

## The Study of FEV<sub>1</sub>, FVC and FEV<sub>1</sub>/FVC in Type 1 Diabetes Mellitus and their Correlation with Duration of Type 1 Diabetes Mellitus

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### Abstract

**Objectives:** To determine the pulmonary functions of patients with type 1 diabetes mellitus. To correlate the pulmonary functions with duration of type 1 diabetes mellitus.

**Material and Methods:** This Cross sectional study was conducted at department of medicine, Mayo hospital Lahore during the months of January to June, 2015. Sixty two patients fulfilling the criteria enrolled through non-probability purposive sampling technique. Informed consent taken and demographic details noted. Pulmonary functions were performed by using a spirometer. Pulmonary functions include FEV<sub>1</sub>, FVC and FEV<sub>1</sub>/FVC ratio were calculated. Data entered and analyzed through SPSS version 17. Mean and standard deviation were calculated for age, height, weight, BMI, duration of diabetes and FEV<sub>1</sub>/FVC ratio. The correlation between duration of diabetes and FEV<sub>1</sub>/FVC ratio was measured by Pearson coefficient. P value < 0.05 was considered as significant.

**Results:** In this study, mean age of the patients was 28.27±6.07 years, male to female ratio was 1.2:1, mean duration of disease in patients was 9.35±3.05 years and mean value of FEV<sub>1</sub>/FVC ratio of the patients was 86.39±31.19. In this study there was negative correlation between duration of disease and FEV<sub>1</sub>/FVC ratio of the patients with disease duration less than 10 years i.e. r=-0.048.

**Conclusion:** Our study concluded that no significant correlation between the pulmonary functions and the duration of type 1 diabetes mellitus but positive correlation in patients with disease duration >10 years.

**Key words:** *pulmonary function, vital capacity, spirometry, Type 1 diabetes mellitus, pearson's correlation, duration of diabetes*

### Introduction

Diabetes mellitus is a syndrome with disordered metabolism and inappropriate hyperglycemia either

due to deficiency of insulin secretion or combination of insulin resistance and inadequate insulin secretion to compensate. Diabetes mellitus affects various organs like eyes, nerves, kidneys and heart.<sup>1</sup> The complications of diabetes mellitus are attributed to the biochemical and structural changes in basement membrane proteins in different organ systems.<sup>2</sup>

It has been proven that the pulmonary functions parameters like FEV<sub>1</sub>, FVC and FEV<sub>1</sub>/FVC are significantly reduced in patients with diabetes.<sup>4</sup> These patients have a restrictive pattern of respiratory abnormality. The impaired respiratory function

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may give way to the development of pulmonary complications. In patients with type 1 diabetes mellitus, a significant restrictive defect associated with decreased lung diffusion capacity has been found for carbon monoxide at a given pulmonary blood flow, mainly due to reduction of membrane conductance compared with non-diabetics.<sup>5</sup>

Until recently, however, few studies had explored lung functions among subgroups of diabetic subjects. It is likely that persistent inadequate glycaemic control over time may be involved in the impairment of lungs function.<sup>6,7</sup>

A study, conducted by Verma et al., in 2009 reported that mean  $FEV_1/FVC$  ratio among 50 type I diabetic patients was  $86.41 \pm 15.54\%$ .<sup>8</sup> Another recent study, conducted by El-Azeem et al., in 2013 reported that mean  $FEV_1/FVC$  ratio among 60 type I diabetic patients was  $84.15 \pm 0.53\%$  while among 40 controls, the mean  $FEV_1/FVC$  ratio was  $92.91 \pm 0.61\%$ . The difference between two groups was highly significant ( $p=0.001$ ).<sup>9</sup> But in another study conducted by Irfan et al, also found that mean  $FEV_1/FVC$  ratio among 64 type I diabetic patients was  $81.94 \pm 8.26\%$  while among 64 controls, the mean  $FEV_1/FVC$  ratio was  $81.407.16\%$ . The difference between both groups was highly insignificant.<sup>10</sup>

$FEV_1/FVC$  ratio was significantly higher in patients with type I diabetes mellitus for 2-5 years  $0.842 \pm 0.009\%$  as compared to those having type I diabetes mellitus for  $>7$  years  $0.836 \pm 0.01\%$  ( $p$ -value= $0.010$ ). This study shows that as the duration of diabetes increases, there is a subclinical change in lung function towards restrictive pattern.<sup>11</sup> There is an association between diabetes mellitus and decreased lung function but the definitive direction and the exact pathophysiological mechanism to explain this association requires further investigations.<sup>12</sup>

The rationale of this study is to determine pulmonary functions of type I diabetes and correlation with duration of diabetes. It has been observed in common practice that patients with any type of diabetes are associated with abnormal pulmonary functions and previous studies have shown restric-

tive pattern as most common pathology. Through this study we want to assess the pulmonary function tests of type I diabetes mellitus patients and see the pattern of pulmonary function abnormality. This identification will help physicians to improve patient's care by timely addressing pulmonary complications.

