International Journal Dental and Medical Sciences Research
Volume 6, Issue 1, Jan-Feb- 2024 pp 430-436www.ijdmsrjournal.com ISSN: 2582-6018

"Study of Lung Functions in Patients with Type 2 Diabetes Mellitus and Normal Individuals"

Bhavya R, Dhruthi G, Chekuri S.N.V.S.K.N. Ravi Varma, Suresh G.
Assistant Professor, Department of Nephrology, Rajarajeswari Medical College & Hospital
Junior resident, Department of General Medicine
Junior Resident, Department of General Medicine
Professor, Department of General Medicine, K.S. Hegde Medical Academy.

Date of Submission: 15-02-2024 Date of Acceptance: 24-02-2024

ABSTRACT:
Diabetes is a growing concern worldwide with a rapidly increasing prevalence. It is known to precipitate microvascular and macrovascular complications. Less has been known about the aftereffects of diabetes on lungs. Studies have shown inconsistent association with pulmonary function and diabetes. The objective of this study was to compare the lung functions of patients with type 2 diabetes mellitus with that of age and sex matched normal individuals.
Method: Thís study was a hospital based cross sectional comparative study conducted over a period of one and half years. Subjects included 60 patients with T2DM and 60 healthy subjects recruited from both in-patient and out-patient departments, age and sex matched. A detailed history and clinical examination was done and details entered in a structured proforma.
Results: A total of 60 cases and 60 healthy subjects (controls) fulfilling the criteria were included in this study, age and sex matched. Among the 60 cases, 33 were females and 27 were males, and among the 60 controls 28 were females and 32 males. Among 60 cases, 24 (40%) had restrictive pattern of lung dysfunction. Among 60 controls, 10 (16.67%) had restrictive pattern of lung dysfunction. This difference was statistically significant with a P value of 0.005. There was significant reductions in percentage predicted values of FVC and FEV1, P value of <0.001 and 0.001 respectively.
Conclusion: This study showed impaired lung function, predominantly restrictive pattern, in patients with diabetes. Pulmonary dysfunction worsened with increase in duration of diabetes.

I. INTRODUCTION

Diabetes mellitus is the most prevalent non communicable and metabolic disorder in the world and characterized by hyperglycaemia resulting from defects in insulin secretion, action or both. It is a big concern because of the devastating effect of its chronic complications. Based on etiopathogenic categories, it is classified as Type 1 and Type 2 diabetes mellitus. In Type 1, there is absolute deficiency of insulin secretion. Type-2 DM, the form driving the current epidemic of diabetes, results from defect in pancreatic beta cells secretion and peripheral tissue resistance to the actions of insulin. Insulin resistance results from genetic factors, decreased physical activity, ageing and obesity. [1,2]

There are histopathological changes seen in lungs of subjects with diabetes mellitus such as thickened alveolar epithelial cells and pulmonary capillary basal lamina leading to reduced pulmonary elastic recoiling of lung tissue. There is impaired diffusion of gases due to reduced pulmonary capillary blood volume and thickening of the basement membrane. Non-enzymatic glycosylation induced alteration of lung connective tissue is the most likely mechanism underlying the mechanical pulmonary dysfunction in Type-2 DM patients. This suggests that lung is one of the 'target organs' in diabetes mellitus. [3]

The review of research work in this field shows the involvement of respiratory system in Type 2 DM. The pulmonary functions in diabetes mellitus are not so extensively documented. The present study is undertaken to evaluate the impact of Type 2 DM on pulmonary functions and compare the results of pulmonary function tests in patients with Type 2 DM and normal individuals

II. MATERIALS AND METHOD

Study design:
Case-control study

Study duration:
1 & ½ years

Study setting:

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Hospital based study at Justice K. S. Hegde Charitable Hospital, attached to K.S.Hegde MedicalAcademy, a unit of Nitte University, Deralakatte, Mangalore.

