Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Gul et al., 2026

FREQUENCY OF LVH IN HYPERTENSIVE PATIENTS AMONG MALE AND FEMALE RATIO AT TERTIARY CARE HOSPITAL

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Received on 20 May, 2026

Accepted on 28 June, 2026

Published on 29 June, 2026

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Abstract

Background: Left ventricular hypertrophy (LVH) is a structural adaptation of the heart that commonly develops in response to chronic hypertension and other cardiovascular disorders. Increased left ventricular wall thickness is associated with diastolic dysfunction, heart failure, arrhythmias, and an increased risk of cardiovascular morbidity and mortality. Echocardiography is the most reliable non-invasive imaging modality for assessing left ventricular wall thickness and identifying LVH. Objective: The present study aimed to determine the frequency and distribution of left ventricular wall thickness among hypertensive patients and to evaluate its association with gender, age, diastolic dysfunction, and heart failure using echocardiography. **Methodology**: A cross-sectional

Pakistan Journal of Medical & Cardiological Review
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Online ISSN 3007-2387
Print ISSN 3007-2379

study was conducted on 376 hypertensive patients aged over 30 years. Echocardiographic examinations were performed to measure left ventricular wall thickness, which was categorized as 12–14 mm, 15–17 mm, and >17 mm. Demographic characteristics and clinical variables, including age, gender, diastolic dysfunction, and heart failure, were recorded. Data were analyzed using descriptive statistics and cross-tabulation to determine the frequency distribution of study variables. Results: Of the 376 participants, 205 (54.5%) were male and 171 (45.5%) were female. Left ventricular wall thickness was 12–14 mm in 105 (27.9%) patients, 15–17 mm in 214 (56.9%) patients, and >17 mm in 57 (15.2%) patients. The highest frequency of increased wall thickness (15–17 mm) was observed among male participants. Most participants belonged to the 61–70-year age group. Diastolic dysfunction was present in 233 (62.0%) patients, with the majority demonstrating a left ventricular wall thickness of 15–17 mm. Heart failure was identified in 136 (36.2%) participants, including 81 males and 55 females. **Conclusion:** Increased left ventricular wall thickness was common among hypertensive patients, particularly in older adults and males. Left ventricular wall thickness was strongly associated with diastolic dysfunction and was frequently observed in patients with heart failure. Echocardiography remains an essential diagnostic tool for the early detection and assessment of left ventricular hypertrophy, facilitating timely clinical management and reducing the risk of adverse cardiovascular outcomes.

Keywords: Left ventricular hypertrophy, hypertension, echocardiography, left ventricular wall thickness, diastolic dysfunction, heart failure.

Introduction

Hypertension is one of the most prevalent non-communicable diseases worldwide and remains a leading modifiable risk factor for cardiovascular morbidity and mortality. According to the World Health Organization (WHO), approximately 1.28 billion adults aged 30–79 years are living with hypertension globally, with nearly two-thirds residing in low- and middle-income countries (World Health Organization, 2023). Persistent elevation of blood pressure leads to structural and functional changes in the cardiovascular system, including left ventricular hypertrophy (LVH), which is one of the earliest manifestations of hypertensive heart disease and an independent predictor of adverse cardiovascular outcomes.

Left ventricular hypertrophy is characterized by an increase in left ventricular mass resulting from chronic pressure overload. Initially, LVH develops as a compensatory mechanism to maintain cardiac output against increased systemic vascular resistance. However, prolonged myocardial hypertrophy eventually becomes maladaptive, leading to impaired ventricular relaxation, myocardial fibrosis, arrhythmias,

heart failure, ischemic heart disease, and sudden cardiac death (Williams et al., 2018). Numerous studies have demonstrated that patients with LVH have a significantly greater risk of cardiovascular events compared with hypertensive patients without LVH (Whelton et al., 2018).

The prevalence of LVH among hypertensive patients varies considerably depending on the study population, diagnostic modality, age, duration and severity of hypertension, and associated comorbidities. Echocardiographic studies have reported that approximately 20–50% of hypertensive individuals develop LVH, whereas even higher prevalence has been observed in patients with poorly controlled or long-standing hypertension (Mancia et al., 2023). Echocardiography remains the gold standard for assessing left ventricular mass because of its high sensitivity and ability to evaluate cardiac geometry and function.

