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

Khan, et al - 2026

"Association of Hypertrophic Cardiomyopathy with Hypertension, Diabetes and its Association with Gender at Lady Reading Hospital Peshawar."

1. Ajmal Khan
Lecturer/Coordinator, Rehman College of Allied Health Sciences, RMI, Peshawar.
Email: ajmal.mashwani1@gmail

2. Asim Gamaryani
PhD Public Health, University of Wollongong, Australia
Email: asimghayoorgamaryani@gmail.com

3. Abdul Haseeb
Visiting Lecturer, KMU, Peshawar.
Email: abdulhaseeb11995@gmail.com

4. Hina Asif
Internee, Rehman Medical Institute, Peshawar.
Email: hinaasifpeaks@gmail.com

5. Adnan Khadim
Lecturer/Coordinator, Abasyn University Peshawar.
Email: adnan.khadim@abasyn.edu.pk

6. Dr Laiba Ajmal*
Consultant Cardiac Imaging, Rehman Medical Institute.
Email: laibamisbah2@gmail.com

Author Details

Keywords: Hypertrophic cardiomyopathy, Hypertension, Diabetes mellitus, Gender, Left ventricular hypertrophy, Echocardiography, Cross-sectional study, Lady Reading Hospital, Peshawar.

Received on 18 May 2026
Accepted on 27 June 2026
Published on 30 June 2026

Corresponding E-mails & Authors*:
Dr Laiba Ajmal*
Email: laibamisbah2@gmail.com

Abstract

Background: Hypertrophic cardiomyopathy (HCM) is a primary myocardial disorder characterized by unexplained left ventricular hypertrophy and is associated with heart failure, arrhythmias, and sudden cardiac death. Hypertension and diabetes mellitus are common cardiovascular risk factors that may influence the development and clinical presentation of HCM. However, limited local evidence is available regarding their association with HCM in the

Pakistani population.

Objective: To determine the association of hypertrophic cardiomyopathy with hypertension, diabetes mellitus, and gender among patients presenting to Lady Reading Hospital, Peshawar.

Methodology: A hospital-based cross-sectional study was conducted at the Cardiology Unit of Lady Reading Hospital (Medical Teaching Institute), Peshawar. A total of 100 participants were enrolled using a convenience sampling technique. Patients with hypertension, left ventricular hypertrophy, hypertrophic cardiomyopathy, or diabetes mellitus who fulfilled the inclusion criteria were included. Data were collected using a structured proforma after obtaining informed consent and ethical approval. Statistical analysis was performed using SPSS version 22. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The Chi-square test was applied to determine the association between HCM and hypertension, diabetes mellitus, and gender. A p-value of <0.05 was considered statistically significant.

Results: A total of 100 participants were included, comprising 55 (55.0%) males and 45 (45.0%) females, with a mean age of 61.54 ± 13.17 years (range: 26–90 years). Hypertrophic cardiomyopathy was diagnosed in 86 (86.0%) participants, including 48 males and 38 females. Hypertension was present in 88 participants, of whom 86 had HCM. A statistically significant association was observed between hypertension and HCM (Pearson Chi-square = 83.766, $p < 0.001$). Diabetes mellitus was present in 49 participants; however, no statistically significant association was found between diabetes

mellitus and HCM (Pearson Chi-square = 2.719, p = 0.099). HCM was more frequently observed in males than females.

Conclusion: Hypertension showed a significant association with hypertrophic cardiomyopathy, suggesting that hypertensive patients are at increased risk of developing myocardial hypertrophy compatible with HCM. In contrast, diabetes mellitus was not significantly associated with HCM in the present study. Although HCM was more common among males, further large-scale multicenter studies are recommended to better evaluate the influence of gender and other cardiovascular risk factors on the occurrence of hypertrophic cardiomyopathy.

