*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*
*e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 11 Ser.3 (November. 2021), PP 58-64*
*www.iosrjournals.org*

# Study of Diabetes Effects on Two Dimensional Echocardiographic Parameters

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***Abstract:***
***Objectives****: The goal of the study is to use two-dimensional echocardiography to investigate the effects of diabetes on echocardiographic parameters and to connect the results with the patients' age, BMI, and gender.*
***Materials and Methods****: This hospital-based study took place in Elshaab University Hospital in Khartoum, Sudan, from August 2016 to August 2019.In both genders, 50 diabetic patients and 48 control persons were included in the study. Patients who were pregnant, had genetic problems, had heart defects, or had any abnormalities other than diabetes were eliminated. Age, gender, height, weight, blood sugar, disease duration, and clinical history were all noted. Left ventricular dimensions (LVS,LVIDd,s,LVPWDd,s), left ventricular volumes (LVEDV&LVESV), LVEF,LVFS,LVM, and aortic root and left atrial diameters in systole and diastole are all echocardiographic measures. (TOSHIBA, XARIO200, SAMSUNG, MYLAB50XVISION CARDIOVASCULA) employing high-frequency applied parasternal long and short-axis, as well as apical window views (two and four chambers).All of the study's variables had been assessed. The relationship between all research parameters and gender, age, and BMI was also examined.IBM SPSS (Statistical Package for the Social Sciences) Statistics version 25 was used to examine the data.*
***Results****: Due to significantly increased left ventricular mass in diabetic patients (215.3 98.5 range 54-528 g) compared to normal subjects (90.2 48.7), LVM proved significant difference between both groups at p-value 0.000 as the mean is significantly associated with increased LVM for diabetic patients at (p-value= 0.003), aortic diameter values was significantly associated with increased blood sugar level for diabetic patients at (p-value= 0.00236). When compared to normal subjects, diabetic patients' left ventricular ejection fraction (55.8 14.1 range 22.5-79-6 percent) reduced as end diastolic volume (EDV) and end systolic volume (ESV) declined. Diabetic individuals had a left atrial diameter (LAD) of 3.6 0.9 cm, which was lower than normal participants' (3.6 0.9 cm).*
*For normal subjects, the left atrium to aortic ratio is increased with body size (at p-value= 0.046), and the left ventricular end diastolic volume (LVESV) is significantly larger in males 47.6 33.4 versus 30.9 15.7 in females (P-value = 0.021), but for diabetic patients, The aortic diameter (AOD) and the left ventricular internal diameter in diastole (LVIDd) also increased with age (p-value =0.042 and 0.047, respectively). Except for age, there was no significant difference in body size between males and females (63.9 10.1 against 52.8 10) (P-value 0.0001).*
***Conclusion:*** *Left ventricular hypertrophy due to myocardial hypertrophy has a considerable impact on two-dimensional echocardiographic parameters, including increased left ventricular mass, aortic and left atrial diameters, and a lower left ventricular ejection fraction. For normal persons, the left atrium to aortic ratio increases with body size, and end diastolic volume is considerably bigger in males versus females for all parameters. For diabetes patients, the left ventricular internal diameter in diastole and Aortic diameter increased with age. There was a considerable difference in age between males and females, but there was no correlation between body size and gender.*
***Key Word****:* ***2D Echocardiography; Normal subjects, diabetes***

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Date of Submission: 05-11-2021 Date of Acceptance: 20-11-2021