Sample size:
Cases – 60
Controls – 60

Study population: study population will be divided into 2 groups
Group A (case) consists of all patients with type 2 DM (>18 years of age) attending the in-patient and outpatient department

- Group B (control) consists of normal individuals (>18 years of age)

According to WHO (World Health Organization) diagnostic criteria for diabetes is:

- Symptoms of diabetes with random blood sugar - ≥200mg/dl or
- Fasting plasma glucose - ≥126mg/dl (7.0mmol/l) or
- 2-hour plasma glucose value after a 75g OGTT - ≥200mg/dl (11.1mmol/l) or
- Glycosylatedhaemoglobin - HbA1c > 6.5%.13

Inclusion Criteria:

- Type 2 Diabetes mellitus patients above 18 years of age

Exclusion Criteria:

- Smokers
- Present or past history of respiratory diseases that might affect lung function such as asthma, COPD, tuberculosis, bronchiectasis, interstitial lung disease.
- History of occupational exposure to any substances that could affect lung function.
- Individuals with current or recent upper respiratory or lower respiratory infection, that could pre-dispose to heightened airway reactivity.
- History of ischemic heart disease in the past.
- Type 2DM patients with macrovascular complications.

Method of collection of data:

Subjects included in the study recruited from both in-patient and out-patient departments was requested to attend a medical interview and undergo physical examination including fundoscopy. Non-smoking type 2 DM patients with no history of respiratory disease, and who gave informed consent was selected for this study and had undergone pulmonary function testing. Healthy, non-smoking, normal individuals were chosen as controls, to undergo pulmonary function testing.

Statistical analysis: All values will be presented as Mean±SD. Comparison of mean values of parameters of diabetic and control subjects was done by using Student's t test.

III. RESULTS

Atotalof60casesand60controls fulfillingthecriteria were includedin this study.

Table 1:GenderDistributionamongcasesandcontrols

	Cases(%)	Controls(%)	Chi-square	Pvalue
Male	**27(45)**	**32(53.3)**	**0.834**	**0.361**
Female	**33(55)**	**28(46.7)**		

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SincetheChisquarePvalueismorethan0.05therewasno differencein gender distribution among cases and controls.

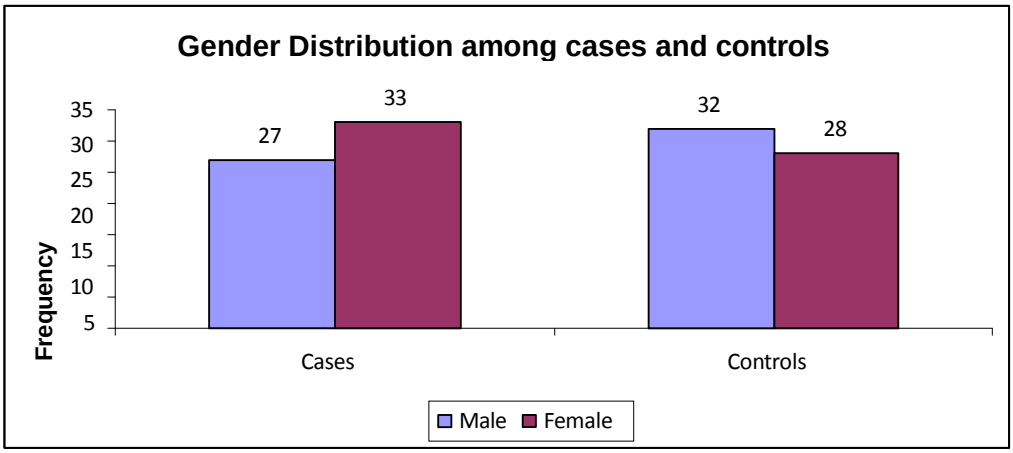

Figure1:Genderdistributionamongcasesandcontrols

Among60cases33werefemales,27weremales.Among60controls28 were females,32 were males.Genderdistribution ofsubjectsamongcases andcontrol shad chi-squarevalueof0.834andpvalue0.361,whichwas not statistically significant. This suggests that the subjects in each group were sex matched.

Table 2:Agedistributionamongcasesandcontrols

Age	Cases(%)	Controls(%)	ChiSquare	Pvalue
<40years	**9(26.7)**	**8(25)**	**0.147**	**0.929**
41-60years	**35(58.3)**	**37(61.7)**		
>60years	**16(15.0)**	**15(13.3)**		

SincetheChisquarePvalueismorethan0.05therewasa significant difference age distribution among cases and controls.

