.526	.268	-.536*	.268
<i>Health Status</i>						
Diagnosis (ref = ACS)						
ADHF	-.520*	.258	-.495	.258	-.513	.257
Both ADHF and ACS	-.319	.435	-.267	.435	-.273	.436
Self-rated health	-.427***	.120	-.432	.120	-.423***	.120
Number of hospitalizations and ER visits	.075*	.030	.074*	.030	.074*	.030
<i>Post-Discharge Stress</i>						
Level of stress	.278***	.039	.267***	.039	.272***	.039
<i>Coping Resources</i>						
Health competence	-.270***	.058	-.263***	.058	-.268***	.058
Perceived social support	-.098***	.026	-.095***	.026	-.089***	.026
<i>Interactions</i>						

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	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
Stress * Health competence	−.035 *	.016				
Stress * Perceived social support	−.015 *	.008				
Intercept	8.312 ***	1.155	8.177 ***	1.155	7.980 ***	1.165
R-square	40 %	41 %	41 %			

ACS acute coronary syndrome, ADHF acute decompensated heart failure

N= 1,541.
* $p < .05$,
** $p < .01$,
*** $p < .001$ (two-tailed tests)