

## PEFR and $FEF_{25-75}$ in type 2 diabetes mellitus and their relationships with its duration

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### Abstract

**Background:** Diabetes mellitus is a major public health problem with increasing incidence worldwide and long term complications of various organs including lungs. The magnitude of the complications of this disease is related to its duration. **Objective:** To observe PEFR and  $FEF_{25-75}$  in type 2 diabetic male and their relationship with duration of the disease. **Methods:** This cross sectional study was carried out in the Department of Physiology, BSMMU, Dhaka, from 1<sup>st</sup> July 2007 to 30<sup>th</sup> June 2008 on 60 type 2 diabetic, non smoker, male of 40-60 years old. For comparison, 30 age, BMI and socioeconomic status matched apparently healthy non diabetic subjects were also studied. Based on the duration of disease, diabetic patients were divided into B<sub>1</sub> (5-10 years) and B<sub>2</sub> (10-20 years). PEFR and  $FEF_{25-75}$  of all the subjects were measured by an electronic spirometer. Data were analyzed by One way ANOVA, Unpaired Student's 't' and Pearson's correlation coefficient tests. **Results:** The mean percentage of predicted values of PEFR and  $FEF_{25-75}$  in non diabetic male were within normal ranges. But, both the parameters were significantly ( $p < 0.001$ ) lower in both the groups of type 2 diabetic male compared to those of non diabetic male. Again, the PEFR and  $FEF_{25-75}$  were lower in the patients of longer duration compared to those of shorter duration but the differences were not significant. However, PEFR was negatively correlated and  $FEF_{25-75}$  was positively correlated with shorter duration of diabetes and the relationships were nonsignificant. On the other hand, both the parameters were negatively correlated with longer duration of diabetes while only PEFR showed significant ( $p < 0.01$ ) relationship. **Conclusion:** The PEFR and  $FEF_{25-75}$  may be lower in type 2 diabetic male, which are inversely related to the duration of the disease.

**Key words:** PEFR,  $FEF_{25-75}$ , Diabetes Mellitus.

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### Introduction

**D**iabetes mellitus is a syndrome of impaired carbohydrate, protein and fat metabolism caused by either lack of insulin secretion or decreased sensitivity of the tissues to insulin<sup>1</sup>. It is one of the leading public health problems with increasing incidence and long term complications of various organs such as kidney, nervous tissue, eye, heart etc. These complications are mainly a consequence of macro and micro vascular damages of the target organs<sup>2</sup>.

Recently the researchers of different countries believe the lung as a target organ of long term diabetes mellitus<sup>3</sup>. They recommended that hyperglycemia causes micro vascular changes such as thickening of basal lamina in the smaller vessels of the lungs, which causes reduction of vascular diffusing capacity. It has also been suggested that this chronic debilitating disease may increase the susceptibility and severity of systemic inflammation of lungs and ultimately

cause peripheral airway obstruction<sup>4</sup> as well as fibrosis of lung tissue<sup>5</sup>. It was also observed that hyperglycemia affects the lung by non enzymatic glycation of chest wall and bronchial tree protein which prevents easy expansion<sup>6</sup>.

An important factor for the long term complications of this chronic debilitating disease is its duration. Chronic hyperglycemia is strongly associated with progressive neurogenic damage<sup>7</sup>. Its severity and extent increases with the duration of diabetes. Davis et al. and MEO et al. reported about the decrement of some spirometric lung function parameters like FVC, FEV<sub>1</sub> and PEFR in this group of patients and the decline was more in patients with longer duration of diabetes<sup>2,6</sup>.

The number of diabetic patients in the world is increasing day by day<sup>8</sup>. It may be raised from 150 million to 220 million by the year 2010<sup>9</sup>. In our country, the number of diabetic patients is also rising gradually. In 1966, about 1% people were affected by diabetes mellitus in Bangladesh, whereas in 2003 it was about 15%<sup>7</sup>. And very recently the numbers of diabetic patients attending in the Out Patient Department (OPD) of different diabetic centers of Bangladesh have been increased markedly, though the actual data is not available. Another surprising observation is that there is no age limitation for presentation of type 2 diabetes and many of the patients are diagnosed after development of one or more complications including nephropathy, neuropathy, retinopathy, cardiovascular disease and others.

