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Pain, return to community status, and 90-day mortality among hospitalized patients with heart failure

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Abstract

Background: Pain is common among patients with heart failure (HF) but has not been examined with short-term discharge outcomes. The purpose was to examine if pain at discharge predicts return to community status and 90-day mortality among hospitalized patients with HF.

Methods: Data from medical records of 2,169 patients hospitalized with HF were analyzed in this retrospective cohort study. The independent variable was a diagnosis of pain at discharge. Outcomes were return to community status (yes/no), and 90-day mortality. Logistic regression was used to address aims. Covariates included age, gender, race, vital signs, comorbid symptoms, comorbid conditions, cardiac devices, and length of stay.

Results: Sample was 66.53 years, 57.4% women, and 55.9% Black race. Of 2,169 patients, 1,601 (73.8%) returned to community and 117 (5.4%) died at or before 90 days. Patients with pain returned to community less frequently (69.6%) compared to patients without pain (75.2%), which was a statistically significant relationship (OR = 0.74, 95% CI: 0.57 to 0.97, $P = .028$). Other variables that predicted return to community status included age, comorbid conditions, dyspnea, fatigue, systolic blood pressure, and length of stay. Pain did not predict increased 90-day mortality. Variables that predicted mortality included age, liver disease, and systolic blood pressure.

Conclusion: Patients with pain were less likely to return to community but did not have higher 90-day mortality. Pain in combination with other symptoms and comorbid conditions may play a role in mortality if acute pain vs. chronic pain can be stratified in a future study.

Keywords

Pain; emergency medical services (EMS); heart failure; mortality; continuity of patient care

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Introduction

A reported 75.3 to 83.7% of patients in the United States with heart failure (HF) who present to the emergency department are hospitalized,[1,2] representing 1 to 2% of all hospital admissions.[3,4] Despite high hospitalization rates, mortality rates have declined to 2.9% of hospital stays.[5] These decreasing trends in hospital mortality rates have subsequently increased the numbers of patients who are discharged home, where they may continue to struggle with overwhelming symptom and treatment burden.[6] In response to these trends, a growing body of literature has focused on improving discharge outcomes among patients with HF who are hospitalized.[7]

Pain may decrease return to community rates (i.e., whether a patient is discharged to home vs. transferred to another hospital or facility) and increase 90-day mortality rates. Previous studies have identified that pain is prevalent in HF, reported as frequently as 85% based on a previous literature review.[8–10] Authors of two previous descriptive studies reported that pain was more common than other classic HF symptoms.[9,10] Pain frequently co-occurs with dyspnea, fatigue,[11] and depression,[9] which decreases functional performance,[9] and may limit patients' ability to meet basic needs after discharge. However, the relationship between pain with short-term discharge outcomes has not been previously evaluated among patients with HF. In a study among 305 hospitalized patients with HF, pain was reported to increase risk of a major adverse cardiac event (including all-cause or cardiac mortality) after discharge over a follow up period of 30 months, though return to community status and 90-day mortality rates were not reported.[12]

Pain is frequently reported among patients with HF in the hospital.[12] Many patients with HF and chest pain present with acute coronary syndrome, an emergent condition which is associated with increased mortality and hospital readmission rates.[13,14] In a previously conducted study of 4,663 patients with HF who activated emergency medical services (EMS), pain constituted 22.2% of all primary complaints.[15] While chest pain was the most common primary complaint of pain (68.1%), patients reported other locations of pain, including abdominal (17.7%), generalized (9.2%), and back (5.03%).[15] The findings from this study indicated that a substantial percentage of patients with HF in the emergency department were experiencing pain that was significant enough to activate EMS. Authors of a second previous study of 122 patients hospitalized with HF reported that over 45% experienced moderate to severe pain.[16] Despite the apparent prevalence of severity of pain among patients with HF in the hospital, the relationship between pain with discharge outcomes is unexplored.

The theoretical framework guiding the study was adapted from a previously developed model that organized the social, clinical, and system factors that influence readmission and short-term mortality among patients with HF or pneumonia.[17] In this previous model, social factors (i.e., sociodemographic, socioeconomic and neighborhood factors) as well as clinical factors were directly related to outcomes (i.e., readmission and 30-day mortality rates) but were indirectly related to process of care factors (i.e., inpatient care status, discharge coordination and post-discharge management).[17] In the adapted model, readmission was replaced by return to community status, and 30-day mortality was replaced by 90-day

mortality. A literature review was conducted to identify variables in past studies that influenced return to community status and 90-day mortality that would be included in the adapted theoretical framework. Variables associated with decreased odds of returning to community were increased age,[18,19] female sex,[18,19] white race,[19] increased length of stay,[18] low systolic blood pressure,[18–20] increased HF severity,[18,20] absence of an implantable cardioverter-defibrillator,[19] and medical history of depression, diabetes, hyperlipidemia, kidney disease, myocardial infarction, peripheral vascular disease, stroke, and valvular heart disease.[18–20] In addition, two common symptoms experienced by patients with HF include dyspnea and fatigue,[10] which when combined reduces capacity to perform self-care and self-maintenance activities, lessening the likelihood that patients will return to their communities following discharge.[9,21]

Authors of other studies have reported factors that predict increased 90-day mortality including increased age,[17,22,23] Black race,[24] body mass index,[22,25] severity of HF,[25] medical history of acute coronary syndrome, depression, hypertension, respiratory disease, liver disease, and atrial fibrillation,[22,23,25] lower blood pressure,[22,23,25] lower sodium and bicarbonate levels,[22,23] worsened renal function,[22,25] edema,[22] and longer length of stay.[18,23] In addition to length of stay, other process of care factors such as complications in the hospital (e.g., infection or ventilation) predicted increased 90-day mortality.[25,26] Social factors may play a role in increased mortality, such as education,[25] lack of a health professional or social support network,[26] living further from a hospital,[17] and rural vs. urban residence.[26] The full model including pain and all other variables identified from currently available empirical and theoretical literature is shown in Figure 1.

