

**Original Research Article**

# A study on the prevalence of diastolic dysfunction in type 2 diabetes mellitus in a tertiary care hospital

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## Abstract

**Background:** A high prevalence of cardiac failure has been reported in diabetes mellitus. Worldwide, this represents a major burden to the health care systems. The association of cardiovascular events and diabetes mellitus emphasizes the need for a screening test like echocardiography to gain knowledge about the cardiac status in diabetic patients.

**Materials and methods:** The present study conducted in a tertiary care hospital over a period of 2 months was designed to determine the prevalence of diastolic dysfunction in type 2 diabetes mellitus and also to assess the risk factors contributing to its cardiovascular complications. A total of 120 patients of both sexes with type 2 diabetes mellitus of any duration were included in the study. Echocardiography was used to investigate for diastolic dysfunction.

**Results:** A total of 66 diabetic patients were detected with diastolic dysfunction among the 120 subjects under study. Highest prevalence of left ventricular diastolic dysfunction was observed in the female population and in the individuals belonging to the age group of more than 45 years. Statistical analysis revealed a significant association between the glycosylated hemoglobin and diastolic dysfunction in diabetic patients with a P-value of 0.001.

**Conclusion:** Cardio vascular disorders accounts for major morbidity and mortality in patients with diabetes mellitus, which may predispose to the development of diabetic cardiomyopathy leading to congestive cardiac failure. Prompt diagnosis and treatment prevents the progression of heart failure in insulin resistance.

## Key words

Diastolic dysfunction, Type 2 diabetes mellitus, Echocardiography, Cardiomyopathy.

## Introduction

More recent data have demonstrated the increasing trend in the incidence of diabetes mellitus. Diastolic dysfunction which is an important predictor of heart failure is commonly encountered in type 2 diabetes mellitus. Left Ventricular Diastolic dysfunction is the early preclinical manifestation of specific cardiomyopathy. The Etiopathogenesis of this diastolic dysfunction, which is a key component of cardiomyopathy, still remains unclear [1]. Several epidemiological studies done worldwide have proved the association between left ventricular diastolic dysfunction and T2DM [2]. Around 75% of diabetic patients has been reported to die from cardiovascular pathology [3]. Echocardiography serves as an essential and excellent non-invasive diagnostic tool in assessing the structural and functional changes in the heart [4]. Several risk factors such as hyperglycemia, hyperlipidemia, and obesity contribute in the evolution of congestive heart failure in diabetes mellitus [5]. Heart failure which is one of the most common complications in diabetic population produces a greater impact globally on the public health. The increase in the cardiovascular complications attributable to diabetes mellitus necessitates the screening for cardiovascular events in diabetic patients.

The objective of this study is to determine the incidence of diastolic dysfunction in diabetic patients and to evaluate the risk factors

associated with diabetes and its cardiovascular complications.

## Materials and methods

This observational descriptive study was done in 120 diabetic patients attending the general medicine outpatient department in Tagore Medical College and Hospital. The study population included patients with history of type 2 diabetes mellitus of any duration and with normal left ventricular systolic function. Both male and female subjects in the age group of 35-65 years were involved in the study. Patients with pre-existing systemic hypertension, coronary artery disease, alcoholism, gestational diabetes mellitus and type 1 diabetes mellitus were excluded from the study. The study was conducted for a period of two months from April 2016 to May 2016. The recent study was initiated after obtaining approval from institutional ethics committee. Informed written consent was obtained from each diabetic subject. A detailed medical history was collected from the study population using a structured questionnaire. They also underwent complete physical examination and biochemical investigations. Demographic data (age, sex, socioeconomic status, co-morbid conditions like hypertension, coronary artery disease, chronic kidney disease, hypothyroidism), anthropometric measurements (height, weight, body mass index, waist circumference, waist-hip ratio) and metabolic parameters (fasting and 2 hours post-prandial blood glucose, HbA1C, lipid profile) were

investigated and recorded. Electrocardiogram, chest X-ray, ultra sonogram was also done for all eligible patients. All the patients included in the study underwent echocardiographic evaluation to assess the left ventricular diastolic function. Data documented and analyzed using Statistical Package for Social Sciences (SPSS), Pearson's Chi Square Analysis test and Fisher exact probability test.

