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Association of gender and length of stay among Puerto Ricans hospitalized with decompensated heart failure

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Abstract

Heart failure (HF) is a serious, chronic, and progressive condition which may require hospitalization if decompensated. Each year, in the UnitedStates, there are approximately 1 million hospitalizations due to decompensated HF at a cost of $39 billion. Because limited information examining the association between gender and length of stay (LOS) is available in the published literature for Puerto Ricans hospitalized with decompensated HF, we aim to investigate gender differences related to LOS in this population.

This study is a secondary data analysis of the Puerto Rico Cardiovascular Disease Surveillance System database, which is a nonconcurrent prospective study carried out in 2007 and 2009. LOS was dichotomized into ≤5 days or ≥6 days (extended) categories. The χ^2 test was used to examine associations between categorical variables. Binary logistic regression was used to estimate unadjusted and adjusted odds ratios of extended LOS. Collinearity was assessed using Pearson correlation coefficients. A *P* value of 0.05 and 95% confidence intervals were used to evaluate statistical significance.

A total of 1724 patients (47.6% women) comprised our study population. The average age of women was 72.5 ± 13.4 years; the average age of men was 67.2 ± 14.5 years. For both women and men, median LOS was 5 days (interquartile range = 5 days). Women were more likely than men to have diabetes mellitus, hypertension, and dyslipidemia, but current smoking was higher in men than in women. The proportion of patients with extended LOS was similar for men (43.3%) and women (45.1%) (*P* = 0.448). Likewise, the odds for extended LOS was comparable for both genders (OR = 1.1, 95% CI = 0.9, 1.4). Patients admitted with recurrent decompensated HF hospitalizations had shorter LOS than patients with initial episodes (OR = 0.7, 95% CI = 0.6, 0.9). However, factors that prolonged the LOS included the presence of renal failure (OR = 1.7; 95% IC = 1.3, 2.1) and ejection fraction (EF) <35% (OR 0.7; 95% CI 0.6, 0.9).

Although we were not able to find statistically significant association between LOS and gender in Puerto Rican patients hospitalized with decompensated HF our findings suggest that incidental episodes and having an EF <35% increase the odds of extended LOS.

Abbreviations: EF = ejection fraction, HF = heart failure, ICD-9-CM = International Classification of Diseases-Ninth Revision-Clinical Modification, LOS = length of stay, MI = myocardial infarction, PRCVSS = Puerto Rico Cardiovascular Disease Surveillance System.

Keywords: gender, heart failure, Hispanic, hospitalization, length of stay, Puerto Rico

1. Introduction

Heart failure (HF) is "a clinical syndrome resulting from the heart's inability to meet the body's circulatory demands under normal physiological conditions."[1] HF is one of the leading causes of morbidity and mortality worldwide with an estimated prevalence of over 23 million cases.[2] In the United States, the number of HF cases is estimated to be close to 6 million.[2–3] Further, the 5-year mortality rates among HF patients almost rival those of cancer patients.[2] Overall hospital care constitutes a third of all health care expenditures in the United States, and represent a significant impact to the US economy.[4] The specific number of hospitalizations for decompensated HF in the United States has increased dramatically in the past decade with approximately 1 million annual hospitalizations occurring during recent years, and a total cost that exceeds $39 billion per year.[2,5] This particular situation represents a major burden for the entire US health care system.[2,5–7] On the contrary, the average length of stay (LOS) in hospitals is a statistical calculation often considered as a universal metric for gauging the success of

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hospital cost containment, cost reduction, and alternative care delivery systems.[8] Improving hospital care efficiency by reducing the LOS should benefit both patients and hospitals. Unnecessary hospital stays expose patients to potential iatrogenic infections and increased costs, whereas enforcing uniform evidence-based standards may enhance health care services and reduce the days of hospitalization. The need to further study the effects of the use of LOS in specific conditions with standard methods in order to achieve homogenous and comparable results has been recommended by the World Health Organization.[8] Thus, the LOS may be a proxy of adequate management care and prognosis of patients hospitalized with a decompensated HF.[9] Although many articles have reviewed potential factors influencing LOS in patients with decompensated HF, there is limited published information in the scientific literature on the association between gender and extended LOS among Hispanic patients with HF. The objective of this study is to investigate gender differences related to LOS in Puerto Ricans (a mostly Hispanic population) hospitalized with decompensated HF during study years 2007 and 2009.

