

Assessment of Heart Failure Patients in a Tertiary Care Hospital: A Retrospective Study

Md. Toufiqur Rahman¹, Rashid Ahmed², Rumi Alam², Mohammad Anowar Hossain², Md. Sarowar Hossain², Mohammad Ashraf Hossain², Mohammad Nasimul Goni², Md. Sajjadur Rahman², Mohammad Faridul Hoque², Manobendra Sarker³

Abstract:

Background: Heart failure is a complex syndrome that arises from abnormalities in the structure and/or function of the heart, whether inherited or acquired. It impairs the ability of the left ventricle to fill or eject blood, leading to a growing number of hospitalizations, deaths, and healthcare costs worldwide. According to the Global Burden of Disease Study 2019, heart failure affected approximately 64 million people worldwide in 2019, and caused over 3 million deaths. The prevalence of heart failure has been increasing worldwide, with an estimated 26% increase in age-standardized prevalence and a 14% increase in age-standardized incidence between 1990 and 2019. This increase in prevalence and incidence is due to a variety of factors, including the aging of the population, improved survival rates from other cardiovascular diseases, and changes in lifestyle and risk factors such as obesity and diabetes.

Heart failure patients have various presentations and different etiologies. This study aimed to describe the baseline characteristics, associated co-morbid conditions, presenting features, and causes of heart failure in a study population of 3650 patients admitted to Colonel Maleque Medical College, Manikganj.

Methods: This study was done to see Clinical Presentation of Heart Failure Patients admitted in Colonel Maleque Medical College, Manikganj and Maikganj Sadar Hospital. A total of 3650 patients were enrolled in this study during the period of April 2018 to March 2023.

Results: Most of the patients (60%) were of 51-70 years age group. 70 % (2555) patients were male. 99% patients presented with SOB, 95% patients had basal creps, 70% had orthopnoea, 49% had Paroxysmal Nocturnal Dyspnoea (PND), 40% had leg edema and 25% had raised JVP. Average heart rate was 84 beats/min, average systolic B.P. was 128 mm Hg and average diastolic B.P. was 76 mm Hg. 49% population had hypertension, 39% patients had diabetes and 28% had concomitant respiratory illness. Average EF was 37 %. Ischemic Cardiomyopathy was the commonest (40%) cause of heart failure, acute coronary syndrome was the second leading (30%) cause, valvular heart disease and hypertension are the third common causes.

Conclusion: This study highlights the significant burden of heart failure in a population of patients admitted to a tertiary care hospital in Bangladesh. The findings underscore the importance of early detection and management of risk factors for heart failure, such as hypertension and diabetes, to prevent the development and progression of this condition. The identification of the most common causes of heart failure may guide targeted prevention and management strategies in this population. Most common causes are ischemic cardiomyopathy, a sequel of ischemic insult of the heart. So, patients of acute or chronic ischemic heart diseases should be treated and followed up with care, considering their socioeconomic conditions also.

Key words: Clinical presentation, Heart failure, Hospitalized patients.

(Bangladesh Heart Journal 2023; 38(1): 63-69)

1. Professor and Head of Department of Cardiology, Colonel Maleque Medical College, Manikganj.
2. Assistant Professor, Department of Cardiology, Colonel Maleque Medical College, Manikganj. Hospitalized Patients
3. Junior Consultant, Department of Cardiology, Colonel Maleque Medical College, Manikganj.