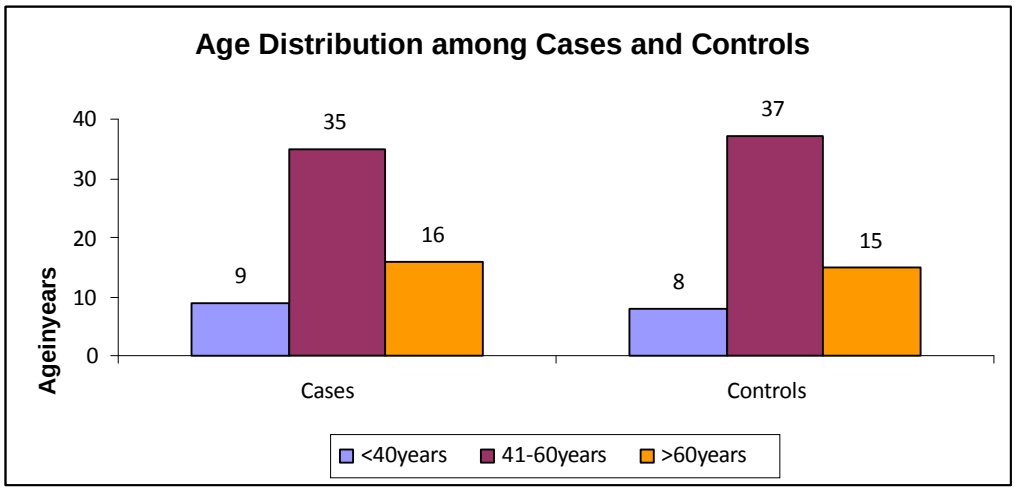

Figure2:Agedistributionamongcasesandcontrols

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Table 3 :ComparisonofPulmonaryfunctiontestintype2diabetes patients and normal subjects

		Cases (%)	Control (%)	Chi square	Pvalue
PFT	Normal	36(60)	50(83.33)	8.044	0.005*
	Restrictive Pattern	24(40)	10(16.67)		

(*indicatessignificantatthe5%levelofsignificance)
SincetheChisquarePvalueislessthan0.05therewasadifferencein pulmonary functions among the subjects.

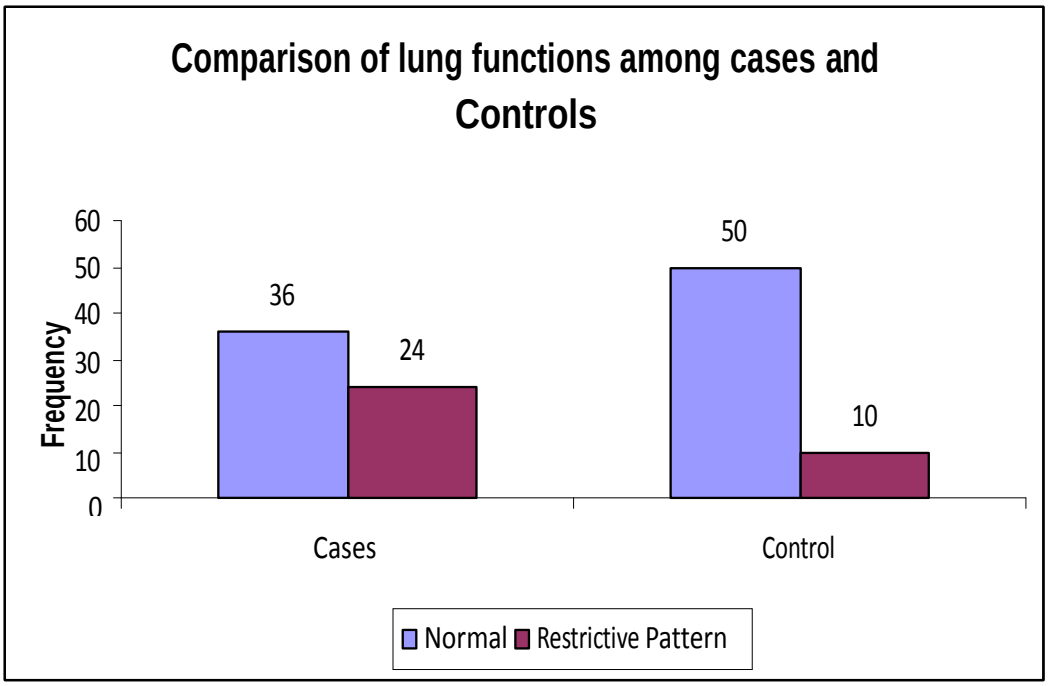

Figure3:Comparisonoflungfunctionsamongcasesandcontrols

Table4:SeverityofRestrictivepatternamongcases

RestrictivepatternofPFT (Casesonly)	Frequency	Percentage
Mild	10	41.68
Moderate	6	25
ModeratelySevere	4	16.66
Severe	4	16.66

