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# ASSOCIATION OF LEFT VENTRICULAR EJECTION FRACTION AND GENDER DIFFERENCES IN ACUTE DECOMPENSATED HEART FAILURE PATIENTS

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## ABSTRACT

**Introduction:** Heart failure is a chronic disease requiring frequent admissions due to episodic acute cardiac decompensation. There are limited data describing gender based characteristics and group comparison of left ventricular ejection fraction in acute decompensated heart failure patients. The present study was conducted to determine the association of left ventricular ejection fraction with gender differences in patients admitted with acute decompensated heart failure.

**Methods:** A cross sectional observational study was carried out for fifteen months in a tertiary care hospital using universal sampling technique including patients with diagnosis of acute decompensated heart failure using Framingham criteria. Left ventricular ejection fraction was determined using modified Simpson's method.

**Results:** Among 386 patients, 54.4% were males and 45.6% females. Females had mean age of 72.8 ± 12.9 years as compared to 66.8 ± 11.2 years of males. Atrial fibrillation was observed in 30.47% males and 21.59% females. Among males, 44.3% had ischemic etiology while among females 43.2% had hypertensive etiology of heart failure. Left ventricular ejection fraction of >55% was observed in 35.8% female patients while <25% was present in 23.3% males.

**Conclusion:** Male patients suffered more from heart failure, atrial fibrillation and ischemic pathology; hypertension was the most common cause of heart failure in female patients. Ejection fraction was also better preserved in females.

**Key Words:** Heart Failure; Heart Decompensation; Heart Ventricles; Echocardiography.

The authors declared no conflict of interest. All authors contributed substantially to the planning of research (HS, MS, AA), data collection (HS, AA), data analysis (HS) and write-up of the article (HS, MS, AA), and agreed to be accountable for all aspects of the work.

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## INTRODUCTION

Heart failure is a global concern contributing to disease burden. Its incidence has increased tremendously during the last few years.[1] Males are more commonly affected than females in patients with previous history of heart failure.[2] However acute decompensated heart failure (ADHF) is more prevalent in women with naïve disease.[3] Non-compliance to medications is the most common precipitating cause of ADHF while acute coronary syndrome contributes to major chunk of de novo heart failure patients.[4] Dyspnea is the most common clinical presentation of patients with heart failure.[5] Men are most commonly affected with systolic dysfunction.[6] While women suffer commonly from diastolic dysfunction.[3,4] However in-hospital mortality had no gender difference between patients with preserved and reduced ejection fraction in a large cohort study.[7] But females were more commonly exposed to arrhythmias then males.[8] Preserved left ventricular ejection fraction (LVEF) has better prognosis than reduced LVEF.[9,10,11] There is very limited data about gender based description of characteristics and group comparison of left ventricular ejection fraction in acute decompensated heart failure.[12] This study was therefore conducted to study gender based characteristics and group comparison of left ventricular ejection fraction in

patients admitted with acute decompensated heart failure.

## MATERIALS & METHODS

This was a cross sectional descriptive observation study carried out at cardiology department of Rehman Medical Institute from 01st May, 2015 to 31st July 2016. A total of 386 patients were included in the study population using universal sampling technique. All those patients were included who were admitted or discharged with diagnosis of decompensated heart failure fulfilling the Framingham criteria aged more than 15 years. Patients who were admitted due to non-cardiac causes like severe pneumonia, ARDS, renal failure were excluded from the study.

Data were collected using a printed questionnaire. Informed written consent was obtained and confidentiality of the patients was ensured. Left Ventricular Ejection Fraction was assessed using Left Ventricular End Diastolic Dimensions and Left Ventricular End Systolic Dimensions by modified Simpson's method.[13] To assess group association patients were divided into 5 groups according to left ventricular ejection fraction (LVEF): LVEF<25%, 26%-35%,36-45%, 46-55% and >55%.

This study was approved by research evaluation unit of Rehman Medical Institute after scrutiny of synopsis.

Data were analyzed by SPSS 20. Shapiro-Wilk test was applied to check the distribution of data. Mean ± Standard Deviation was determined for quantitative variables. Qualitative variables were expressed as frequencies and percentages. Chi Square test was used to assess the association between qualitative variables and gender. Independent T test was applied to analyze gender association with quantitative variable. A $p \leq 0.05$ was considered significant.

## RESULTS

A total of 386 patients were admitted with diagnosis of acute decompensated heart failure among whom 210(54.4%) patients were males and 176(45.6%) were females. Mean hospital stay was 3.4±1.8 days for males and 3.8±2.1 days for female patients. A total of 350 patients were discharged uneventfully, 32 patients stay was complicated by arrhythmias while 4 patients expired. Baseline characteristics of both male and female patients are shown in Table 1.