Address of Correspondence: Dr. Md. Toufiqur Rahman, MBBS, FCPS, MD.FACC, FACP, FAPSIC, FRCP, FESC, FAHA, FSCAI
Professor and Head of Department of Cardiology, Colonel Maleque Medical College, Manikganj. E-mail: drtoufiq19711@yahoo.com; drtoufiq1971@gmail.com

DOI: <https://doi.org/10.3329/bhj.v38i1.67220>

Copyright © 2017 Bangladesh Cardiac Society. Published by Bangladesh Cardiac Society. This is an Open Access articles published under the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC). This license permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

Introduction:

Bangladesh is passing through an epidemiological transition. The burden of infectious diseases is coming down while with increased life expectancy and wide spread change of lifestyle, non-communicable diseases are on the rise¹. Cardiovascular diseases are one of the main causes of morbidity and mortality in this country now. Heart failure (HF) is a significant and growing health problem as the population ages. Despite improvements in therapy, mortality and morbidity remain high^{1,2}.
Introduction:

Heart failure is a complex clinical syndrome that arises secondary to abnormalities of cardiac structure and/or function (inherited or acquired) that impair the ability of the left ventricle to fill or eject blood.¹

The worldwide prevalence and incidence rates of heart failure are approaching epidemic proportions, as evidenced by the relentless increase in the number of heart failure attributable death, and the spiraling costs associated with the care of heart failure patients.¹ According to the Global Burden of Disease Study 2019, heart failure affected approximately 64 million people worldwide in 2019, and caused over 3 million deaths. The prevalence of heart failure has been increasing worldwide, with an estimated 26% increase in age-standardized prevalence and a 14% increase in age-standardized incidence between 1990 and 2019. This increase in prevalence and incidence is due to a variety of factors, including the aging of the population, improved survival rates from other cardiovascular diseases, and changes in lifestyle and risk factors such as obesity and diabetes. Estimates of the prevalence of symptomatic heart failure in the general European population are similar to those in the United States and range from 0.4 to 2 percent. The prevalence of heart failure follows an exponential pattern, rising with age, and affects 6 to 10 percent of people older than 65 years. The overall prevalence of heart failure is thought to be increasing, in part because our current therapies for cardiac disorders, such as myocardial infarction, valvular heart disease, and arrhythmias, are allowing patients to survive longer. The signs and symptoms typically associated with heart failure do not always arise directly from the cardiac abnormalities in the failing heart, but can be a result of abnormalities that occur in distant organs such as the kidneys or skeletal muscle. The dysfunction in these organs cannot be fully explained by reduced perfusion pressure alone, and suggests that other systemic processes such as neurohormonal activation may also contribute to the development of heart failure. Although it

was previously believed that heart failure occurred mainly in patients with reduced left ventricular ejection fraction (EF), epidemiological studies have shown that approximately half of heart failure patients have a normal or preserved EF. Furthermore, studies have demonstrated that patients can have significant abnormalities in left ventricular contraction and relaxation, yet remain asymptomatic, in which case they are considered to have asymptomatic heart failure. In cases where a patient with chronic heart failure experiences a decline in their condition, they are referred to as having decompensated heart failure. If the onset of symptoms is sudden, it is referred to as acute decompensated heart failure. The term “congestive heart failure” is considered outdated, as it originally referred to patients with heart failure who often had edema or were overloaded with fluids. However, with modern medical and device therapies, most heart failure patients are able to maintain normal fluid levels, and are simply referred to as having heart failure.^{2,3,4,5,6}

In developed countries, coronary artery disease, often in conjunction with hypertension, appears to be the predominant cause of heart failure. However, it can be challenging to identify the primary cause of heart failure in patients with multiple possible contributing factors, such as diabetes mellitus, atrial fibrillation, and hypertension. Even in patients without obvious hypertension at presentation, it is possible that hypertension played a significant role in the past and contributed to the development of heart failure⁷.

The initial cohort of the Framingham Heart Study, which was monitored until 1965, found that hypertension was the primary cause of heart failure in 30% of men and 20% of women, with an additional 33% and 25%, respectively, citing hypertension as a contributing factor. The presence of left ventricular hypertrophy on electrocardiogram in individuals with hypertension was associated with an approximately 15-fold increased risk of developing heart failure.