These previous studies form an important body of literature that support several variables that influence discharge outcomes. However, pain during discharge was not reported, which represents an important gap in knowledge. Identifying if pain at discharge worsens return to community status and short-term mortality may improve discharge and transitions of care practice guidelines. The purpose of this study was to examine the relationship between pain with return to community status and 90-day mortality among hospitalized patients with HF. The aims were to evaluate a discharge diagnosis of pain as a predictor of 1) return to community status and 2) 90-day all-cause mortality among patients with HF who were hospitalized. Covariates were age, gender, race, comorbidities, HF symptoms (i.e., fatigue and dyspnea), cardiac devices, vital signs, and length of stay. The hypotheses were that a diagnosis of pain at hospital discharge predicts 1) decreased rates of return to community and 2) increased 90-day mortality among patients with HF who were hospitalized.

Methods

Design and data sources

This study was a retrospective cohort design. The original dataset source consisted of 6,582 patients transported from their home or community by EMS to the emergency department (ED) between 2009 and 2017. These data were originally published in a study that reported predictors of EMS use and transports.[27] Patients were included in the parent study dataset if they provided a self-report HF diagnosis, were age 21 years or older, and were transported to one of three area Midwestern hospitals after activating EMS.[27] The local

university institutional review board granted approval for both the parent study and current study. For the current study, medical record data was obtained from the Indiana Network for Patient Care (INPC) and prepared by the Regenstrief Institute, which specializes in integration of health care datasets. Abstracting medical record data is considered a valid technique for studying outcomes among patients with HF.[28] The data collected by EMS personnel from patients transported to the emergency department were then matched with their corresponding hospital electronic medical record data obtained from INPC using either the patient's name, date of birth, gender, and/or unique encounter identification number. The full merging procedure for these two datasets has been described in a previous study which examined the impact of presenting with a primary complaint of pain on hospitalization status, in-hospital mortality, and length of stay.[29]

The inclusion and exclusion criteria for the current study were applied to the final merged and deidentified dataset. The inclusion criterion was patients who were discharged from an inpatient unit following initial transport by EMS to the ED. The exclusion criteria were 1) patients who died in the hospital, 2) patients who left against medical advice, and 3) patients with incomplete data for the outcome variables and covariates (see measures). Applying these criteria led to a final sample of 2,169 patients. Figure 2 provides a complete depiction of the data sources for each variable included in the study as well as the merging process for the two datasets.

Measures

The independent variable for both hypotheses was a discharge diagnosis of pain obtained using the International Classification of Diseases (ICD)-9 or ICD-10 diagnoses codes in the patient's medical record from INPC, which consisted of either locations of pain or pain conditions.[30] The dataset contained over 60,000 entries for diagnoses, 71.8% of which were coded as discharge diagnoses, and these were used to identify the presence of pain in the sample. The ICD codes for pain were organized into 5 locations, which included abdominal, back/shoulder, chest, head/neck, and extremities. Pain that could not be assigned to a location was categorized as "unspecified."

The dependent variable of return to community status (for hypothesis 1) was obtained from the INPC dataset. Return to community status was defined as a binary variable (yes/no), with yes indicating a routine discharge to the patient's home or community, and no indicating a discharge to either a hospice facility, skilled nursing facility, or a transfer to another hospital (e.g., federal hospitals, intermediate care facilities, psychiatric hospitals, long term care facilities, or rehabilitation facilities).

The dependent variable of 90-day mortality (for hypothesis 2) was obtained from the INPC dataset. Ninety days was chosen as the mortality timepoint for this study to apply to patients with both acute pain and chronic pain because the ICD-9 and 10 diagnoses codes for pain largely do not differentiate acute and chronic pain. In addition, estimates of short-term mortality may be less susceptible to bias.[3]

Demographic variables were age, self-reported gender and race (Black, Other, White), and were obtained from the EMS dataset. Clinical variables were comorbid conditions,

HF symptoms, cardiac devices, labs, vital signs, and length of stay. Comorbid conditions included arthritis, atrial fibrillation, moderate to severe chronic kidney disease, coronary artery disease, chronic obstructive pulmonary disease, depression, diabetes, hyperlipidemia, essential hypertension, liver disease, myocardial infarction, peripheral vascular disease, stroke, and valvular heart disease. HF symptoms included dyspnea and fatigue. Cardiac devices included implantable cardioverter-defibrillators. Labs were peak troponin I and peak B-type natriuretic peptide, which were collected during hospitalization, but were not available for all patients. Vital signs included systolic blood pressure and heart rate and were obtained by EMS personnel during transport to the ED. Length of stay consisted of the time from admission to an inpatient unit until discharge from the hospital, in days.

Statistical analyses

Demographic characteristics were summarized for the entire sample and by patients who were discharged with and without pain. The frequencies of locations of pain diagnoses were tabulated to better describe pain in the sample. Patients could have more than one location of pain recorded. Univariate analyses were used to examine if patients who were discharged with and without a complaint of pain differed in demographic characteristics, clinical characteristics, return to community status, and 90-day mortality. A correlation matrix was created to assess for multicollinearity among the independent variables. All analyses were conducted using Stata v.17 with a p-value of <.05 for significance.