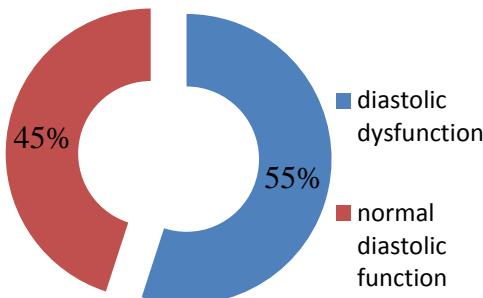
### Echocardiography

Echocardiograms were recorded with TOSHIBA nemio XG ultrasound system using 2D and Doppler analysis. Subjects were examined in Left Lateral Decubitus and Supine Posture using standard parasternal long axis, short axis and apical views. All recordings and measurements were done by the same observer according to the recommendation of American Society of Echocardiography [6]. The parameters studied were ejection fraction (EF), left ventricle posterior wall diameter (LPWD), transmural early diastolic rapid filling velocity (E), atrial contraction late filling velocity (A) and E/A ratio. E/A ratio less than 1 or more than 2 represents left ventricular dysfunction.

### Results

Among the 120 patients studied, a total of 66 (55%) individuals were identified to have diastolic dysfunction by echocardiography (**Figure – 1**).

**Figure 1: Prevalence of diastolic dysfunction in type 2 diabetes mellitus**



The frequency and percentage of the parameters studied among the diabetic population were given in **Table - 1**. **Table - 2** shows the mean and standard deviation of the characteristics evaluated in this study.

**Table - 1:** Frequency of the variables in type 2 diabetes mellitus (n=120).

Variables	Frequency (%)	
Gender	Male	73 (60.8%)
	Female	47 (39.2%)
Age Group	< 45 years	33 (27.5%)
	> 45 years	87 (72.5%)
Duration of diabetes	< 5 years	84 (70.0%)
	> 5 years	36 (30.0%)
E/A Ratio	<1	95 (75.8%)
	> 2	29 (24.2%)

**Table - 2:** Demographic, metabolic and echocardiography variables in type 2 diabetes mellitus.

Variables	Mean $\pm$ S.D
Age	50.4 $\pm$ 8.358
Age of onset	45.9 $\pm$ 9.229
Height	154.73 $\pm$ 9.420
Weight	59.93 $\pm$ 11.786
Body mass index	24.59 $\pm$ 4.216
Waist circumference	88.31 $\pm$ 8.649
Waist hip ratio	0.921 $\pm$ 0.113
Fasting blood sugar	157.68 $\pm$ 56.631
2 hours post-prandial blood sugar	248.71 $\pm$ 78.485
Glycosylated hemoglobin(HbA1C)	9.59 $\pm$ 1.899
Cholesterol	179.74 $\pm$ 36.677
Triglycerides	164.28 $\pm$ 60.826
Low-density lipoprotein	96.62 $\pm$ 31.698
High-density lipoprotein	39.57 $\pm$ 8.984
Very low-density lipoprotein	42.19 $\pm$ 10.568
EF	66.25 $\pm$ 3.804
LPWD	10.61 $\pm$ 0.919
E	77.24 $\pm$ 19.154
A	78.24 $\pm$ 12.945
E/A RATIO	1.04 $\pm$ 0.201

The risk factors associated with diabetes and cardiovascular diseases such as advancing age, male gender, obesity and hyperlipidemia were given in **Table - 3** and **Table - 4**.

Statistical analysis of the data in **Table - 4** shows a significant association between the level of glycosylated hemoglobin and diastolic dysfunction.

**Table - 3:** Comparison of the risk factors of diabetes and diastolic function (n=120).

Variable		Diabetic patients with diastolic dysfunction (frequency and percentage)	Diabetic patients with normal diastolic function (frequency and percentage)
Age	< 45 years	13 (10.8%)	20 (16.7%)
	>45 years	53 (44.2%)	34 (28.3%)
Gender	Male	25 (20.8%)	48 (40.0%)
	Female	41 (34.2%)	6 (5.0%)
Body mass index	< 23 kg/m <sup>2</sup>	24 (20.0%)	6 (5.0%)
	>23 kg/m <sup>2</sup>	42 (35.0%)	48 (40.0%)
HbA1c	< 7%	2 (1.7%)	47 (39.2%)
	> 7%	64 (54.3%)	7 (5.9%)

