Anger and depression predict hospital use among chronic heart failure patients

Roslyn C Jenner, Esben S Strodl and Robert D Schweitzer

Abstract

Costly hospital readmissions among chronic heart failure (CHF) patients are expected to increase dramatically with the ageing population. This study investigated the prognostic ability of depression, anger and anxiety, prospectively, and after adjusting for illness severity, on the number of readmissions to hospital and the total length of stay over one year. Participants comprised 175 inpatients with CHF. Depression, anger, anxiety, and illness severity were measured at baseline. One year later, the number of readmissions and length of stay for each patient were obtained from medical records. Depression and anger play a detrimental role in the health profile of CHF patients.

What is known about the topic?
Research suggests that psychological factors may predict hospital usage yet there are few studies that have investigated the relationship between psychological constructs and hospital admission for individuals with chronic heart failure.

What does this paper add?
Hierarchical regressions revealed that depression uniquely predicted number of readmissions to hospital and that anger uniquely predicted the length of stay in hospital. Anxiety was not significantly predictive of either number of readmissions or length of stay in hospital.

What are the implications for practitioners?
Interventions targeting depression and anger may reduce hospital utilisation, subsequent hospital costs and improve quality of life.

THE HIGH INCIDENCE of chronic heart failure (CHF) is expected to increase exponentially over the next few decades as a result of the expanding ageing population and technological advances in medicine that prolong life.[1-5] Not only does CHF impact upon quality of life but it brings with it a burden on health care resources, particularly in relation to expensive hospital readmissions. Emerging literature has suggested that psychological factors may be significantly related to health,

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mortality and hospital usage in the CHF population.[4,6] Examination of these factors has indicated that more severe depression may be significantly associated with or predictive of increased hospital readmissions.[7-13] The level of depression may also be related to lengthier stays in hospital as suggested by Sullivan et al.[8] More studies are required to verify these results, especially those that control for illness severity and include length of stay as an outcome variable.

Prospective research is needed to clarify the role of psychological variables as predictors of hospital use and whether depression is a unique predictor. It is possible that the recorded effects of depression on hospital use are actually attributable to broader negative affect as opposed to depressed mood. No studies have been undertaken to date that have adequately addressed this gap in the literature. Depression and anxiety are commonly comorbid and are highly correlated,[14,15] yet there has been very little research into anxiety and CHF. Only one study has provided any evidence of increased hospital use

relating to anxiety,[11] and studies looking at mortality in CHF patients have found no significant results.[16,17] Research to date has not shown a relationship between anxiety and hospital use, however it is important to include this variable to better understand whether depression is a unique predictor or whether there is a spectrum of negative affect which is associated with hospital readmissions.

Anger has long been known to be associated with other cardiovascular diseases and readmission rates[18] so it is surprising that no research has examined the relationship between anger and CHF. As the nature of this relationship is not understood, there is clearly a need for prospective studies to clarify the relationship. Given that depression and anger are highly correlated,[19] by accounting for anger, as with anxiety, it may help clarify whether depression alone is responsible for higher readmissions and longer stays in hospital, or again whether a spectrum of negative affect is associated with hospital admissions.

As such, the current study aims to clarify the relationship between depression, anxiety and anger, and hospital use among CHF patients by utilising a prospective design. The current study proposes two hypotheses. Firstly, that depression but not anger or anxiety will predict length of stay in hospital over 1 year after accounting for illness severity. Secondly, depression but not anger or anxiety will predict the number of readmissions to hospital over 1 year after accounting for illness severity.

Methods

Participants

Participants were 211 inpatients who were diagnosed by a cardiologist as meeting the criteria for CHF. Participants were recruited from the Prince Charles Hospital in Brisbane as part of a wider study. Exclusion criteria were cognitive deficits (dementia, delirium, and intellectual disability) and poor English language skills. Of the 211 participants initially included, one participant subsequently asked not to be included in the study and 10 participants were excluded due to incorrect or missing patient numbers that prevented collection of hospital readmission details. Data were inspected for missing values, accuracy and extreme outliers. Missing data were imputed using estimation maximisation when there was less than 5% missing data on a variable. Sixteen participants with extreme missing data were excluded from the study. Finally, nine outliers were also excluded from the study, leaving a total of 175 to be used for final analyses.

Measures

Anxiety was measured by the State–Trait Anxiety Inventory (STAI) designed by Spielberger.[20] For the purposes of the current study only the trait anxiety subscale was measured. The trait subscale (STAI-T) of the STAI is a 20-item questionnaire that asks for a response to statements such as "I feel pleasant" and "I am a steady person", with responses made on a four-point scale ("almost never", "sometimes", "often" and "almost always"). Construct validity of the STAI-T has been demonstrated by its ability to discriminate between those who are highly anxious neuropsychiatric patients and normal controls.[20] The current study found the STAI-T to have excellent reliability, with a Cronbach's alpha of 0.89.