**Table 1: Characteristics of patients (n=368).**

| Variables | Male (n = 210) | Female (n = 176) | *P* value |
|---|---|---|---|
| Age in years (Mean ± SD) | 66.8 ± 11.2 | 72.8 ± 12.9 | 0.013 |
| Body Mass Index (Mean ± SD) | 23.76 ± 5.83 | 25.8 ± 6.33 | 0.840 |
| Diabetic [f (%)] | 76(36.2%) | 56(31.8%) | 0.690 |
| Hypertensive [f (%)] | 85(40.5%) | 122(69.3%) | 0.028 |
| Hyperlipidemic [f (%)] | 77(36.7%) | 59(33.5%) | 0.710 |
| Atrial fibrillation [f (%)] | 64(30.47%) | 38(21.59%) | 0.034 |
| Smokers [f (%)] | 125(59.5%) | 07(3.9%) | 0.031 |
| Systolic BP (Mean ± SD) | 128.6 ± 16.9 | 136.9 ± 18.3 | 0.026 |
| Diastolic BP (Mean ± SD) | 82.3 ± 7.6 | 87.6 ± 8.1 | 0.026 |
| NYHA Class (Mean ± SD) | 02.4 ± 1.3 | 02.6 ± 0.9 | 0.033 |
| In hospital Treatment | | | |
| Diuretics [f (%)] | 186(88.6%) | 150(85.2%) | 0.650 |
| Vasodilators [f (%)] | 148(70.5%) | 129(73.3%) | 0.631 |
| Inotropes [f (%)] | 58(27.6%) | 55(31.3%) | 0.718 |
| NPPV [f (%)] | 10(4.8%) | 13(7.4%) | 0.620 |
| IABP [f (%)] | 03(1.4%) | 05(2.8%) | 0.890 |

Male and female patients differed in etiology of heart failure. Patients were grouped into four different groups depending upon underlying etiology of heart failure and are shown in Figure 1. Ischemic heart disease was more common among males, whereas hypertension was the main underlying condition in females.

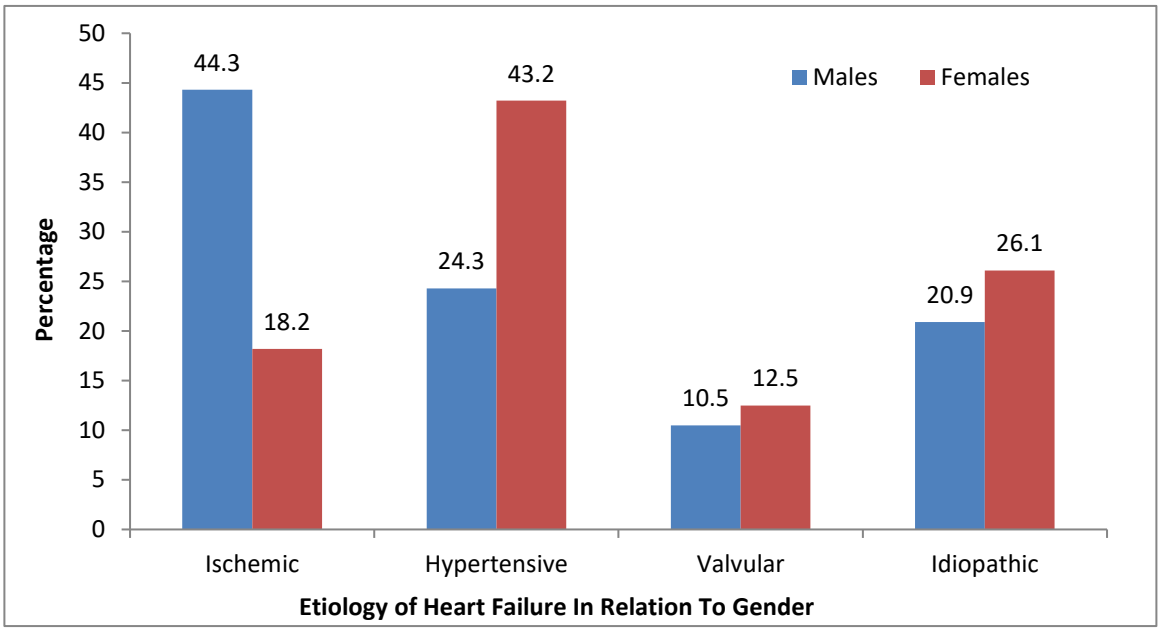


**Figure 1: Gender based etiology of acute decompensated heart failure**

Comparative statistics were done for both male and female patients using independent T test and difference was not significant for both valvular and idiopathic causes of heart failure with *p* value of 0.76 and 0.84 respectively. However there was significant difference in both ischemic and hypertensive etiologies of acute decompensated heart failure with *p* value of 0.013 and 0.026 respectively as shown in Table 2.