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## I. Introduction

Insulin resistance, metabolic clutters, and autonomic disturbing impacts are among the pathophysiological mechanisms, which result in the clinical phenotypes of left ventricular hypertrophy (LVH), diastolic dysfunction, fibrosis, and reduced cardiac usable reserve [1].In the initial autopsy research, the major finding of diabetic cardiomyopathy was LVH [2].At 25 cm (beta=0.32, $p<0.001$), 30 cm (beta=0.38, $p<0.001$), and 35 cm (beta=0.34, $p < 0.0005$) distal to the arch, left ventricular mass index was independently linked with aortic diameters.[3]. The percentage of blood ejected into the aorta by the left ventricle during systole is known as the left ventricular ejection fraction. The final systolic and diastolic volumes in the ventricles are used to calculate its value on an echocardiography. This statistic is a useful index for estimating the follow-up of patients with a reduced left ventricular ejection fraction (LVEF). Diabetic individuals exhibited the same effect [4] and (EF), as well as LV end-diastolic and end-systolic volumes (LVEDV and LVESV, respectively) are widely employed as clinical indicators of global LV systolic function or LV remodeling [5, 6]. An ejection fraction of more than 55 percent is considered typical. This indicates that with each pulse, 55 percent of the blood in the left ventricle is pumped out. Heart failure with reduced ejection fraction can be caused by a variety of issues, including cardiomyopathy (a disease of the heart muscle), which weakens the heart muscle and affects its ability to pump properly, and high blood pressure (elevated pressure in the arteries), which causes the heart to work harder to pump against increased pressure, weakening the muscle [7]. In aortic rout (AR), aortic root dilation and abnormal geometry of the outflow tract and sinuses play a critical pathophysiologic roles [8].The purpose of this study was to see how diabetics affected two-dimensional echocardiographic parameters. From August 2016 to August 2019, this hospital-based study was conducted on patients of the echocardiographic unit at Elshaab University Hospital in Khartoum, Sudan. A total of 50 hypertension patients were enrolled in the study, with 48 normal participants serving as the control group.

## II. Material And Methods

During the cardiologist's examination, a well-designed Data sheet was used to capture the data of the patients.

The data sheet comprised demographic information such as age, gender, height, and weight, as well as personal information such as blood sugar levels and clinical history. Left ventricular dimensions (LVS, LVIDd,s, LVPWDd,s), left ventricular volumes (LVEDV&LVESV),EF,F& LVM, and Aortic root diameter (measured in Anterior aortic root and Left Atrial diameters) are all echocardiographic parameters that are measured in systole and diastole. During each exam, high frequency applied parasternal long and short-axis (PLAX & PSAX) and apical window views (PA2CH, PA4CH (Two and four chambers) views estimated by Teichholz's M-Mode of 2D echocardiography were employed on machines (TOSHIBA, XARIO200, SAMSUNG, MYLAB50XVISION CARDIOVASCULA).Left Atrial at end-diastole (lowest point(2) [9], and LVM determined by formula (LV Mass = 0.81.04[([LVEDD + IVSd + PWd] 3 - LVEDD3)] + 0.6). A uniform approach was used to measure height and weight. The body mass index (BMI) is computed by dividing a person's weight in kilograms (minus 1 kilogram for clothes) by their height in meters squared (BMI = kg/m2), where kg is their weight in kilograms and m2 is their height in meters squared. Overweight is defined as a BMI of 25.0 or higher, while the healthy range is 18.5 to 24.9 [10].

**Study Design:** This is a hospital-based retrospective research..

**Study Location:** The research was carried out in the teaching hospital's Echocardiographic Unit at Al-shaab Teaching Hospital in Khartoum, Sudan.

**Study Duration:** The study will run from August 2016 through August 2019.

**Sample size :**50 diabetes patients were compared to 48 healthy people in this study.

**Sample size calculation:** IBM SPSS (Statistical Package for the Social Sciences) Statistics version 25 was used to examine the data. Pearson's correlation coefficient was used to assess the relationship between all research parameters and gender, age, and BMI (r).A p-value of less than 0.05 was judged statistically significant, while a p-value of less than 0.0001 was deemed extremely significant.

**Subjects & selection method**: All variables in the study, which included both healthy people and diabetics, were divided into two main categories:

- Diabetes' effects on left ventricular dimensions, mass, and aortic and left atrial diameter measurements, as well as their relationship to ultimate diagnosis and demographic variables, when compared to normal people
- Diabetes' effects on left ventricular sizes and ejection fraction measures, as well as their relationship to ultimate diagnosis and demographic factors when compared to healthy persons.