Introduction

Hypertrophic cardiomyopathy (HCM) is one of the most common inherited cardiac disorders and is characterized by unexplained left ventricular hypertrophy in the absence of abnormal loading conditions such as severe valvular disease or uncontrolled hypertension. Although its global prevalence is approximately 1 in 500 individuals (0.2%), HCM remains underdiagnosed because many patients are asymptomatic until complications develop. The disease is associated with heart failure, atrial and ventricular arrhythmias, thromboembolic events, and sudden cardiac death, making early identification essential (1,2,3).

Hypertension is one of the leading causes of cardiovascular morbidity and mortality worldwide, accounting for nearly half of stroke and ischemic heart disease cases and approximately 13% of global deaths (1). Persistent elevation of blood pressure produces structural and functional changes in the myocardium, including left ventricular

hypertrophy (LVH), myocardial remodeling, interstitial fibrosis, and impaired diastolic function (2,3,4). The renin–angiotensin–aldosterone system (RAAS) plays a significant role in promoting myocardial hypertrophy and fibrosis, further contributing to adverse cardiac remodeling (5,6,7). Evidence from the Framingham Heart Study demonstrated that LVH independently predicts cardiovascular morbidity and mortality regardless of blood pressure levels, while persistent hypertension with LVH substantially increases the risk of sudden cardiac death (8,9). Since hypertension itself can produce ventricular hypertrophy, distinguishing hypertensive heart disease from HCM is clinically important.

Diabetes mellitus is another major cardiovascular risk factor associated with structural and functional abnormalities of the heart. Chronic hyperglycemia contributes to myocardial fibrosis, oxidative stress, endothelial dysfunction, and altered myocardial metabolism, leading to diabetic cardiomyopathy and ventricular hypertrophy. Patients with diabetes are at increased risk of developing LVH and heart failure, which remain leading causes of mortality among diabetic individuals (10). Recent evidence has suggested that fibroblast growth factor-21 (FGF21) may directly induce myocardial hypertrophy, providing further insight into the mechanisms linking diabetes with ventricular hypertrophy (11). The coexistence of hypertension and diabetes may accelerate myocardial remodeling and complicate the diagnosis and progression of HCM.

Although HCM is primarily a genetic disorder, several acquired cardiovascular risk factors may influence its clinical presentation and disease progression. Patients frequently present with symptoms related to impaired diastolic function, left ventricular outflow tract obstruction, myocardial ischemia, or cardiac arrhythmias. Chest pain,

exertional dyspnea, palpitations, syncope, and atrial fibrillation are common manifestations, whereas a considerable proportion of patients remain asymptomatic until advanced disease develops (13,14,15). Atrial fibrillation is particularly important because it increases the risk of heart failure and thromboembolic stroke in patients with HCM (15).

Echocardiography remains the cornerstone for the diagnosis of HCM, allowing accurate assessment of ventricular wall thickness, systolic and diastolic function, left ventricular outflow tract obstruction, and left atrial size. Traditionally, a septal wall thickness of ≥15 mm with asymmetric septal hypertrophy is considered diagnostic in appropriate clinical settings (16). Doppler echocardiography further evaluates systolic anterior motion of the mitral valve, dynamic outflow tract obstruction, ventricular function, and diastolic abnormalities, all of which have important prognostic implications (17,18,19,20). In addition, left atrial enlargement resulting from chronic diastolic dysfunction and elevated filling pressures is associated with adverse cardiovascular outcomes and atrial fibrillation (20).

Several studies have suggested that demographic and metabolic factors may influence the occurrence and severity of HCM. Hypertension and diabetes contribute to myocardial hypertrophy and fibrosis, potentially modifying disease expression, while gender differences have been reported in clinical presentation, disease progression, and outcomes. Women often present at an older age with more advanced symptoms and have been shown to experience a higher proportion of stroke-related mortality compared with men (21). Understanding the relationship between HCM and these

comorbid conditions is essential for improving diagnosis, risk stratification, and patient management.

Despite the growing burden of cardiovascular disease in Pakistan, limited local data are available regarding the association of hypertrophic cardiomyopathy with hypertension, diabetes mellitus, and gender. Investigating these relationships in patients presenting to Lady Reading Hospital Peshawar will provide valuable evidence regarding the distribution of HCM among high-risk individuals and may contribute to improved screening strategies, early diagnosis, and clinical management within the local population.