To answer hypothesis 1, multiple logistic regression analysis was conducted to evaluate pain at discharge as a predictor of return to community status.[31] Covariates included in the final model were those available in the dataset and supported by the theoretical framework and empirical evidence. Prior to regression, demographic and clinical variables were compared by return to community status to evaluate if any additional variables should be added to the regression. Following completion of these analyses, medical history of arthritis and myocardial infarction were included in the final model. Covariates included age,[17–19] gender,[18,19] race,[19] medical history (arthritis, atrial fibrillation, chronic kidney disease, coronary artery disease, chronic obstructive pulmonary disease, depression, diabetes, hyperlipidemia, liver disease, myocardial infarction, peripheral vascular disease, stroke, and valvular heart disease),[18–20,22–25,32] HF symptoms (dyspnea and fatigue),[9,21] presence of implantable cardioverter-defibrillator,[18] vital signs (systolic blood pressure,[18,19] heart rate),[19] and length of stay.[18]

To answer hypothesis 2, multiple logistic regression analysis was conducted to evaluate pain at discharge as a predictor of 90-day mortality. Originally, the same full list of variables identified from the theoretical framework was fitted to the 90-day mortality model as the return to community status model. However, the number of deaths at 90 days (117) precluded all covariates identified from being included. A revised model was constructed using variables that were significant following completion of univariate analyses comparing demographic and clinical variables by 90-day mortality (see Table 2). In addition, gender was added to the model given previous evidence supporting a relationship between gender and mortality. Covariates included in the final model for 90-day mortality were age,[17,22,23] gender,[17,20] medical history (atrial fibrillation, chronic kidney disease, chronic obstructive

pulmonary disease, hypertension, liver disease, peripheral vascular disease, and valvular heart disease),[18–20,22–25,32] systolic blood pressure,[20,22,25] and length of stay.[23]

Results

Demographics are presented for the entire sample and for patients discharged with pain and without pain in Table 1. The mean age of the total sample was 66.53 years (*SD* 13.68 years) The sample was 57.4% women, 42.6% men, and 43.4% White, 55.9% Black, and 0.7% Other. Patients who were discharged with pain were younger (64.96 years vs. 67.03 years), were more frequently women, had a higher number of comorbid conditions, including arthritis, chronic kidney disease, coronary artery disease, chronic obstructive pulmonary disease, depression, diabetes, hyperlipidemia, hypertension, peripheral vascular disease, and had higher prevalence of fatigue and dyspnea compared to patients discharged without pain. In contrast, patients who were not discharged with pain had a higher peak B-type natriuretic peptide, but values were high in both samples (910.53 in the no pain group vs. 752.77 in the pain group). There were no statistically significant differences by race in terms of pain presence.

A total of 523 patients of 2,169 (24.1%) were discharged with pain. Locations of pain are presented in Figure 3 and included chest pain (n = 165), back/shoulder pain (n = 81), extremity pain (n = 80), head/neck pain (n = 61), and abdominal pain (n = 18). In addition, 300 patients were discharged with an indeterminate pain location, the majority of which were neuropathic conditions (e.g., diabetic neuropathy), and unspecified acute or chronic pain.

Return to community status

Of the 2,169 patients hospitalized with HF, 1,601 (73.8%) returned to the community and 568 (26.2%) did not return to the community. The discharge locations of the 568 patients who did not return to community included skilled nursing facilities (n = 359, 63.2%), another hospital (n = 165, 29.0%), or hospice facilities, (n = 44, 7.7%). Of the 523 patients discharged with pain, 364 (69.6%) returned to community while 1,237 of 1,646 (75.2%) patients without pain returned to community ($P = .012$) (Table 1). In the univariate analyses (Table 2), patients who were older, women, presented with a history of arthritis, atrial fibrillation, chronic kidney disease, coronary artery disease, depression, diabetes, hyperlipidemia, peripheral vascular disease, stroke, valvular heart disease, comorbid fatigue, higher B-type natriuretic peptide, and had a longer length of stay less frequently returned to community after discharge. Conversely, patients who presented with a history of myocardial infarction, comorbid dyspnea, and a higher systolic blood pressure and heart rate more frequently returned to community.

The hypothesis that pain would predict decreased return to community status was supported in the regression model (see Table 3). A diagnosis of pain predicted 26% decreased odds of returning to community (95% CI: 0.57 to 0.97, $P = .028$) when compared to patients without pain. Covariates that predicted decreased odds of returning to community were older age, medical history of atrial fibrillation, chronic kidney disease, depression, diabetes, peripheral vascular disease, stroke, comorbid fatigue, and longer length of stay. In contrast, medical

history of myocardial infarction, comorbid dyspnea, and a higher systolic blood pressure during admission predicted increased odds of returning to community.

90-day all-cause mortality

A total of 117 patients hospitalized with HF died at or before 90 days (5.4%) following discharge. In the univariate analyses (Table 2), patients who were older, presented with a medical history of atrial fibrillation, chronic kidney disease, liver disease or valvular heart disease, a lower systolic blood pressure, and had a longer length of stay more frequently died at or before 90 days, while patients with a medical history of chronic obstructive pulmonary disease and hypertension less frequently died at or before 90 days.

The hypothesis that pain would predict increased 90-day mortality was not supported (see Table 4). Patients discharged with pain more frequently died at or before 90 days (29/523, 5.5%) compared to patients without pain at discharge (88/1,646, 5.3%), but this was not statistically significant ($P = .861$). Similarly, patients with a discharge diagnosis of pain had increased mortality (OR = 1.08; 95% CI: 0.69 to 1.70. $P = .733$) in the logistic regression model but it was not statistically significant. Variables that predicted 90-day mortality were older age, history of liver disease, and a lower systolic blood pressure. The original model of 23 covariates produced largely similar results compared to the reduced model of 11 covariates (data from the original model not shown). The only difference was that in the larger model, chronic kidney disease significantly predicted increased odds of 90-day mortality where in the reduced model it was not statistically significant.

Discussion

Pain at discharge significantly predicted decreased return to community status after controlling for other variables. However, pain at discharge was not a significant predictor of 90-day mortality. This study provides an important contribution to the literature by characterizing the relationship between pain and discharge outcomes among patients with HF who are hospitalized.

National trends indicate that patients discharged with HF are returning to their communities less frequently. Over 25% of patients with HF are now discharged to long-term care facilities such as nursing homes or hospice,[33] as the general HF population becomes older, more frail, and more frequently hospitalized.[34] Authors of a previous study of 13,196,801 encounters from 2002 to 2017 reported that the percentage of patients hospitalized with HF who returned to community declined from 74.0% to 69.0%.[33,35] These rates are comparable to the 73.8% of patients that were discharged to community in this study, though the percentage of patients discharged to long-term care facilities in the current study was lower, at 13.4% compared to 18.6%. Patients with HF who receive care in long term facilities, particularly skilled nursing facilities, tend to have higher rates of mortality and readmission,[18,36] higher rates of chronic pain (>80%),[37] and increased pressure ulcer risk.[38] The findings from this study indicate that pain, alongside other symptoms and comorbid conditions, play an important role in whether patients return to their community after discharge. Additional research is needed to separate chronic from acute pain as chronic pain may play a bigger role in return to community status than acute pain conditions.