## Methods

The study was conducted at department of medicine, Mayo hospital, Lahore during the months of January to June, 2015. The sample size was sixty two cases, calculated with 95% confidence level, 5% margin of error and taking magnitude of mean  $FEV_1/FVC$  ratio i.e.  $93.8 \pm 0.2\%$  among type I diabetic patients.

The study group included non-smoker type 1 diabetic patients of age 15-40 years either gender with history of type I diabetes mellitus for 5-7 years, 7-10 years and  $>10$  years. Patients with history of smoking, chronic obstructive pulmonary disease, asthma, cirrhosis of liver, autoimmune diseases, occupational exposure such as pneumoconiosis, neuromuscular or cardiovascular diseases or any physical disability that may affect lung function as kyphoscoliosis, pectusexcavatum and pectus-carinatum and patients having  $BMI > 30 \text{ kg/m}^2$  were excluded in this study.

62 patients fulfilling the criteria were enrolled in the study from outpatient department of Mayo hospital, Lahore. Informed consent was taken. The demographic details including name, age, gender, height, weight and contact number were noted. Pulmonary functions were performed by using a computerized spirometer. Pulmonary function parameters include  $FEV_1$ , FVC and  $FEV_1/FVC$  ratio were calculated for each patient and noted on proforma. Data entered and analyzed through SPSS version 17. Mean and standard deviation were calculated for age, height, weight, BMI, duration of diabetes and  $FEV_1/FVC$  ratio. The correlation between duration of diabetes and  $FEV_1/FVC$  ratio was measured by Pearson coefficient.  $P$ -value  $< 0.05$  will be considered as significant. Data was

stratified for BMI (Underweight, Normal) and duration of diabetes (5-7 years, 7-10 years and > 10 years).

**Results**

Total 62 patients were enrolled. Mean age of patients was 28.27±6.07 years. 54.84% were male and 45.16% were female. Mean height of the patients was 1.66±0.11 meters. Mean weight of the patients was 70.38±4.46 kg. Mean BMI value of the patients was 25.57±2.94 kg/m<sup>2</sup>. Mean disease duration of the patients was 9.35±3.05 years with minimum and maximum duration of 5 and 15 years respectively. 19(30.65%) patients have disease duration of 5-7 years, 20(32.26%) patients have disease duration of 7-10 years and 23(37.10%) patients have disease duration >10 years. Table-1

Mean value of FEV<sub>1</sub> of the patients was 1.62±0.59L with minimum and maximum values of 0.50 and 2.50 L respectively. Mean value of FVC of the patients was 1.90±0.63 L with minimum and maxi-

**Table 1:** Profile of Study Participants

Parameters	Mean	SD	Minimum	Maximum
Age(year)	28.27	6.07	18	38
Height(m)	1.66	0.11	1.52	1.85
Weight(kg)	70.38	4.46	64	79
BMI(kg/m <sup>2</sup> )	25.57	2.94	19.38	30.80
Duration of DM(years)	9.35	3.05	05	15

imum values of 0.80 and 3.00 L respectively.

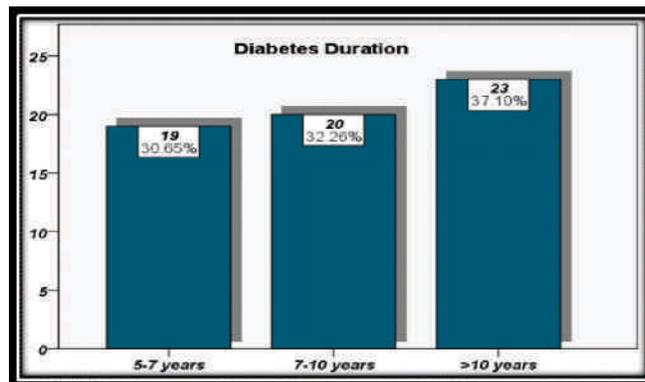
Mean value of FEV<sub>1</sub>/FVC ratio of the patients was 78±50 with minimum and maximum of 43 and 93 respectively. Table-2

There was negative correlation between the duration of disease and FEV<sub>1</sub>/FVC ratio, r=-0.48, p-value=0.713. There was no significant correlation between the duration of DM and FEV<sub>1</sub>/FVC ratio

**Table 2:** Pulmonary Function Tests of Participants

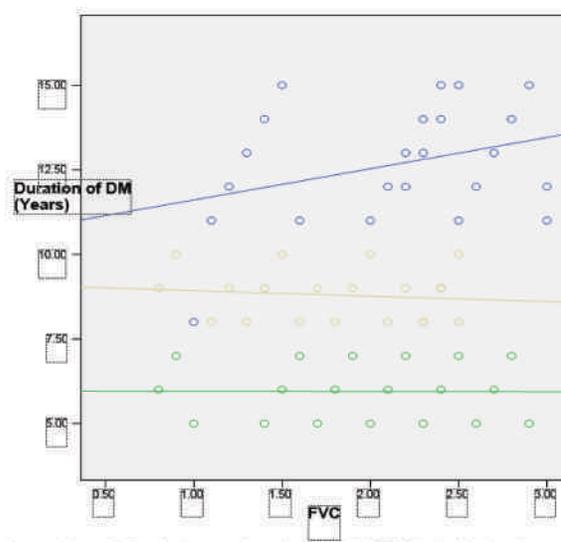
PFTs	Mean	SD	Minimum	Maximum
FEV <sub>1</sub> (L)	1.62	0.59	0.50	2.50
FVC (L)	1.90	0.63	0.80	3.00
FEV <sub>1</sub> /FVC(%)	78	10.87	43	93

stratifying by normal BMI, r = -0.038, p-value = 0.853.