Methodology

The study was conducted as a cross-sectional study at the Cardiology Unit of Lady Reading Hospital (Medical Teaching Institute), Peshawar. The hospital was selected because it is the largest tertiary care center in Khyber Pakhtunkhwa and receives a large number of cardiac patients from across the province, providing an adequate study population. The study was initiated after obtaining permission from the Head of the Cardiology Department.

A convenience sampling technique, a non-probability sampling method, was used to recruit participants. Patients who were readily available during the study period and fulfilled the eligibility criteria were enrolled consecutively.

The study participants included patients attending the cardiology wards and echocardiography laboratory of Lady Reading Hospital, Peshawar. Data were collected

using a pre-designed structured proforma after explaining the purpose of the study and obtaining informed consent from each participant.

Patients diagnosed with hypertension, left ventricular hypertrophy, hypertrophic cardiomyopathy, or diabetes mellitus were included in the study. Patients who were unwilling to participate, those with other causes of ventricular hypertrophy such as aortic stenosis, myocardial infiltrative diseases (e.g., amyloidosis or glycogen storage disorders), other types of cardiomyopathies, and individuals with congenital heart disease were excluded.

Data were collected using a structured questionnaire developed in consultation with the research supervisor. Ethical approval was obtained from the Institutional Ethics Review Committee before commencement of the study. Written permission was also obtained from the Head of the Cardiology Department, and informed consent was obtained from all participants prior to data collection. Clinical and demographic information was recorded through patient interviews and review of relevant medical records.

The collected data were entered and analyzed using SPSS version 22. Continuous variables were summarized as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. The association between hypertrophic cardiomyopathy and hypertension, diabetes mellitus, and gender was assessed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

Results

After collecting data from the participants through pre-formed proforma, it was analyzed using IBM SPSS software version 22. Various statistical tools and tests were

applied for finding out the results. The analyses and their interpretation is discussed one by one in the given passages.

A total of 100 participated in this study in which 55 (55.0%) were male and 45(45.0%) were female. Among males 48 were HCM and 7 were non HCM and among females 38 were HCM and 7 were non HCM.