**Inclusion criteria**

Normal participants served as controls for diabetic patients who were evaluated for echocardiography for various indications and symptoms.

**Exclusion criteria:**
Pregnant women, patients with genetic problems, and patients with heart defects or other abnormalities, as opposed to diabetic patients.

**Procedure/ methodology**
After obtaining written informed consent, the data of the selected patients was collected retrospectively using a well-designed data sheet. Age, gender, height, weight, and length of consanguineous DM, as well as clinical history, were all provided on the data sheet. The ultimate diagnosis of the echo findings is based on the blood sugar level. All echocardiographic parameters were determined using echocardiographic picture samples obtained during cardiologist's examination. After the assessment, the final diagnosis is written in the patient's request. A uniform approach was used to measure height and weight. The body mass index (BMI) was computed by multiplying the weight in kilograms (minus 1 kg for clothing) by the height in meters squared.[10].The patient's blood sugar was recorded on the exam request form. During each exam, high frequency applied parasternal long and short-axis (PLAX & PSAX) and apical window views (PA2CH, PA4CH (two and four chambers) views estimated by Teichholz's M-Mode of 2D echocardiography were employed on machines (TOSHIBA, XARIO200, SAMSUNG, MYLAB50XVISION CARDIOVASCULA)..

**Statistical analysis:**
IBM SPSS statistics version 25 was used to quantitatively examine the data. The Chi-square test was used to assess categorical data that were expressed as numbers, percentages, and figures (Pie chart and Bar chart).Continuous variables were represented as mean SD and evaluated using Student's t-test and ANOVA for variables that passed normality tests and Mann–Whitney U-test for those that failed normality testing. Pearson's correlation coefficient was used to examine correlations (r).A p-value of less than 0.05 was deemed statistically significant, while a p-value of less than 0.0001 was deemed extremely significant.

## III. Result

The findings of the study's measurements were divided into two categories for demographic factors and four categories for echocardiographic parameter dimensions.1st table: shows For both groups (normal people and diabetes patients), mean SD values of left ventricular dimensions and mass include (LVIDd (left ventricular internal diameter in diastole), LVIDs (left ventricular internal diameter in systole), IVS d (inter ventricular septum in diastole) , ), LVIDs( left ventricular internal diameter in systole ),IVS d(inter ventricular septum in diastole ) , LVPWd ( left ventricular posterior wall in diastole ), LVPWs( left ventricular posterior wall in systole ) & LVM(left ventricular mass ) which were measured (3.8 ± 1.1cm , 2.4 ± 0. group (4.9 ± 1.1cm , 11.9 ± 53.3cm, 1.1 ± 0.5cm , 1.2 ± 0.6cm , 1.4 ± 1.2cm & 215.3 ± 98.5 g ) respectively for diabetic patients.

**Table 1:** demonstrates the mean and standard deviation of echocardiographic values in healthy people and diabetics:

| Parameters | Normal subjects | | | Diabetic patients | | |
|---|---|---|---|---|---|---|
| | Mean ± SD | Minimum | Maximum | Mean ± SD | Minimum | Maximum |
| Interventricular septum diameter (IVSD/cm) | 0.9 ± 0.5 | 0.2 | 4 | 1.1 ± 0.5 | 0.1 | 3.9 |
| Left ventricular internal diameter in diastole (LVIDd/cm) | 3.8 ± 1.1 | 1.8 | 6 | 4.9 ± 1.1 | 2 | 8.3 |
| Left ventricular posterior wall in diameter (LVPWd/cm) | 1.1 ± 1.2 | 0 | 8.7 | 1.2 ± 0.6 | 0.1 | 4.9 |
| Left ventricular internal diameter in systole (LVIDS/cm) | 2.4 ± 0.8 | 0.6 | 3.8 | 11.9 ± 53.3 | 1.3 | 378 |
| Left ventricular posterior wall in systole (LVPWs/cm) | 1.1 ± 0.6 | 0.2 | 3.2 | 1.4 ± 1.2 | 0 | 7.9 |
| Left ventricular mass (LVM /g) | 90.2 ± 48.7 | 28 | 232 | 215.3 ± 98.5 | 54 | 528 |
| Aortic diameter (AOD/cm) | 2.3 ± 0.8 | 1.3 | 4.3 | 2.7 ± 0.6 | 1 | 3.8 |
| Left atrial diameter (LAD/cm) | 2.8 ± 1.1 | 0.7 | 4.6 | 3.6 ± 0.9 | 2 | 6.1 |
| Left ventricular end diastolic volume (LVEDV/ml) | 77.9 ± 48.6 | 9.4 | 217.6 | 112.3 ± 54.7 | 12.6 | 285.9 |
| Left ventricular end systolic volume (LVESV/ml) | 36.4 ± 24.0 | 7.4 | 134.6 | 53.8 ± 39.8 | 14 | 199 |
| Left ventricular ejection fracture (LVEF%) | 64.2 ± 8.8 | 31 | 83.9 | 55.8 ± 14.1 | 22.5 | 79.6 |

