Original Article

Journal of Iranian Medical Council, Volume 7, Issue no. 4
http://dx.doi.org/10.18502/jimc.v7i4.16643

The Prevalence of Various Stages of Heart Failure in Individuals Over 40 Years Old: The Findings from Yazd Health Study

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Received: Oct 12 2023
Accepted: Dec 27 2023

Citation to this article:
Jokar M, Sadeghi S, Zare E, Haghaninezhad H, Soltani MH, Taghi Sarebanhassanabadi M, et al. The Prevalence of Various Stages of Heart Failure in Individuals Over 40 Years Old: The Findings from Yazd Health Study. *J Iran Med Counc*. 2024;7(4):804-10.

Abstract

Background: The staging of Heart Failure (HF) in the population at risk of progression emphasizes early identification and prevention of HF. Therefore, this study aims to evaluate the prevalence of various stages of HF in individuals over 40 years old within a large population of Iranian adults.

Methods: In this descriptive cross-sectional study, a random sub sample of Yazd Health Study (YaHS) participants aged 40-70 years was evaluated. History and clinical examination of the patients was conducted by a cardiologist and then, the participants underwent echocardiography to determine the stages of heart failure.

Results: Among 410 Yazd population -the representative sample with mean age 58.0±9.2 years, 183 patients (44.6%) were in stage 0, 121 (29.5%) in stage A, 77(18.8%) in stage B, and 29 (7.1%) in stage C heart failure. No individuals were in stage D. There was a significant difference between the frequency of individuals with different stages of HF in terms of diabetes, hypertension, obesity, and history of ischemic heart disease ($p<0.05$). In addition, the frequency of HF increased in the age group >60 years and the obesity group ($p<0.05$).

Conclusion: According to these, about half of the patients with HF were in stage A and B. Therefore, appropriate measures are needed to identify these groups of patients, especially individuals with risk factors of diabetes, hypertension, obesity and those over 60 years to prevent the progression of the disease to higher stages which lead to poorer outcome.

Keywords: Diabetes mellitus, Echocardiography, Epidemiology, General population, Heart failure, Hypertension, Left ventricular dysfunction, Prevalence

Introduction

Heart Failure (HF) is a serious health concern (1) and poses a great burden on individuals and society (2). It affects over 6 million individuals in the United States and leads to more than one million hospitalizations annually (3). The incidence of heart failure in the adult population and those ≥ 65 years is 2 and 5-9%, respectively (2). The clinical syndrome characterization of heart failure includes signs of pulmonary and systemic venous congestion, exercise intolerance, and symptoms of dyspnea, due to the impaired filling or outflow of blood from the Left Ventricle (LV) (4,5).

The population aging and prevalence of risk factors, including diabetes (6), hypertension (4), and obesity (4), contribute to heart failure development (7). Moreover, left ventricular hypertrophy and Left Ventricular Ejection Fraction (LVEF) (8) less than 50% are strong risk factors for heart failure (4). It seems that the development of congestive heart failure may be preceded by a phase of asymptomatic Left Ventricular Systolic Dysfunction (LVSD) (9). Thus, inhibitor therapy of angiotensin-converting enzyme might delay the progression of heart failure in these individuals (9).

Stage of heart failure (A, B, C, D) was identified according to 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure (10). Moreover, asymptomatic individuals without major risk factors for HF [hypertension, diabetes, metabolic syndrome, exposure to cardiotoxic agent, positive family history of cardiomyopathy and atherosclerotic Cardiovascular Diseases (CVD)] and without cardiac functional or structural abnormalities are considered as stage 0 (11). Some studies have shown the remarkable incidence of early stages of heart failure in individuals (7). Based on the mentioned studies, stage B heart failure has been observed in 24–34% and stage C in 12–13% of these individuals (7,12). If a higher-risk population is detected, the incidence of stage B and C heart failure will be even higher (7).

The staging of heart failure in the population at risk of progression emphasizes early identification and prevention; therefore, this study aims to evaluate the prevalence of various stages of heart failure in individuals over 40 years old within a large population of Iranian adults.

