



RESEARCH ARTICLE

REDUCED PULMONARY FUNCTIONS IN TYPE-2 DIABETES AND ITS CORRELATION WITH DURATION OF DIABETES

Dr. Gouher banu, S., Dr. Shrilaxmi, B., Dr. Jyothi, K., Dr. Sumangala, P. and Dr. Manjunatha, A.

Department of Physiology, B.L.D.E.U.'s Shri B. M Patil Medical College, Hospital and Research centre, Bijapur

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ABSTRACT

Objective: The purpose of this study was to evaluate pulmonary functions in patients with type 2 diabetes mellitus and to determine their correlations with duration of diabetes.

Material & methods: 40 type2 diabetic patients, aged 30-60years, with diabetic duration of 1-20 years, were included in the study. FVC, FEV1, FEV1%, PEFR, & MEP are recorded & the results were compared with age and sex matched control (non diabetic) subjects. Results were analyzed by calculating Mean \pm SD, using Student's t test, and Pearson correlation.

Results: All the respiratory parameters are reduced in type2 diabetic patients compared to control of which FEV1, FEV1%, & MEP show highly significant reduction ($p=5.953E-06$, $4.19E-07$, $1.206E-06$ respectively for FEV1, FEV1%, & MEP). Lung functions are negatively correlated with duration of diabetes ($r=-0.324$).

Conclusion: The present study shows reduced dynamic lung functions in type2 diabetic subjects. Lung functions are negatively correlated with duration of diabetes. As MEP is significantly reduced in study group we attribute this reduction in lung function tests to respiratory muscle weakness. Breathing exercises to strengthen the respiratory muscle may improve the lung function tests.

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INTRODUCTION

The pulmonary function tests are age old time tested parameters for assessing respiratory health of a person and are important for clinical, diagnostic and prognostic values. This work is intended to study the effect of type 2 Diabetes Mellitus on dynamic Pulmonary function tests. There is alarming increase in the incidence and prevalence of Diabetes Mellitus particularly in Asian Indians. The prevalence of diabetes for all age groups worldwide was 2.8% in 2000 and is estimated to reach 4.4% by 2030. The total number of diabetics is projected to rise from 171million in 2000 to 366million in 2030¹.

In Type1 Diabetes lung function has been investigated in several clinical studies & evidenced reduced elastic recoil^{2,3}, reduced lung volumes², diminished respiratory muscle performance⁶, decreased in pulmonary diffusion capacity for carbon monoxide^{2,4,5,7,8}, But there are very few data concerning pulmonary function abnormalities in patients with type 2 diabetes mellitus⁹. Several respiratory alterations have been reported in association with Diabetes Mellitus, including respiratory muscle dysfunctions, chest wall abnormalities & autonomic neuropathy.¹⁰

MATERIAL AND METHODS

The study group include 40 type2 diabetic patients (males $n=25$, Females $n=15$), aged 30-60 years (mean 52.3 ± 7.7 years), with diabetic duration of 1-20 years (mean $= 6.4 \pm 5.2$ years), taken from Diabetic clinic of

B.L.D.E.A.'s Shri B. M Patil Medical College, Hospital and Research centre, Bijapur using simple random sampling.. The study group was compared with 40 Non diabetic age & sex matched subjects taken from teaching and non teaching employees of B.L.D.E'S Shri B.M.Patil Medical College Bijapur. The ethical clearance was obtained from the institution.

Inclusion criteria

Apparently healthy individuals with type 2 diabetes mellitus are included in study. The apparent health status of the subjects was determined by thorough clinical examination and history taking.

Exclusion criteria

Subjects with a history of smoking and alcohol, recent / remote history of cardio respiratory diseases, history of respiratory allergy & with acute respiratory infection in the previous three months are excluded from the study.

