e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(1); 343-349

Original Research Article

A Study on Diastolic Dysfunction in Newly Diagnosed Type 2 Diabetes Mellitus and Its Correlation with Glycosylated Hemoglobin

Chiranjeevi Parnapalli[1], Bhargav Kiran Gaddam[2], Mani Ratnam Kothamasu[3]

[1]Postgraduate, General Medicine, Mahatma Gandhi medical College and Research Institute, Sri Balaji Vidyapeeth University, Pondicherry

[2]Associate Professor, General medicine, Mahatma Gandhi medical College and Research Institute, Sri Balaji Vidyapeeth University, Pondicherry

[3]DMO, Cardiology, Anu Neuro & Cardiac Sciences, Vijayawada, Andhra Pradesh

Received: 01-10-2025 / Revised: 15-11-2025 / Accepted: 21-12-2025

Corresponding author: Dr. Bhargav Kiran Gaddam

Conflict of interest: Nil

Abstract

Background: Diabetes mellitus (DM) is a long-term metabolic disease marked by elevated blood glucose levels, resulting from inadequate insulin production, resistance to insulin effects, or a combination of both. The interplay between diabetes and cardiovascular health is particularly important in the context of diastolic dysfunction, a precursor to heart failure with preserved ejection fraction (HFpEF).

Objective: This study investigates the occurrence of diastolic dysfunction in individuals newly diagnosed with type 2 diabetes mellitus (T2DM) and examines its association with glycosylated haemoglobin (HbA1c), a key indicator of long-term blood glucose regulation.

Methods: The prospective non interventional study was conducted for one year duration on 52 newly diagnosed type 2 diabetes mellitus aged between 18 to 60 years. ECG, 2D ECHO, FBS, PPBS, HBA1C was done. The study was conducted on the basis of presence of diastolic dysfunction on echocardiography. Quantitative data was analysed with the help of 't' test and qualitative data with the Chi Square and Fisher Exact Test. Statistical significance was taken as $P < 0.05$.

Results: Among 52 participants, individuals aged ≤55 years, only 5 (22.7%) had LV diastolic dysfunction, while among those older than 56 years, a substantial 24 (80.0%) had LV diastolic dysfunction. The distribution based on gender shows equal prevalence of LV diastolic dysfunction among both males and females. Among individuals with HbA1c <6.4%, 4 (50.0%) had LV diastolic dysfunction, while those with HbA1c ≥6.5%, a larger proportion, 25 (56.8%), had LV diastolic dysfunction. Among individuals with FBS <125 mg/dL, 9 (42.9%) had LV diastolic dysfunction, while those with FBS ≥126 mg/dL, 20 (64.5%) had LV diastolic dysfunction. Among individuals with PPBS <200 mg/dL, 10 had LV diastolic dysfunction, while those with PPBS ≥200 mg/dL, 19 had LV diastolic dysfunction.

Conclusion: Left ventricular diastolic dysfunction (LVDD) is frequently present in newly diagnosed, normotensive type 2 diabetes mellitus (T2DM) patients, indicating that subclinical cardiac involvement may start early in the disease course. Implementation of early cardiac evaluation, combined with stringent glycemic control and lifestyle modifications, may potentially delay or prevent the progression to overt heart failure in diabetic individuals.

Keywords: Type 2 Diabetes Mellitus, Left ventricular diastolic dysfunction, Glycosylated haemoglobin (HbA1c).

DOI: 10.25258/ijcpr.18.1.56

Introduction

Type 2 diabetes mellitus (T2DM) is a long-standing metabolic condition marked by insulin resistance and an inadequate compensatory insulin secretion, leading to sustained elevations in blood glucose levels. It is the most prevalent form of diabetes, commonly linked to lifestyle factors, genetic predisposition, and components of metabolic syndrome such as obesity and hypertension. [1-3] The global prevalence of diabetes has seen an alarming rise over recent decades. According to 2024 statistics, over 800 million adults are currently living with diabetes worldwide, a staggering increase that underscores the scale of this public health challenge. India, often referred to as the "diabetes capital of the world," is home to an estimated 212 million

individuals with diabetes in 2024. Urbanization, changing dietary patterns, and genetic predisposition contribute to this phenomenon, making diabetes a major healthcare concern in the Indian subcontinent. This surge has profound implications, as diabetes is a major risk factor for cardiovascular diseases, including diastolic dysfunction. [4-5]