**Table 2**: Shows the mean differences of echocardiography parameters in the normal and diabetes groups were compared

| Dependent Variable | (I) Group | (J) Group | Mean Difference (I-J) | P-value | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Left ventricular mass (LVM/g) | Normal subjects | Diabetic patients | -125.1 | 0.000 | -163.0 | -87.1 |
| Left ventricular internal diameter in systole (LVIDS/cm) | Normal subjects | Diabetic patients | -1.1 | 0.000 | -1.6 | -0.6 |
| Left ventricular end diastolic volume (LVEDV/ml) | Normal subjects | Diabetic patients | -34.4 | 0.003 | -56.9 | -11.8 |
| Left ventricular end systolic volume (LVESV/ml) | Normal subjects | Diabetic patient | -17.4 | 0.038 | -33.9 | -1.0 |
| Left ventricular ejection fracture (LVEF%) | Normal subjects | Diabetic patient | 8.4 | 0.002 | 3.3 | 13.5 |

**Table 3:** depicted diabetic patients' final diagnoses **:**

| Final Diagnosis (DM) | Frequency | Percent |
|---|---|---|
| Left ventricular hypertrophy (LVH) | 18 | 36.0% |
| NORMAL echo finding | 19 | 38.0% |
| Dilated cardiomyopathy (DCM) | 6 | 12% |
| Ischemic heart disease (IHD) | 7 | 14.0% |
| Total | 50 | 100.0% |