The following Pulmonary function parameters are recorded in the subjects: The subject was informed about the procedure, and consent has been taken before recording. The highest reading of 3 trials in a sitting posture at room temperature, in morning hours was recorded.

a. FVC (Forced Vital Capacity): By using Benedict-Roth's recording spirometer.

b. FEV1 (Forced Expiratory Volume at the end of First Second): By using Benedict-Roth's recording spirometer.

c. FEV1% (Percentage of Forced Expiratory Volume at the end of First second)

$$FEV1\% = \frac{FEV1 \times 100}{FVC}$$

d. PEFR (Peak Expiratory Flow Rate): By using mini Wright's Peak flow Meter.

e. MEP (Maximum Expiratory Pressure): By using Modified Black's Apparatus.

Statistical analysis

All the data are presented as Mean \pm SD. The level of significance by Student's t test. Correlation was done by using pearson correlation.

RESULTS

Anthropometric parameters of control & diabetic subjects are summarized in (Table1). All the values of FVC- forced vital Capacity(ml), FEV1- Forced vital capacity in first second(ml), FEV1%, PEFR- Peak expiratory flow rate(L/min), MEP- Maximum expiratory pressure(mm Hg) are reduced in study (diabetics) group compared to control group(table2, Fig1). Statistically very highly significant reduction is seen in FEV1, FEV1%, & MEP. [p <0.001]

Table 1. Age and Anthropometric parameters of subjects of Control and Diabetic groups

Parameters	Control group (n=40)	Diabetic group (n=40)	P value
Age (years)	52.32 \pm 7.66	52.3 \pm 7.6	0.9
Height (cms)	159.57 \pm 7.75	161.05 \pm 9.13	0.44
Body Weight (kg)	58.70 \pm 11.68	58.71 \pm 10.12	1
BMI (kg / m ²)	23.18 \pm 3.87	22.69 \pm 3.41	0.55

Data presented are mean \pm SD; *p<0.05 Significant, **p<0.01 Highly significant, *** p <0.001 very highly significant

Table 2: Respiratory parameters of Diabetic subjects Vs control subjects

Parameters	Diabetic (n=40)	Control (n=40)	Level of significant
FVC in ml	1742.0 \pm 664.0	1877.5 \pm 572.0	0.33
FEV1 in ml	1160.0 \pm 496.0	1680.0 \pm 460.0	5.953E-06***
FEV1%	67.44 \pm 16.51	90.94 \pm 8.19	4.19E-07***
PEFR in L/min	310 \pm 96.66	364 \pm 150.4	0.059
MEP in mm Hg	31.75 \pm 15.34	64.25 \pm 34.33	1.206E-06***

(Values are Mean \pm SD); *p<0.05 Significant, **p<0.01 Highly significant, *** p <0.001 very highly significant.

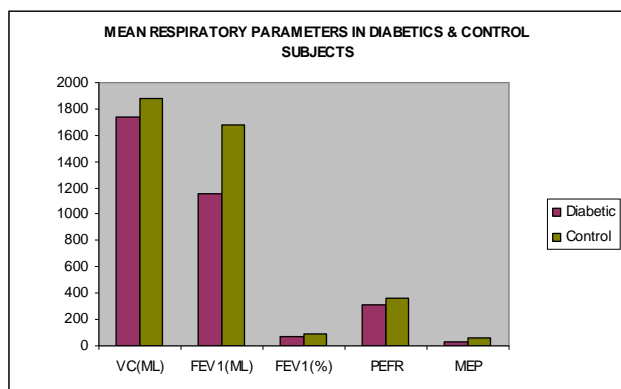


Fig. 1. Mean spiratory parameters in diabetics and control

In diabetics the decrease in FVC is 135ml(7.2%), FEV1 is 520ml(30.95%), FEV1% is 23.50%(25.84%), PEFR is 54lt/min (14.83%), & MEP is 32.50mmHg (50.58%), compared to control subjects. In our study lung function tests are negatively correlated with the duration of diabetes mellitus. FEV1% is significantly & negatively correlated with duration of diabetes (r=-0.342) Fig2.