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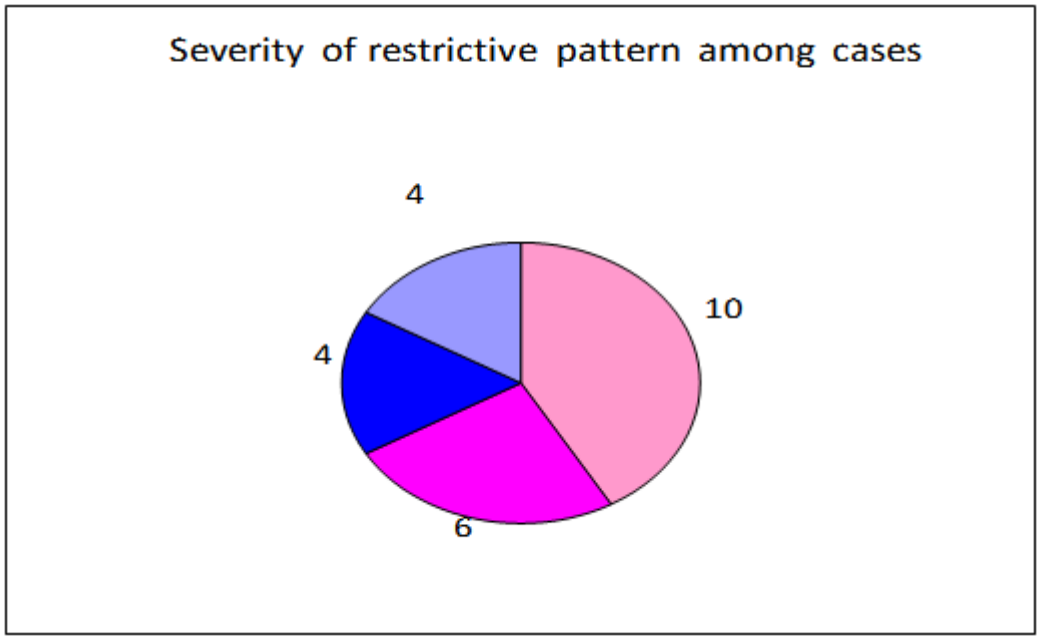

Figure4 :Severityofrestrictivepatternamongcases

Among the 24 cases; 10(41.68%) had mild restrictive pattern, 6(25%) caseshad moderate restrictive pattern, 4(16.66%) had moderately severe and 4(16.6%) had severe restrictive pattern.

Table 5: Comparison of mean predicted values of pulmonary function among cases and controls

	MeanPredictedSpirometricIndices		tvalue	Pvalue
	Cases	Controls		
FVC	82.13±19.475	90.52±13.857	-2.717	0.008*
FEV1	90.40±21.466	96.95±15.673	-1.909	0.059
FEV1/FVC	110.88±9.334	107.47±10.937	1.841	0.068

(*indicatessignificantatthe5%levelofsignificance)

Dataarepresentedasmean(±standarddeviation);pvaluesareforthose with T2DM versus those without, using t tests and chi-square statistical testing when appropriate.

Table 6: Correlating duration of T2DM and various Spirometric indicesamong patients with T2DM

Percentage Predicted Spirometric Indices	DurationofT2DM	
	rvalue	Pvalue
FVC	-0.44	<0.001*
FEV1	-0.425	0.001*
FEV1/FVC	0.048	0.713

(* indicates significant at the 5% level of significance)r = Pearson's correlation coefficient

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Table7 : CorrelationbetweenDurationofDiabetesMellitusandPulmonary Function Test

	Median	IQR (InterQuartileRange)	MannWhitneyU	Pvalue
Normal	**36**	**12to60**	**272.5**	**0.016***
Restrictive	**72**	**15to180**		

(*indicatessignificantatthe5%levelofsignificance)
Since the Mann Whitney U, P value is less than 0.05 there was a difference in median duration of diabetes.