**Table 2: Comparison of etiology of acute decompensated heart failure with gender**

| Type of Heart Failure | Male | Female | p value |
|---|---|---|---|
| Ischemic | 93(44.3%) | 32(18.2%) | 0.013 |
| Hypertensive | 51(24.3%) | 76(43.2%) | 0.026 |
| Valvular | 22(10.5%) | 22(12.5%) | 0.760 |
| Idiopathic | 44(20.9%) | 46(26.1%) | 0.840 |

Patients were divided into 5 different groups depending upon left ventricular ejection fraction determined by modified Simpson's method. Independent T test was applied to determine group association. Both male and female patients differed significantly in patients with >55% and <25% ejection fraction with *p* value of 0.018 and 0.011 respectively as shown in Table 3.

**Table 3: Group comparison of Left Ventricular Ejection Fraction with gender.**

| Variable | Male | Female | *P* value |
|---|---|---|---|
| Left Ventricular Ejection Fraction (LVEF) | | | |
| <25% | 49(23.3%) | 21(11.9%) | 0.018 |
| 25-35% | 52(24.8%) | 28(15.9%) | 0.578 |
| 36-45% | 41(19.5%) | 31(17.6%) | 0.641 |
| 46-55% | 38(18.1%) | 33(18.8%) | 0.704 |
| >55% | 30(14.3%) | 63(35.8%) | 0.011 |

## DISCUSSION

Results showed a mean age of 66.8 ± 11.2 years for males, while females had a mean age of 72.8 ± 12.9 years. A multi-hospital nationwide registry study of 31,689 patients showed that women tended to have increased age and comorbidities at presentation after ST segment elevation myocardial infarction (STEMI).[14] Moreover risk of developing heart failure in women is higher as compared to men.[15] Yet, 54.4% of total patients of heart failure in the present study were males and 45.6% were females. It is explainable with the fact that atherosclerosis and coronary artery disease are more common in males than females.[16] It was perhaps the same reason that in this study population, 125(32.38%) patients of heart failure had ischemic etiology, and acute coronary syndrome was the leading cause in male patients 93(44.3%) causing an increased frequency of acute decompensated heart failure in these patients.

In the present study, 30.47% males and 21.59% females with heart failure were suffering from atrial fibrillation; the reason may be that men have more right ventricular dilatation and right ventricular dysfunction than women as documented previously.[17,18,19] The reason behind more female patients having atrial fibrillation despite having lower right sided chamber sizes could be that 35.8% of female heart failure patients had preserved ejection fraction. A population based cohort study previously done showed that 66% patients of newly diagnosed Heart Failure with Preserved Ejection Fraction (HFpEF) had developed either prior, concurrent, or later atrial fibrillation,[20] thereby explaining right ventricular dilatation and dysfunction being the possible mechanism of atrial fibrillation in male patients, with HFpEF being the possible mechanism in female patients.

The study showed that 14.3% males and 35.8% females had preserved ejection fraction. Men have more right ventricular mass and right ventricular volume but lower ejection fraction than females due to sex hormones even in non-heart failure patients;[21] additionally, men suffer from more right ventricular dysfunction than women.[17-19]

Current results showed that 69.3% female patients were hypertensive as compared to 40.5% male patients when compared by mean Systolic and Diastolic blood pressure levels. Hypertensive cardiomyopathy was the most common form of heart failure in females contributing to 43.2% disease burden. Similar findings were observed by National Health and Nutritional Survey (NHANES) of United States, in which, hypertension in elderly women was doubly more common than in men.[22] Gender differences in hypertension are related to the renin angiotensin system, bradykinin and nitric oxide system.[23] A study published in JAMA showed that because of hypertension women had a threefold greater risk of developing heart failure[24] and that could be the reason hypertensive cardiomyopathy was most common etiology in women patients of heart failure in the present study population. Moreover, another study showed that hypertensive women have more vascular and myocardial stiffness than men as age progresses,[25] hence supporting the current results of hypertension being the most common etiology of heart failure in elderly women.

## CONCLUSION

Heart failure was more common among males than females, with ischemic cardiomyopathy being the most common etiology, and they also suffered more with atrial fibrillation. Similarly, hypertensive cardiomyopathy was the most common cause of heart failure in female patients, however they had more preserved ejection fraction than males.

## LIMITATIONS

Being a cross sectional study carried out at a single cardiology institute, the results do not truly predict the trends in general population but will serve as a platform for further population based studies.

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