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The Prevalence of Left Ventricular Hypertrophy Among Type-2 Diabetes Mellitus Patients

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ABSTRACT

Background: Left ventricular hypertrophy (LVH) is a common cardiovascular alteration in individuals with type-2 diabetes mellitus. The chronic metabolic disturbances caused by diabetes, such as hyperglycemia and insulin resistance, lead to structural and functional changes in the heart. This study aimed to determine the prevalence of left ventricular hypertrophy among patients with type-2 diabetes mellitus. ***Methods:*** This prospective observational study was conducted in the Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, from June 2022 to May 2023. 87 patients diagnosed with type-2 diabetes mellitus, aged 20 to 70, were enrolled using a purposive sampling technique. Demographic and clinical data were recorded, and MS Office tools were used for data analysis. ***Results:*** In our study, most patients (55.2%) were aged 60 and above, with nearly one-third in the 45-59 age group. Regarding left ventricular geometry, we found eccentric left ventricular hypertrophy (LVH) in 42% of patients and concentric LVH in 30%. Regular left ventricular geometry was observed in 20% of the cases. In this study, the prevalence of left ventricular hypertrophy was 72%. ***Conclusion:*** Among patients with type 2 diabetes mellitus (T2DM), the prevalence of left ventricular hypertrophy (LVH) is alarmingly high, with a slightly higher frequency of eccentric LVH compared to concentric LVH. T2DM and LVH most likely have a reciprocal relationship, meaning that each illness may impact the onset or course of the other

Keywords: *Hypertension, Left ventricular hypertrophy, LVH, Prevalence, Type-2 diabetes mellitus, T2DM*

1. INTRODUCTION

Type-2 diabetes mellitus (T2DM), together with Diabetes mellitus, has become a significant public health problem of this century. The World Health Organization reports that diabetes affects more than 150 million people worldwide at present, and this population is predicted to rise to 300 million by 2025. Most new diabetes cases will occur in developing countries [1]. Adult patients between 45 and 64 carry a high burden of T2DM across these areas because they represent their working ages, thus inflicting damage to their health along with their economic well-being [1]. Heart diseases from T2DM serve as the primary disease responsible for death among diabetic patients because they contribute to 50% of total mortality rates [2].

Multiple physiological paths lead to cardiovascular complications in people with T2DM. Persistent hyperglycemia, insulin resistance, oxidative stress, and low-grade inflammation play central roles in vascular and myocardial remodeling. The cardiac manifestation of metabolic dysfunction known as left ventricular hypertrophy (LVH) emerges early as one of the essential cardiovascular complications of this condition [3]. LVH appears as an enlargement of the left ventricular mass, which remains a protective mechanism against elevated hemodynamic load but will eventually lead to heart failure development along with arrhythmias and elevated mortality rates [4]. The metabolic problems of Type 2 Diabetes Mellitus patients make them vulnerable to developing left ventricular hypertrophy independent of diagnosed hypertension [5].

The prevalence of LVH was investigated among T2DM patients through multiple research studies while they measured pressure control factors, diabetes duration, and glycemic control status. Patients with normotensive diabetes have a larger left ventricle than those without the disease [5]. Blood pressure control below 140/90 mmHg is essential for diabetic patients, per the American Diabetes Association recommendation to reduce cardiovascular risks [6]. The inadequate control of diabetes among many patients leads them to face increased risks for target organ damage, with LVH as one of the consequences [7].

Therapeutic evidence indicates that substandard blood sugar management leads to detrimental modifications of the heart structure. Research has demonstrated that both elevated HbA1c levels and fasting blood glucose measurements contribute to an increased risk of developing LVH because metabolic stress leads to faster myocardial tissue enlargement [8,9]. Research about LVH prevalence in type 2 diabetes mellitus patients exists globally, yet South Asian populations with high diabetes and heart disease rates lack their own specific studies.

The main objective of this study is to assess the frequency of left ventricular hypertrophy in patients with type-2 diabetes mellitus who receive care at a tertiary hospital in Bangladesh. This study reveals LVH frequencies in diabetic patients with the primary goal of highlighting early cardiac screening standards and combined metabolic-cardiovascular patient care systems for diabetic patients.

Objective

The objective of this study was to determine the prevalence of left ventricular hypertrophy among patients with type-2 diabetes mellitus.

2. METHODOLOGY & MATERIALS

This prospective observational study was conducted at the Department of Cardiology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from June 2022 to May 2023. A total of 87 patients with type-2 diabetes mellitus (T2DM) were included in this study. A convenient purposive sampling technique was used for the sample selection.