Gender differences in the development of LVH have attracted increasing attention over the past decade. Although hypertension affects both men and women, differences in hormonal status, body composition, ventricular remodeling, arterial stiffness, and cardiovascular risk profiles may influence the occurrence and progression of LVH. Men generally exhibit higher blood pressure levels during early adulthood, whereas the prevalence of hypertension increases substantially among women after menopause due to the loss of estrogen's cardioprotective effects (Mancia et al., 2023). Consequently, the pattern and frequency of LVH may differ between the two sexes.

Several studies have suggested that women with hypertension are more likely to develop concentric left ventricular remodeling and hypertrophy, while men may demonstrate greater ventricular dilation and eccentric hypertrophy. These differences are believed to result from variations in myocardial response to pressure overload, neurohormonal activation, and vascular physiology (Gardin et al., 2020). However, findings across different populations remain inconsistent, emphasizing the need for further evaluation in diverse ethnic and regional settings.

South Asian populations experience a disproportionately high burden of hypertension and cardiovascular disease due to increasing urbanization, sedentary lifestyles, obesity, diabetes mellitus, and dietary risk factors. In Pakistan, hypertension represents a major public health challenge, with national surveys reporting prevalence rates exceeding 25% among adults. Unfortunately, a large proportion of patients remain undiagnosed or have inadequately controlled blood pressure, predisposing them to target-organ damage such as LVH, chronic kidney disease, stroke, and heart failure (Iqbal et al., 2021).

Early identification of LVH in hypertensive patients has important clinical implications. Regression of LVH through effective blood pressure control has been associated with a significant reduction in cardiovascular morbidity and mortality. Current international hypertension guidelines recommend routine evaluation for target-organ damage in hypertensive patients, particularly those with long-standing or poorly controlled disease, as the presence of LVH influences cardiovascular risk stratification and therapeutic decisions (Williams et al., 2018; Mancia et al., 2023).

Despite the increasing burden of hypertension in Pakistan, limited local evidence is available regarding the frequency of LVH and its distribution between male and female hypertensive patients. Most published studies have been conducted in Western populations, where demographic characteristics, healthcare access, and cardiovascular risk factors differ considerably from those observed in South Asia. Understanding gender-specific patterns of LVH in the local population may facilitate earlier diagnosis, improve cardiovascular risk assessment, and support more individualized management strategies.

Therefore, the present study aims to determine the frequency of left ventricular hypertrophy among hypertensive patients attending a tertiary care hospital and to compare its occurrence between male and female patients. The findings of this study are expected to contribute to the existing literature by providing local epidemiological evidence that may assist clinicians in identifying high-risk individuals and improving strategies for the prevention of hypertensive heart disease.

Methodology

This descriptive cross-sectional study was conducted at the tertiary care hospitals, Hayatabad Medical Complex and Lady Reading Hospital, over a period of 6–8 months. A total sample of 376 hypertensive patients was calculated using the OpenEpi sample size calculator based on a reported prevalence of 44%. Participants were selected using a non-probability convenience sampling technique.

The study included hypertensive patients aged 30 years or older with a confirmed diagnosis of hypertension and echocardiographically confirmed left ventricular hypertrophy (LVH). Patients without a confirmed diagnosis of hypertension, those with congenital or acquired structural heart diseases (e.g., aortic coarctation or aortic stenosis), and women with pregnancy-induced hypertension were excluded.

Data were collected using a structured proforma that recorded demographic characteristics, duration of hypertension, blood pressure measurements, cardiovascular risk factors (such as diabetes, obesity, and smoking), clinical symptoms (chest pain, fatigue, and dyspnea), electrocardiographic and echocardiographic findings, type of LVH,

echocardiographic parameters including wall thickness, ejection fraction, and diastolic dysfunction, along with informed patient consent. Data were entered and analyzed using SPSS version 27. Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The association between LVH and demographic and clinical variables, including gender and age, was assessed using appropriate statistical tests, with a p-value of <0.05 considered statistically significant.

GENDER WISE DISTRIBUTION

In our study a total of 376 samples were study in which 205 (54.5%) male and 171 (45.5%) female. The patient age is >30 years. The left ventricular wall thickness 12-14mm (27.9%) , 15-17mm (56.9%) and greater than 17mm (15.2%).