Materials and Methods

Population Sampling

This descriptive cross-sectional study was conducted on a random sub sample of Yazd health study participants consisting of 410 individuals aged 40-70 years. Details of the Yazd Health Study were previously published (13). The inclusion criteria were being YaHS participants over 40 years of age. The exclusion criteria were pregnant women, patients with a history of psychosis and other cognitive disorders, and patients with incomplete medical records.

The demographic data, including age, gender, and history of underlying disease, comprising diabetes, hypertension, Ischemic Heart Disease (IHD), dyslipidemia, Body Mass Index (BMI), taking alcohol and smoking were all extracted from the YaHS database of the participants. History and physical examination of the patients were conducted by a cardiologist, and then these individuals underwent echocardiography.

Determination of the symptoms and related functional status

The Goldman Specific Activity Scale (SAS) questionnaire was applied to determine the symptoms and related functional limitations. This is a self-administered questionnaire and assesses symptoms during 21 specific activities known as metabolic equivalents of energy expenditure.

It classifies functional status into 4 sequential classes: Class I is capable to do activity equivalent to ≥ 7 METS exercise capacity without limiting symptoms.

- Class II:5 to 7 METS
- Class III:2 to 5 METS
- Class IV to < 2 METS

A change in the SAS was performed to determine the functional limitations due to fatigue and dyspnea. Fluid retention was defined as the treatment of edema or dyspnea resulting in a weight loss of 10 pounds over 5 days (14).

Echocardiographic analysis

Echocardiography was conducted in supine and left lateral decubitus position with a General Electric Vivid4 echocardiography machine.

LVEF measurement of the individuals was first determined by Simpson's technique and visual

Table 1. The characteristics of YaHS subsample (n=410) who participated in the study 2020-2021

Quantitative characteristics	Mean±SD	Minimum	Maximum
Age (year)	58.0±9.24	40	77
Height (*cm*)	164.7±9.1	139	190
Weight (*Kg*)	74.4±12.7	44	113
BMI	27.49±4.5	17.4	44.1

Table 2. The frequency of heart failure in YaHS subsample (n=410) who participated in the study 2020-2021

Stage of heart failure	Frequency(%)
Stage 0 (normal)	183(44.6)
Stage A	121(29.5)
Stage B	77(18.8)
Stage C	29(7.1)
Total	410(100)

estimation; all the individuals with LVEF<50% were re-examined by the echocardiographic fellowship.

The Regional Wall Motion Score Index was assessed by the 16-segment model.

Left Ventricle End Diastolic Volume (LVEDV) was evaluated from apical two and four-chamber views. The LV mass index in the parasternal view was evaluated from the linear dimensions (7).

The LV abnormal structure was defined as LVEDV) index to Body Surface Area [LVEDV to BSA] (male and female >74 mL/m^2 and >61 mL/m^2, respectively) and LV mass index to BSA (male and female >116 g/m^2, >96 g/m^2).

In addition, the abnormal systolic function was assessed with LVEF.

The LVEF limit was determined to detect mild abnormal changes (male: ≤51%, female: ≤53%). The LV dilatation was defined as the end-diastolic diameter of 52.2 *mm* in females, and 58.4 *mm* in males. In addition, the valvular heart disease was evaluated (15).

HF Stages

HF Stages were determined based on the 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure (10).

Ethical Considerations

The Ethics Committee of Shahid Sadoughi University approved this study (IR.SSU.MEDICINE.1400.085). Informed consent was obtained from all the YaHS participants at the time of enrollment.

Statistical analysis

The data were entered into SPSS, version 19. The chi-square test was used for the analysis of the data. p<0.05 was assumed significant.

Results

The characteristics of the patients, including age, height, weight and BMI are shown in table 1. Among 410 individuals with a mean age 58.0±9.24 years and BMI 27.49±4.5 kg/m^2, 173 (42.2%) were women and 237 (57.8%) were men. Moreover, the history of disease, including diabetes, hypertension, and IHD were observed in 109 (26.5%), 139 (33.9%), and 35 (8.5%), respectively. Smoking was also observed in 65 individuals (15.8%). The frequency of the patients in terms of the heart failure stage is shown in table 2. As shown in table 2, stage 0 (Normal) was observed in 44.6% of the patients and stage A, B, and C were observed in 29.5, 18.8, and 7.1% of the patients, respectively.