Anger was measured by the State–Trait Anger Expression Inventory, second edition (STAXI), developed by Spielberger.[21] For the purposes of the current study only the trait anger subscale was measured. This subscale consisted of 10 items on a four-point scale ranging from one ("almost never") to four ("almost always"). Good validity has been indicated by strong correlations between the trait anger score and the Buss–Durkee Hostility Inventory and the MMPI Hostility (HO) and Overt Hostility (Hv) scales.[21] The current study found the STAXI to have excellent reliability, with a Cronbach's alpha of 0.86.

Depression was measured using the Beck Depression Inventory, second edition (BDI). The BDI is a 21-item questionnaire developed by Beck, Steer and Brown.[15] The questionnaire is based on the criteria for depression as outlined by the Diagnostic and Statistical Manual of Mental

1 Percentage of participants in each demographic, medical, depression, anger and anxiety category	
Categorical variables	**%**
Education	
Primary school	26.7
Junior high	34.9
Senior high	19.2
Technical/TAFE	12.2
Undergraduate	5.2
Postgraduate	1.7
Marital status	
Single	10.4
Married	56.1
Defacto	4.0
Divorced	10.4
Widow or widower	19.1
Current employment	
Pensioner or retired	84.9
Unemployed	3.5
Employed	11.6
New York Heart Association grade	
One	0.0
Two	25.5
Three	61.8
Four	12.7
Depression category	
Minimal	74.3
Mild	12.6
Moderate	8.0
Severe	5.1
Anxiety	
Low	9.7
Normal	85.1
High	5.1
Anger	
Low	34.9
Normal	54.9
High	10.3

of 14 to 19 indicates mild depression; 20 to 28 indicates moderate depression; and 29 to 63 indicates severe depression. The current study found the BDI to have excellent reliability, with a Chronbach's alpha of 0.87.

Demographic variables including age, sex, and employment (pension or retired, unemployed, employed), highest level of education obtained (primary school, junior high school, senior high school, TAFE/technical, undergraduate university, postgraduate university), and marital status (single, married, defacto, divorced, widow or widower) were also included in the survey. Data were also collected for body mass index, heart rate, and diastolic and systolic blood pressure. Illness severity was measured using left ventricular ejection fraction (LVEF) and the New York Heart Association grading (NYHA).

Procedure

Ethics clearance was obtained before the commencement of the study from the Prince Charles Hospital Ethics Committee and the Queensland University of Technology Ethics Committee. The participants were recruited from inpatient attendance at Prince Charles Hospital, a large metropolitan hospital. While most of the participants resided in the hospital's catchment area, the hospital also services patients from rural and remote areas who require specialist services. Patients diagnosed as having CHF by a cardiologist were given a questionnaire to complete after informed consent was gained. The questionnaire also contained other surveys not relevant to the current study. Each participant filled in the questionnaire with the help of the researcher as part of a structured interview. Medical details were gathered by nursing staff from medical charts.

Twelve months after the completion of the questionnaire, the length of stay and frequency of admission for each patient was obtained from the Prince Charles Hospital medical records.

Results

The BDI and the STAXI were transformed using log and reciprocal transformations respectively, to

Disorders IV and measures severity of depressive symptoms. Each question requires the participant to circle one of four agreement statements, with zero indicating less severe depression and four indicating more severe depression. A total score

2 Mean rates of illness severity

Medical characteristics	M
Body mass index	28.95 (6.95)
Heart rate	72.74 (13.90)
Systolic blood pressure	111.45 (19.66)
Diastolic blood pressure	63.38 (9.63)
Left ventricular ejection fraction	33.85 (15.03)

correct for significant positive skew. Inspection of residual plots indicated that the relationship between the predictors and the number of readmissions and length of stay displayed normality, linearity and homoscedacity. The demographic, illness severity, anxiety, anger and depression categories are displayed in Box 1, while continuous illness severity indicators are displayed in Box 2.

Most participants were male (74%) with a mean age of 67.77 (SD, 14.12) years. The average health of the participants was poor, as demonstrated by several medical covariates. Due to the depth of missing data among the illness severity indicators, only LVEF and NYHA were included in the final analyses to indicate illness severity.

Depression was low, with most participants experiencing only minimal depression (74.3%). Anxiety and anger scores were on average at normal levels. The mean anxiety score was 39.43 (SD, 9.01) and the mean anger score was 15.89 (SD, 6.07). Hospital records revealed that over half of the patients (54.9%) were readmitted to hospital at least once over the year. Of those who were readmitted there was a mean of 1.13 (SD, 1.86) readmissions per year and a mean length of stay of 7.01 (SD, 12.72) days per year.