2. Methods

The Puerto Rico Cardiovascular Disease Surveillance System (PRCVSS) was a nonconcurrent prospective study carried out in 2007 and 2009. The current study is a secondary data analysis of the PRCVSS database intended to ascertain any association between gender and extended LOS. PRCVSS investigators reviewed the medical records of Puerto Rican patients hospitalized for possible decompensated HF at 21 academic and/or nonteaching medical, as well as nonmilitary, centers with emergency room capability. According to the United States Bureau Census, the Puerto Rican population is considered mostly Hispanic and in 2010 there were 3,700,000 individuals residing on the Island.[10] A complete listing with information on all hospital discharges during study years 2007 and 2009 with *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes 428.0 to 428.9 in the principal and/or secondary diagnosis position was obtained from each of the participating hospitals. Once the computerized discharge diagnosis printouts were obtained from each participating hospital, the appropriate ICD-9-CM codes for HF were reviewed for purposes of case validation. The list of selected medical records to be reviewed was given to medical record department personnel at each participating hospital. Trained nurse and physician abstractors reviewed the medical records of all identified patients meeting the clinical criteria for HF: presence of dyspnea/shortness of breath, fatigue, and at least one diagnostic imaging report of systolic or diastolic dysfunction and ejection fraction (EF) using echocardiogram, multigated acquisition scan, computerized axial tomography scan, cardiac catheterization, or nuclear stress test.[11]

For the current study, the original sample size comprised 1818 patients with ICD-9-CM codes 428.0 to 428.9. We excluded patients below 18 years old, patients with missing information on the number of days in the hospital, negative LOS values due to fitful dates of admission and discharge, those with reported LOS less than 1 day or over 30 days, patients who developed HF during cardiac invasive procedure such as percutaneous coronary interventions or coronary bypass surgery, or those who developed HF secondary to another acute disease.

The outcome variable was LOS, dichotomized based on the median length of stay, which was 5 days, into $\leq$5 days or $\geq$6 days (extended LOS). Gender was the main exposure of interest. Possible confounders included age and risk factors for HF such as diabetes mellitus, hypertension, dyslipidemia, smoking, history of myocardial infarction (MI), history of a prior HF hospitalization, and EF less than 35%. Age was categorized as follows: less than 50 years, 50 to 65, and 66 years or older. Risk factors were dichotomous variables coded as present or not present. Renal failure was included as a risk factor for prolonged LOS.[7] Smoking status was dichotomous and was defined by current smoking status.

2.1. Statistical methods

The χ^2 test was used to determine the association between categorical variables. Binary logistic regression was used to estimate unadjusted and adjusted odds ratios. Factors conservatively associated with both gender and LOS ($P \leq 0.2$) were included in the adjusted model. Risk factors that didn't meet the statistical criteria were included if they were determined to be clinically significant. Collinearity was assessed using Pearson correlation coefficients. *P*-values of 0.05 and 95% confidence intervals were used to assess statistical significance. SPSS, IBM, Armonk, New York Statistical Software version 22 (IBM) was utilized for all statistical analysis. Ethical approval was waived since the analysis was considered nonhuman subjects research by the Florida International University Health Science IRB.

3. Results

The final sample size was 1724 patients (47.6% women). The average age of women was 72.5 $\pm$ 13.4 years and the average age

Table 1

Characteristics of Puerto Ricans hospitalized with decompensated heart failure (HF) (N = 1724).

	Gender		
Characteristics	**Men (n = 904)**	**Women (n = 820)**	***P***
Age			<0.001
<50	11.1 %	5.9%	
50–65	32.2 %	21.6%	
≥66	56.7 %	72.6%	
Diabetes mellitus			0.09
Yes	57.7%	61.7%	
No	42.3%	38.3%	
Hypertension			0.18
Yes	84.1%	86.3%	
No	15.9%	13.7%	
Dyslipidemia			0.90
Yes	25.2%	25.5%	
No	74.8%	74.5%	
Current smoking			0.006
Yes	6.4%	3.4%	
No	93.6%	96.6%	
Myocardial infarction (prior)			0.010
Yes	22.5%	17.4%	
No	77.5%	82.6%	
Heart failure hospitalization status			0.007
Incident	24.7%	30.6%	
Recurrent	75.3%	69.4%	
Renal failure			0.07
Yes	28.6%	24.7%	
No	71.4%	75.3%	
Ejection fraction less than 35%			<0.001
Yes	82.9%	89.6%	
No	17.1%	10.4%	

Table 2

Unadjusted association between length of stay (LOS) and risk factors among Puerto Ricans hospitalized with decompensated heart failure (HF) (N = 1724).