**Table 4:** Presented means of final diagnosis Cross tabulated with Echocardiographic measurements for DM group

| Final Diagnosis | LVH | NORMAL | DCM | IHD | P-value |
|---|---|---|---|---|---|
| Duration | 9.33 ± 8.17 | 12.93 ± 10.79 | 8.50 ± 6.35 | 9.86 ± 8.13 | 0.587 |
| Blood Sugar | 160.11 ± 87.10 | 146.61 ± 84.45 | 128.33 ± 36.01 | 115.43 ± 81.38 | 0.616 |
| Interventricular septum diameter (IVSD/cm) | 1.34 ± 0.69 | 0.96 ± 0.30 | 1.04 ± 0.29 | 0.95 ± 0.34 | 0.095 |
| Left ventricular internal diameter in diastole (LVIDd/cm) | 5.16 ± 1.20 | 4.52 ± 0.58 | 4.80 ± 1.87 | 5.53 ± 1.02 | 0.142 |
| Left ventricular posterior wall in diastole (LVPWd/cm) | 1.22 ± 0.41 | 1.19 ± 0.93 | 0.98 ± 0.22 | 1.06 ± 0.22 | 0.839 |
| Left ventricular end diastolic volume (LVEDV/ml) | 113.13 ± 49.29 | 103.61 ± 30.21 | 115.93 ± 105.03 | 130.5 ± 70.67 | 0.744 |
| Left ventricular end systolic volume (LVESV/ml) | 52.29 ± 28.14 | 36.98 ± 17.08 | 85.67 ± 68.72 | 76.17 ± 55.78 | 0.017* |
| Left ventricular ejection fracture (LVEF%) | 54.59 ± 16.06 | 62.83 ± 6.76 | 44.83 ± 17.49 | 49.11 ± 12.70 | 0.013* |
| Left ventricular fraction shorten (LVFS%) | 28.19 ± 12.00 | 34.64 ± 4.29 | 24.13 ± 9.60 | 28.62 ± 12.44 | 0.069 |
| Left ventricular internal diameter in systole (LVIDs/cm) | 6.39 ± 11.16 | 2.97 ± 0.47 | 3.74 ± 1.81 | 57.22 ± 141.45 | 0.112 |
| Left ventricular posterior wall in systole (LVPWs/cm)LVPWs | 1.53 ± 1.09 | 1.01 ± 0.36 | 2.25 ± 2.79 | 1.06 ± 0.36 | 0.122 |
| Aortic diameter (AOD/cm) | 2.57 ± 0.56 | 2.62 ± 0.59 | 3.03 ± 0.60 | 2.80 ± 0.63 | 0.374 |
| Left atrial diameter (LAD/cm) | 3.37 ± 0.93 | 3.39 ± .074 | 4.41 ± 1.39 | 3.75 ± 0.52 | 0.078 |
| Aortic diameter / Left atrial ratio (AO/LA %) | 1.33 ± 0.51 | 1.40 ± 0.32 | 1.49 ± 0.53 | 1.59 ± 0.38 | 0.583 |
| Left ventricular mass (LVM/g) | 271.89 ± 111.90 | 157.37 ± 49.99 | 232.83 ± 117.73 | 212.00 ± 63.93 | 0.003* |

**Table 5:** Correlating Diabetic Patients' Demographic Data and Echocardiography Parameters with Duration and Blood Sugar Results

| Correlations | Duration | | Blood Sugar | |
|---|---|---|---|---|
| | Pearson Correlation ( r ) | P-value | Pearson Correlation ( r ) | P-value |
| Age/year | 0.259 | 0.069 | -0.26 | 0.068 |
| Weight/kg | 0.056 | 0.699 | 0.188 | 0.191 |

| | | | | |
|---|---|---|---|---|
| Height/cm | 0.099 | 0.493 | 0.111 | 0.444 |
| Body max index (BMI/kg/cm$^2$) | -0.007 | 0.963 | 0.125 | 0.385 |
| Interventricular septum diameter (IVSD/cm) | -0.096 | 0.508 | 0.073 | 0.612 |
| Left ventricular internal diameter in diastole (LVIDd/cm) | 0.183 | 0.202 | 0.096 | 0.506 |
| Left ventricular posterior wall in diastole (LVPWd/cm) | -0.134 | 0.354 | -0.019 | 0.897 |
| Left ventricular end diastolic volume (LVEDV/ml) | -0.173 | 0.229 | 0.079 | 0.584 |
| Left ventricular end systolic volume (LVESV/ml) | -0.09 | 0.533 | 0.102 | 0.48 |
| Left ventricular ejection fracture (LVEF%) | -0.069 | 0.635 | -0.196 | 0.173 |
| Left ventricular fractionshortenLVFS%) | -0.134 | 0.352 | -0.146 | 0.311 |
| Left ventricular internal diameter in systole (LVIDs/cm) | -0.027 | 0.851 | -0.246 | 0.086 |
| Left ventricular posterior wall in systole (LVPWs/cm)LVPWs | -0.271 | 0.057 | 0.037 | 0.799 |
| Aortic diameter (AOD/cm) | 0.209 | 0.144 | -0.314 | 0.026 |
| Left atrial diameter (LAD/cm) | 0.134 | 0.353 | -0.132 | 0.361 |
| Aortic diameter / Left atrial ratio (AO/LA %) | 0.082 | 0.571 | 0.142 | 0.326 |
| Left ventricular mass (LVM/g) | -0.007 | 0.961 | 0.026 | 0.86 |