No individuals were in the stage D.

The frequency comparison of the patients with various stages of HF in terms of age, gender, hypertension, *etc*. is shown in table 3. As shown in table 3, there was a significant difference between the frequency of the patients with different stages of HF in terms of diabetes, hypertension, and history of IHD (p<0.05). In this regard, the age range of over 60 years, men gender, hypertension, a history of heart disease, BM>30I, and diabetes were observed in 50.2, 57.8, 33.9, 8.5, 21.4, and 26.5% of the patients, respectively. In addition, the frequency of HF increased in the age group > 60 years and the obesity group (p<0.05). Moreover, the frequency of HF, especially HF stage A in individuals > 60 years was significantly higher than others (p<0.05).

Discussion

The frequency distribution of heart failure stages was assessed in individuals over 40 years old, revealing

Table 3. Determinants of the Herat failure in the study population

Variable	Normal Frequency (%)	Stage A Frequency (%)	Stage B Frequency (%)	Stage C Frequency (%)	Total Frequency (%)	p-value
Age range (yr) <60 >60	126(61.8) 57(27.7)	41(20.1) 80(38.8)	26(12.7) 51(24.8)	11(5.4) 18(8.7)	204(100) 206(100)	<0.001
Gender Female Male	75(43.4) 108(45.6)	63(36.4) 58(24.5)	26(15) 51(21.5)	9(5.2) 20(8.4)	173(100) 237(100)	0.034
Hypertension Yes No	0(0) 183(67.5)	82(59) 39(14.4)	40(28.8) 37(13.7)	17(12.2) 12(4.4)	139(100) 271(100)	<0.001
History of Ischemic Heart Disease (IHD) Yes No	0(0) 183(48.8)	0 (0) 121(32.3)	16(45.7) 61(16.3)	19(54.3) 10(2.7)	35(100) 375(100)	<0.001
Body Mass Index (BMI) Non-obese (<30) Obese (>30)	183(56.8) 0(0)	64(19.9) 57(64.8)	55(17.1) 22(25)	20(6.2) 9(10.2)	322(100) 88(100)	<0.001
Diabetes Mellitus (self-report) Yes No	0(0) 183 44.6)	63(57.8) 121(29.5)	28(25.7) 77(18.8)	18(16.5) 29(7.1)	109(100) 301(100)	<0.001

that the frequencies of stage 0, A, B, and C were 44.6, 29.5, 18.8, and 7.1%, respectively. Ammar *et al* assessed the prevalence of heart failure stages in 2029 individuals in Olmsted country in the US. The participants were classified in terms of symptoms, physical examination, echocardiogram and medical records data, revealing that 32, 22, 34, 12 and 0.2% of the patients were in stages 0, A, B, C, and D, respectively (15). Moreover, the 5 years survival in stages 0, A, B, C, and D was 99, 97, 96, 75, and 20%, respectively (16). Compared to the study of Ammar *et al*, in Olmsted County on individuals ≥45, our findings showed some differences.

A higher prevalence of stage 0 (44.6 *vs*. 32%) and a lower prevalence of HF stages A and B (48.3 *vs*. 56%) were observed. However, the same prevalence of HF stage C (12 *vs*. 12%) was also observed. This study was consistent with the current study, regarding not evaluating the plasma NT-proBNP concentrations.

Moreover, in this study, individuals with LVH in echocardiography (but not in ECG) were placed in stage B. Perhaps, this is the reason for the lower number of stage B subjects in this research.

Gaborit *et al* assessed the prevalence of early-stage HF in 400 patients aged ≥ 60 years, with ≥1 risk factor for HF and the findings demonstrated that 44.25, 37.5, and 18.25% of the patients were in stage A, B, stage C, respectively (7). In addition, in this study, individuals with higher stages of heart failure were older and had more atrial fibrillation. According to these findings, over half of the patients were in stage B or C. The higher stage of heart failure was associated with the increased plasma level of NT-proBNP and troponin-I as well as a decreased quality of life (7).

