Alteration of Pulmonary Functions in Male Adults with Type 2 Diabetes Mellitus

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Received: June 2019; Accepted: July 2019; Published: August 1, 2019.
Citation: Kharel Sushil, Mainalee Mandira. Alteration of Pulmonary Functions in Male Adults with Type 2 Diabetes Mellitus. World Family Medicine. 2019; 17(8): 4-8. DOI: 10.5742MEWFM.2019.93666

Abstract

Background: Pulmonary function test is a routine procedure for the assessment and evaluation of respiratory ailments.

Aims and objectives: Diabetes mellitus (DM) is a metabolic disorder leading to various vascular complications. This study was aimed to know the extent of impairment of lung function in diabetics among the urban population around Sinamangal, Kathmandu and to know the variations in the values of the Forced Vital Capacity (FVC), Peak Expiratory Flow Rate (PEFR), Forced Expiratory Volume in the first second (FEV1), and FEV1/FVC percentage among Type 2 Diabetes Mellitus and non-diabetic healthy population.

Methods: A cross-sectional study was conducted at Kathmandu Medical College, Nepal, from September 2018 to February 2019. Adult males, 105 with DM and 105 non-DM healthy matched subjects were enrolled for this study. After obtaining informed written consent, all were evaluated for anthropometric parameters, blood sugar (fasting and post prandial), and pulmonary functions (using digital spirometer). Results were analyzed by calculating Mean ± SD, using Student's t test, Karl Pearson correlation and ANOVA test.

Results: Mean FVC, FEF25-75, FEV1, FEV1/FVC% and PEFR were found to be significantly lower in patients with Type 2 DM as compared to non-DM; there were significant differences between mean PFT values among diabetics and non-diabetics ($P < 0.05$).

Conclusion: Lungs are affected in patients of diabetes and pulmonary function test should be performed in diabetics in order to prevent further complications which will definitely help in maintaining quality of life.

Key words: Type 2 Diabetes Mellitus, Pulmonary Function Test (PFT), Spirometer.

Introduction

Diabetes mellitus (DM) is a systemic disease that causes various pathophysiological alterations in different organ systems and the multiple complications affecting these systems is responsible for the vital cause of morbidity and mortality associated with the disease (1). Diabetes is one of the most common metabolic disorders which is increasing day by day. As stated by the International Diabetes Federation, diabetes affects at least 285 million people worldwide, and the number is expected to reach 438 million by the year 2030, with two-thirds of all diabetes patients in low- to middle-income countries (2). DM is known to cause various metabolic, micro and macro vascular abnormalities as well as disruptions in the normal functioning of many organ systems such as the kidneys, nerves, respiratory and the cardiovascular system (3). Diabetes is not associated with any specific pulmonary signs and symptoms and hence routine screening for pulmonary disease is usually not done in diabetic patients. However broad micro-vascular circulation and extensive connective tissue in the lung raise the probability that the lung may also be a target organ in diabetic patients (4, 5). In subjects with type 2 diabetes mellitus, there is evidence of the involvement of lungs demonstrating thickened alveolar walls, capillary walls and the arteriolar walls, all of which could result in pulmonary ailments (6). Decreased elastic recoil, reduced respiratory muscle performance, reduced lung volume, autonomic alterations occurring in respiratory muscles are a few significant changes taking place in Diabetes Mellitus (7). Although many studies are being carried out on the after effects of diabetes mellitus on lung functions, the literature pertaining to this is not in abundance in Nepal. Therefore this study was undertaken to find out the effects of diabetes mellitus on lung function tests in patients with Type 2 Diabetes Mellitus who attended to medical OPDs of Kathmandu Medical College.