The relationship between T2DM and diastolic dysfunction is increasingly recognized, with hyperglycaemia playing a central role in its pathogenesis. Chronic high blood glucose levels lead to myocardial fibrosis, increased oxidative stress, and changes in calcium handling within cardiac myocytes. These pathological changes result in increased ventricular stiffness and impaired myocardial relaxation. Studies have shown a prevalence of diastolic dysfunction ranging from 30% to 75% in individuals with diabetes, with the variability influenced by factors such as age, duration of diabetes, and glycaemic control. [6-8]

Persistently high HbA1c levels are strongly linked to an increased likelihood of cardiovascular complications, particularly diastolic dysfunction. The pathophysiological mechanisms linking HbA1c and diastolic dysfunction include chronic inflammation, endothelial dysfunction, and myocardial fibrosis.[9]

Identifying the correlation between HbA1c levels and diastolic dysfunction can help clinicians prioritize glycaemic control as part of a comprehensive strategy to mitigate cardiovascular risks. This study aims to fill the existing knowledge gaps by investigating the prevalence of diastolic dysfunction in newly diagnosed T2DM patients and evaluating its association with HbA1c levels. Such insights can contribute to the development of tailored interventions for improving cardiovascular outcomes in this population.[10]

Materials and Methods

This is a prospective non interventional study carried out in Department of General Medicine, Mahatma Gandhi Medical College and Research Institute, Pondicherry. Consecutive sampling of all patients reporting with newly diagnosed type 2 diabetes mellitus was carried out for one year (recruitment period). Newly diagnosed type 2 diabetes mellitus under the age of 18-60 years were considered as inclusion criteria. All patients with already diagnosed type 2 DM and taking antidiabetic treatment, cardiac diseases like valvular heart disease, ischemic and hypertensive heart disease, congestive heart failure, cardiomyopathy, renal failure, chronic pulmonary disease, severe anaemia and haemoglobinopathies were excluded from the study

Methodology

Patients with Cardiac disease presenting to Department of General Medicine (OPD, EMS and Inpatient), Mahatma Gandhi Medical College and Research Institute, Puducherry were assessed based on inclusion/exclusion criteria. After selection, informed consent was obtained from the eligible subjects. Data was collected on dependent and independent variables using a semi-structured proforma which recorded demographic details and relevant clinical and laboratory data from the study subjects. Patients underwent thorough clinical examination supported by relevant investigations like blood glucose on admission, FPG/PPPG, renal function tests including electrolytes, fasting lipid profile (FLP), ECG, routine urine and microscopy study, fundoscopy, chest radiography and HBA1C was estimated. Diastolic dysfunction was evaluated by echocardiography according to recommendations of the American Society of Echocardiography. Data was summarized and presented as tabular and graphical presentations with calculated measures of central tendency and/or measures of variation.

In Chaudhary et al study done in 2015 in Uttar Pradesh, the HBA1C levels in the LVDD was 7.67+.9 and without LVDD was 7.24+.64. With this means and standard deviations, 95% confidence interval and 10% alpha error, the sample size was calculated to be 26 in each group (52 in total) by Open Epi software.

Results

Age and Gender: The study was conducted on 52 patients to evaluate the age and sex distribution of the patient. The severity of the disease was also studied in both the genders and different age groups. The distribution of LV diastolic dysfunction across different age groups reveals a significant trend. Among individuals aged ≤55 years, only 5 (22.7%) had LV diastolic dysfunction, while 17 (77.3%) did not. In contrast, among those older than 56 years, a substantial 24 (80.0%) had LV diastolic dysfunction, whereas only 6 (20.0%) were free from it. The mean age of individuals with LV diastolic dysfunction was significantly higher (66.9 ± 10.8 years) compared to those without (43.9 ± 13.3 years), with a statistically significant p-value (<0.001).

The distribution based on gender shows that both males and females have a similar prevalence of LV diastolic dysfunction. Among females, 14 (53.8%) had the condition, while 12 (46.2%) did not. Similarly, among males, 15 (57.7%) had LV diastolic dysfunction, whereas 11 (42.3%) did not.

Distribution according to HBA1c levels were detailed in Table 1 and Figure 1.