Despite these trends in transitions of care outcomes, mortality trends have stabilized over the past decade, though they remain high.[39] While survival in the hospital has improved, authors of previous studies have reported that 90-day mortality rates remain at 11 to 14.7%.[20,24,25] These mortality rates are higher than the 5.4% mortality rate observed in this sample. This difference may be explained by the different timeframes of data collection, the different regions sampled (U.S. vs. Spain/India), or the different ages of the samples (66.53 vs. 82.3 years). A pain diagnosis during discharge was not significantly associated with 90-day mortality rates in this study. This finding is somewhat congruent with one study which did not report a significant relationship between pain and mortality, though this previous study recruited from hospice and outpatient clinics rather than patients who were hospitalized, and reported mortality outcomes at 1–3 years.[40] In another study of 4,878 patients with HF, presenting with either chest pain or a history of chest pain did not predict significant differences in 1-year mortality, though it is unclear if this finding applies to patients with both cardiac and non-cardiac pain.[41]

One explanation for the findings are the rates of comorbid conditions in the sample. Patients with HF are increasingly presenting with high multimorbidity based on several large population studies.[3,42] Interestingly, 9 of 14 comorbid conditions included in the study were more prevalent among the patients with pain. The univariate analyses and regression results indicated that patients who were discharged with pain were on average sicker, and this may have influenced the mortality results. However, only 4 of the included comorbid conditions were more prevalent among patients that died, and only liver disease and kidney disease significantly predicted increased mortality in regression models. These findings are in contrast with identified research of comorbid conditions and 90-day mortality and may be due to the lower mortality rates in our sample (n = 117), but may indicate that pain is one of many comorbid symptoms that contributes to decreased return to community status rates.

Symptom management is predicated on both comprehensive assessment and implementing evidence-based interventions among patients with HF.[43] The findings from this study demonstrate the relationship between pain with dyspnea, fatigue, and depression, as patients with pain had significantly higher prevalence rates of all three symptoms compared to patients without pain. This finding is supported by previous literature, as authors of previous studies have identified a connection between pain, fatigue, depression and functional performance, though dyspnea was not examined.[9] While many symptoms have received significant attention, pain remains underassessed and undertreated in this population. However, symptom severity was not available in the dataset and so additional research could examine the relationship between symptom severity and outcomes. In addition, there are additional symptoms that were not captured with the available data that could be explored, such as sleep disturbances.

The adapted theoretical framework developed for this study from a preexisting model of discharge outcomes among patients with HF was partially supported. The findings supported previous literature that older age significantly predicts worse return to community status and 90-day mortality.[17–19,22,23] However, it was unexpected that neither gender nor race predicted return to community status or 90-day mortality rates, though the univariate analysis for gender and return to community status was statistically significant. Authors

of a previous study reported that patients who were women and white tended to return to community less frequently.[19] The only variables that predicted mortality were age, history of liver disease, and lower systolic blood pressure, which may be due to the lower number of deaths in the sample. Comorbid dyspnea predicted increased odds of returning to community, which was an unexpected finding. It may be that dyspnea was treated successfully during hospitalization which would explain why patients with dyspnea were more likely to return to community. Ultimately, further revisions and testing of the adapted framework for discharge outcomes among patients with HF which integrate both theoretical and empirical support are needed.

Pain among patients from HF in the hospital is poorly characterized and may stem from pre-existing pain or new pain from hospitalization or treatment. The results are consistent with previous literature reporting that patients with HF frequently experience non-cardiac pain, including abdomen, joint, and extremity pain.[11,40,44] However, the data did not allow for distinction between acute and chronic pain in our sample. Both acute and chronic pain ICD codes were retained in the final database as it was not possible to determine if an acute pain diagnosis resolved or progressed to chronic pain following discharge, nor was it possible to designate some ICD pain codes as acute or chronic in nature, particularly for locations of pain. To compensate, a shorter mortality outcome was chosen to better apply to both acute and chronic pain, though this may not have completely resolved all issues (e.g., differences in treatment for chronic pain vs. acute pain). It is therefore possible that some patients in the sample may have been discharged with acute (for example, post-surgical) pain, which may have had better treatment regimens or resolved shortly after discharge and therefore not have impacted return to community status or mortality in the same capacity as chronic pain.

Additional research is needed to examine outcomes among patients with clearly demarcated chronic vs. acute pain, for example, by using the recently adopted ICD-11 codes which include a more complete depiction of chronic pain conditions.[45] Future research may examine pain severity rather than pain prevalence, as all-cause mortality rates have been reported as higher among patients with moderate or severe pain compared to patients with mild pain.[12] Most literature concerning pain in HF has only reported locations of pain, rather than etiologies or subtypes. Pain subtypes are easier to ascribe to some ICD codes, such as neuralgia or diabetic neuropathy, but less clear with others, such as back or leg pain.