Sample Selection

Inclusion Criteria:

- Patients aged between 20 and 70 years.
- Diagnosed cases of type-2 diabetes mellitus.
- Willingness to provide informed written consent.

Exclusion Criteria:

- Patients with type-1 diabetes mellitus.
- Presence of electrocardiographic abnormalities.
- Patients with atrial fibrillation, flutter rhythms, or distorted ECGs.
- Those undergoing renal dialysis.
- History of myocardial infarction or recent hospitalization due to cardiac events.
- Incomplete or unavailable echocardiographic data.

Data collection procedure

Data on demographic and clinical characteristics, including age, sex, BMI, duration and control of diabetes and hypertension, FBS, HbA1C, creatinine, lipid profile, and blood pressure, were collected and recorded. Left ventricular geometry was assessed via echocardiography to identify concentric or eccentric LVH. Written informed consent was obtained from the participants. Patient confidentiality was maintained.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using descriptive statistical methods. Key variables were expressed as means ± standard deviation (SD) for continuous data and frequencies or percentages for categorical data. Graphs and charts were generated to present distributions and proportions visually.

3. RESULTS

In this study, most participants (55.2%) were aged 60 and above, with almost one-third falling into the 45-59 age group. All of our patients had hypertension. In this study, 52% of the cases were male, while the remaining 48% were female. In this study, nearly two-thirds of patients had a BMI greater than 27.5 kg/m², while 25.3% had a BMI ranging from 23 to 27.5 kg/m². Upon analyzing the duration of hypertension among the cases, it was found that the majority of patients had a duration of hypertension of less than 5 years. Additionally, 35.6% of the cases had a duration of 5–15 years, and 23.0% had hypertension for more than 15 years. In this study, 60% of the cases had controlled hypertension, while 40% had uncontrolled hypertension. Upon analyzing the duration of diabetes among the cases, it was observed that nearly half of the patients (46.0%) had a duration of diabetes of less than 5 years. Additionally, 37.9% of the cases had diabetes for 5–15 years, and 16.1% had diabetes for more than 15 years. In analyzing the patients' fasting blood sugar, we found that nearly three-fourths of the cases (71.3%) had controlled levels, while the rest (28.7%) had uncontrolled levels. The diagnostic findings indicate that systolic blood pressure had an average of 144 mm Hg (±11.4), while diastolic blood pressure averaged 79 mm Hg (±9.7). The HbA1C level was 7.8% (±1.2%). Creatinine levels averaged 1.2 (±0.27). Total cholesterol was measured at 4.9 mmol/l (±0.22). Additionally, the LDL-cholesterol was 3.4 (±0.28), and the HDL-cholesterol result was 5.71 (±1.9). According to the analysis of left ventricular geometry, eccentric left ventricular hypertrophy (LVH) was found in 42% of the patients, while concentric LVH was observed in 30%. Expected results were observed in 20% of the cases. In this study, the prevalence of left ventricular hypertrophy was 72%.

Table 1: Age distribution of patients (N=87)

Age (Years)	Number of patients (n)	Percentage (%)
<45	9	10.3%
45–59	30	34.5%
≥60	48	55.2%
Total	87	100%

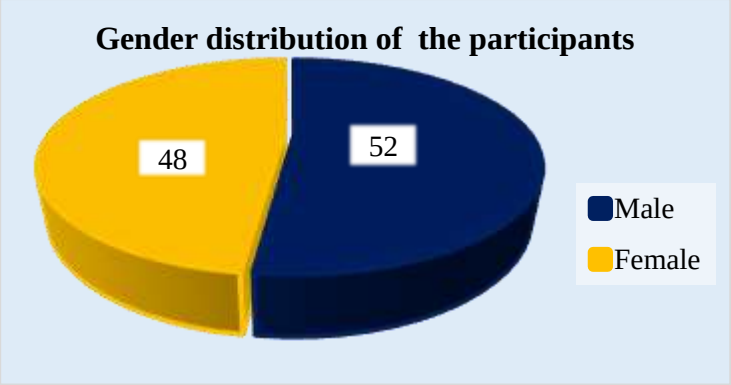

Figure I: Pie chart showed gender wise patients' distribution (N=87)