**Figure 1:** Frequency distribution of duration of diabetes

There was no significant correlation between the duration of diabetes mellitus and FEV<sub>1</sub>/FVC ratio stratifying by overweight or obese BMI, r = -0.069, p-value=0.687. There was no significant correlation between the duration of diabetes mellitus and FEV<sub>1</sub>/FVC ratio stratifying by disease duration 5-7 years, r=-0.009, p-value=0.971.



**Figure-2:** Correlation between duration of DM & FVC stratifying by Duration of disease

There was no significant correlation between the duration of diabetes mellitus and FEV<sub>1</sub>/FVC ratio stratifying by disease duration 7-10 years, r=-0.0269, p-value=0.251. There was weak positive correlation between duration of disease and FEV<sub>1</sub>/

FVC ratio stratifying by disease duration >10 years,  $r=0.027$ ,  $p\text{-value}=0.903$ .

## Discussion

The study was conducted at department of medicine, Mayo hospital Lahore to determine the pulmonary function of type 1 diabetic patients and their correlations with duration of disease. Diabetes mellitus is a disease with multi-organ damage and several studies locally and internationally have been attempted to find correlation between diabetes and lung functions.<sup>13-15</sup>

In this study, mean disease duration of the patients was  $9.35\pm 3.05$  years and mean value of  $FEV_1/FVC$  ratio of the patients was  $86.39\pm 31.19$  with minimum and maximum of 62.50 & 230.00 respectively. Reduced values of Forced vital capacity and vital capacity have been reported in earlier studies.<sup>20</sup>

In one study, conducted by Innocenti F et al.<sup>21</sup> reported a decreased  $FEV_1$  and FVC in patients with type 1 diabetes as compared to their counterparts. In a study, conducted by Verma et al, in 2009 reported that mean  $FEV_1/FVC$  ratio among 50 type I diabetic patients i.e.  $86.41\pm 15.54\%$ .

Another recent study, conducted by El-Azeem et al, in 2013 reported that mean  $FEV_1/FVC$  ratio among 60 type I diabetic patients was  $84.15\pm 0.53\%$  while among 40 controls, mean  $FEV_1/FVC$  ratio was  $92.91\pm 0.61\%$ . The difference between two groups was highly significant ( $p=0.001$ ).

But in another study conducted by Irfan et al, mean  $FEV_1/FVC$  ratio among 64 type I diabetic patients was  $81.94 \pm 8.26\%$  while among 64 controls, mean  $FEV_1/FVC$  ratio was  $81.407.16\%$ . The difference between two groups was highly insignificant.

Another study by Hiroshi MORI et al, 22 reported no correlation of pulmonary function tests with duration of diabetes, the degree of microangiopathy and treatment.

In our study no significant correlation found between duration of disease and  $FEV_1/FVC$  ratio of the patients i.e.  $r = -0.048$  and also no significant

correlation found when data was stratified by BMI and duration of type 1 diabetes. Only positive correlation found in type 1 diabetics having disease duration more than 10 years i.e.  $r = 0.903$ .

In a study by Ulagavarshini Sankarasubbu and Balasubramanian Kabali reported a significant decrease of  $FEV_1/FVC$  in patients with type 1 diabetes > 7 years as compared to those having disease duration of 2-3 years i.e.  $P = <0.05$ . A restrictive pattern of pulmonary functions found in patients having type I diabetes for 6-7 years as compared to those having disease duration of 2-3 years.<sup>23</sup>

Different studies demonstrated that FVC and  $FEV_1$  were significantly reduced in type 1 diabetics while  $FEV_1\%$  was not significantly different in both cases and controls. A restrictive lung pathology found in diabetes.

One study by Amal Abd El-Azeem I et al reported that impairment of pulmonary function found to be more marked in diabetic patients after 10 years. Type I diabetic patients have lower FVC and  $FEV_1/FVC\%$  than predicted.

Makkar P. et al. studied pulmonary function of type 1 diabetics from Bikaner and found a significant reduction of FVC,  $FEV_1$ , PEF, MEF 75% and MEF 25%.

Irfan M. et al,<sup>10</sup> investigated pulmonary functions of diabetic patients in Pakistani population and observed a significant reduction of FVC and  $FEV_1$  as compared to non-diabetics.

Pinar. et al. explained that long duration of diabetes, presence of high grade pulmonary microangiopathy and reduced DLCO in patients with type 1 diabetes mellitus, were due to the fact that the patients using insulin had longer duration of disease.

## Conclusion

Our study concluded a negative correlation between the pulmonary functions of patients with type 1 diabetes mellitus and duration of disease <10 years but a weak positive correlation in patients with duration of disease >10 years.

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