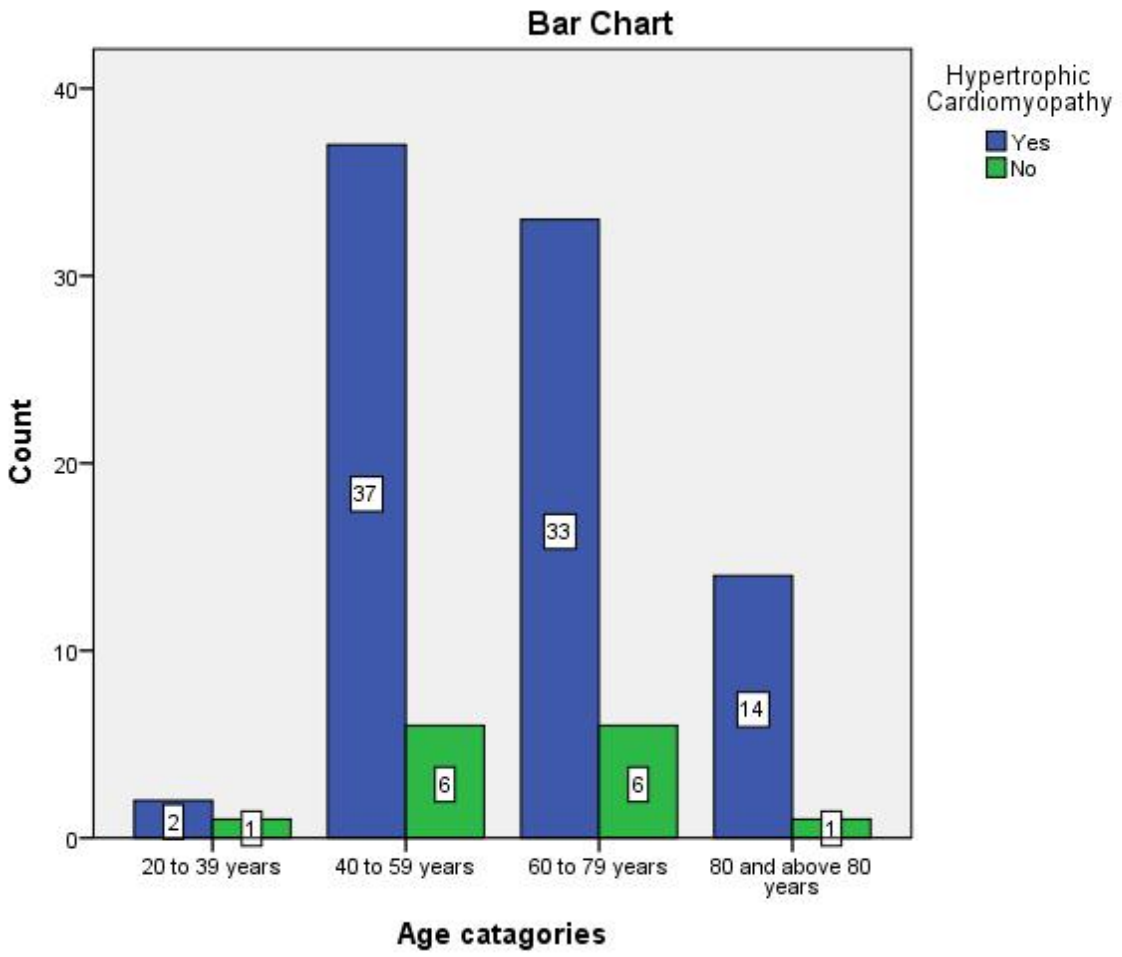
Their age ranging from 26 years to 90 years. The mean age was 61.54 years with a standard deviation of ±13.169. The minimum age was 26 years while maximum age was 90 years. Among all 100 participants, male subjects were 55 (55.0%) and female subjects were 45 (45.0%). Ages were divided into groups, Group 1(20-39 years), Group 2(40-59years), Group 3(60-79 years), Group 4(80 and above 80 years).

For the relationship of HCM and hypertension, Pearson Chi-square test was used to check for significance where P=0.000 which show that test is highly significant and conclude that there is relationship of Hypertension with Hypertrophic Cardiomyopathy.

To find association of Diabetes and HCM Pearson Chi-square test was used to check for significance where p value was 0.99 which show that test was insignificant and we assumed that there is no relationship of Diabetes mellitus with Hypertrophic Cardiomyopathy.