**Table 6:** shows the relationship between gender and all variables in the normal and diabetic groups:

| Parameters | Normal subjects | | | Diabetic patients | | |
|---|---|---|---|---|---|---|
| | Gender | | P-value | Gender | | P-value |
| | Male | Female | | Male | Female | |
| Age/year | 46.5 ± 15.0 | 43. ± 9.7 | 0.381 | 63.9 ± 10.1 | 52.8 ± 10.2 | 0.000 |
| Weight/kg | 65.8 ± 15.3 | 63.3 ± 13.7 | 0.561 | 84.0 ± 24.4 | 82.1 ± 21.7 | 0.78 |
| Height/cm | 163.3 ± 9.3 | 157.0 ± 13.7 | 0.06 | 173.1 ± 12.5 | 169.9 ± 10.9 | 0.349 |
| Body max index (BMI/kg/cm$^2$) | 25.5 ± 8.9 | 25.2 ± 6.4 | 0.896 | 27.7 ± 6.1 | 28.4 ± 6.9 | 0.739 |
| Interventricular septum diameter (IVSD/cm) | 107.9 ± 13.5 | 104.9 ± 16.0 | 0.518 | 142.3 ± 69.8 | 147.8 ± 91.7 | 0.813 |
| Left ventricular internal diameter in diastole (LVIDd/cm) | 0.8 ± 0.2 | 0.9 ± 0.6 | 0.425 | 1.2 ± 0.7 | 1.1 ± 0.2 | 0.536 |
| Left ventricular posterior wall in diastole (LVPWd/cm) | 4.2 ± 1.0 | 3.7 ± 1.2 | 0.164 | 4.8 ± 1.1 | 5.0 ± 1.1 | 0.513 |
| Left ventricular end diastolic volume (LVEDV/ml) | 1.5 ± 2.1 | 0.9 ± 0.4 | 0.097 | 1.3 ± 0.8 | 1.1 ± 0.3 | 0.267 |
| Left ventricular end systolic volume (LVESV/ml) | 94.0 ± 54.9 | 70.1 ± 44.0 | 0.106 | 116.4 ± 55.9 | 107.9 ± 54.3 | 0.588 |
| Left ventricular ejection fracture (LVEF%) | 47.6 ± 33.4 | 30.9 ± 15.7 | 0.021 | 58.4 ± 42.5 | 48.8 ± 36.0 | 0.396 |
| Left ventricular fraction shorten (LVFS%) | 64.0 ± 7.0 | 64.2 ± 9.7 | 0.939 | 55.1 ± 14.8 | 56.5 ± 13.5 | 0.728 |
| Left ventricular internal diameter in systole (LVIDs/cm) | 34.7 ± 5.1 | 34.9 ± 7.3 | 0.891 | 29.2 ± 10.3 | 31.3 ± 9.6 | 0.446 |
| Left ventricular posterior wall in systole (LVPWs/cm)LVPWs | 2.6 ± 0.9 | 2.4 ± 0.8 | 0.458 | 5.3 ± 9.4 | 19.0 ± 76.5 | 0.367 |
| Aortic diameter (AOD/cm) | 1.3 ± 0.7 | 1.1 ± 0.6 | 0.114 | 1.1 ± 0.5 | 1.6 ± 1.6 | 0.198 |
| Left atrial diameter (LAD/cm) | 2.5 ± 1.0 | 2.3 ± 0.7 | 0.44 | 2.7 ± 0.6 | 2.7 ± 0.6 | 0.901 |
| Aortic diameter / Left atrial ratio (AO/LA %) | 2.8 ± 1.0 | 2.9 ± 1.1 | 0.714 | 3.5 ± 0.9 | 3.6 ± 0.9 | 0.563 |
| Left ventricular mass (LVM/g) | 1.4 ± 0.3 | 1.3 ± 0.3 | 0.15 | 1.4 ± 0.5 | 1.4 ± 0.4 | 0.676 |