Many studies on pulmonary functions in type 2 diabetic patients have been done in other countries<sup>2-3, 5-6</sup>. With the best of our knowledge no data is available in our country. On the basis of these rationales, the present study was conducted to observe some aspects of lung functions in type 2 diabetic male to evaluate their lung function status and its association with duration of this devastating disease.

## Methods

This cross-sectional study was carried out in the Department of Physiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, from 1<sup>st</sup> July 2007 to 30<sup>th</sup> June 2008. The Departmental Ethical Committee approved the protocol. Total 90 non-smoker male subjects of 40-60 years of age were selected for the study. Subjects with COPD, asthma, any lung infections, any heart disease, renal insufficiency (s. creatinine > 1.5 mg/dl)<sup>10</sup>, obesity (BMI > 22.9)<sup>11</sup> or with any structural chest deformity were excluded from the study. Of them, 30 age, BMI and socioeconomic status matched apparently healthy non diabetic subjects (Group A) were randomly selected from the community, for comparison. Sixty (60) type 2 diabetic patients (Group B, study group) were selected from the Out Patients Department (OPD) of Bangladesh Institute of Research and Rehabilitation on Diabetes, Endocrine and Metabolic Disorders (BIRDEM). Based on duration of the disease, diabetic patients were again subdivided into B<sub>1</sub> (with 5-10 years duration) and B<sub>2</sub> (with 10-20 years duration). After selection of the subjects, the purpose of the study was explained in detail to each subject with a cordial attitude, giving emphasis on the benefits they would obtain from this study. They were encouraged for their voluntary participation. They were also allowed to withdraw themselves as soon as they desire. To avoid the diurnal variation of the ventilatory variables, all the subjects were requested to attend at Department of Physiology of BSMMU within 9 a.m. (after taking their breakfast at 7 a.m) on the day of examination. Before examination an informed written consent was taken from each subject. A detail personal, medical, family, socioeconomic, occupational and drug history was recorded in a preformed questionnaire. Thorough physical examinations were done. Height and weight of all the subjects were measured for the calculation of BMI. Then 5 ml of venous blood was collected from every subject (for estimation of serum glucose, creatinine and HbA<sub>1c</sub>). All the

hematological and biochemical tests were done by standard laboratory procedure. After that, PEFR and FEF<sub>25-75</sub> of all the subjects were measured by an electronic spirometer (RMS Medspiror). The spirometric data were expressed as Mean ± SD of percentage of predicted values and analyzed by One way ANOVA, Unpaired Student's 't', and Pearson's correlation coefficient tests, as applicable.

**Results**

The demographic variables of the study subjects are presented in Table I. All the groups were matched for age and BMI.

**Table I:** Age and BMI in different groups (n=90)

Groups	n	Age (years)	BMI (kg/m <sup>2</sup> )
A	30	49.56 ± 5.59	20.63 ± 1.42
B <sub>1</sub>	30	51.70 ± 4.69	21.40 ± 1.70
B <sub>2</sub>	30	51.90 ± 5.82	21.30 ± 1.60

Statistical analysis:

Groups	p value
A vs B <sub>1</sub> vs B <sub>2</sub>	0.184 <sup>ns</sup>
A vs B <sub>1</sub>	0.115 <sup>ns</sup>
A vs B <sub>2</sub>	0.119 <sup>ns</sup>
B <sub>1</sub> vs B <sub>2</sub>	0.884 <sup>ns</sup>

Data are expressed as Mean ± SD. For comparison among the groups one way ANOVA and between the groups Independent sample 't' test were done..

Group A = Apparently healthy non diabetic male for control.

Group B<sub>1</sub> = Diabetic male with duration 5-10 years.

Group B<sub>2</sub> = Diabetic male with duration 10-20 years.

ns = Not significant.

n = Number of subjects.

Duration of diabetes and Glycosylated hemoglobin (HbA<sub>1c</sub>) level were higher in group B<sub>2</sub> than those of B<sub>1</sub>, which is shown in Table II.

**Table II:** Mean duration of diabetes and HbA<sub>1c</sub> in study groups (n=60)

Groups	n	Duration (years)	HbA <sub>1c</sub> (%)
B <sub>1</sub>	30	7.40 ± 1.90	6.48 ± 0.69
B <sub>2</sub>	30	13.90 ± 1.91	7.21 ± 1.20

Data are expressed as Mean ± SD.