Implications for nursing

Patients with HF experiencing pain in the hospital are often expected to implement complex pain management regimens following discharge, yet may not receive the associated education.[16] Despite pain representing a crucial nursing sensitive indicator,[46,47] 80% of 147 registered nurses in a previous study indicated that pain management practices should be improved among patients with HF.[48] Nurses can provide unique and effective evidence-based interventions because of their role in comprehensive case-management, holistic assessment of pain and associated socioeconomic factors, improvement of self-management capacity, and provision of personal and involved education and support.[46,47] Future nursing studies could focus on understanding the roles and needs of nurses in pain management,

education, and support for patients which may lead to increased pain management awareness and improved clinical guidelines.[48]

Limitations

There are some limitations to this work that should be considered. The use of secondary data limited our ability to fully characterize the pain in the sample. Despite the use of ICD-9 and 10 codes to confirm a diagnosis of pain, these codes are unable to completely distinguish between acute and chronic pain. Considering this limitation, this study was designed to examine outcomes that are applicable to patients discharged with either chronic pain or acute pain. Additional studies are needed to better characterize chronic pain, pain severity, and treatments received for pain during hospitalization and at discharge. The use of secondary data limited the ability to characterize all factors that may influence return to community status and mortality. Examples include reasons for hospitalization, HF severity, complications in the hospital, labs, medications, rehospitalization, and socioeconomic factors.[9,22–26] Future research is needed to evaluate all pertinent factors that influence return to community and mortality rates, with a larger number of mortality events. Given that all patients in this dataset were transported by EMS, results of this study may not be generalizable to patients who arrived at the emergency department through other means. Lastly, these data were obtained from a large Midwest metropolitan health center, and so findings may not represent other areas. Future studies should include a broader representation of hospital settings and include all patients with HF, not just those who present to the emergency department following EMS transport.

Conclusion

Pain at discharge significantly predicted decreased returned to community status. However, pain at discharge was not associated with 90-day mortality. The theoretical framework regarding hospitalized patients with HF and discharge outcomes that was developed based on empirical literature was partially supported by the study results. Chronic pain may play a combined role with other symptoms and comorbid conditions to negatively influence post-discharge outcomes. Pain was frequently reported and documented upon discharge, and this study provides a unique contribution by examining patients with HF and pain at discharge from the hospital and subsequent association with short-term discharge outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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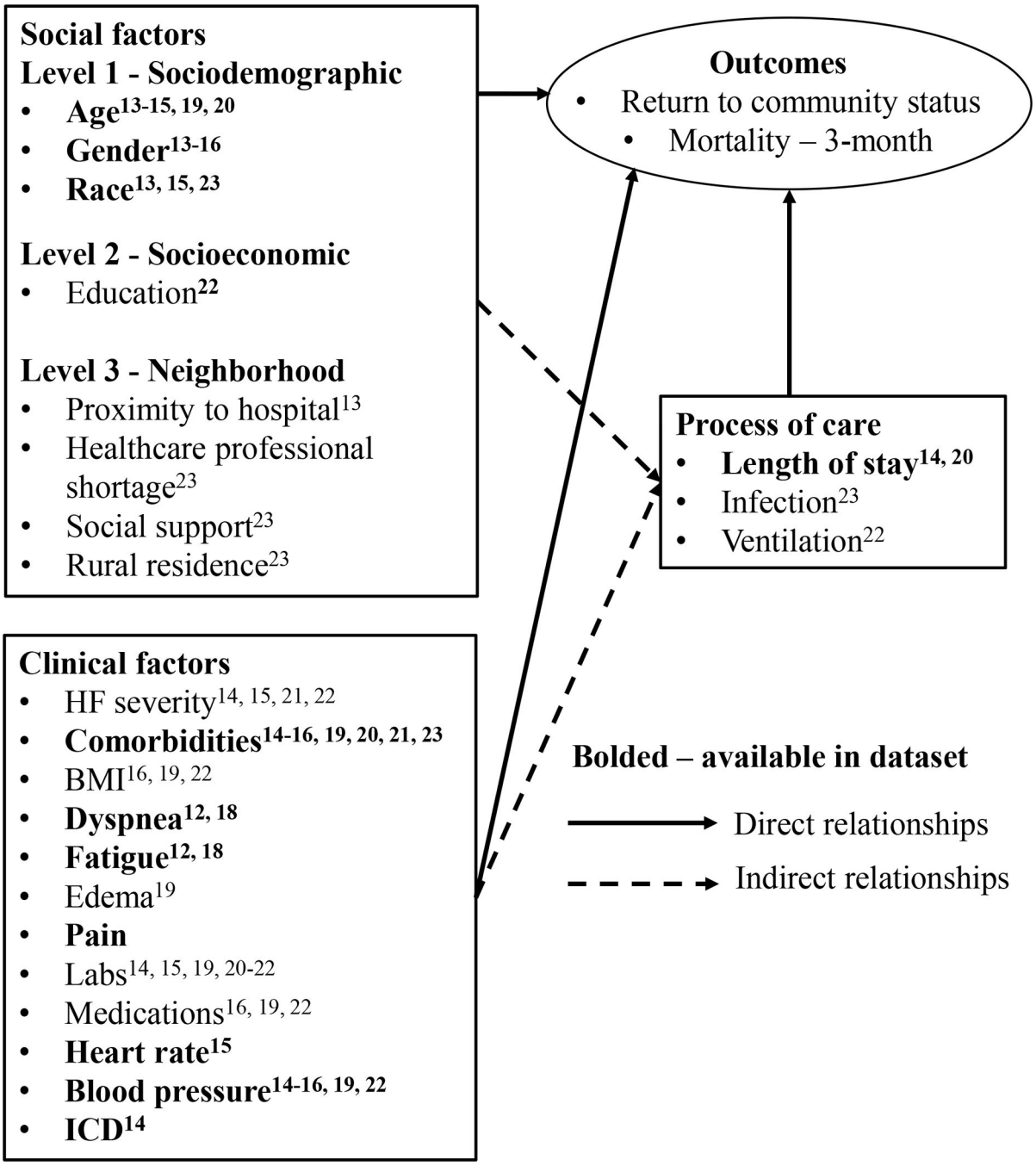

Figure 1 –.

Theoretical framework of variables influencing discharge outcomes among patients with HF with bolded variables available in the dataset.