**Table 7: displays the relationship between all factors and age and BMI in the normal and diabetic groups.**

| parameter | Diabetic patients | | | Normal subjects | | | | |
|---|---|---|---|---|---|---|---|---|
| | BMI | | Age | BMI | | | Age | |
| Pearson Correlation ( r ) | P-value | Pearson Correlation ( r ) | Pearson Correlation ( r ) | P-value | Pearson Correlation ( r ) | P-value | Pearson Correlation ( r ) | P-value |
| Blood Sugar | 0.385 | 0.125 | 0.068 | -0.26 | 0.814 | 0.035 | 0.582 | -0.081 |
| Interventricular septum diameter (IVSD/cm) | 0.395 | -0.123 | 0.703 | 0.055 | 0.704 | 0.056 | 0.919 | 0.015 |
| Left ventricular internal diameter in diastole (LVIDd/cm) | 0.205 | 0.183 | 0.042 | -.289* | 0.508 | -0.097 | 0.741 | 0.048 |
| Left ventricular posterior wall in diastole (LVPWd/cm) | 0.549 | -0.087 | 0.676 | 0.061 | 0.093 | -0.243 | 0.886 | 0.021 |
| Left ventricular end diastolic volume (LVEDV/ml) | 0.207 | 0.182 | 0.114 | -0.226 | 0.426 | -0.116 | 0.53 | -0.092 |
| Left ventricular end systolic volume (LVESV/ml) | 0.193 | 0.187 | 0.174 | -0.196 | 0.532 | -0.091 | 0.66 | -0.064 |
| Left ventricular ejection fracture (LVEF%) | 0.981 | -0.004 | 0.205 | 0.182 | 0.93 | 0.013 | 0.233 | -0.174 |
| Left ventricular fraction shorten (LVFS%) | 0.238 | 0.17 | 0.869 | -0.024 | 0.967 | 0.006 | 0.121 | -0.224 |
| Left ventricular internal diameter in systole (LVIDs/cm) | 0.65 | -0.066 | 0.639 | -0.068 | 0.876 | -0.023 | 0.405 | 0.122 |
| Left ventricular posterior wall in systole (LVPWs/cm)LVPWs | 0.732 | -0.05 | 0.783 | -0.04 | 0.917 | 0.015 | 0.064 | 0.266 |
| Aortic diameter (AOD/cm) | 0.663 | -0.063 | 0.047 | .282* | 0.88 | 0.022 | 0.045 | 0.288* |
| Left atrial diameter (LAD/cm) | 0.598 | -0.076 | 0.891 | -0.02 | 0.685 | 0.059 | 0.482 | 0.103 |
| Aortic diameter / Left atrial ratio (AO/LA %) | 0.271 | -0.159 | 0.263 | -0.161 | 0.046 | 0.286* | 0.005 | 0.398* |
| Left ventricular mass (LVM/g) | 0.873 | 0.023 | 0.595 | 0.077 | 0.672 | -0.062 | 0.024 | 0.323* |