The median duration of diabetes was 36 months (about 3 years) in patients with normal pulmonary function and 72 months (about 6 years) in those with restrictive pattern. Median duration of diabetes was higher among cases with abnormal pulmonary function when compared to those with normal pulmonary function which was statistically significant (P value 0.016).

IV. DISCUSSION

DIABETES AND LUNG FUNCTION:

In the Framingham Heart Study, which included 3,254 participants of the Framingham Offspring Cohort, Walter et al. studied the relationship between T2DM and pulmonary function using spirometry. They also assessed the relationship between FBS and pulmonary function. They found significant reduction in pulmonary function in patients with T2DM and those with higher FBS. Subjects with T2DM were found to have lesser predicted levels of FVC than FEV1 and higher FEV1/FVC ratio. Findings are consistent with restrictive pattern of pulmonary function. [4]

Similar results were obtained by Lange et al. in the Copenhagen City Heart Study. This was a cross sectional study which included 284 subjects with T2DM among 11,763 participants.[5]

The Fremantle Diabetes Study prospectively studied the relationship between DM, glycaemic control, and pulmonary function. This was a community-based cohort study which included 495 European descent participants with T2DM with no previous history of respiratory disease. They were made to undergo baseline spirometry between 1993 and 1994. There was greater than 10% decrease in predicted values of FVC and FEV1 at baseline. Prospective analysis of 125 participants after 7 years showed increased decline at a rate of 68, 71 and 84ml/year for FVC, FEV1 and VC.[6]

Another study conducted by Benbassat et al. measured FEV1, FVC and PEFR among diabetes patients found that there was no significant difference in the predicted values. RV/TLC was elevated in type 1 diabetes patients when compared to T2DM patients. Lung functions did not show any correlation with glycaemic control, duration of diabetes or microvascular complications. DLCO was normal in both groups.65 Restrictive pattern of pulmonary function was observed in Indian study conducted by Swathi et al. It was a case control cross sectional study. There was significant reduction in all spirometric indices except FEV1/FVC, in subjects with T2DM when compared to their normal counterparts. 66 A study conducted in Japan by Asanuma et al. also reported reduction of both FVC and FEV1 in individuals with DM compared to nondiabetic subjects.[7]

DURATION OF DIABETES AND LUNG FUNCTION:

Adeyeye et al. conducted a cross sectional study to observe the difference in lung functions in patients with T2DM. A total of 200 subjects were included in the study. The mean observed and predicted values of FEV1, FVC and PEFR 53 were significantly lower than the predicted in all cases (P value <0.001). They also found that longer duration of diabetes was associated with lower pulmonary functions.[8]

A cross sectional and prospective study conducted by Yeh et al. in which analyses was done using baseline and 3 years follow up data on 1,100 diabetic and 10,162 non-diabetic middle-aged adults from the ARIC study. FVC and FEV1 were measured at baseline and 3-year follow-up using standard spirometry. Inverse association was observed between duration of diabetes and spirometric values. In prospective analyses, FVC declined faster in diabetic adults than in their non-diabetic counterparts (P= 0.01).[9]

In a study conducted in Indian population by Kumari et al. which included 90 subjects with T2DM there was a decrease in FVC from 8.26% in diabetic patients with duration of diabetes less than 5 years when compared to patients with duration of diabetes more than 11 years in whom there was 16.35% reduction in FVC.[10]

Current study also shows significant association between the percentage predicted values of the various spirometric indices and the duration of diabetes. FVC showed significant negative correlation with duration of diabetes (r= -0.44, P=<0.001), FEV1 also showed negative correlation with duration of diabetes (r= -0.425, P=0.001) while FEV1/FVC showed a positive correlation which was not statistically significant (r=0.048, P=0.713).The results obtained in our study are consistent with the previous studies. The median duration of diabetes was 36 months among cases with normal lung function, while the median duration of diabetes was found to be 72 months in diabetic patients who had lung dysfunction. This difference was statistically significant with a P value of 0.016.

V. CONCLUSION

This study showed impaired lung function predominantly restrictive pattern in patients with diabetes. Results are like other larger studies. It is important to study lung function in patients with diabetes as impaired lung function may lower the threshold for acute or chronic lung diseases among subjects with diabetes. Pulmonary dysfunction worsened with increase in duration of diabetes. There was statistically significant association between lung dysfunction and other indices of microvascular injury. Further prospective studies are needed to confirm this observation and to establish lung dysfunction as a marker of microvascular complication.

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