Table 1: Distribution according to the HbA1c

HbA1c	LV Diastolic Dysfunction Present	LV Diastolic Dysfunction Absent	Total
<6.4%	4 (50.0%)	4 (50.0%)	8
≥6.5%	25 (56.8%)	19 (43.2%)	44
Total	29	23	52

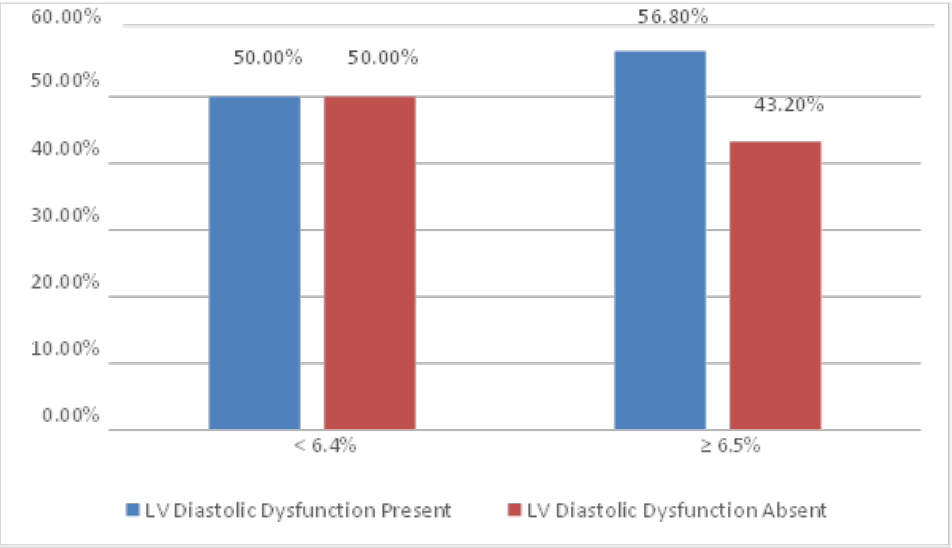

Figure 1: Distribution according to the HbA1c

Fasting blood glucose levels appear to have a relationship with LV diastolic dysfunction. Among individuals with FBS <125 mg/dL, 9 (42.9%) had LV diastolic dysfunction, while 12 (57.1%) did not. In contrast, among those with FBS ≥126 mg/dL, 20 (64.5%) had LV diastolic dysfunction, while 11 (35.5%) did not. Distribution according to FBS levels were explained in figure 2.

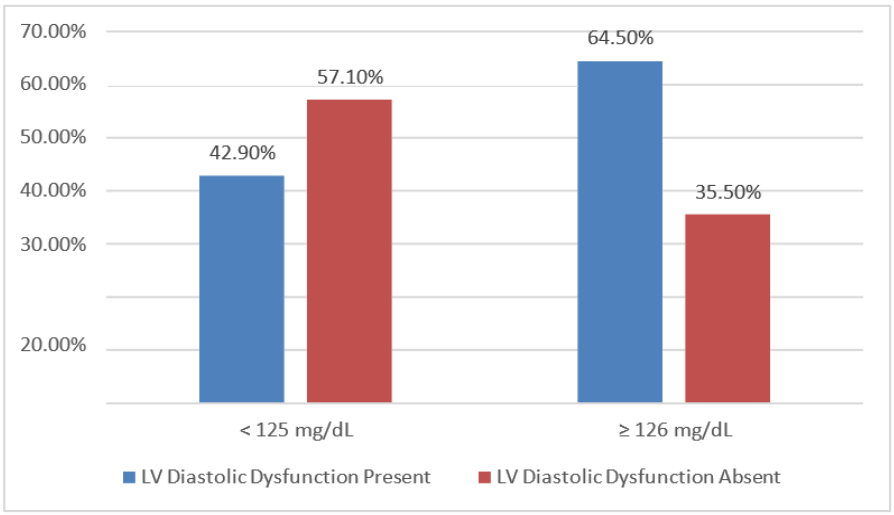

Figure 2: Distribution according to the Fasting Blood Glucose

Postprandial blood glucose levels also appear to influence the prevalence of LV diastolic dysfunction. Among individuals with PPBS <200 mg/dL, 10 (41.7%) had LV diastolic dysfunction, whereas 14 (58.3%) did not. However, among those with PPBS ≥200 mg/dL, a higher proportion, 19 (67.9%), had LV diastolic dysfunction compared to 9 (32.1%) who did not.