Association of Age with HCM

Graph 1

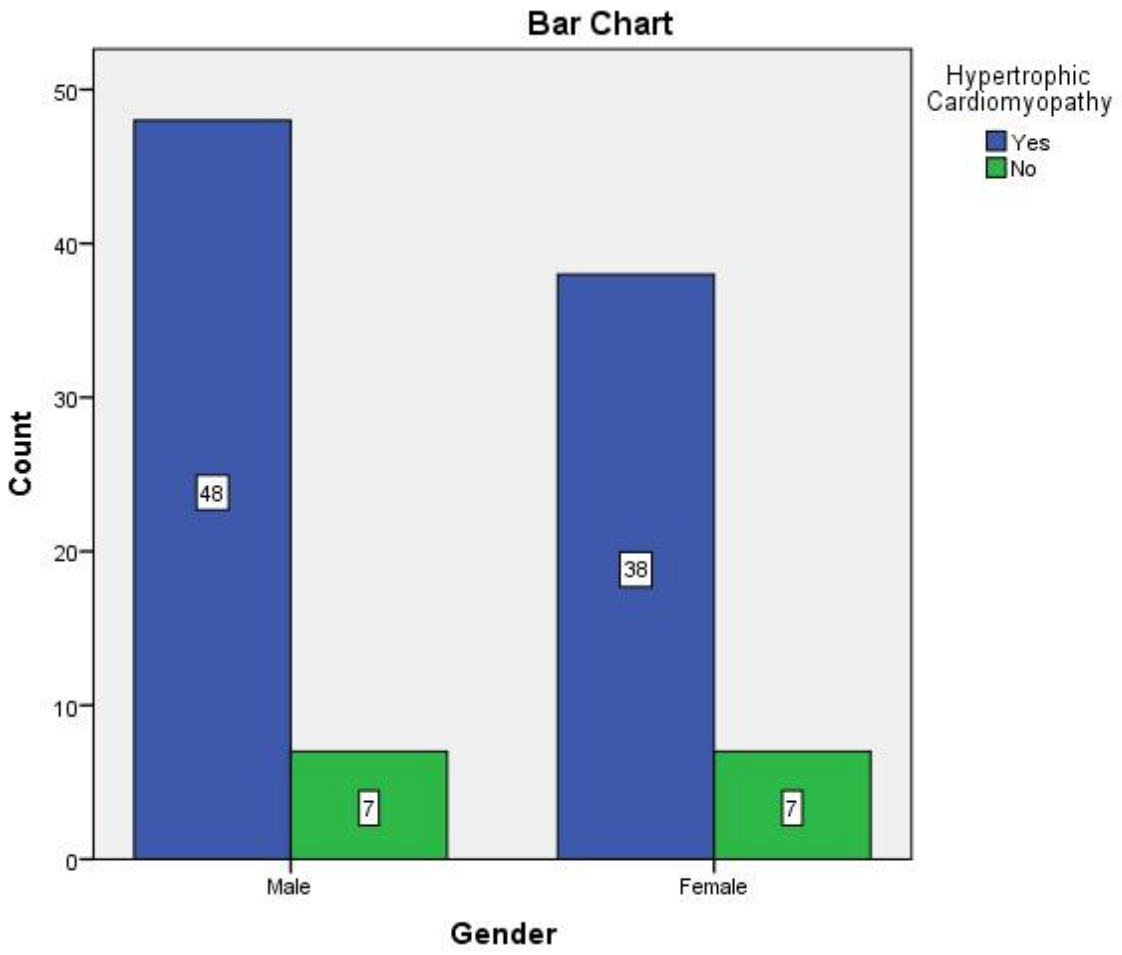


A total of 100 participants 86 were having HCM from both male and female gender were selected for the study with age ranging from 26 years to 90 years. The mean age was 61.54 years with a standard deviation of ±13.169. The minimum age was 26 years while maximum age was 90 years. Among all 100 participants, male subjects were 55 (55.0%) and female subjects were 45 (45.0%). Ages were divided into groups, group

1(20-39 years), group 2(40-59years), group 3(60-79 years), group 4(80 and above 80 years)

Gender association with HCM

Graph 2



A total of 100 participated in this study in which 55 (55.0%) were male and 45(45.0%) were female. Among males 48 were HCM and 7 were non HCM and among females 38 were HCM and 7 were non HCM.

Association of Hypertension with HCM.

Table 1

Hypertension * Hypertrophic Cardiomyopathy Crosstabulation				
Count				
		Hypertrophic Cardiomyopathy		
		Yes	No	Total
Hypertension	Yes	86	2	88
	No	0	12	12
Total		86	14	100

Table 2

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	83.766[a]	1	.000		
Continuity Correction[b]	75.846	1	.000		
Likelihood Ratio	61.902	1	.000		

Fisher's Exact Test				.000	.000
Linear-by-Linear Association	82.929	1	.000		
N of Valid Cases	100				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.68.

b. Computed only for a 2x2 table

Pearson Chi-square test was used to check for significance where p value was P=0.000 which show that test is highly significant and conclude that there is relationship of Hypertension with Hypertrophic Cardiomyopathy.

Association of Diabetes mellitus with HCM.