HbA<sub>1c</sub> = Glycosylated hemoglobin.

Group B<sub>1</sub> = Diabetic male with duration 5-10 years.

Group B<sub>2</sub> = Diabetic male with duration 10-20 years.

n = Number of subjects.

The results of both of the lung function parameters are shown in Table III.

**Table III:** Mean percentage predicted values of PEFR and FEF<sub>25-75</sub> in different groups (n=90)

Groups	n	PEFR (%)	FEF <sub>25-75</sub> (%)
A	30	86.33 ± 14.52	124.60 ± 24.72
B <sub>1</sub>	30	70.36 ± 13.57	96.27 ± 8.37
B <sub>2</sub>	30	64.03 ± 16.59	96.23 ± 17.68

Statistical analysis:

Groups	p value
A vs B <sub>1</sub> vs B <sub>2</sub>	0.000***
A vs B <sub>1</sub>	0.000***
A vs B <sub>2</sub>	0.000***
B <sub>1</sub> vs B <sub>2</sub>	0.111 <sup>ns</sup>

Data are expressed as Mean ± SD. For comparison among the groups one way ANOVA and between the groups Independent sample 't' test were done..

Group A = Apparently healthy non diabetic male for control.

Group B<sub>1</sub> = Diabetic male with duration 5-10 years.

Group B<sub>2</sub> = Diabetic male with duration 10-20 years.

\*\*\* = p < 0.001.

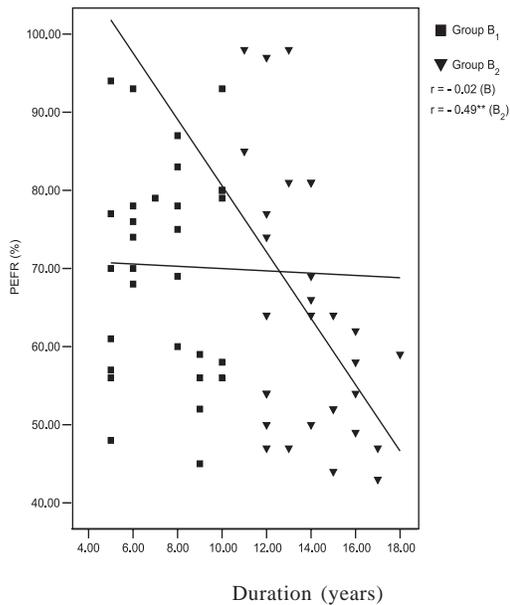
ns = nonsignificant

n = Number of subjects.

The mean percentage of predicted values of PEFR and FEF<sub>25-75</sub> were significantly ( $p < 0.001$ ) lower in both the study groups (B<sub>1</sub> and B<sub>2</sub>) than those of control (A), whereas these values in B<sub>2</sub> were lower in comparison to B<sub>1</sub> and the difference was statistically not significant.

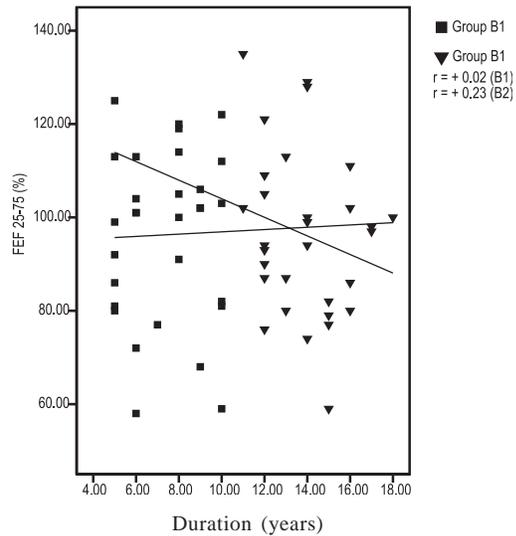
Relationships of PEFR and FEF<sub>25-75</sub> with duration of diabetes in different study groups are shown in Figure 1 and 2.

PEFR was negatively correlated with duration of diabetes in both the study groups, however the relationship was statistically significant ( $p < 0.01$ ) only in B<sub>2</sub>. Again FEF<sub>25-75</sub> was positively correlated in group B<sub>1</sub> and negatively correlated in group B<sub>2</sub>, with the duration of diabetes and the relationship was statistically nonsignificant.