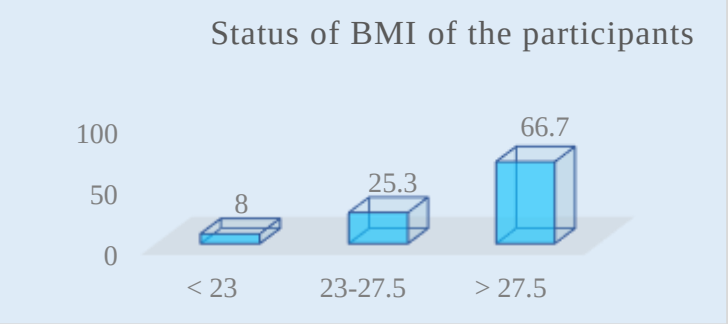

Figure II: Column chart showed BMI status wise patients (N=87)

Table 2: Duration of hypertension (N=87)

Duration of hypertension	Number of patients (n)	Percentage (%)
<5 years	36	41.4%
5–15 years	31	35.6%
>15 years	20	23.0%

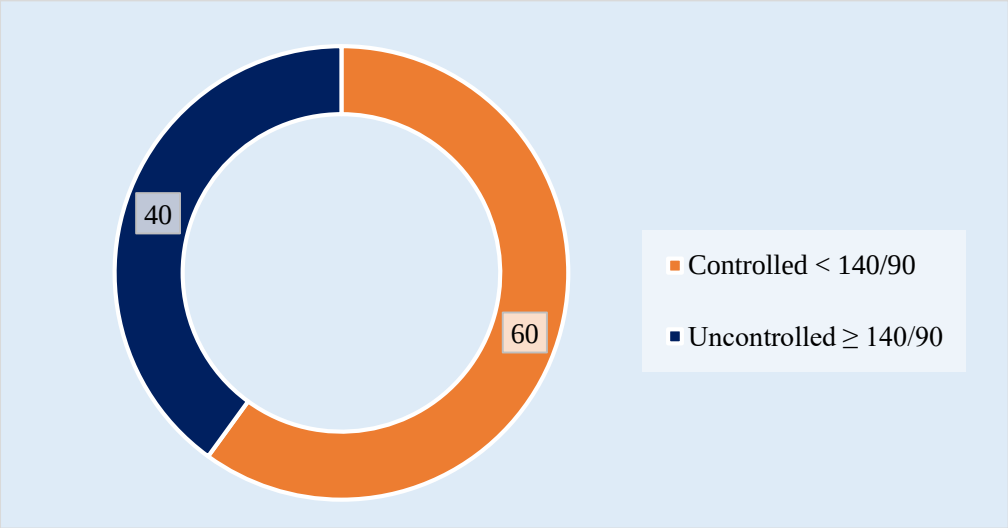

Figure III: Ring chart showed control of hypertension (mmHg) among patients (N=87)

Table 3: Duration of diabetes (N=87)

Duration of diabetes	Number of patients (n)	Percentage (%)
<5 years	40	46.0%
5–15 years	33	37.9%
> 15 years	14	16.1%

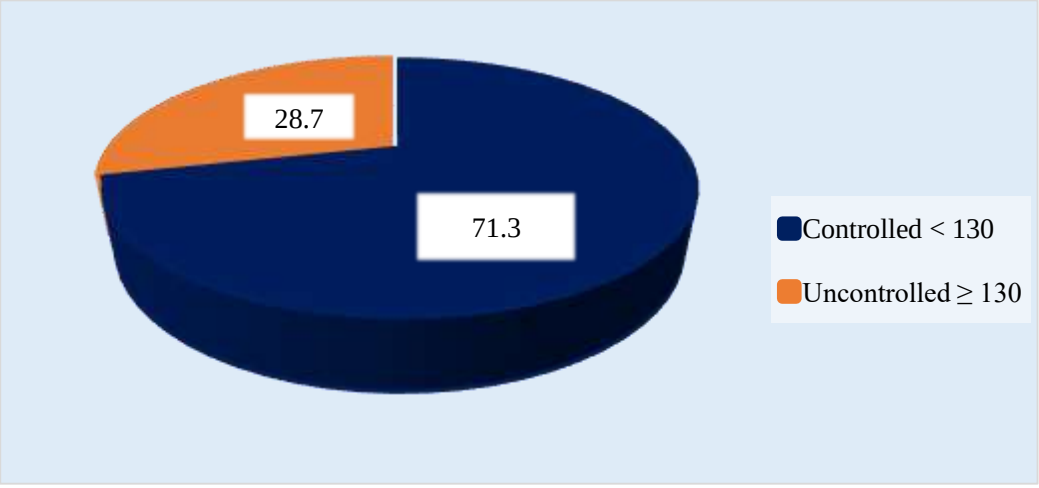

Figure IV: Pie chart showed status of fasting blood sugar level (mg/dl) among patients (N=87)