Table 1: *Gender of Patient*

Gender of patient					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	205	54.5	54.5	54.5
	Female	171	45.5	45.5	100.0
	Total	376	100.0	100.0	

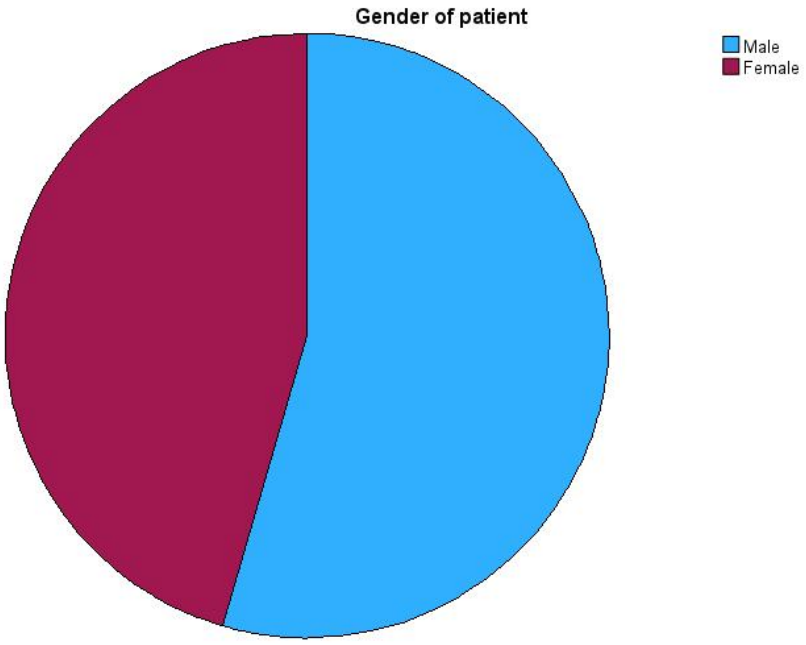

Figure 1 Gender of Patient

Table 2 : *Left Ventricular Wall Thickness*

Left Ventricular Wall Thickness In mm					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	12-14	105	27.9	27.9	27.9
	15-17	214	56.9	56.9	84.8
	> 17	57	15.2	15.2	100.0
	Total	376	100.0	100.0	

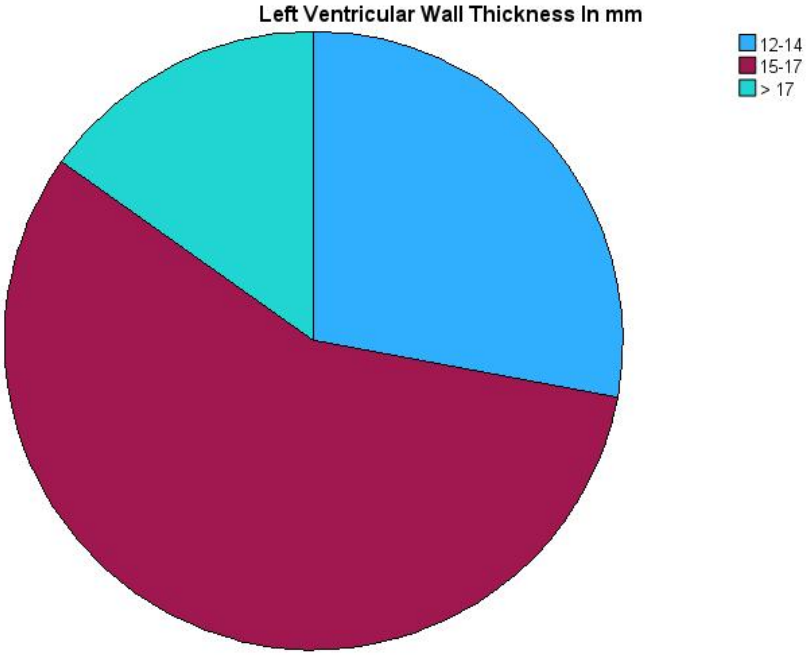

Figure 2 : Left Ventricular Wall Thickness

GENDER-SPECIFIC FREQUENCY DISTRIBUTION OF LEFT VENTRICULAR WALL THICKNESS

The distribution of left ventricular wall thickness by gender in our data is displayed in the table below. Where 171 are women and 205 are men. 39 males and 66 females in 12–14 mm 15 to 17 mm There are 131 men and 83 women, and there are 35 men and 22 women over 17 mm.