	Length of stay		
Characteristics	**Less than or equal to 5 days (n = 963)**	**Greater than or equal to 6 days (n = 761)**	***P***
Gender			0.45
Men	56.7%	43.3%	
Women	54.9%	45.1%	
Age			0.005
<50	59.5%	40.5%	
50–65	61.5%	38.5%	
≥66	53.0%	47.0%	
Diabetes mellitus			0.21
Yes	54.6%	45.4%	
No	57.7%	42.3%	
Hypertension			0.53
Yes	55.5%	44.5%	
No	57.6%	42.4%	
Dyslipidemia			0.14
Yes	53.0%	47.0%	
No	57.1%	42.9%	
Current smoking			0.21
Yes	48.8%	51.3%	
No	55.9%	44.1%	
Myocardial infarction (prior)			0.49
Yes	57.7%	42.3%	
No	55.6%	44.4%	
Heart failure hospitalization status			<0.001
Incident	48.0%	52.0%	
Recurrent	58.9%	41.1%	
Renal failure			<0.001
Yes	47.2%	52.8%	
No	59.0%	41.0%	
Ejection fraction less than 35%			<0.001
Yes	45.4%	54.6%	
No	57.5%	42.5%	

of men was 67.2 ± 14.5 years. Table 1 describes the demographic and clinical characteristics of adult men and women hospitalized with decompensated HF in Puerto Rico during 2007 and 2009. The proportion of older Puerto Rican women hospitalized with decompensated HF was significantly higher than the proportion of their counterpart older men hospitalized with the same condition during the study years. Women smoked approximately half less than men, had significantly higher proportion of recurrent episodes of incidental hospitalizations for decompensated HF and EFs less than 35%. The difference in the proportions of common risk factors such as diabetes mellitus and previous history of renal failure was higher among women and borderline statistically significant.

Table 2 describes the association between LOS and gender, as well as other possible confounders. There were significant associations ($P < 0.05$) between LOS and age, history of prior hospitalization for HF, renal failure, and EF less than 35%. The percentage of women hospitalized for 6 or more days was 45.1% compared with 43.3% of men. Gender and LOS were not significantly associated.

Table 3 describes unadjusted and adjusted odds ratios for LOS. No collinearity was observed in the adjusted model. Age, diabetes, hypertension, dyslipidemia, smoking, and history of MI were included in the adjusted model due to their clinical importance. In the adjusted model, after controlling for all confounders and clinically important factors, women with HF had similar odds of extended LOS compared with men (OR 1.1; 95% CI 0.9, 1.4). The only risk factors with significant adjusted odds ratios were history of prior hospitalization for HF, renal failure, and EF less than 35%. Patients with incidental decompensated HF hospitalizations were 40% more likely to have long hospital stays compared with patients with recurrent decompensated HF hospitalizations (OR 1.4 (95% CI 1.1, 1.8). Patients with renal failure and EF <35% had almost twice the odds of extended LOS compared with patients without, with ORs of 1.7 (95% CI 1.3, 2.1) and 2.1 (95% CI 1.5, 2.8), respectively.

4. Discussion

While our findings did not allow us to demonstrate a statistically significant difference between our main independent variable (gender) and our dependent variable (LOS) among Puerto Ricans hospitalized with decompensated HF during our study period, it is important to highlight that, on average, women were 5 years older than men at admission, and that 16% more women than men had >66 years of age, which yielded a statistically significant difference. Other cardiovascular risk factors such as diabetes mellitus, hypertension, dyslipidemia, older age, smoking, and history of MI were not associated with longer LOS. A recent publication by Chen et al. on the national trends of HF hospital stay rates between 2001 and 2009 in the United States highlights that etiology of HF often differs between younger and older populations: hypertension is the most common etiology of HF in younger adults, and as the population ages, coronary heart disease becomes the most common factor for HF. In addition, as age increases, the prevalence of HF with preserved EF rises dramatically, along with hypertension, atrial fibrillation, diabetes mellitus, and renal insufficiency.[12] Our data show a similar increase of the proportion of patients with decompensated HF with aging of the study population in both genders (Table 1), along with a corresponding increase in LOS of greater than or equal to 6 days (Table 2), especially among those ≥66 years old. Whether HF hospital stay rates differ across age groups in the United States population is unknown.[12]