Table 2: Mean comparison of different variables

Variable	LV Diastolic Dysfunction Present (mean ± SD)	LV Diastolic Dysfunction Absent (mean ± SD)	P value (T Test)
Age (in years)	66.9± 10.8	43.9± 13.3	<0.001
HbA1C (%)	7.30± 1.34	7.71± 2.10	0.388
FBS (mg/dl)	162 ± 46.6	143 ± 63.9	0.218
PPBS (mg/dl)	207 ± 53.2	183 ± 70.2	0.178

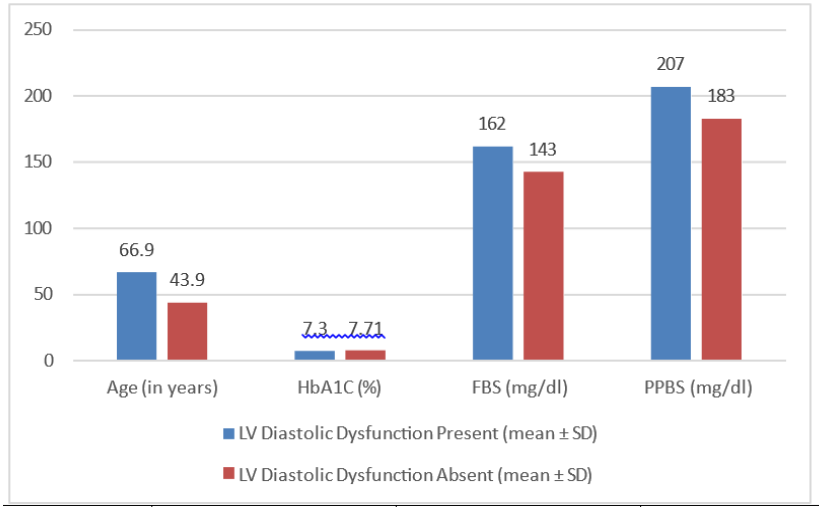

Figure 3: Mean comparison of different variables

The mean comparison highlights key differences between individuals with and without LV diastolic dysfunction. However, there was no significant difference in mean HbA1c levels (p=0.388), fasting blood glucose levels (p=0.218), or postprandial blood glucose levels (p=0.178) between the two groups. Mean comparison of different variables explained in Table 2 and Figure 3. Association of LV diastolic dysfunction with age and gender explained in Table 3 and Table 4 respectively.

Table 3: Association of LV diastolic dysfunction and age

Age	LV Diastolic Dysfunction		Total	p Value
	Absent	Present		
≤ 55 years	17	5	22	0.763
>56 years	6	24	30	
Total	23	29	52	

Table 4: Association of LV diastolic dysfunction and gender

Gender	Lv Diastolic Dysfunction		Total	p Value
	Absent	Present		
Female	12	14	26	0.549
Male	11	15	26	
Total	23	29	52	

When examining the relationship between fasting blood glucose levels and LV diastolic dysfunction, it was observed that among individuals with FBS <125 mg/dL, 9 had LV diastolic dysfunction, whereas 12 did not. In contrast, among those with FBS ≥126 mg/dL, 20 had LV diastolic dysfunction, whereas 11 did not. The McNemar test did not indicate a significant association (χ^2=0.200, p=0.655), suggesting that fasting blood glucose levels alone may not be a strong predictor of LV diastolic dysfunction.

The relationship between postprandial blood glucose and LV diastolic dysfunction was analyzed. Among individuals with PPBS <200 mg/dL, 10 had LV diastolic dysfunction, while 14 did not. Among those with PPBS ≥200 mg/dL, 19 had LV diastolic dysfunction, while 9 did not. However, the McNemar test revealed no significant association (χ^2=0.0526, p=0.819), indicating that postprandial blood glucose levels may not be a strong independent risk factor for LV diastolic dysfunction.