The difference between this study and Gabori's study is that in their study, patients over the age of 60 years with ≥1 risk factor for heart failure entered into the study; however, in the current study, patients over age 40 years entered into the study, and the mean age of the patients was 58 years. Moreover, 44.6% of the patients had no risk factors (stage 0). Furthermore, the definition of the stage C of heart failure in the two studies was different. Gaboris *et al* identified the stage C of HF using three criteria, including abnormal echocardiography and clinical signs/increased plasma NT-proBNP concentrations, but in this study, plasma NT-proBNP concentrations were not used (7).

Jorge *et al* evaluated the prevalence of HF stages in 633 individuals over 45 years in Brazil and America. The patients underwent BNP measurements, clinical

evaluations, electrocardiogram and tissue Doppler echocardiography (TDE) on the same day based on the guidelines of the ACCF/AHA. They observed that stage 0 was seen in 11.7%, stage A in 36.6%, stage B in 42.7%, and stage C in 9.3% of the individuals. This study revealed that the incidence of heart failure in individuals was high (11).

Compared to the study by Jorge *et al*, our findings presented some differences. A higher prevalence of stage 0 (44.6 *vs*. 11.7%), a lower prevalence of stages A and B (48.3 *vs*. 79%), and fewer cases of stage C (7.1 *vs*. 9.3%) were found in comparison to Jorge's study. The comparison of this study with Jorge's study demonstrated a higher prevalence of diabetes (26.5 *vs*. 25%), coronary heart disease (8.5 *vs*. 17%) and obesity (21.4 *vs*. 33%). These differences may be due to the multi-ethnicity and socio-economic aspects and the number of persons in the studied population (11). In addition, hypertension was lower in this study (33.9 *etc*. 58%).

Moreover, in the current study, the frequency of stage B heart failure was 18.8%. Due to the high cost and unavailability of B-type Natriuretic Peptide (BNP) kits, it was not considered in this research. It seems that it may be the reason for the lower stage B in the present research.

The comparison of the prevalence of heart failure in terms of age range showed that the frequency of heart failure stages in individuals > 60 years old was significantly higher than in those < 60 years old. In this regard, 72.3 % of the individuals over 60 years were in stages A to C of heart failure, while this frequency in individuals < 60 years was 38.2%.

This difference was more evident in stage A heart failure, indicating the relationship of risk factors of heart failure with increasing age. This finding was consistent with other studies conducted in this field. Azevedo *et al* compared two groups of the patients in the age range > 65 years, and 45-64 years in terms of stages of heart failure and revealed a higher frequency of individuals with stages B, and C in individuals > 65 years than individuals < 65 years (16). Approximately, 1% of the individuals over 50 years developed heart failure, and this frequency doubled with each decade of life (17), causing HF as the leading cause of death in the elderly (18). During the aging, the deterioration of the structure and function of the heart leads to an increase in the possibility of HF (19).

Additionally, the present study revealed that there was a relationship between the stages of heart failure with hypertension, diabetes, and obesity, while no relationship was found with gender. Vasan *et al* also demonstrated a relationship between the stages of heart failure with age, diabetes, hypertension, and obesity (20).

Chamberlain *et al* (21) reported that there was a strong association between HF with high blood pressure, coronary artery disease, arrhythmia and diabetes in individuals less than 75 years than in individuals over 75 years. This finding was consistent with this study. In addition, obese individuals were at increased risk of heart failure (22,23), impaired quality of life (24), and re-hospitalization (25).

Conclusion

According to these findings, about the half of the patients with heart failure were in stage A, and B. Therefore, appropriate measures are required to identify this group of patients, especially in individuals with risk factors of diabetes, hypertension, being over 60 years and obesity to prevent the progression of the disease to higher stages and poorer outcomes.

Acknowledgement

The authors would like to thank the participants and staff responsible for conducting the Yazd Health Study and authorities of Shahid Sadoughi University of Medical Sciences for their cooperation. No financial support was received in relation to this study.

Conflict of Interest

There was no conflict of interest in this manuscript.

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