Two hierarchical regressions were conducted. For the first analysis, the first step included both illness severity indicators, NYHA and LVEF. The second step included depression, anger and anxiety. The criterion variable for the first hierarchical regression was length of stay as measured in days. The second hierarchical regression employed the same variables as predictors as in the first analysis, but the criterion variable changed to number

3 Summary of hierarchical regression analysis for predicting length of stay in hospital over one year (N = 163)

	β	Squared semi-partial coefficients
Step 1		
NYHA	0.06	0.00
LVEF	–0.00	0.00
Step 2		
NYHA	0.03	0.00
LVEF	–0.04	0.00
Depression	0.06	0.00
Anxiety	–0.06	0.00
Anger	0.19*	0.03

$R^2 = 0.00$ for Step 1 ($P = 0.78$); $\Delta R^2 = 0.04$ for Step 2 ($P = 0.10$). NYHA = New York Heart Association; LVEF = left ventricular ejection fraction. *$P < 0.05$.

4 Summary of hierarchical regression analysis for predicting number of readmissions to hospital over 1 year (N = 163)

	β	Squared semi-partial coefficients
Step 1		
NYHA	0.06	0.00
LVEF	–0.11	0.01
Step 2		
NYHA	–0.10	0.01
LVEF	–0.14	0.02
Depression	0.19*	0.03
Anxiety	–0.16	0.02
Anger	0.16	0.02

$R^2 = 0.02$ for Step 1 ($P = 0.25$); $\Delta R^2 = 0.05$ for Step 2 ($P < 0.05$). NYHA = New York Heart Association; LVEF = left ventricular ejection fraction. *$P < 0.05$.

of readmissions to hospital. The results are displayed in Box 3 and Box 4, respectively. Only anger significantly predicted length of stay in hospital (t=2.088; P<0.05) and only depression predicted the number of readmissions to hospital (t=2.089; P <0.05) after controlling for illness

severity. Neither the medical covariates nor anxiety predicted length of stay in hospital or number of readmissions to hospital.

Discussion

The aim of this prospective study was to explore the predictive ability of depression, anger and anxiety on the course of CHF patients as assessed by the number of readmissions to hospital and the number of days hospitalised over 1 year after controlling for illness severity. The results revealed that depression was predictive of the number of readmissions to hospital, but contrary to the hypotheses, anger was predictive of length of stay whereas depression was not. As hypothesised, anxiety was not found to predict number of readmissions to hospital or length of stay in hospital. The results reflect an emerging trend in the literature that suggests that psychological factors are related to the course of CHF, with depression predicting the frequency of readmissions to hospital.[7-13] The use of a hierarchical regression model has allowed us to provide the first analysis of CHF and hospital use that includes anger, anxiety and depression.

Previous research has yielded seven studies that have found a significant relationship between depression and hospital readmissions in the CHF population consistent with the current findings. Faris et al[9] concluded that depression was a significant risk factor for increased hospital readmissions even after controlling for medical illness and demographic factors in a study of 396 CHF patients. Major depression was found to predict readmission, after controlling for illness severity over 1 year, in a study of 374 CHF patients by Jiang et al.[7] Sullivan et al[8] also found a similar pattern of readmission rates that were significantly related to depression. Vaccarino et al[10] concluded that previous readmissions to hospital were significantly related to depression after accounting for illness severity in 391 CHF patients. A larger scale study by Braunstein et al[11] conducted on 122630 CHF patients found rates of depression in their population were significantly related to hospital readmissions. Koenig[13]

found that during a period of 6 to 9 months after baseline measures, those with major depression had significantly more readmissions than the no depression group. In contrast, Freedland et al[22] and Rumsfeld et al[23] failed to find significant results. However, these two studies had either small sample sizes or short follow-up periods.

There are physiological and behavioural explanations for the relationship between depression and number of readmissions to hospital. Physiologically, higher depression rates have been linked to lower immune systems.[24] As lower immunity is related to greater hospital use,[25] this may explain why depression significantly predicts hospital readmission rates. Behaviourally, depression has been associated with non-adherence to medications and consequently lower health functioning among a sample of 522 CHF patients.[26] Depression among coronary heart disease patients is also associated with non-adherence to risk-reducing behaviours such as exercise, cessation of smoking and attendance at a cardiac rehabilitation program.[27] Non-adherence to these behaviours may worsen health and thus increase readmissions.