## IV. Discussion

The current study compared adult diabetic patients to normal participants in terms of 2-dimensional echocardiographic measures of echocardiographic parameters, taking into account their age, body mass index, and gender, and evaluating diabetic consequences. Left ventricular dimensions and LVM (left ventricular mass) for diabetic patients and normal participants were compared (table 1), with average LVM (215.3 98.5 range 54-528 g) for diabetic group differing from (90.2 48.7range 28-232 g) for normal group. As a dependent variable, LVM at p-value 0.000, there is a significant difference in mean and standard deviation between the two groups (mean difference -125.1 with 95 percent confidence interval (-163.0 lower and - 87.1 higher)) (table 2) due to myocardial hypertrophy, which was affected in LVH (left ventricular hypertrophy evidence by 36.0 percent of 18 patients out of 50 diabetic patients were diagnosed with LVH (table 3), and there is a significant association between LVH and LVM (p-value 0.003). (Table 4)Also, in diabetics, AOD (aortic diameter) of 3.6 0.9 cm demonstrated high relationship with blood sugar (Pearson Correlation (r)-0.314 and p-value 0.026).(See table 5) particularly because left ventricular hypertrophy has been linked to an increased incidence of aortic enlargement [8].HbA1c levels are positively linked with LV mass and aortic stiffness, both of which have a negative independent impact on early diastolic velocity e′, the latter through an increase in after load, according to (Kozakova, M, Morizzo et al, 2017).Lower diastolic and systolic LV longitudinal performance, as well as greater aortic stiffness and a higher prevalence of LV hypertrophy, are found in Type 2 diabetic individuals with inadequate glycemic control (HbA1c 6.5%) [11]. Diabetic was shown to be strongly associated with LVIDd (left ventricular internal diameter in diastole) (person correlation -1.1 and p-value 0.000). (table 2).When the left ventricular dimension, LVM, and aortic diameter were correlated with demographic characteristics, there was no significant correlation between left ventricular dimension and mass with gender, body size, or age for both groups, with the exception that the left atrium to aortic ratio increased with body size (person correlation (r) 0.286 and p-value 0.046) for the control group. For diabetes patients, LVIDd (left ventricular internal diameter in diastole) and Aortic diameter rose with age (Pearson Correlation ( r )-.289 and p-value 0.042) and Pearson Correlation ( r 0.282 and p-value 0.047).Age was substantially higher in males (63.9 10.1) than females (52.8 10) (P-value 0.0001). (Table 6 & 7). The diabetic group's LA diameter was 3.6 0.9 cm, compared to 3.6 0.9 cm in normal subjects (table 1), and with the range of normal reference done by (Harkness, Allan, et al.2020)[12], who considered it enlarged when it exceeded 3.8 cm in women and 4.2 cm in men because LA dysfunction is strongly linked to left ventricular diastolic dysfunction, which is closely linked to abnormal myocardial function.

Ejection fracture mean value (55.8 14.1 percent, range 22.5-79-6 percent) was determined by the end diastolic volume (EDV) of 112.3 54.7ml depend on End diastolic volume (EDV) measured 112.3 54.7ml and End systolic volume (ESV) measured 53.8 39.8 ml for diabetic patients (table 1) and normal reference done by (Harkness, Allan, et al,2020) [12] because With each heartbeat, 55 percent of the blood in the left ventricle is pumped out, and heart failure with a reduced ejection fraction can be caused by a variety of issues, including cardiomyopathy (a disease of the heart muscle), which weakens the heart muscle and impairs its ability to pump properly [13].Thirteen diabetic patients provide evidence, accounting for 26% of the 50 patients diagnosed with myocardial ischemia (table3) and When compared to a previous study done by (M Kato - 2020), the prognostic utility of LVESVI in patients with stable coronary artery disease was also detailed to be prevalent to that of LVEF or LVEDV (mean different and p-values include -34.4,0.003, -17.4, 0.038, and 8.4,0.002) when were considered as dependent variables (table 2) in this study.[6].When these parameters were compared to demographic characteristics, ESV was only significantly larger in males 47.6 33.4 versus 30.9 15.7 in females (P-value = 0.021) for the normal group, but there was no significant association between gender and all other parameters except age, which was significantly larger in males 63.9 10.1 versus 52.8 10 females (P-value 0.0001) (table6), but there was no significant relation with age and body size for diabetic patients (table 7).

## V. Conclusion

Left ventricular hypertrophy due to myocardial hypertrophy, which increased left ventricular mass and aortic diameter and decreased left ventricular ejection fraction, but left atrial diameter (LAD) for diabetic patients with left atrial dysfunction, which was strongly linked to left ventricular diastolic dysfunction. In normal persons, the left atrium to aortic ratio increases with body size, but diabetic patients' LVIDd (left ventricular internal diameter in diastole) and Aortic diameter rise with age. Because half of the total blood in the left ventricle is pushed out with each heartbeat, diabetics have a lower ejection fraction owing to cardiomyopathy, which is a weakening of the heart muscle that limits its capacity to pump properly. When it was compared to left ventricular volumes with demographic characteristics, only ESV was significantly larger in males versus females in the normal group, but there was no significant relationship between age, body size, or gender in diabetic patients, except that age was significantly larger in males versus females.

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