Table 3: *Gender wise distribution of left ventricular thickness*

Gender of patient * Left Ventricular Wall Thickness In mm Crosstabulation				
Count				
	Left Ventricular Wall Thickness In mm			Total
	12-14	15-17	> 17	

Gender of patient	Male	39	131	35	205
	Female	66	83	22	171
Total		105	214	57	376

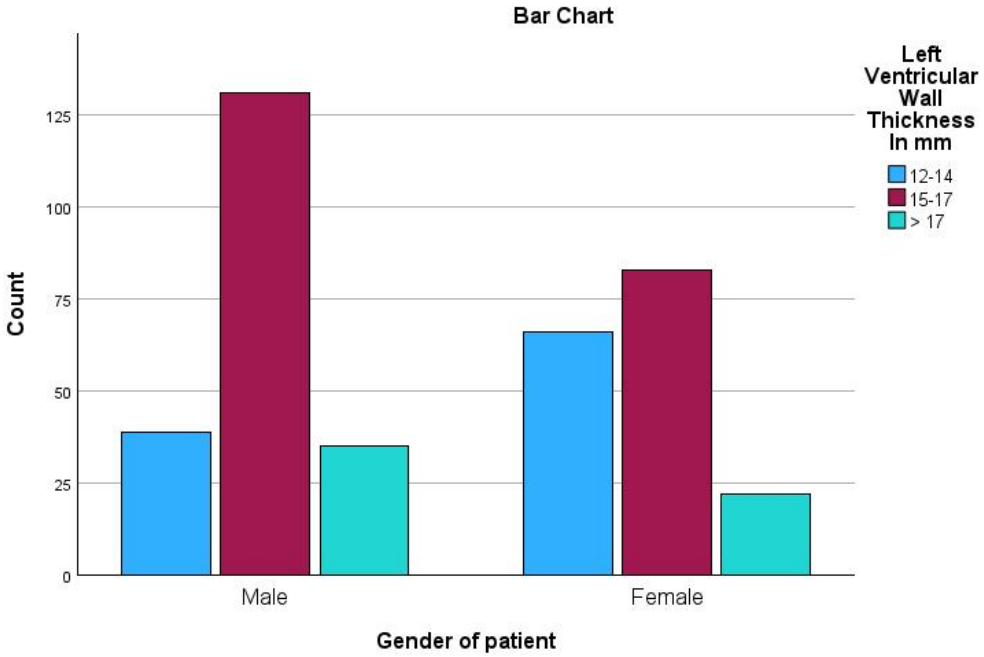

Figure 3 : Gender Based Left ventricular wall thicknesses

FREQUENCY DISTRIBUTION OF HEART FAILURE AMONG GENDERS

Among the total 376 participants total male participants were 205 (54%) and females were 171. Among 205 male participants 81 had heart failure and 124 had no heart failure. Among the 171 female participants 55 had heart failure and 116 had no heart failure.

Table 4: *Heart Failure Frequency among Genders*

Gender of patient * Heart Failure Crosstabulation

Count

		Heart Failure		Total
		1.00	2.00	
Gender of patient	Male	81	124	205
	Female	55	116	171
Total		136	240	376