Group B<sub>1</sub> = Diabetic male with duration 5-10 years  
Group B<sub>2</sub> = Diabetic male with duration 10-20 years  
\*\* =  $p < 0.01$

**Figure 1:** Correlation of percentage of predicted value of PEFR with duration of diabetes in study groups (n=60)



Group B<sub>1</sub> = Diabetic male with duration 5-10 years  
Group B<sub>2</sub> = Diabetic male with duration 10-20 years

**Figure 2:** Correlation of percentage predicted value of FEF<sub>25-75</sub> with duration of diabetes in study groups (n = 60)

## Discussion

The present study was undertaken to observe some aspects of spirometric lung function status in type 2 diabetic male subjects. To evaluate it, PEFR and FEF<sub>25-75</sub> were measured in this group of patients of 5-10 and 10-20 years durations. For comparison, age, sex and socioeconomic status matched healthy non diabetic control was taken. The values of lung function parameters in non diabetic subjects were almost similar to the findings of control subjects reported by different investigators of different countries<sup>12, 13</sup> as well as in our country<sup>14</sup>.

In this study, the mean of percentage of predicted values of PEFR and FEF<sub>25-75</sub> in type 2 diabetic male patients of different durations were significantly ( $p < 0.001$ ) lower than those of non diabetic subjects and this finding is consistent with findings of different investigators of different countries<sup>6, 15-16</sup>. Again, these parameters in diabetic patients of 10-20 years duration was lower than those of 5-10 years duration but the difference was not statistically significant. These observations are also in

agreement with those of different investigators of other countries<sup>6, 16</sup>.

In the diabetic patients of 5-10 years duration, PEFR was negatively and FEF<sub>25-75</sub> was positively correlated with the duration of the disease and the relationships were statistically nonsignificant. On the other hand, both the parameters were negatively correlated with duration of the disease in the patients of 10-20 years duration, but only PEFR showed statistical significance ( $p < 0.01$ ). These observations are in partial agreement with those of Meo et al. (2007), where they reported of significant negative correlation with FEF<sub>25-75</sub><sup>2</sup> with the disease duration. On the other hand, Benbassat et al. (2001) observed no correlation between lung function parameters and duration of the disease or glycemic control<sup>17</sup>.

Various researchers of different countries suggested that the diabetes mellitus may cause irreversible collagen cross linking in thoracic as well as lung tissues. It was also suggested that chronic hyperglycemia may cause fibrous tissue formation in the chest wall and bronchial tree protein (specially collagen) by non enzymatic glycation, and eventually reduction in compliance of lung and subsequent chronic airflow obstruction<sup>18</sup>. Again, long standing hyperglycemia may cause autonomic as well as somatic (phrenic) neuropathy, which alters bronchial activity and respiratory muscle function<sup>19</sup>.

Moreover, hyperglycemia causes over production of mitochondrial super oxides and ultimately a secondary reduction in antioxidant defense of the lungs. So there may be increased susceptibility to environmental oxidative insults and subsequent loss of ventilatory and respiratory function<sup>20-21</sup>. Again hyperglycemia also causes NO-dependent endothelial dysfunction and decreased production of NO and ultimately bronchoconstriction occurs<sup>22</sup>. Diabetes mellitus is also associated with poor skeletal muscle strength and quality, which may be due to increased protein catabolism<sup>23</sup>. For this reason respiratory muscle endurance also decreases in diabetes mellitus<sup>16</sup>.

In the present study, PEFR and FEF<sub>25-75</sub> were reduced in diabetic patients of both the study groups and comparatively lower values were observed in patients of longer duration denotes decreased lung compliance and airflow obstruction. The exact mechanism for this reduction could not be elucidated from this type of study, but it may be due to glycation of the chest wall and bronchial tree protein, increased muscle protein catabolism and decreased production of bronchodilator agent (NO). Moreover the negative correlation of PEFR and FEF<sub>25-75</sub> with longer duration of diabetes mellitus may be indicative of long standing hyperglycemia, which may intensify the devastating effect of the disease.

### Conclusion

The PEFR and FEF<sub>25-75</sub> may be lower in type 2 diabetic male, which are inversely related to the duration of the disease.

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