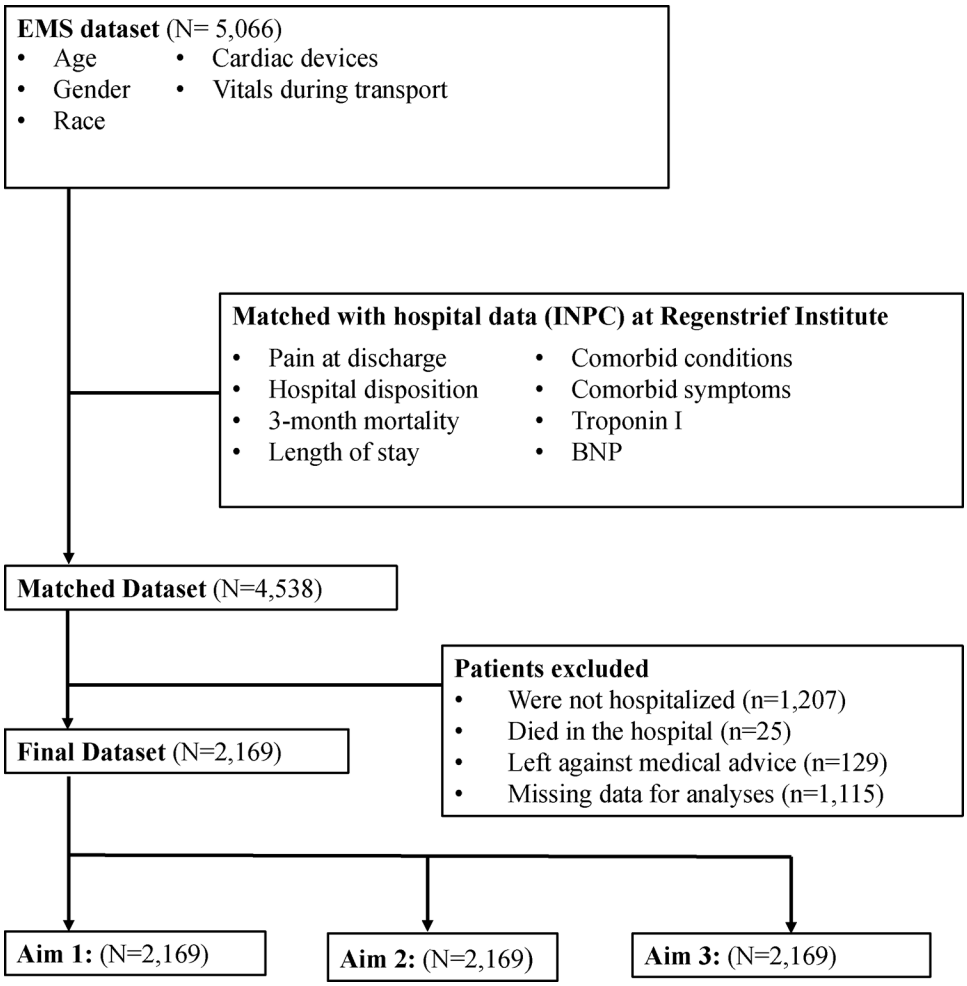

Figure 2 –.

Flowsheet of merging of EMS and INPC datasets and data sources for variables used in the study.

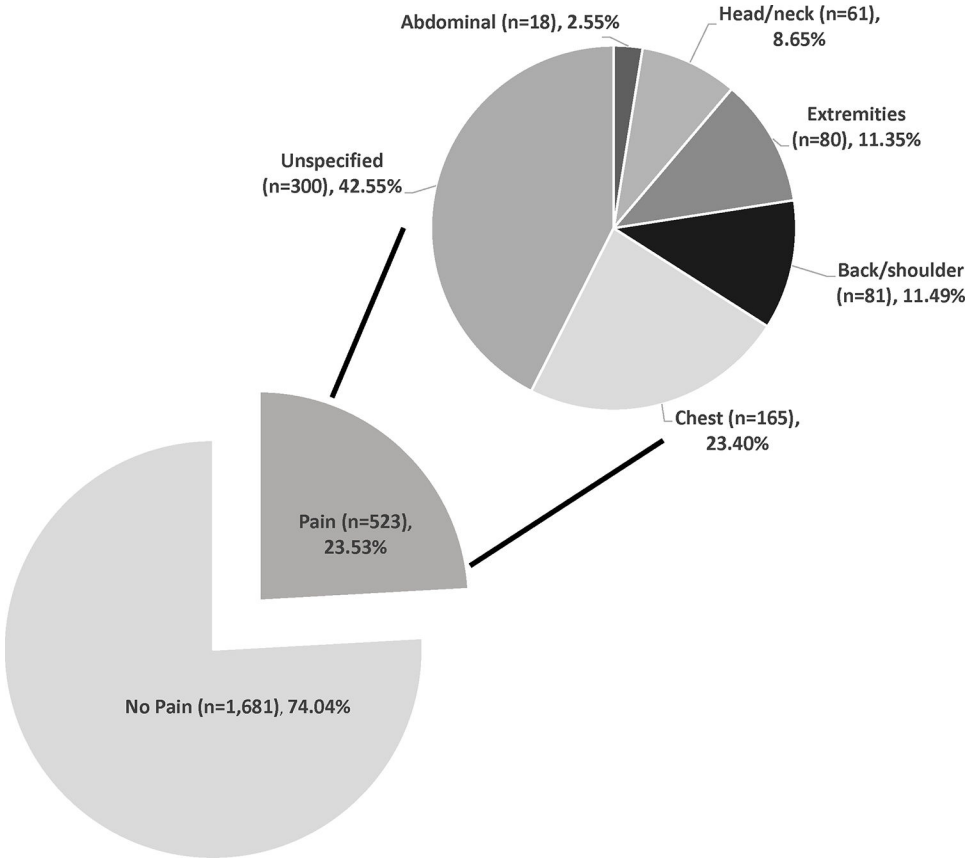

Figure 3 –.
Locations of pain reported (n = 523 out of 2,169).