Table 3

Diabetes mellitus * Hypertrophic Cardiomyopathy Crosstabulation		
Count		
	Hypertrophic Cardiomyopathy	Total

		Yes	No	
Diabetes mellitus	Yes	45	4	49
	No	41	10	51
Total		86	14	100

Table 4

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.719[a]	1	.099		
Continuity Correction[b]	1.851	1	.174		
Likelihood Ratio	2.803	1	.094		
Fisher's Exact Test				.149	.086
Linear-by-Linear Association	2.691	1	.101		
N of Valid Cases	100				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.86.

b. Computed only for a 2x2 table

Pearson Chi-square test was used to check for significance where p value was 0.99 which show that test was insignificant and we assumed that there is no relationship of Diabetes mellitus with Hypertrophic Cardiomyopathy.

Discussion

According to my study conclusion hypertension is associated with hypertrophic cardiomyopathy with supporting evidence from chi square test p=0.000 this is consistent with a conclusion from an article published a (J Am coll Cardiol 1989; 13:580-4), In which out of 113 patients 39 with both hypertrophic cardiomyopathy and systemic hypertension were identified. Their ages ranged from 31 years to 84 years (mean + SD 60 ? 13),82% of them were greater than 50 years old. The remaining 74 patients with the diagnosis of hypertrophic cardiomyopathy without hypertension were significantly younger. Eighteen (46%) of the 39 patients were women. The article shows that hypertrophic cardiomyopathy with associated hypertension is a disease of the elderly.

Topol et al. Described severe concentric hypertrophy and heart failure in 21 patient's age greater than 59 years with mild to moderate hypertension. Although thy labeled the syndrome "hypertensive hypertrophic cardiomyopathy" to distinguish it from classic hypertrophic cardiomyopathy associated with asymmetric hypertrophy (14).

A relevant issue raised by Tarazi and Levy is that the severity of hypertrophy often cannot be related to the severity or duration of hypertension. They suggested that some patients may have a predisposed myocardial sensitivity to the development of hypertrophy in the setting of hypertension (15).

Diabetes mellitus association with hypertrophic cardiomyopathy was insignificant as per analysis of our data processing. Chi square test result with a p value of =0.99 which

suggest insignificance of test and prove that there is no association of diabetes mellitus with hypertrophic cardiomyopathy. Published literature material also lack supporting evidence of diabetes mellitus association with hypertrophic cardiomyopathy.

Conclusion and Recommendation

Conclusion of my study is that hypertrophic cardiomyopathy is associated with hypertension while diabetes mellitus has no any direct evidence for association with hypertrophic cardiomyopathy. Male gender were predominantly as compared to female gender.

Following recommendation should be referred;

- Hypertensive patients should be managed with non-pharmacologic interventions/therapeutic lifestyle modifications to lower BP.
- Patients with pre-hypertension should be followed up yearly to detect and treat hypertension as early as possible. Pharmacological treatment should be based on the individual patient's global cardiovascular risk. In subjects with medium risk or higher, the threshold for commencing HTN treatment should be lower.
- Dietary modification that effectively lower BP are weight loss, reduced salt intake, increase potassium intake and consumption of overall healthy dietary pattern, called the DASH diet (consume a diet rich in fruits and vegetables, rich in low fats dietary product, and reduced in saturated fat and cholesterol). Other dietary factors may also affect BP, but the effects are small.
- Therapeutic lifestyle changes should be recommended for pre-HTN patients and stage-1 hypertensive patient. In newly diagnosed uncomplicated hypertensive with no compelling indications, choice of first line monotherapy is indicated (21).