Table 5: Association of LV diastolic dysfunction and HbA1c

HbA1c	Lv Diastolic Dysfunction		Total	p Value
	Absent	Present		
< 6.4%	4	4	8	0.002
≥ 6.5%	19	25	44	
Total	23	29	52	

The association between HbA1c levels and LV diastolic dysfunction was found to be significant and explained in Table 5. Among individuals with HbA1c <6.4%, 4 had LV diastolic dysfunction, whereas 4 did not. However, among those with HbA1c ≥6.5%, 25 had LV diastolic dysfunction, whereas 19 did not. The McNemar test yielded a statistically significant result (χ^2=9.78, p=0.002), indicating that poor glycemic control, as reflected by higher HbA1c levels, is significantly associated with an increased prevalence of LV diastolic dysfunction. Comparison between HBA1C levels and LV diastolic dysfunction levels are depicted in Figure 4.

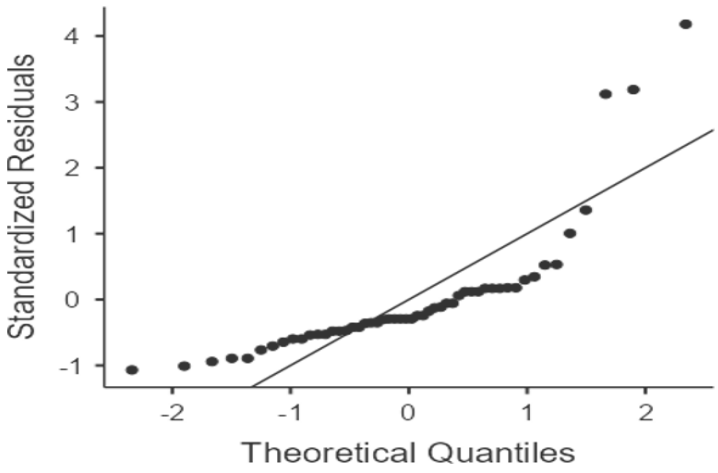

Figure 4: Comparison table between HbA1c levels and LV diastolic dysfunction

Discussion

This study aimed to evaluate the prevalence of left ventricular diastolic dysfunction (LVDD) in individuals newly diagnosed with type 2 diabetes mellitus (T2DM) and to explore its association with glycosylated haemoglobin (HbA1c), a key indicator of chronic glycemic control. The results of this study reveal a notable incidence of subclinical cardiac dysfunction even at the initial stage of diabetes diagnosis, emphasizing the early cardiovascular impact of the disease. In this study, while the difference in mean HbA1c values between those with and without LVDD was not statistically significant, a strong association was observed when patients were categorized by HbA1c thresholds. This suggests that even moderate elevations in HbA1c could influence myocardial relaxation and structure, potentially through mechanisms such as myocardial fibrosis, oxidative stress, and endothelial dysfunction. These findings highlight the necessity of incorporating cardiac screening protocols into the initial evaluation of asymptomatic T2DM patients.

Age emerged as a significant determinant of diastolic dysfunction, aligning with existing literature, while fasting and postprandial glucose levels demonstrated a trend toward association without reaching statistical significance. Gender did not appear to influence the prevalence of LVDD within this sample.

The sharp contrast in prevalence between the older and younger age groups highlights that advancing age is a significant determinant of impaired diastolic function in diabetic individuals, suggesting that age-related myocardial changes are likely compounded by the metabolic disturbances inherent to diabetes.

The findings of the present study, therefore, are in strong concordance with the existing literature, reinforcing the conclusion that age plays a crucial and independent role in the progression of LVDD in patients with T2DM. Thus, the study reinforce the well-established role of age as a significant determinant of left ventricular diastolic dysfunction in patients newly diagnosed with type 2 diabetes and emphasize the importance of early cardiovascular evaluation, particularly in elderly individuals with diabetes

In the present study, parallel distribution of gender did not significantly influence the development of diastolic dysfunction. The minimal difference between male and female prevalence suggests that the metabolic, vascular, and myocardial consequences of diabetes may exert a similar

pathological effect on both sexes, irrespective of gender-related physiological distinctions.