**Table - 4:** Comparison of the different parameters in diabetic patients with and without diastolic dysfunction.

Variable	Diabetic patients with diastolic dysfunction (Mean and SD)	Diabetic patients with normal diastolic dysfunction (Mean and SD)	P-value
Age (Years)	52.1061±8.398	48.333±7.8979	0.680
Duration of diabetes (Years)	5.341±3.4899	4.4074±3.5886	0.769
Body mass index (kg/m <sup>2</sup> )	24.25±3.9758	24.945±4.478	0.596
Waist circumference (WC-cm)	88.18±7.8394	88.463±9.621	0.287
Waist hip ratio (WHR)	0.9284±0.1203	0.9122±0.995	0.169
Total cholesterol	180.3788±35.805	178.9630±38.0597	0.838
Triglyceride	166.9545±49.9295	161±74.74	0.504
LDL-cholesterol	98.2121±30.7988	94.667±32.949	0.841
HDL- cholesterol	40.0909±10.3221	38.9444±7.0588	0.504
HbA1c (%)	9.8515±2.1399	9.1593±1.5266	0.001
EF (%)	66.333±3.9432	66.1481±3.6622	0.546
E/A Ratio	0.815±0.1753	1.2463±0.2075	0.106

## Discussion

Diabetes is an important risk factor of cardiomyopathy which evolve to heart failure. A detailed evaluation of the cardiovascular function in diabetes mellitus by echocardiography is useful to demonstrate left ventricular diastolic dysfunction. The association of diabetes with

hypertension, obesity and dyslipidemia derange the left ventricular diastolic function earlier. The study population comprised of 73 (60.8%) males and 47 (39.2%) females among the total of 120 patients with history of type 2 diabetes mellitus of any duration. The mean age of the subjects was 50.4±8.358 years. Diabetic patients with diastolic dysfunction was compared with the

population with normal echocardiogram findings using several parameters such as age, gender, body mass index, duration and family history of diabetes, lipid profile and glycosylated hemoglobin. The prevalence of diastolic dysfunction in diabetic subjects in the present study was 66 (55.0%). This finding is in accordance with the study conducted by Patil, et al. in which the prevalence rate of diastolic dysfunction was 54.33% [1]. Diastolic dysfunction was found to be higher in the older people of more than 45 years of age compared to the individuals in the age group of less than 45 years. The prevalence of diastolic dysfunction in the males and females were 25 (20.8%) and 41 (34.2%) respectively. Higher prevalence rate of diastolic dysfunction was noted among the elderly diabetic women in the study by Alfried Germing, et al. [7]. This similar trend was also observed in the study under discussion. Among the 66 diabetic patients with diastolic dysfunction, obesity was observed in 42 individuals with a body mass index of more than  $23 \text{ kg/m}^2$ . This result was supported by the study by Russo, et al. [8] which showed a strong correlation between obesity and left ventricular diastolic dysfunction. Diastolic dysfunction was more prevalent in the patients with higher HbA1C. The mean value of HbA1C of the subjects with diastolic dysfunction was  $9.8515 \pm 2.1399$  and that of the patients with normal diastolic function was  $9.1593 \pm 1.5266$ . Statistical significance exists between HbA1C and diastolic dysfunction in type 2 diabetic patients. This data implies a close association of glycosylated hemoglobin and diastolic dysfunction. The fact that the value of HbA1C is directly proportional to the incidence of diastolic dysfunction also has been reported by Abhay Kumar Chaudhary, et al. in their study conducted in Meerut [9]. Echocardiography has been of immense help in this study to diagnose diastolic dysfunction in diabetic subjects who were normotensive and with no known cardiac disease. The clinical use of 2D echocardiogram in detecting the cardiac derangements in type 2 diabetes mellitus has been justified in various studies [10]. Left ventricular diastolic

dysfunction represents the earliest first stage indicator of diabetic cardiomyopathy [11, 12] and thus evaluation of cardiac status is mandatory in all diabetic patients.

## Conclusion

Diabetes has been established as one of the major etiological factor in the development of cardiomyopathy and consequently heart failure. The results from this study reinforce the vital role of echocardiogram to evaluate the diastolic functional parameters. Early diagnosis and therapeutic interventions in diabetes mellitus before the deleterious cardiac sequelae become established, modulate the cardiac metabolism and prevent congestive cardiac failure.

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