Table 1

Demographic and clinical characteristics of hospitalized patients with HF and univariate analysis comparing patients discharged with and without pain (N=2,169)

Variable	Total sample (N=2,169)	Discharged without pain (n=1,646)	Discharged with pain (n=523)	p-value
	Mean ± SD or n (%)	Mean ± SD or n (%)	Mean ± SD or n (%)	
Age in years	66.53 ± 13.68	67.03 ± 13.92	64.96 ± 12.76	.002[a]
Gender				
Women	1,245 (57.40)	912 (55.41)	333 (63.67)	.001[b]
Men	924 (42.60)	734 (44.59)	190 (36.33)	
Race				
Black	1,213 (55.92)	940 (57.11)	273 (52.20)	.124[c]
Other	15 (0.69)	12 (0.73)	3 (0.57)	
White	941 (43.38)	694 (42.16)	247 (47.23)	
Medical history				
Arthritis	105 (4.84)	71 (4.31)	34 (6.50)	.042[b]
Atrial fibrillation	527 (24.30)	399 (24.24)	128 (24.47)	.914[b]
Chronic kidney disease	671 (30.94)	473 (28.74)	198 (37.86)	<.001[b]
Coronary artery disease	979 (45.14)	690 (41.92)	289 (55.26)	<.001[b]
COPD	856 (39.47)	611 (37.12)	245 (46.85)	<.001[b]
Depression	296 (13.65)	190 (11.54)	106 (20.27)	<.001[b]
Diabetes	510 (23.51)	309 (18.77)	201 (38.43)	<.001[b]
Hyperlipidemia	939 (43.29)	644 (39.13)	295 (56.41)	<.001[b]
Hypertension	825 (38.04)	599 (36.39)	226 (43.21)	.005[b]
Liver disease	138 (6.36)	101 (6.14)	37 (7.07)	.444[b]
Myocardial infarction	430 (19.82)	335 (20.35)	95 (18.16)	.274[b]
Peripheral vascular disease	220 (10.14)	134 (8.14)	86 (16.44)	<.001[b]
Stroke	79 (3.64)	63 (3.83)	16 (3.06)	.414[b]
Valvular heart disease	202 (9.31)	147 (8.93)	55 (10.52)	.277[b]
HF symptoms				
Fatigue	95 (4.38)	59 (3.58)	36 (6.88)	.001[b]
Dyspnea	434 (20.01)	304 (18.47)	130 (24.86)	.001[b]
Devices				
ICD	79 (3.64)	56 (3.40)	23 (4.40)	.290[b]
Labs				
Peak troponin I in ng/mL (n=1,748)	2.57 ± 46.21	3.32 ± 53.76	0.46 ± 3.98	.059[a]
Peak BNP in pg/mL (n=1,283)	873.03 ± 1188.65	910.53 ± 1252.50	752.77 ± 947.42	.020[a]
Vitals				

Variable	Total sample (N=2,169)	Discharged without pain (n=1,646)	Discharged with pain (n=523)	p-value
	Mean ± SD or n (%)	Mean ± SD or n (%)	Mean ± SD or n (%)	
Systolic blood pressure in mmHg	147.02 ± 42.66	147.16 ± 43.82	146.55 ± 38.81	.759[a]
Heart rate in BPM	94.18 ± 26.41	94.47 ± 27.33	93.26 ± 23.28	.322[a]
Length of stay in days	6.02 ± 7.53	6.02 ± 8.00	6.01 ± 5.80	.968[a]
Return to community status	1,601 (73.81)	1,237 (75.15)	364 (69.60)	.012[b]
3-month mortality	117 (5.39)	88 (5.35)	29 (5.54)	.861[b]

BNP; B-type natriuretic peptide: BPM; beats per minute: COPD; chronic obstructive pulmonary disease: HF; heart failure: SD; standard deviation

[a] independent samples t-test;

[b] chi2;

[c] Fisher's Exact

Table 2

Univariate analyses of demographic and clinical characteristics among patients who did or did not return to community and among patients who were alive or dead at 90 days

Variable	Return to community (n=1,601) Mean ± SD or n (%)	Did not return to community (n=568) Mean ± SD or n (%)	p-value	Alive at 90 days (n=2,052) Mean ± SD or n (%)	Died at 90 days (n=117) Mean ± SD or n (%)	p-value
Age	64.35 ± 13.08	72.67 ± 13.47	<.001[a]	66.30 ± 13.64	70.59 ± 13.76	.001[a]
Gender						
Women	890 (55.59)	355 (62.50)	.004[b]	1,178 (57.41)	67 (57.26)	.976[b]
Men	711 (44.41)	213 (37.50)		874 (42.59)	50 (42.74)	
Race						
Black	914 (57.09)	299 (52.64)	.142[c]	1,147 (55.90)	66 (56.41)	>.999[c]
Other	10 (0.62)	5 (0.88)		15 (0.73)	0	
White	677 (42.29)	264 (46.48)		890 (43.37)	51 (43.59)	
Medical history						
Arthritis	66 (4.12)	39 (6.87)	.009[b]	99 (4.82)	6 (5.13)	.882[b]
Atrial Fibrillation	334 (20.86)	193 (33.98)	<.001[b]	489 (23.83)	38 (32.48)	.034[b]
Chronic kidney disease	444 (27.73)	227 (39.96)	<.001[b]	620 (30.21)	51 (43.59)	.002[b]
Coronary artery disease	689 (43.04)	290 (51.06)	.001[b]	927 (45.18)	52 (44.44)	.877[b]
COPD	651 (40.66)	205 (36.09)	.056[b]	820 (39.96)	36 (30.77)	.048[b]
Depression	182 (11.37)	114 (20.07)	<.001[b]	285 (13.89)	11 (9.40)	.169[b]
Diabetes	349 (21.80)	161 (28.35)	.002[b]	487 (23.73)	23 (19.66)	.312[b]
Hyperlipidemia	665 (41.54)	274 (48.24)	.006[b]	896 (43.66)	43 (36.75)	.142[b]
Hypertension	614 (38.35)	211 (37.15)	.612[b]	795 (38.74)	30 (25.64)	.005[b]
Liver disease	106 (6.62)	32 (5.63)	.408[b]	124 (6.04)	14 (11.97)	.011[b]
Myocardial infarction	334 (20.86)	96 (16.90)	.042[b]	406 (19.79)	24 (20.51)	.848[b]
Peripheral vascular disease	138 (9.43)	82 (14.44)	<.001[b]	202 (9.84)	18 (15.38)	.054[b]
Stroke	30 (1.87)	49 (8.63)	<.001[b]	75 (3.65)	4 (3.42)	.894[b]
Valvular heart disease	133 (8.31)	69 (12.15)	.007[b]	185 (9.02)	17 (14.53)	.046[b]