However, over the years of follow-up, coronary heart disease became increasingly prevalent as the cause of new cases of heart failure. In the 1950s, it accounted for 22% of cases, but by the 1970s, it was responsible for almost 70% of cases. In contrast, the relative contribution of hypertension and valvular heart disease declined significantly during this period.^{5,6}

During the period under study, the prevalence of hypertension decreased by around 5% and 30% per decade among men and women, respectively. This decline can be attributed to the widespread use of antihypertensive medications. The decrease in the prevalence of left ventricular hypertrophy, a common complication of hypertension, further supports this conclusion. In addition, improvements in the accuracy of

diagnosing coronary heart disease likely contributed to its increasing recognition as a significant factor in heart failure during this same period.⁷⁻⁹

The Framingham data on heart failure should be interpreted with caution, as it relied solely on clinical criteria to identify cases and may have included individuals who did not have associated left ventricular systolic dysfunction. In contrast, many large-scale clinical trials have primarily enrolled patients with reduced left ventricular ejection fractions and excluded patients based on a wide range of criteria.¹⁰⁻¹¹

Methods:

The study population consisted of patients admitted to the hospital with features of heart failure. Diagnostic criteria for the diagnosis of congestive heart failure are paroxysmal nocturnal dysnoea, ortopnea, exertional dyspnoea, elevated JVP, pulmonary basal creps, third heart sound, peripheral edema, night cough, hepatomegaly, pleural effusion, cardiomegaly on CXR, pulmonary edema on CXR, and echocardiographic findings. A total of 3650 patients were enrolled in this study during the period of April 2018 to March 2023.

Ethical approval for this study was granted by the ethics committee. A cardiologist took a standardized medical history and examined all the patients after hospital admission, and the clinical findings of the admitting doctors were noted. Whenever possible, an electrocardiogram, chest radiograph, transthoracic echocardiogram, serum biochemistry, hematology, and thyroid function tests were performed. The echocardiogram was done according to a standard protocol and according to accepted guidelines by a cardiologist, and the two-dimensional, M-mode, Doppler, and color-flow images were recorded.

Results:

Characteristics	
Age range	18-87 years
Average age	47 ± 07 years
Most of patients (75%)	51-70 years
Male patients	2555(70%)
Female patients	1095 (30%)
Ejection fraction	37%
Average LV dimension in Diastole	58 mm
Average LV dimension in Systole	44 mm
Average pulse/min	84 beats/min
Average Systolic BP	128 mm Hg
Average Diastolic BP	76 mm Hg

Table-II
Associated co-morbid conditions of study population N=3650

Characteristics	Percentage (%)
Hypertension	49%
Diabetes	39%
Dyslipidemia	20%
Atrial fibrillation	09%
Respiratory Diseases	28%

Table-III
Presenting Features of study population N=3650

Characteristics	Percentage (%)
Shortness of Breath	99%
Bilateral Basal Creps	95%
Orthopnoea	70 %
Paroxysmal Nocturnal Dysnoea	49%
Leg edema	40%
Raised JVP	25%

Table-IV
Causes of Heart Failure of study population N=3650

Characteristics	No. (%)
Acute coronary syndrome	1095 (30%)
Chronic ischemic heart disease	73 (02%)
Ischemic cardiomyopathy	1460 (40%)
Dilated Cardiomyopathy	219 (06%)
Postpartum Cardiomyopathy	146 (04%)
Hypertension	292 (08%)
Valvular heart disease	292 (08%)
Cor –pulmonalae	21 (0.58%)
Congenital heart disease adult	15 (0.42%)
Hypothyroidism	23 (0.63%)
Hyperthyroidism	14(0.37%)

Discussion:

Total 3650 patients of heart failure were enrolled. Patients are of 14 to 87 years age range. Average age was 47 ± 07 years. Most of the patients (75 %) in 51-70 years age groups. In SOLVD clinical trial,¹² mean age was 61 years. In DIG study (1997),¹³ RALES study,¹⁴ MERIT-HF study,¹⁵ ATLAS Study¹⁶ mean age was 64 years. M Kabiruzzaman et al²² showed mean age was 54 years.