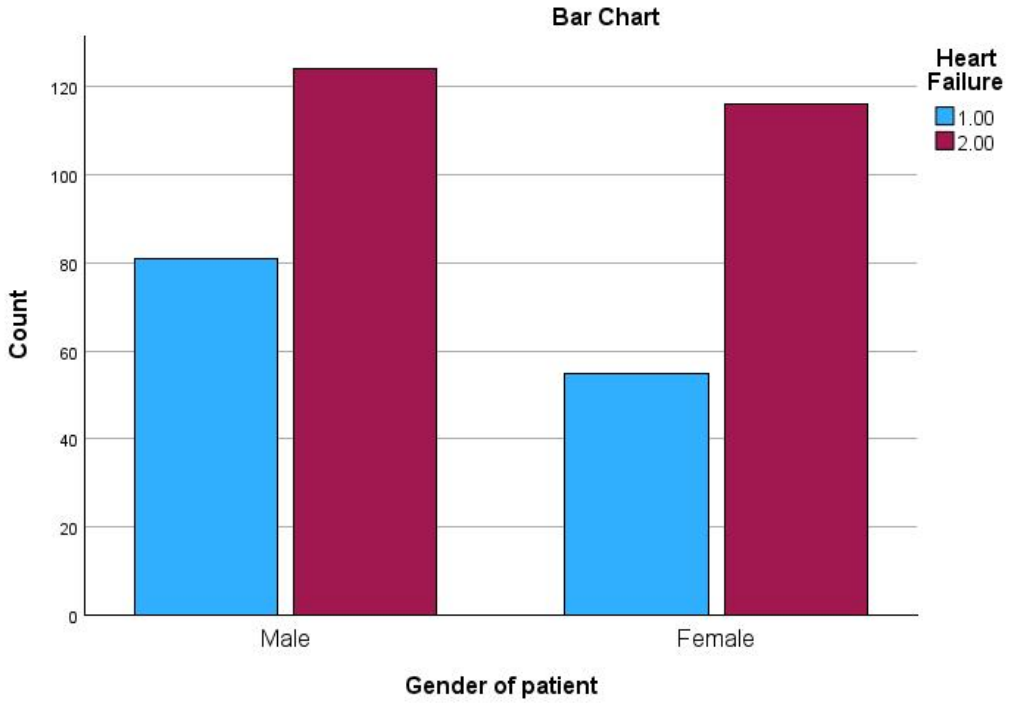

Figure 4: Frequency of Heart Failure Gender Based

AGE WISE DISTRIBUTION

A total of 376 samples were collected in which in which 22 samples having age 30-40 years,85 sample having age 41-50 years 151 patient having age 51-50 years and in 154 patient age 61-70 years.

Table 5: *Age wise distribution of Left ventricular wall thickness*

Age of Patient * Left Ventricular Wall Thickness In mm Crosstabulation

Count

		Left Ventricular Wall Thickness In mm			Total
		12-14	15-17	> 17	
Age of Patient	30 -40 Years	4	16	2	22
	41-50 Years	25	55	5	85
	51-60 Years	38	60	17	115
	61-70 Years	38	83	33	154
Total		105	214	57	376

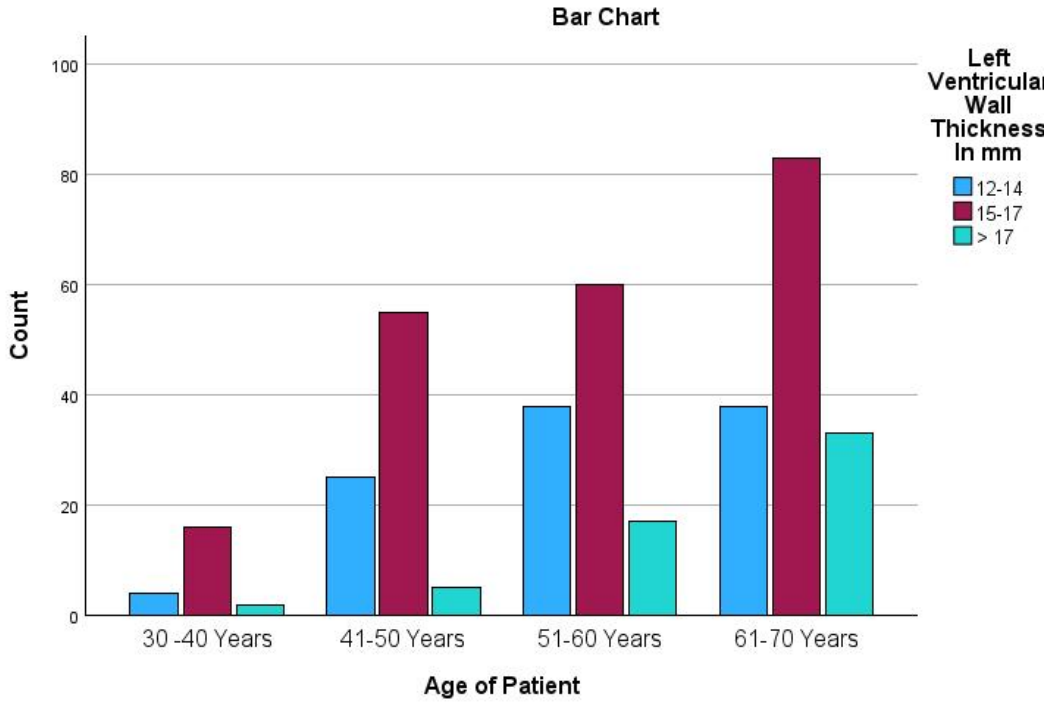

Figure 5: Age wise Distribution of Left ventricular wall thickness

DIASTOLIC DYSFUNCTION WISE DISTRIBUTION

Out of 376 samples 233 have diastolic dysfunction and 143 have no diastolic dysfunction. Out of 233 in which 19 patients having left ventricular hypertrophy (12-14mm) and 166 having (15-17mm) and 48 possessing a left ventricular wall that is thicker than 17 mm.