DISCUSSION

In our study all pulmonary functions are significantly reduced in Diabetics compared to control subjects. Davis Wendy A (2004)¹¹ *et al* , demonstrated decline of >10% of FVC & FEV1 in the 125 prospectively studied patients. Absolute measures continued to decline at an annual rate of 68, & 71ml/year for FVC, FEV1 respectively. Reduced spirometric measurements may be due to basal lamina thickening & fibrosis¹². Other possible contributory factors include glycation of chest wall or bronchial tree protein^{3,13}. Autonomic and/or phrenic neuropathy causing alterations in bronchial reactivity & respiratory muscle function¹⁴. Devis Timothy, *et al* (2000)¹⁵, demonstrated that diabetes is associated with reduced lung function. Each of FVC, FEV1, & PEFR were an average of \geq 9.5% lower than predicted values. P. Lange (2002) in their longitudinal analysis of ventilatory capacity in diabetic and nondiabetic adults participants found that in both sexes, FEV₁ & FVC were consistently lower in diabetic individuals compared with healthy individuals.¹⁶

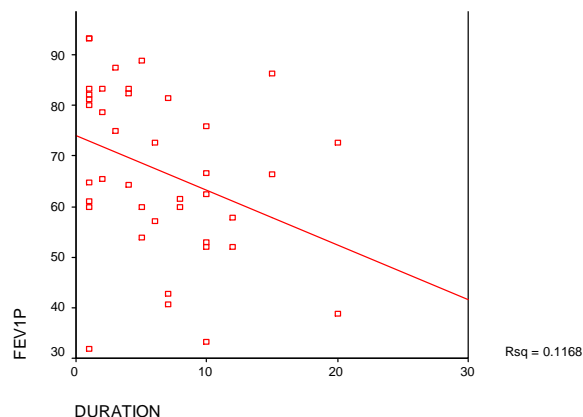


Figure 2 Graph showing the correlation between duration of diabetes & FEV1

The very highly significant reduction in MEP (50.58%) is in accordance with the following studies. Sanjeev sinha *et al* , demonstrated statistically comparable decrease in MEP in Type2 diabetes patients. Hyperglycemia and dyslipidaemia might have a contributory role in its pathogenesis¹⁷. A number of biochemical and functional changes of skeletal muscles, including respiratory muscles, have been reported in diabetes¹⁸. The mechanism of impairment of respiratory muscle function may be related to neuropathy, myopathy or both^{6 18 19}. In our study lung function tests are negatively correlated with the duration of diabetes mellitus. FEV1% is significantly & negatively correlated with duration of diabetes ($r=-0.342$). Following studies are in accordance with our study. Davis W A (2004), demonstrated that declining lung function measures were associated with duration of diabetes¹¹. In Framingham heart study by Robert E Walter(2003), demonstrated an association between duration of diabetes and reduced pulmonary function tests²⁰. Another study by Devis Timothy *et al* (2000), demonstrated that duration of diabetes was independently predictive of reduced lung function¹⁵. Sandler *et al* (1987) concluded that the degree of pulmonary dysfunction was correlated with the duration of diabetes².

CONCLUSION

1. We found that FEV1, FEV1% & MEP are significantly reduced ($p=5.953E-06$, $4.19E-07$, & $1.206E-06$). FVC & PEFR are insignificantly reduced in type2 diabetics.
2. We also found that respiratory parameters are negatively correlated with duration of diabetes. FEV1% is significantly correlated with the duration of diabetes. ($r= -0.342$).

The possible mechanism for highly significant reduction in FEV1 & FEV1% in study group may be due to respiratory muscle weakness, as confirmed by significantly reduced MEP in our study & also by other workers. The mechanism of muscle weakness in diabetic patients may be due to glycosylation of proteins such as collagen in the chest wall & pulmonary tree. Hence, we propose

1. Repeated recording of simple, non invasive, dynamic lung function tests like (FVC, FEV1, FEV1%, PEFR, MEP) may help to assess the prognosis of type2 diabetes in clinical practice.
2. Regular breathing exercises to strengthen the respiratory muscles may improve the pulmonary function tests in Type 2 diabetic patients & requires further study.

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