A significant relationship between anger and either number of readmissions or length of stay in hospital was not predicted. Previously, there has been no research undertaken to investigate a link between anger and hospital use among CHF patients. However, the findings of studies that have investigated anger and health outcomes in illnesses related to CHF have found a link. Related illnesses like cardiovascular diseases are frequently linked to the level of anger.[28] Consistent with the findings of the current study, anger in coronary heart disease patients has been linked to poor health outcomes such as mortality[29] and morbidity.[30] Two studies have found that anger is not related to hospital use among myocardial infarction and ischaemic heart disease patients.[31,32] However, both studies focused exclusively on cardiac events which may or may not have required hospitalisation, rather than hospital readmissions for any reason, as an outcome variable. Thus, not all admissions to hospital were recorded in either study, which may

explain the lack of significant findings between anger and hospital usage. There are no studies to corroborate the current findings in a CHF population, but evidence from coronary heart disease patients suggests that the emotion of anger may play a role in health outcomes.

The significant relationship between anger and length of stay in hospital may also be explained by both physiological and behavioural means. Evidence exists that anger has an adverse influence on the body and health outcomes. Anger activates the sympathetic nervous system,[32,33] increasing cardiovascular reactivity such as heart rate and blood pressure,[32,34] as well as increasing cortisol and catecholamine levels.[35] The overall effect of anger is a flight-or-fight response similar to that of stress which can be detrimental to the health of CHF patients. For example, there is evidence that the function of the left ventricle of the heart deteriorates after patients with coronary heart disease become angry.[36] The long-term physiological effects produced by anger, such as prolonged cortisol release, can also suppress the immune system.[37] A lowered immune system has been linked to more frequent hospital use and longer stays in hospital.[25] Thus, anger may be detrimental to the health of CHF patients, leading to lengthier stays in hospital.

Another possible explanation for the role of anger in hospital use may be behavioural in nature. Adherence to medication recommendations also seems to be affected by anger. A study by Lee et al[38] concluded that hypertensive males who were high in hostility, and therefore associated anger, were less likely to follow their medication regimes. Non-adherence to medication regimes may lead to worsening health and thus longer readmissions. In addition, hostile participants also reported more symptoms associated with a new medication regardless of whether they were in an experimental or control group. Thus, anger may increase hospital use in the current sample by adversely affecting health and increasing symptom reporting.

Consistent with the predictions of this study, anxiety was not significantly predictive of either length of stay or number of readmissions to hospital. Currently, there is very little research on the prognostic usefulness of anxiety with regard to hospital utilisation in CHF patients. One study that did attempt to relate anxiety to hospital use was conducted by Braunstein et al,[11] who found anxiety to be a risk factor for more frequent hospital admissions. The interpretation of this study is obstructed by the inclusion of somatoform and personality disorders within the anxiety category, possibly inflating the effect. No other studies on CHF patients have examined anxiety and hospital use. Most studies examining anxiety and CHF outcomes have used mortality as an outcome variable. Even in these studies there has been little evidence of anxiety as a useful predictor of outcome.[16,17]

It is unclear why level of anxiety is not related to number of readmissions and length of stay. One possibility may be the suggestion that certain aspects of anxiety, namely phobic anxiety and panic disorder that may not be detected effectively by the STAI, are responsible for a significant relationship between anxiety and health or health outcomes.[16] This implies that anxiety in general does not predict such outcomes as hospital readmissions and length of stay, yet phobic anxiety and panic disorder may predict outcomes. Future research should therefore examine phobic anxiety as well as trait anxiety on the course of CHF patients.

In summary, these results suggest that it is not a broad category of negative affect that results in increased hospital use. The issue is more complex than that suggested by previous research. That is, depression affects frequency of readmission but not length of stay, while the reverse appeared to be true for anger.

Future studies should consider the following limitations to the current study when designing new research. First, due to logistical considerations hospital data were only gained from the one primary hospital. Some of the participants who initially completed the questionnaire came from distant rural and remote areas and so it was not feasible to access records from all of the smaller hospitals that service these areas. This resulted in both a smaller sample size, as well as

an inability to allow the exploration of relationships that may exist in rural and remote participants. Also, it is anticipated that the size of the relationships between depression, anger and hospitalisation will increase with a larger follow-up period as this will allow a greater variability in the dependent measures.

The current research has implications for the screening of CHF patients, intervention implementation and financial resource planning and distribution. Intervention studies that assess and reduce depression and anger should be conducted, focusing specifically on the effect these reductions have on the number of readmissions and length of stay in hospital. This has important implications for financial planning for the inevitable increase in the CHF population expected over the next decade. The costs of providing interventions to reduce depression and anger may prove more cost-effective than readmitting these patients. As this study is the first of its kind to investigate the effects of the emotion of anger on hospital use among the CHF population, more research is required to replicate these findings. Further research should also be conducted to explain why depression would explain the number of readmissions to hospital but not the length of stay, and why anger would predict the length of stay and not the frequency of readmissions. Finally, exploration of psychological variables including the types of anxiety and their respective effects on hospital use would be beneficial to help explain the mixed results emerging in the literature.

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Competing interests

The authors declare that they have no competing interests.

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