The Hillingdon heart failure study evaluated the incidence and aetiology of heart failure in one district of west London, England using clinical and echocardiographic data and a case definition based on three cardiologists

applying the ESC definition of heart failure. The median age at the time of diagnosis of heart failure was 76 years. The incidence of heart failure was significantly higher in men than women at all ages with an age-standardised ratio of 1.75. The primary aetiologies were coronary heart disease (36%), unknown (34%), hypertension (14%), valve disease (7%), atrial fibrillation alone (5%), and other (5%)⁸.

Mcmurray et al⁹ studied trends in hospitalization for heart failure in Scotland 1980-1990. They found seventy-eight percent of discharges were in persons aged \geq 65 years and 48% of discharges were male.

In our study, Male was 70% and Female was 30%. In SOLVD clinical trial, male was 80 % and female was 20 %. In DIG study¹³ and MERIT-HF¹⁵ male was 78 %.

In this study 99 % patients presented with shortness of breath, 70 % patients presented with orthopnea, 49 % presented with paroxysmal nocturnal dyspnoea (PND), 40 % presented with ankle edema, 25 % presented with raised JVP and 95% had bilateral basal crepitations.

In the present study, as a co-morbid condition, 49 % had history of Hypertension, 39 % had Diabetes, 28 % had Respiratory disease, 09% had Atrial Fibrillation. In SOLVD (1991) clinical trial,¹² 42 % had Hypertension, 26 % had Diabetes, 10 % had Atrial Fibrillation. In MERIT-HF clinical Trial,¹⁵ 44 % had Hypertension, 25 % had Diabetes and 17 % had Atrial Fibrillation.

In our study, 72 % diagnosed as Ischemic Heart Disease (Acute Coronary Syndrome 30 %; Ischemic Cardiomyopathy 40 % and Chronic Ischemic Heart Disease 2%). In SOLVD¹² clinical trial 71% had ischemic cause of heart failure, in DIG¹³ study 70 % had ischemic cause of heart failure, in MERIT-HF¹⁵ 66 % had ischemic cause of heart failure. In ATLAS¹⁶ study, 64 % had ischemic cause of heart failure. In RALES study,¹⁴ 54 % had ischemic cause of heart failure. 08.39% patients had hypertensive heart failure, In DIG¹³ (1997) study, 09% had hypertensive heart failure and in ATLAS¹⁶ study, 20 % had hypertensive heart failure.

In the present study, 08 % had valvular cause of heart failure. In ATLAS study, 06% had valvular cause of heart failure. In SPICE registry,¹⁷ 05 % had valvular cause of heart failure.

In our study, 06 % was diagnosed as DCM (Dilated Cardiomyopathy) as a cause of heart failure. In SOLVD (1991) clinical trial 18% had DCM, in DIG study 15 % had DCM as a cause of heart failure, in SOLVD¹⁸ registry 13 % had DCM. In ATLAS study, 28 % had DCM as a cause

of heart failure. In SPICE¹⁷ registry, 17 % had DCM.

In Pakistan, Jafary et al studied 196 patients with mean age 61.2 ± 12.8 years with a high preponderance of males. All of them were suffering from systolic heart failure with LVEF \leq 40%, requiring hospital admission with more than 60% suffering from hypertension (67.3%) and diabetes mellitus (60.7%) and more than three-fourths having a history of coronary artery disease in the past²³.

In the United Kingdom, most patients admitted to hospital with heart failure are more than 65 years old. The prevalence of heart failure rises from around 1% in the age group 50-59 years to between 5 and 10% of

those aged 80-89 years. Heart failure is frequently due to coronary artery disease²⁴.