Table 6: *Diastolic Dysfunction wise distribution of Left Ventricular Wall Thickness*

Diastolic Dysfunction * Left Ventricular Wall Thickness In mm Crosstabulation					
Count					
		Left Ventricular Wall Thickness In mm			Total
		12-14	15-17	> 17	
Diastolic Dysfunction	Yes	19	166	48	233
	No	86	48	9	143
Total		105	214	57	376

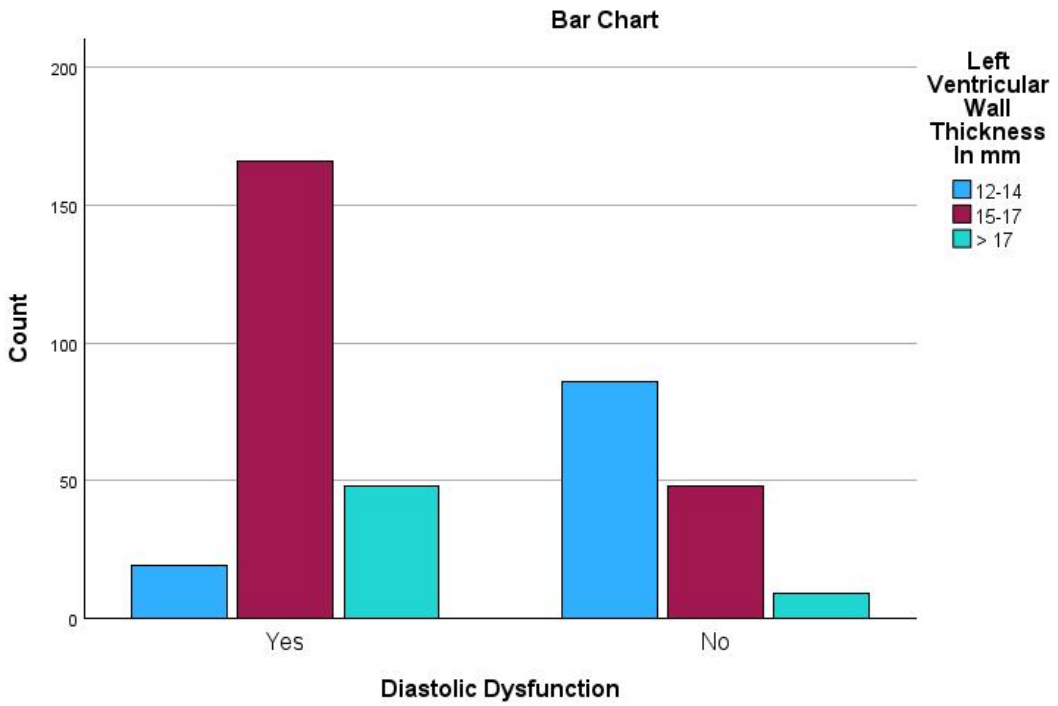

Figure 6: Diastolic Dysfunction wise Distribution of Left ventricular wall thicken

Discussion

This study demonstrated that a significant percentage of hypertensive patients in Peshawar who were evaluated for subclinical cardiac dysfunction and hypertension-related conditions had gender-based left ventricular hypertrophy. There were 376 patients in the sample of these, 171 patients, or 45.5% are female and 205 patients, or 54.5%, are male. Despite the sample's gender distribution being fairly balanced, this suggests a small male predominance. Because men and women are almost equally represented, the study's conclusions can be seen as being more inclusive because they are reasonably generalizable across genders. As previously study discuss available study examine the prevalence and other clinical correlate of left ventricle hypertrophy mostly in hypertensive patient and in general population among 1900 patients 49.5% are women and 41.2% are man. This indicates that women had a higher prevalence of left ventricular hypertrophy than men did. This gender based related prevalence is in line with finding reported by Levy at al in the Framingham population by the Simone at al in the strong heart study. We also collected data from participants with risk factors other than hypertension like diabetes, obesity and hyperlipidemia. Treatments intended to

lower the risk of developing more severe types of LVH may be guided by the identification of patients with high LVWT. Medications (such antihypertensive drugs), lifestyle changes (like exercising and controlling weight), and careful observation for possible cardiovascular issues could all be of this The data presented in Table 3.1 reveals the gender distribution of the patient sample, with 54.5% of the participants being male (205 patients) and 45.5% female (171 patients). This relatively balanced gender distribution suggests that gender is not a significant confounding factor in the study population, allowing for a clearer analysis of the relationship between gender and other variables such as left ventricular wall thickness and diastolic dysfunction. Further examination of these associations is important to understand if gender influences the prevalence or severity of conditions like left ventricular hypertrophy.