The findings from the present study align closely with the aforementioned research, reinforcing the conclusion that gender does not serve as a protective or predisposing factor in the development of LVDD in T2DM patients. This observation has meaningful clinical implications, as it underscores the importance of uniform cardiovascular risk assessment and echocardiographic screening for LVDD in diabetic patients of both genders, ensuring early detection and intervention regardless of sex. The data further highlight that therapeutic strategies aimed at preventing diastolic dysfunction should focus primarily on glycemic optimization, lifestyle modifications, and early cardiovascular surveillance, rather than differentiating risk based on gender. In the present study, the association between glycemic control, reflected through glycosylated hemoglobin (HbA1c) levels, and the occurrence of left ventricular diastolic dysfunction (LVDD) was carefully analyzed.

Although the numerical difference appears subtle, the results point toward a noticeable trend, where higher HbA1c levels correlate with an increased frequency of LV diastolic dysfunction, suggesting that poor long-term glycemic control might contribute significantly to subclinical myocardial impairment in diabetic individuals.

Zhao et al.[11], in their study focused on newly diagnosed type 2 diabetes mellitus patients, highlighted a remarkably clear and strong relationship between rising HbA1c levels and worsening diastolic function.

Struthers et al.[12] echoed these insights by suggesting that the deleterious cardiac effects of hyperglycemia extend beyond the simple stiffening of myocardial tissue. Their study linked higher HbA1c values to autonomic dysfunction, endothelial injury, and heightened systemic inflammation, all of which act synergistically to compromise the diastolic function of the heart, particularly in diabetic individuals who often remain asymptomatic in the early stages.

Several Indian studies also reinforce this correlation. Porel et al.[13], in a cross- sectional study, concluded that HbA1c could serve as a predictive marker of LVDD in newly diagnosed, non-hypertensive type 2 diabetic patients. Likewise, Guria et al.[14] and Perumal et al.[15] reported a significant positive correlation between HbA1c and diastolic dysfunction, supporting the hypothesis that chronic glycemic burden leads to myocardial fibrosis and stiffness. However, the absence of statistical significance in the current study might be attributed to certain limitations such as small sample size, variability in disease duration, and individual differences in cardiac adaptation. Additionally, some patients with early diabetes may develop diastolic dysfunction independent of glycemic control due to coexisting factors like age, obesity, or autonomic neuropathy.

In the present study, an attempt was made to assess the relationship between fasting blood glucose (FBG) levels and the presence of left ventricular diastolic dysfunction (LVDD) among patients with type 2 diabetes mellitus. The analysis revealed that patients with FBG at or above 126 mg/dL demonstrated a markedly higher prevalence of 64.5%. This clear upward shift underscores the growing recognition that elevated fasting glucose levels, even when isolated from long-term glycemic control measures like HbA1c, are closely linked with early myocardial functional changes, especially impairments in diastolic relaxation.

Ryu et al.[16] reported that FBS had a significant association with worsening diastolic parameters, supporting the idea that elevated fasting glucose reflects poor metabolic control and early myocardial metabolic abnormalities.

The role of postprandial glucose in cardiovascular complications, particularly in diabetic patients, has been widely studied. Turner et al.[17] emphasized that sustained hyperglycemia, including both fasting and postprandial elevations, accelerates myocardial fibrosis, vascular stiffness, and other structural changes in the heart that lead to diastolic dysfunction.

In their study, the authors highlighted that postprandial glucose spikes have a particularly detrimental effect on vascular tone and myocardial compliance, suggesting that even transient post-meal glucose elevations can contribute to long-term cardiac damage. This finding is consistent with the present study, where postprandial hyperglycemia appears to be a key factor in the early development of LVDD.

Conclusion

The present study confirms that left ventricular diastolic dysfunction (LVDD) is frequently present in newly diagnosed, normotensive type 2 diabetes mellitus (T2DM) patients.

The difference in HbA1c levels between patients with and without LVDD was not statistically significant, an increasing trend of LVDD prevalence was noted in patients with higher HbA1c, and suggesting poor glycemic control could play a contributory role in early cardiac remodelling. The study findings emphasize the importance of routine cardiovascular screening using echocardiography in all newly diagnosed

T2DM patients, to enable early detection of asymptomatic diastolic dysfunction and guide timely interventions.

Implementation of early cardiac evaluation, combined with stringent glycemic control and lifestyle modifications, may potentially delay or prevent the progression to overt heart failure in diabetic individuals.