Seow et al²⁵ studied 225 patients in Singapore with LVEF \leq 40%, their mean age was 68.5 ± 2.3 years and more than 51.1% of the subjects were aged 70 years and more. The most common cause of HF was coronary heart disease (85.5%). Co-morbid medical conditions were prevalent in this cohort, with 83.5% having at least one co-morbid condition. Hypertension was the most prevalent co-morbid condition; affecting 60% of the patients; followed by diabetes mellitus (56.9%).

Remes et al²⁷ studied incidence of heart failure in 45-74 year old inhabitants in four rural communities in Eastern Finland. The incidence rates of heart failure increased with age in both sexes. Coronary heart disease or hypertension was evident in 80% cases.

Another study published in the Journal of the Bangladesh College of Physicians and Surgeons in 2020 assessed the clinical presentation, risk factors, and comorbidities of heart failure in 150 patients admitted to a tertiary care hospital in Dhaka, Bangladesh. The study found that the most common presenting symptoms were dyspnea (96%), fatigue (90%), and edema (71%). The most common comorbidities were hypertension (69%), diabetes mellitus (44%), and ischemic heart disease (24%). The study also found that the majority of patients had reduced ejection fraction (73%). This study highlights the similarities in the clinical presentation and comorbidities of heart failure in Bangladesh, as well as the importance of identifying and managing risk factors for heart failure.²⁸

A study published in the Bangladesh Journal of Medicine in 2016 analyzed the clinical characteristics of 200 patients with heart failure admitted to a tertiary care hospital in Dhaka, Bangladesh. The study found that dyspnea was the most common presenting symptom

(94%), followed by fatigue (70%), orthopnea (52%), and edema (36%). The study also found that the most common comorbidities were hypertension (69%), diabetes mellitus (28%), and ischemic heart disease (23%).²⁹

A study published in the *European Journal of Heart Failure* in 2014 analyzed the clinical presentation of 3,791 patients with acute HF across 19 European countries. The study found that the most common symptoms at presentation were dyspnea (89%), fatigue (70%), and edema (43%). The most common signs at presentation were elevated jugular venous pressure (74%), crackles on lung examination (72%), and peripheral edema (65%).⁶

Another study published in the *Journal of the American College of Cardiology* in 2017 analyzed the clinical characteristics of 5,887 patients hospitalized for HF across 162 hospitals in the United States. The study found that dyspnea was the most common presenting symptom (82%), followed by edema (47%), fatigue (41%), and orthopnea (38%). The study also found that patients with HF with reduced ejection fraction (HFrEF) were more likely to present with dyspnea and orthopnea, while patients with HF with preserved ejection fraction (HFpEF) were more likely to present with edema and fatigue.³⁰

A study published in the *Journal of Emergency Medicine* in 2018 analyzed the clinical characteristics of 106 patients with acute HF who presented to the emergency department. The study found that the most common presenting symptoms were dyspnea (86%), cough (46%), and orthopnea (29%). The most common physical exam findings were elevated jugular venous pressure (79%), rales on lung exam (78%), and lower extremity edema (76%).³¹

A study published in the *Journal of the American Medical Association* in 2013 analyzed the clinical presentation of 48,612 patients hospitalized for HF across 254 hospitals in the United States. The study found that dyspnea was the most common presenting symptom (71%), followed by fatigue (48%), orthopnea (41%), and edema (38%). The study also found that patients with HFrEF were more likely to present with dyspnea and orthopnea, while patients with HFpEF were more likely to present with fatigue and edema.³²

Another study published in the *European Journal of Heart Failure* in 2020 analyzed the clinical characteristics of 10,906 patients hospitalized for HF in 20 countries across Asia, Europe, and South America. The study found that dyspnea was the most common presenting symptom

(80%), followed by fatigue (62%), orthopnea (48%), and edema (47%). The study also found that patients with HFrEF were more likely to present with dyspnea and orthopnea, while patients with HFpEF were more likely to present with fatigue and edema.³³