Regarding left ventricular wall thickness (Table 3.2), the majority of patients (56.9%) fall within the 15-17 mm range, with a smaller proportion of patients having a wall thickness between 12-14 mm (27.9%) or greater than 17 mm (15.2%). This distribution of left ventricular wall thickness is critical for understanding the presence of pathologies such as hypertrophy, which is often associated with increased thickness. The data indicates that most patients have mild to moderate left ventricular wall thickness, while a smaller proportion shows more significant hypertrophy, potentially signaling a higher risk of cardiovascular complications. The prevalence of these categories provides insight into the state of cardiac health in the sample population. Crosstabulation data on the relationship between gender and left ventricular wall thickness (Table 3.3) demonstrates that male patients have a higher prevalence of both moderate and severe left ventricular hypertrophy, as 131 males (39%) exhibit wall thicknesses in the 15-17 mm range, and 35 males (17%) in the >17 mm range. In contrast, a larger proportion of female patients (66 females, 39%) fall into the 12-14 mm category, with fewer in the higher ranges. These findings suggest that males may be more prone to developing thicker left ventricular walls compared to females, potentially due to factors like hormonal influences or the greater prevalence of risk factors such as hypertension in males. The relationship between diastolic dysfunction and left ventricular wall thickness (Table 3.4) indicates that patients with more pronounced hypertrophy (i.e., greater than 15 mm) are more likely to have diastolic dysfunction, with 166 patients in the 15-17 mm

group and 48 in the >17 mm group reporting diastolic dysfunction. This association underscores the clinical significance of increased left ventricular wall thickness in relation to cardiac function, specifically diastolic dysfunction, which is a marker of impaired cardiac relaxation and filling capacity.

Limitations

Following are the limitations of our study.

The study relied solely on echocardiography to diagnose LVH, without considering other imaging techniques or diagnostic tests (e.g., MRI, CT scans, or ECG). The reliance on one method may limit the detection of LVH, especially in cases where other techniques might provide more accurate or comprehensive information.

The study does not account for the presence of comorbid conditions, such as diabetes, dyslipidemia, or chronic kidney disease, which often co-occurs with hypertension and may influence the development and severity of LVH.

Recommendations

Based on the findings of this study, the following recommendations are made:

More Gender-Specific Research: Additional research should examine gender-specific characteristics that contribute to the prevalence and management of hypertension, as there were more male patients in the study. This could assist create methods that are specifically designed for both male and female patients.

Targeted Hypertension Awareness Programs: Since hypertension was more common in men in this study, public health campaigns should concentrate on increasing awareness of the condition. To stop hypertension from developing, these programs should place a strong emphasis on early diagnosis and lifestyle modifications.

Comorbidity Inclusion: To evaluate the effects of common comorbidities on hypertension and create a more comprehensive treatment strategy, future research should take into account patients with conditions like diabetes or chronic renal disease.

Frequent Screening and Monitoring: Echocardiography, one of the diagnostic criteria in this study, should be used to ensure that people over 30 receive regular screening for hypertension in both clinical and community settings.

Gender-Specific Management Protocols: In order to manage hypertension, healthcare professionals should think about creating gender-specific protocols that take into

account behavioural, social, and physiological characteristics that may vary between males and females.

These suggestions may improve patient outcomes, promote more successful public health initiatives, and improve the management of hypertension

Conclusion

The aim of our study was to determine. Gender based prevalence of left ventricular hypertrophy in hypertensive patient. The gender-based study of left ventricular hypertrophy in hypertensive patient is relatively balanced in male with left ventricular hypertrophy 54.5% (205 patients) and female with left ventricular hypertrophy is 45.5% (171 patients). Moderate hypertrophies which have important implication for cardiovascular health other research explore the underlying cause of left ventricular hypertrophy in the population and to investigate potential sex-based differences

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