References

1. Lawes CM, Vander Hoorn S, Rodgers A. Global burden of blood-pressure-related disease, 2001. **Lancet.** 2008;371(9623):1513-8.
2. Nadruz W. Myocardial remodeling in hypertension. **J Hum Hypertens.** 2015;29(1):1-6.
3. Van Hoeven KH, Factor SM. A comparison of the pathological spectrum of hypertensive, diabetic, and hypertensive-diabetic heart disease. **Circulation.** 1990;82(3):848-55.
4. Janardhanan R, Kramer CM. Imaging in hypertensive heart disease. **Expert Rev Cardiovasc Ther.** 2011;9(2):199-209.
5. Brok R. Functional obstruction of the left ventricle (acquired aortic subvalvular stenosis). **Guys Hosp Rep.** 1957;106:221-38.
6. Brok R. Functional obstruction of the left ventricle (acquired aortic subvalvular stenosis). **Guys Hosp Rep.** 1959;109:126-43.
7. Re RN. Intracellular renin and the nature of intracrine enzymes. **Hypertension.** 2003;42(2):117-22.
8. Sadoshima J, Xu Y, Slayter HS, Izumo S. Autocrine release of angiotensin II mediates stretch-induced hypertrophy of cardiac myocytes in vitro. **Cell.** 1993;75(5):977-84.
9. Levy D, Garrison RJ, Savage DD, Kannel WB, Castelli WP. Prognostic implications of echocardiographically determined left ventricular mass in the Framingham Heart Study. **N Engl J Med.** 1990;322(22):1561-6.
10. Sullivan JM, Zwaag RV, El-Zeky F, Ramanathan KB, Mirvis DM. Left ventricular hypertrophy: effect on survival. **J Am Coll Cardiol.** 1993;22:508-13.

11. American Diabetes Association. FGF21 causes left ventricular hypertrophy [Internet]. Arlington (VA): American Diabetes Association; [cited 2026 Jul 13]. Available from: https://professional.diabetes.org/rdb/fgf21-causes-left-ventricular-hypertrophy
12. Maron BJ, Gardin JM, Flack JM, Gidding SS, Kurosaki TT, Bild DE. Prevalence of hypertrophic cardiomyopathy in a general population of young adults. **Circulation.** 1995;92(4):785-9.
13. American Heart Association. High blood pressure [Internet]. Dallas (TX): American Heart Association; [cited 2026 Jul 13]. Available from: https://www.heart.org/en/health-topics/high-blood-pressure
14. Maron BJ, Wolfson JK, Epstein SE, Roberts WC. Intramural ("small vessel") coronary artery disease in hypertrophic cardiomyopathy. **J Am Coll Cardiol.** 1986;8(3):545-57.
15. Debonnaire P, Joyce E, Hiemstra Y, Mertens BJ, Atsma DE, Schalij MJ, et al. Left atrial size and function in hypertrophic cardiomyopathy patients and risk of new-onset atrial fibrillation. **Circ Arrhythm Electrophysiol.** 2017;10:e004052.
16. Maron BJ, Epstein SE. Hypertrophic cardiomyopathy: recent observations regarding the specificity of three hallmarks of the disease—asymmetric septal hypertrophy, septal disorganization, and systolic anterior motion of the anterior mitral leaflet. **Am J Cardiol.** 1980;45(1):141-54.
17. Sherrid MV, Gunsburg DZ, Moldenhauer S, Pearle G. Systolic anterior motion begins at low left ventricular outflow tract velocity in obstructive hypertrophic cardiomyopathy. **J Am Coll Cardiol.** 2000;36(4):1344-54.

18. Barac I, Upadya S, Pilchik R, et al. Effect of obstruction on longitudinal left ventricular shortening in hypertrophic cardiomyopathy. **J Am Coll Cardiol.** 2007;49(11):1203-11.
19. Kato TS, Noda A, Izawa H, et al. Discrimination of nonobstructive hypertrophic cardiomyopathy from hypertensive left ventricular hypertrophy on the basis of strain rate imaging by tissue Doppler ultrasonography. **Circulation.** 2004;110(25):3808-14.
20. Maron BJ, Spirito P, Green KJ, Wesley YE, Bonow RO, Arce J. Noninvasive assessment of left ventricular diastolic function by pulsed Doppler echocardiography in patients with hypertrophic cardiomyopathy. **J Am Coll Cardiol.** 1987;10(4):733-42.
21. Weber MA, Schiffrin EL, White WB, Mann S, Lindholm LH, Kenerson JG, et al. Clinical practice guidelines for the management of hypertension in the community. **J Clin Hypertens (Greenwich).** 2014;16(1):14-26.

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about