Table 4: Diagnostic findings (N=87)

Diagnostic findings	Mean ±SD
Systolic BP (mm Hg)	144±11.4
Diastolic BP (mm Hg)	79±9.7
HbA_1C (%)	7.8 ±1.2%
Creatinine	1.2 ±0.27
Total cholesterol (mmol/l)	4.9 ±0.22
LDL-cholesterol (mmol/l)	3.4 ±0.28
HDL-cholesterol (mmol/l)	5.71 ±1.9

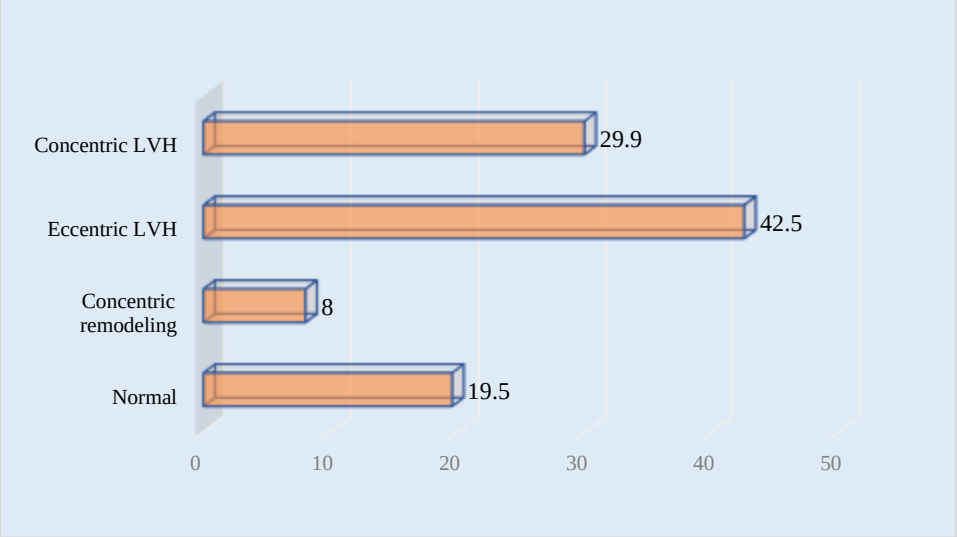

Figure V: Bar chart showed left ventricular geometry in the patients (N=87)

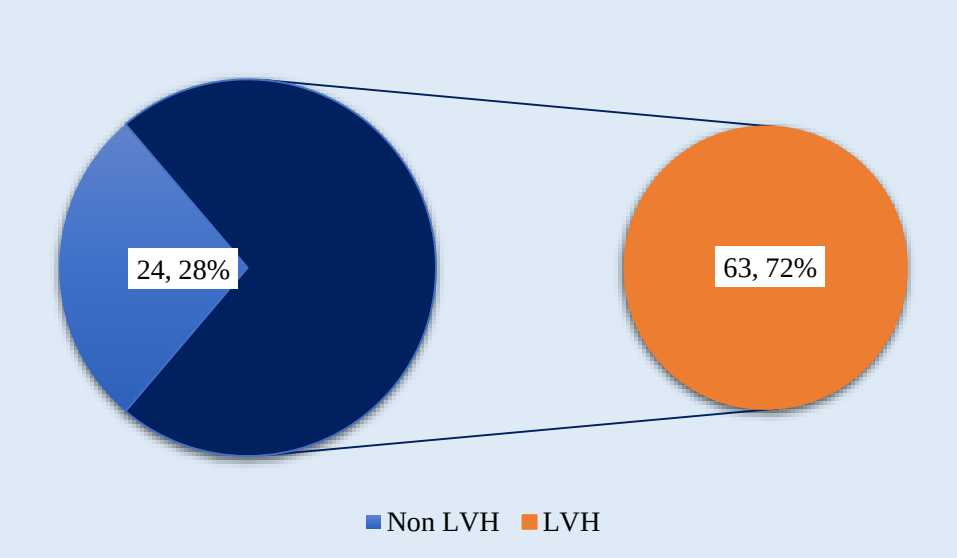

Figure VI: Pie chart showed prevalence of LVH among patients (N=87)

4. DISCUSSION

The research examined left ventricular hypertrophy (LVH) frequency among type-2 diabetes mellitus (T2DM) patients at a tertiary care center in Bangladesh. A significant proportion of 72% of patients with type-2 diabetes mellitus showed LVH findings through research, while eccentric LVH affected 42% of cases alongside 30% identified with concentric LVH. The study results demonstrate how individuals with T2DM face severe cardiovascular issues while confirming that diabetes acts as a leading independent cause for heart structural abnormalities.