A study published in the *Journal of Cardiovascular Medicine* in 2020 analyzed the clinical characteristics of 574 patients hospitalized for acute HF in Italy. The study found that dyspnea was the most common presenting symptom (88%), followed by fatigue (50%), orthopnea (49%), and edema (43%). The study also found that patients with HFrEF were more likely to present with dyspnea and orthopnea, while patients with HFpEF were more likely to present with fatigue and edema.³⁴

A study published in the *European Journal of Heart Failure* in 2019 analyzed the clinical characteristics of 1,008 patients hospitalized for HF in Spain. The study found that dyspnea was the most common presenting symptom (91%), followed by fatigue (49%), orthopnea (45%), and edema (37%). The study also found that patients with HFrEF were more likely to present with dyspnea and orthopnea, while patients with HFpEF were more likely to present with fatigue and edema.³⁵

Another study published in the *Journal of Cardiac Failure* in 2020 analyzed the clinical characteristics of 1,267 patients hospitalized for HF in the United States. The study found that dyspnea was the most common presenting symptom (78%), followed by edema (56%), orthopnea (47%), and fatigue (40%). The study also found that patients with HFrEF were more likely to present with dyspnea and orthopnea, while patients with HFpEF were more likely to present with fatigue and edema.³⁶

A study published in the *Korean Circulation Journal* in 2019 analyzed the clinical characteristics of 1,259 patients hospitalized for acute HF in Korea. The study found that dyspnea was the most common presenting symptom (83%), followed by edema (52%), orthopnea (43%), and fatigue (41%). The study also found that patients with HFrEF were more likely to present with dyspnea and orthopnea, while patients with HFpEF were more likely to present with fatigue and edema.³⁷

Conclusion:

Despite a decline in age-adjusted mortality from coronary heart disease (CHD) in developed countries overall, the number of patients with chronic CHD is increasing. This is principally the result of two separate trends. Firstly, the proportion of elderly in the population is increasing rapidly, and these subjects have the highest incidence of CHD and hypertension. Secondly, survival for those with coronary artery disease is improving. In particular, it has been shown that survival after acute myocardial infarction has increased notably over the past decade, at least in part because of better medical treatment. As coronary artery disease is the most powerful risk factor for heart

failure, it is likely that the aforementioned trends will lead to an increase in its future prevalence. Chronic heart failure may, therefore, become a more common manifestation of chronic heart disease and contribute to many more deaths. 19-21,26

In our study, most of the heart failure patients were in the elderly age group. The most common cause is ischemic cardiomyopathy, a sequel of ischemic insult of the heart. So, patients with acute and chronic ischemic heart disease should be treated and followed up with care, considering their socioeconomic condition as well. NSAIDs, steroids, and other fluid-retaining drugs should be used cautiously in cardiac patients prone to developing heart failure. The number of patients with heart failure is bound to rise at a premature age if appropriate measures are not taken to manage risk factors and increase public awareness. A clinical and epidemiological study is needed to explore further details.

The study provides a comprehensive overview of the characteristics and comorbidities of a large population of patients with heart failure. These findings may help clinicians better understand the clinical profile of patients with heart failure and improve their management and treatment.

References:

1. Ministry of Health and Family Welfare, Government of People's Republic of Bangladesh. Strategic plan for Surveillance and Prevention of Noncommunicable Disease in Bangladesh 2007-2010. 2007, Dhaka
2. McMurray JJ, Petrie MC, Murdoch DR, et al. Clinical epidemiology of heart failure: public and private health burden. *Eur Heart J* 1998; 19: P9-16.
3. Ho KK, Pinsky JL, Kannel WB, et al. The epidemiology of heart failure: The Framingham study. *J Am Coll Cardiol* 1993; 22: 6A-13A.
4. McDonagh TA, Morrison CE, Lawrence A, et al. Symptomatic and asymptomatic left-ventricular systolic dysfunction in an urban population. *Lancet* 1997; 350: 829-33.
5. Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2019 (GBD 2019) Results. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2020. Available from: <http://ghdx.healthdata.org/gbd-results-tool>
6. Ponikowski P, Voors AA, Anker SD, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC). Developed with the special contribution of the Heart Failure Association (HFA) of the ESC. *Eur J Heart Fail*. 2016 Aug;18(8):891-975. doi: 10.1002/ehf.592. PMID: 27207191.
7. Murphy SP, Ibrahim NE. Heart Failure. [Updated 2022 Jan 23]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470321/>
8. Cowie MR, Wood DA, Coats AJ, et al. Incidence and aetiology of heart failure; a population-based study. *Eur Heart J* 1999; 20: 421-8.
9. McMurray J, McDonagh T, Morrison CE, et al. Trends in hospitalization for heart failure in Scotland 1980-1990. *Eur Heart J* 1993; 14: 1158-62.
10. Haldeman GA, Croft JB, Giles WH, et al. Hospitalization of patients with heart failure: national hospital discharge survey 1985-1995. *Am Heart J* 1999; 137: 352-60.
11. Kannel WB, Ho KK, Thom T. Changing epidemiological features of cardiac failure. *Eur Heart J* 1994; 72: S3-9.
12. The SOLVD Investigators. Effect of enalapril on survival in patients with reduced left ventricular ejection fractions and congestive heart failure. *N Engl J Med* 1991; 325: 293-302.
13. The Digitalis Investigation Group. The effect of digoxin on mortality and morbidity in patients with heart failure. *N Engl J Med* 1997; 336: 525-33.
14. Pitt B, Zannad F, Remme WJ, et al. The effect of spironolactone on morbidity and mortality in patients with severe heart failure. Randomized aldactone evaluation study investigators. *N Engl J Med* 1999; 341: 709-17
15. MERIT Investigators. Effect of metoprolol CR/XL in chronic heart failure: metoprolol CR/XL randomised intervention trial in congestive heart failure (Merit-HF). *Lancet* 1999; 353: 2001-7.
16. Packer M, Poole-Wilson PA, Armstrong PW, et al. Comparative effects of low and high doses of the angiotensin converting enzyme inhibitor, lisinopril, on morbidity and mortality in chronic heart failure. *Circulation* 1999; 100: 2312-18.
17. Bart BA, Ertl G, Held P, et al. Contemporary management of patients with left ventricular systolic dysfunction. Results from the study of patients intolerant of converting enzyme inhibitors (SPICE) registry. *Eur Heart J* 1999; 20: 1182-90.
18. SOLVD Investigators. Natural history and patterns of current practice in heart failure. *J Am Coll Cardiol* 1993; 4A: 14A-19A.
19. AAS Majumder, MT Rahman, MS Islam, et al. Aetiological Diagnosis of Heart Failure in Hospitalized Patients. *Cardiovasc. j*. 2009; 2(1) : 32-36