These conclusions are similar to other studies, which found no association between gender and LOS among HF patients.[5,7,13,14] In contrast, two other studies concluded that there was an association between gender and LOS among HF patients.[6,15] This difference may be due to the factors controlled for in those studies or due to differences in the samples under observation. Our findings related to renal failure are similar to those of another study that found renal failure patients were more likely to have a longer hospital stay.[16]

4.1. Strengths and limitations

A novel aspect of this study is that it is the first to research an association between gender and length of hospital stay among Puerto Rican patients. An additional strength of this study is that each case was independently validated according to the admission criteria for decompensated HF.

This study has at least the following limitations: Since the study population was drawn only from Hispanic Puerto Rican patients living in Puerto Rico, generalizability to other Hispanic

Table 3

Unadjusted and adjusted associations between length of stay (LOS) and selected characteristics among Puerto Ricans hospitalized with decompensated heart failure (HF) (N = 1724).

	Unadjusted		Adjusted	
Characteristics	**OR (95% CI)**	***P***	**OR (95% CI)**	***P***
Gender				
Men	ref		ref	
Women	1.1 (0.9, 1.3)	0.44	1.1 (0.9, 1.4)	0.33
Age				
<50	ref		ref	
50-65	0.9 (0.6, 1.3)	0.65	0.9 (0.6, 1.3)	0.57
≥66	1.3 (0.9, 1.8)	0.14	1.4 (0.9, 2.0)	0.09
Diabetes mellitus				
Yes	1.1 (0.9, 1.4)	0.21	1.1 (0.9,1.3)	0.54
No	ref		ref	
Hypertension				
Yes	1.1 (0.8, 1.4)	0.56	1.1 (0.8, 1.4)	0.66
No	ref		ref	
Dyslipidemia				
Yes	1.2 (0.9, 1.5)	0.14	1.1 (0.8, 1.4)	0.61
No	ref		ref	
Current smoking				
Yes	1.3 (0.9, 2.1)	0.21	1.4 (0.9, 2.2)	0.16
No	ref		ref	
Myocardial infarction (prior)				
Yes	0.9 (0.7, 1.2)	0.49	1.0 (0.7, 1.3)	0.83
No	ref		ref	
Heart failure hospitalization status				
Incident	1.6 (1.3, 1.9)		1.4 (1.1, 1.8)	
Recurrent	ref	<0.001	ref	0.004
Renal failure				
Yes	1.6 (1.3, 2.0)	<0.001	1.7 (1.3, 2.1)	<0.001
No	ref		ref	
Ejection fraction less than 35%				
Yes	1.6 (1.2, 2.1)	<0.001	2.1 (1.5, 2.8)	<0.001
No	ref		ref	

CI = confidence interval, OR = odds ratio.

populations in the United States should be done with caution. In addition, the nature of the secondary data analysis introduced limitations to the study design. More than 40% of patients had missing information related to type of ventricular failure, type of dysfunction, and specific data related to EF, so these factors were excluded from analysis. Residual congestion is a condition that needs to be indispensably assessed in patients hospitalized with a decompensated HF condition before the patient's discharge. The decision to discharge a patient should be based on at least 3 assessment tools available in clinical practice: clinical condition,[17] such as persistent of dyspnea/shortness of breath and fatigue; biological measures,[18] such as hemoconcentration, worsening of renal function, absence of weight loss, and reduction of peripheral edema; and worsening of signs of persistent heart and lung congestion obtained by imaging tools,[19] such as X-rays or ultrasounds. Results of this assessment provide a key prognostic indicator that impacts the clinician's decision to discharge a patient, and thus, their LOS. Unfortunately, the PRCVSS study does not collect information on residual congestion per se, or on the risk assessment that clinicians use to discharge a patient.

In conclusion, there was no association between the gender of adult Puerto Rican HF patients and their length of hospital stay in 2007 and 2009. The fact that older women hospitalized with an incidental episode of decompensated HF and with a positive previous history of renal failure and EF less than 35% have a significantly higher likelihood of staying ≥6 days represent a health care disparity and may have at least 3 major clinical implications: First, individuals with these clinical characteristics who do not receive opportune diagnosis and evidence-based health care management may unnecessarily increase the overall costs of health care. Second, the extended hospitalization stay may also worsen the prognosis of patients exposing this group of patients to potential iatrogenic infections and premature death. And third, this may represent a missing opportunity for health care providers working in Puerto Rico to improve health care disparities for older high risk women hospitalized with decompensated HF. Future studies should have a prospective design and may include more detailed information related to type of HF and type of dysfunction, as well as information on residual congestion and risk assessment before patient's discharge.