Variable	Return to community (n=1,601) Mean ± SD or n (%)	Did not return to community (n=568) Mean ± SD or n (%)	p-value	Alive at 90 days (n=2,052) Mean ± SD or n (%)	Died at 90 days (n=117) Mean ± SD or n (%)	p-value
HF symptoms						
Fatigue	50 (3.12)	45 (7.92)	<.001[b]	89 (4.34)	6 (5.13)	.684[b]
Dyspnea	341 (21.30)	93 (16.37)	.012[b]	412 (20.08)	22 (18.80)	.737[b]
Devices						
ICD	64 (4.00)	15 (2.64)	.138[b]	75 (3.65)	4 (3.42)	.894[b]
Labs						
Troponin (n=1,748)	2.49 ± 48.89	2.79 ± 37.73	.894[a]	2.66 ± 47.48	0.84 ± 3.16	.132[a]
BNP (n=1,283)	815.47 ± 1127.64	1037.89 ± 1336.42	.007[a]	860.67 ± 1192.88	1077.92 ± 1103.80	.108[a]
Vitals						
Systolic blood pressure	150.55 ± 43.06	137.06 ± 39.89	<.001[a]	148.24 ± 42.65	125.61 ± 36.90	<.001[a]
Heart Rate	94.91 ± 26.32	92.13 ± 26.58	.032[a]	94.12 ± 26.42	95.23 ± 26.26	.657[a]
Length of stay	4.67 ± 4.78	9.82 ± 11.51	<.001[a]	5.89 ± 7.58	8.14 ± 6.22	<.001[a]

BNP; B-type natriuretic peptide; chronic obstructive pulmonary disease: HF; heart failure: ICD; Implantable cardioverter-defibrillator: SD; standard deviation

[a] independent samples t-test;

[b] chi2;

[c] Fisher's Exact

Table 3

Logistic regression of a discharge diagnosis of pain on return to community status (N=2,169, 1,601 returned to community)

Variable	Odds Ratio (95% CI)	Std. Error	p-value
Pain diagnosis at discharge	0.74 (0.57 – 0.97)	0.100	.028
Age	0.95 (0.94 – 0.96)	0.005	<.001
Gender (reference level = Men)			
Women	0.98 (0.77 – 1.24)	0.118	.860
Race (reference level = White)			
Black	1.11 (0.88 – 1.40)	0.131	.398
Other	0.78 (0.21 – 2.92)	0.525	.707
Medical history			
Arthritis	0.73 (0.46 – 1.15)	0.171	.176
Atrial fibrillation	0.75 (0.58 – 0.97)	0.098	.027
Chronic kidney disease	0.78 (0.61 – 0.99)	0.096	.045
Coronary artery disease	0.84 (0.66 – 1.08)	0.106	.169
COPD	1.24 (0.98 – 1.57)	0.149	.080
Depression	0.50 (0.37 – 0.68)	0.078	<.001
Diabetes	0.73 (0.56 – 0.95)	0.100	.021
Hyperlipidemia	0.96 (0.76 – 1.23)	0.119	.766
Liver disease	0.88 (0.55 – 1.43)	0.217	.617
Myocardial infarction	1.57 (1.15 – 2.13)	0.246	.004
Peripheral vascular disease	0.64 (0.45 – 0.90)	0.113	.011
Stroke	0.22 (0.13 – 0.39)	0.064	<.001
Valvular heart disease	0.97 (0.68 – 1.39)	0.177	.859
Comorbid symptoms			
Dyspnea	1.58 (1.16 – 2.14)	0.246	.003
Fatigue	0.60 (0.37 – 0.97)	0.148	.038
Cardiac devices			
ICD	1.72 (0.86 – 3.45)	0.610	.123
Vitals			
Systolic blood pressure, per 10 mmHg increase	1.05 (1.02 – 1.08)	0.001	.001
Heart rate, per 10 BPM increase	1.00 (0.96 – 1.05)	0.002	.964
Length of stay	0.87 (0.85 – 0.89)	0.010	<.001

BPM; beats per minute: CI: Confidence interval; COPD: chronic obstructive pulmonary disease; ICD: implantable cardioverter-defibrillator

Table 4

Logistic regression of a discharge diagnosis of pain on 90-day mortality (N=2,169, 117 died)

Variable	Odds Ratio (95% CI)	Std. Error	p-value
Pain diagnosis at discharge	1.08 (0.69 – 1.70)	0.249	.733
Age	1.02 (1.01 – 1.04)	0.008	.004
Gender (reference level = Men)			
Women	1.00 (0.67 – 1.48)	0.202	.992
Medical history			
Atrial fibrillation	1.10 (0.72 – 1.69)	0.240	.651
Chronic kidney disease	1.35 (0.87 – 2.10)	0.304	.187
COPD	0.73 (0.48 – 1.11)	0.155	.140
Hypertension	0.70 (0.43 – 1.15)	0.175	.159
Liver disease	2.22 (1.19 – 4.14)	0.706	.012
Peripheral vascular disease	1.53 (0.88 – 2.64)	0.427	.129
Valvular heart disease	1.25 (0.71 – 2.19)	0.358	.446
Vitals			
Systolic blood pressure, per 10 mmHg increase	0.89 (0.85 – 0.93)	0.002	<.001
Length of stay	1.01 (1.00 – 1.03)	0.008	.079

CI: Confidence interval; COPD: chronic obstructive pulmonary disease