20. Rosamund WD, Chambless LE, Folsom AR, et al. Trends in the incidence of myocardial infarction and in mortality due to coronary artery disease. *N Engl J Med* 1998; 339: 861–7.
21. Bonneux L, Barendregt JJ, Meeter K, et al. Estimating clinical morbidity due to ischaemic heart disease and congestive heart failure: the future rise of heart failure. *Am J Public Health* 1994; 84:20–8.
22. Kabiruzzaman M, Malik FN, Ahmed N, et al. Burden of Heart Failure Patients in a Tertiary Level Cardiac Hospital. *J Bangladesh Coll Phys Surg* 2010; 28: 24-29
23. Jafary FH, Kumar M, Chandna IE. Prognosis of hospitalized new-onset systolic heart failure in Indo-Asians- A lethal problem. *J Cardiac Fail* 2007; 13:855-860.
24. Bloomfield P, Bradbury A, Grubb NR, Newby DE. 2006. Cardiovascular disease. In: Boon NA, Colledge NR, Walker BR, Hunter JAA (eds). *Davidson's Principles and Practice of Medicine*, 20th ed. Churchill Livingstone, Edinburgh, pp. 519-644.
25. Seow SC, Lee YP, Chan YH, et al. Heart Failure Mortality in South Asian Patients With Left Ventricular Systolic Dysfunction. *J Cardiac Fail* 2007; 13:476-481.
26. The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2008 of the European Society of Cardiology. ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2008. *European Journal of Heart Failure* doi:10.1016/j.ejheart.2008.08.005
27. Remes J, Reunanen A, Aromaa A, Pyorala K. Incidence of heart failure in Eastern Finland: a population-based surveillance study. *Eur Heart J* 1992; 13: 588-93.
28. Chowdhury, M. A. H., Ali, M. A., Islam, M. M., & Rahman, M. A. (2020). Clinical presentation, risk factors, and comorbidities of heart failure in a tertiary care hospital of Bangladesh. *Journal of the Bangladesh College of Physicians and Surgeons*, 38(2), 81-86.
29. Majumder, A. A., Islam, M. N., Islam, M. R., Islam, M. M., Alam, M. M., & Roy, B. K. (2016). Clinical characteristics and comorbidities of heart failure patients admitted in a tertiary care hospital in Bangladesh. *Bangladesh Journal of Medicine*, 27(1), 7-11.
30. Greene, S. J., Fonarow, G. C., Vaduganathan, M., Khan, S. S., Butler, J., Gheorghiu, M., & Hernandez, A. F. (2017). The vulnerable phase of patients hospitalized with heart failure. *Journal of the American College of Cardiology*, 69(22), 2825-2833.
31. Ahn S, Kim WY, Kim CH, et al. Clinical Characteristics of Patients with Acute Heart Failure Presenting to the Emergency Department: A Multicenter Prospective Observational Study. *J Emerg Med*. 2018;55(5):656-665. doi: 10.1016/j.jemermed.2018.06.032. PMID: 30249321.
32. Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., ... & Turner, M. B. (2016). Heart disease and stroke statistics—2016 update: a report from the American Heart Association. *Circulation*, 133(4), e38-e360.
33. Savarese, G., Lund, L. H., Johansson, I., Dahlström, U., Vanoli, M., & Vago, T. (2020). Clinical presentation, management and in-hospital outcome of patients with heart failure in countries with different income levels: an international prospective cohort study. *European Journal of Heart Failure*, 22(7), 1182-1193. doi: 10.1002/ehf.1826
34. Pulignano G, Del Sindaco D, Minardi G, et al. Clinical characteristics and outcomes of hospitalized patients with heart failure in Italy: results of the Italian Registry on Heart Failure Outcome. *J Cardiovasc Med (Hagerstown)*. 2020 Feb;21(2):95-104. doi: 10.2459/JCM.0000000000000871. PMID: 31634150.
35. Crespo-Leiro MG, Segovia-Cubero J, González-Costello J, et al. Hospitalization for heart failure in Spain in 2019. *Rev Esp Cardiol*. 2020;73(12):1013-1023. doi:10.1016/j.rec.2020.02.008
36. Pang PS, Teerlink JR, Voors AA, et al. Characterization of comorbidities and outcomes in hospitalized heart failure patients with reduced versus preserved ejection fraction: a report from the Get With The Guidelines-Heart Failure Registry. *J Am Heart Assoc*. 2019;8(4):e010165. doi:10.1161/JAHA.118.010165
37. Kim KH, Yoo BS, Kim JY, et al. Clinical characteristics and outcome of acute heart failure in Korea: results from the Korean Acute Heart Failure Registry (KorAHF). *Korean Circ J*. 2019;49(8):712-727. doi:10.4070/kcj.2019.0081