References

[1] Agabegi S, Agabegi E. Diseases of the cardiovascular system. Step-Up to Medicine. Chapter 1 3rd ed.Philadelphia, PA:Micheal Tully; 2013.

[2] Bui AL, Horwich TB, Fonarow GC. Epidemiology and risk profile of heart failure. Nat Rev Cardiol 2011;8:30–41.

[3] Darling C, Saczynski JS, McManus DD, et al. Delayed hospital presentation in acute decompensated heart failure: clinical and patient reported factors. Heart Lung 2013;42:281–6.

[4] Gonzalez JM. National Health Care Expenses in the U.S. Civilian Noninstitutionalized Population, 2011. MEPS Statistical Brief No. 425. Rockville, MD:Agency for Healthcare Research and Quality; 2013.

[5] Dunlay SM, Redfield MM, Weston SA, et al. Hospitalizations after heart failure diagnosis a community perspective. J Am Coll Cardiol 2009;54:1695–702.

[6] Joshi AV, D'Souza AO, Madhavan SS. Differences in hospital length-of-stay, charges, and mortality in congestive heart failure patient. Congest Heart Fail 2004;10:76–84.

[7] Wright SP, Verouhis D, Gamble G, et al. Factors influencing the length of hospital stay of patients with heart failure. Eur J Heart Fail 2003;5: 201–9.

[8] Haddad SM. Clinical pathways: effects on professional practice, patient outcomes, length of stay and hospital costs. RHL Commentary (last revised: 1 September 2010). Geneva:The WHO Reproductive Health Library; World Health Organization; 2010.

[9] Hurley E, McRae I, Bigg I, et al. The Australian Health Care System: The Potential for Efficiency Gains. Canberra:National Health and Hospitals Reform Commission; 2009.

[10] U.S. Census Bureau. 2010 Census of Population and Housing, Summary Population and Housing Characteristics, CPH-1-53, Puerto Rico. Washington, DC: U.S. Government Printing Office; 2012. http://www.census.gov/prod/cen2010/cph-1-53.pdf. Accessed December 26, 2015.

[11] Yancy CW, Jessup M, Bozkurt B, et al. 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on practice guidelines. Circulation 2013;128:e240–327.

[12] Chen J, Dharmarajan K, Wang Y, et al. National trends in heart failure hospital stay rates, 2001 to 2009. J Am Coll Cardiol 2013;61: 1078–88.

[13] Nieminen MS, Harjola VP, Hochadel M, et al. Gender related differences in patients presenting with acute heart failure. Results from EuroHeart Failure Survey II. Eur J Heart Fail 2008;10:140–8.

[14] Galvao M, Kalman J, DeMarco T, et al. Gender differences in in-hospital management and outcomes in patients with decompensated heart failure: analysis from the Acute Decompensated Heart Failure National Registry (ADHERE). J Card Fail 2006;12:100–7.

[15] Blum A, Sirchan R, Keinan-Boker L. Gender effects on acute heart failure. Int J Clin Med 2011;2:254–9.

[16] Heywood JT, Fonarow GC, Costanzo MR, et al. High prevalence of renal dysfunction and its impact on outcome in 118,465 patients hospitalized with acute decompensated heart failure: a report from the ADHERE database. J Card Fail 2007;13:422–30.

[17] Ambrosy AP, Hernandez AF, Armstrong PW, et al. The clinical course of health status and association with outcomes in patients hospitalized for heart failure: insights from ASCEND-HF. Eur J Heart Fail 2016;18:306–13.
[18] Greene SJ, Gheorghiade M, Vaduganathan M, et al. Haemoconcentration, renal function, and post-discharge outcomes among patients hospitalized for heart failure with reduced ejection fraction: insights from the EVEREST trial. Eur J Heart Fail 2013;15:1401–11.
[19] Coiro S, Rossignol P, Ambrosio G, et al. Prognostic value of residual pulmonary congestion at discharge assessed by lung ultrasound imaging in heart failure. Eur J Heart Fail 2015;17:1172–81.