The LVH prevalence rates stated by Dawson et al. equaled between 43% and 71% depending on study population characteristics and diagnostic criteria used [10]. Parsa et al. analyzed diabetic patients in Shiraz, Iran, for their study and discovered that LVH affected 88% of participants, with eccentric hypertrophy occurring more than concentric hypertrophy [11]. The prevalence rates of LVH demonstrate that this condition exists widely in diabetic populations worldwide, especially among South Asians and Middle Eastern communities.

Different research studies documented significantly reduced numbers of patients with LVH. Nardi et al. discovered an LVH occurrence of 20.7% in diabetic subjects [12], while our study demonstrated an LVH prevalence of 72%, which held opposite results. These discrepancies in findings can result from population variations along with diabetes duration, glycemic and blood pressure control levels, and the detection tools used for LVH diagnosis (electrocardiography or echocardiography). The research data showed that body mass index (BMI) exceeded 27.5 kg/m² in 63% of patients, and uncontrolled hypertension was present in 40% of patients who were both known risk factors for left ventricular mass enlargement and hypertrophy. The patients with a diabetic timeline exceeding 5 years demonstrated an estimated 54% rate since the diabetes status might have reinforced the structural cardiac changes.

Glycemic control for our patients showed poor results since 28.7% of patients reported fasting blood sugar levels above 130 mg/dL. Evidence from Jobe et al. establishes that LVH develops from uncontrolled hyperglycemia mainly when assessed through electrocardiographic measurements [13]. Elderly diabetes patients displayed echocardiographic LVH and ventricular function impairment at higher rates compared to non-diabetic elderly adults, according to findings from Lee et al. [14]. Based on these findings, extended metabolic disorder plays a significant role in generating cardiac remodeling.

The main contribution of our study revealed eccentric LVH to be more commonly observed than concentric LVH. The prevalent mechanism of volume overload in this pattern can result from prolonged high blood glucose and high insulin levels, together with energy malfunction in the heart tissue. Research by Santra et al. found that normotensive diabetic patients possessed enlarged left ventricular mass that exceeded measurements from non-diabetic patients due to diabetes-specific metabolic effects on the heart [5].

This study delivers broad implications that will affect medical service delivery. Due to the common occurrence of LVH in diabetic patients, it becomes essential to establish echocardiography testing as a standard assessment during diabetes care. The discovery of LVH during the early stages enables medical practitioners to start proper interventions through better blood pressure management and lifestyle changes with improved glycemic control. The timely implementation of these treatment methods appears to stop LVH from developing into heart failure along with its related cardiovascular complications. Estimating dyslipidemia and cholesterol uptake impairment as major factors that contribute to diabetic cardiovascular issues according to Seto et al. highlights the necessity of lipid treatment for these patients [15].

This research supports policy development. For Bangladesh and other low—and middle-income regions, reducing access to advanced testing resources leads to a priority need for implementing budget-friendly screening equipment while teaching patients about their cardiovascular dangers. Implementing long-term blood pressure regulation alongside diabetes control measures will efficiently lower LVH occurrences and its linked medical problems.

Discrepancies between our findings and previous studies may be due to ethnic differences, diagnostic criteria, and healthcare access. Research by Lv et al. demonstrated that diabetes and LVH influence each other because elevated blood pressure from diabetes typically leads to ventricular enlargement, which worsens diabetes pathology [16]. This two-way hypothesis demonstrates why diabetic patient treatment should use a comprehensive care plan which addresses both metabolism-related and structural cardiovascular conditions.

5. CONCLUSION AND RECOMMENDATIONS

In patients with type 2 diabetes mellitus (T2DM), left ventricular hypertrophy (LVH) is notably prevalent, with eccentric LVH slightly more frequent than concentric LVH. The interplay between T2DM and LVH is bidirectional, indicating each may contribute to the other's development or progression. This relationship underscores the need for integrated management strategies addressing metabolic and cardiovascular health in T2DM patients. Healthcare professionals should optimize glycemic control, manage blood pressure, and address cardiovascular risk factors. Regular cardiac monitoring and tailored

interventions could help mitigate LVH's impact in T2DM patients.

Limitations of the study

The small sample size and single-center design may limit our findings' generalizability. While valuable, echocardiographic assessment could be complemented by advanced imaging techniques like cardiac MRI in future studies for greater accuracy in characterizing LV geometry. We did not assess additional confounders such as smoking status, physical activity, or medication adherence, which could influence LVH development.

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