Limitations

There are few limitations highlight the need for larger, longitudinal, and multi-centre studies to better understand the relationship between glycemic parameters and early cardiac dysfunction in T2DM are listed below:

Small Sample Size, Cross-Sectional Design, Selection Bias, Confounding Variables, Ethnic and Regional Specificity, Lack of Advanced Imaging, Short Duration of Diabetes, Self-Reported or Missing Data, Single-Centre Study, No Follow-Up.

References

1. World Health Organization. Diabetes. [cited 2023 Dec 12]. Available from: https://www.who.int/news-room/fact-sheets/detail/diabetes.
2. Grundy SM, Neeland IJ, Tannassoul H, et al. Prevention of type 2 diabetes: implications of the new guidelines. Lancet Diabetes Endocrinol. 2023;11(5):338- 347.
3. Centers for Disease Control and Prevention. Risk factors for type 2 diabetes. [cited 2023 Dec 15]. Available from: https://www.cdc.gov/diabetes/prevention/about/risk-factors.html.
4. Poirier P, Bogaty P, Garneau C, Marois L, Dumesnil JG. Diastolic dysfunction in normotensive men with well-controlled type 2 diabetes: Importance of maneuvers in echocardiographic screening for preclinical diabetic cardiomyopathy. Diabetes Care. 2001;24(1):5-10.
5. Zarich SW, Arbiter MB. Diabetic cardiomyopathy. Can J Cardiol. 2001;17(3): 411-9.
6. Boudina S, Abel ED. Diabetic cardiomyopathy revisited. Circulation. 2007;115(25):3213-23.
7. Paulus WJ, Tsch\u00f6pe C. A novel paradigm for heart failure with preserved ejection fraction: Comorbidities drive myocardial dysfunction and remodeling through coronary microvascular endothelial inflammation. J Am Coll Cardiol. 2013;62(4):263-71.
8. Fang ZY, Prins JB, Marwick TH. Diabetic cardiomyopathy: Evidence, mechanisms, and therapeutic implications. Endocr Rev. 2004;25(4):543-67.
9. From AM, Scott CG, Chen HH. Changes in diastolic dysfunction in diabetes mellitus over time. Am J Cardiol. 2009;103(10):1463-6.
10. Jørgensen PG, Biering-Sørensen T, Mogelvang R, Fritz-Hansen T, Galatius S, Jensen JS. Predictive value of echocardiographic diastolic dysfunction in asymptomatic patients with type 2 diabetes for incident cardiovascular disease and mortality. Diabetes Care. 2013;36(11): 3753-8
11. Zhao Z, Zhang Y, Zhang J, et al. The relationship between glycosylated hemoglobin and diastolic dysfunction in newly diagnosed type 2 diabetes mellitus patients. Cardiovasc Diabetol. 2017;16(1):1-7.
12. Struthers AD, Best J, Sattar N, et al. Diastolic dysfunction and glycemic control in diabetes. J Am Coll Cardiol. 2009;53(3):249-256.
13. Porel R, Shyama S, Ahmad S, Kumar N, Ahmad S, Biswas R, Ojha VS. Can glycated haemoglobin (HbA1c) be used as a predictor of left ventricular diastolic dysfunction in non-hypertensive patients with newly diagnosed type 2 diabetes mellitus: a cross-sectional study at a tertiary care centre in Eastern India. BMJ Open. 2024 Mar 19;14(3):e081269.
14. Guria RT, Prasad MK, Mishra B, Marandi S, Kumar A, Dungdung A. Association of Glycosylated Haemoglobin (HbA1c) Level With Left Ventricular Diastolic Dysfunction in Patients With Type 2 Diabetes. Cureus. 2022 Nov 17;14(11):e31626
15. Perumal V, Narayanan N, Rangarajan J, et al. A study to correlate HbA1C levels and left ventricular diastolic dysfunction in newly diagnosed type II diabetes mellitus. J. Evolution Med. Dent. Sci. 2016;5(51):3312-3317
16. Ryu J, Lee S, Park H, et al. Association between serum glycated hemoglobin and left ventricular diastolic function in patients with diabetes mellitus. J Cardiovasc Ultrasound. 2016;24(4):299-305.
17. Turner RC, Millns H, Neil HA, et al. Hyperglycemia and its cardiovascular sequelae I type 2 diabetes mellitus. Lancet. 1998;352 (9131): 833-836.