Methods

After obtaining ethical clearance, the study was carried out in 105 diabetic male subjects attending the outpatient department (OPD)/ward at Kathmandu Medical College Teaching Hospital, Nepal and 105 normal healthy subjects belonging to the same sex were taken as a control group. Previously diagnosed diabetic patients of more than 5-years duration, non- smokers, with no past history of any respiratory ailments and ruled out cardiovascular diseases were enrolled. Patients with acute or chronic respiratory disease or cardio respiratory disease, with history of smoking or tobacco chewing were excluded in this study.
Pulmonary Function Tests were performed using a computerized Spirometer, self-calibrating, which fulfilled the criteria for standardized pulmonary function tests. All tests were done according to American Thoracic Society/ European Respiratory Society (ATS/ERS) guidelines in a quiet room in sitting position by trained personnel (8). After taking detailed history and relevant clinical examination, informed written consent was taken. Then anthropometric parameters like height and weight were measured and recorded. Each subject was instructed to visit the laboratory with 6 hours of fasting on a specific date; the blood samples (3 ml volume) was drawn for estimation of fasting blood sugar. After explaining and demonstrating the technique for carrying out lung function tests, subjects were made to undergo lung function tests using digital spirometer 3 times at 15 minutes interval. The forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), and peak expiratory flow rate (PEFR), FEV_1/FVC, FEF 25-75% were recorded. The subject was instructed to give a blood sample for post prandial estimation of blood sugar 2 hours after the meal.

Results

We studied 105 type 2 diabetic patients and 105 non-diabetic patients. Type 2 DM patients and controls were selected by applying inclusion and exclusion criteria using random sampling method. Detailed anthropometric and physiological data were collected after giving written consent; spirometry was performed and Forced vital capacity (FVC), Forced expiratory volume in 1 second (FEV_1), & FEV_1/FVC were recorded. Peak expiratory flow rate (PEFR) and FEF 25-75% were recorded and analyzed. The results were assessed and evaluated with age and matched control (non-diabetic) subjects. Statistical analysis was done by calculating Mean ± SD, using Student's t test, Karl Pearson correlation and ANOVA test.

The physical variables of the Type 2 DM and the non-DM (control group) are shown in Table 1. Age range of the subjects was 41 – 68 years with mean age of DM 58.46 ± 7.56 and of the non-DM 56.45± 6.44 years. Mean height of diabetic group was 1.66 ± 0.08 meters and of non-diabetic group was1.69 ± 0.14 meter. Whereas, mean weight of diabetic was 68 ± 7.63 Kg and non-diabetic 62 ± 5.69 Kg. A total of 210 males, 105 diabetics and 105 non-diabetics matched for age, height and weight were enrolled in this study. From the result, the FEV_1, FVC, FEF, FEV_1/ FVC ratios were obtained and analyzed. The mean difference in values for pulmonary function was highly significant ($P < 0.05$) between diabetics and non-diabetics. The mean FVC in diabetics was 2.10 ± 0.72 L and in non-diabetics was 2.50 ± 0.74 L (Table 2). The decrease in FEV_1 in diabetics (1.49 ± 0.53) as compared to non-diabetics (2.02 ± 0.38) clearly indicates obstructive pulmonary disease (Figures 1 & 2).

Table 1: Physical characteristics of diabetics and non-diabetics

S No	Variables	Diabetics (Mean ± SD)	Non-diabetics (Mean ± SD)
1	Age (Years)	58.46 ± 7.56	56.45± 6.44
2	Height (meters)	1.66 ± 0.08	1.69 ± 0.14
3	Weight (Kg)	68 ± 7.63	62 ± 5.69

Table 2: Comparison of variations in pulmonary function test (PFT) among DM and non-DM group

S No	Pulmonary Function Test	Diabetes Mellitus (DM) Group (Mean ± SD)	Non-DM group (Control) (Mean ± SD)	P Value
1	FVC (L)	2.10 ± 0.72	2.50 ± 0.74	P < 0.05
2	FEF_{25-75} (L/S)	2.03 ± 0.43	2.53 ± 1.05	P < 0.05
3	PEFR (L/S)	3.95 ± 0.35	5.27 ± 0.43	P < 0.05
4	FEV1(L)	1.49 ± 0.53	2.02 ± 0.38	P < 0.05
5	FEV1 /FVC (%)	72.45 ± 10.83	83.13 ± 13.57	P < 0.05

The difference in values of FVC, FEF_{25-75}, PEFR, FEV_1, FEV_1/FVC ratio found in the two groups was statistically significant (P < 0.05).

Figure 1: Mean Forced Vital Capacity (FVC) and FEV1 compared between Diabetes Mellitus (DM) and non-DM Subjects in Litres.

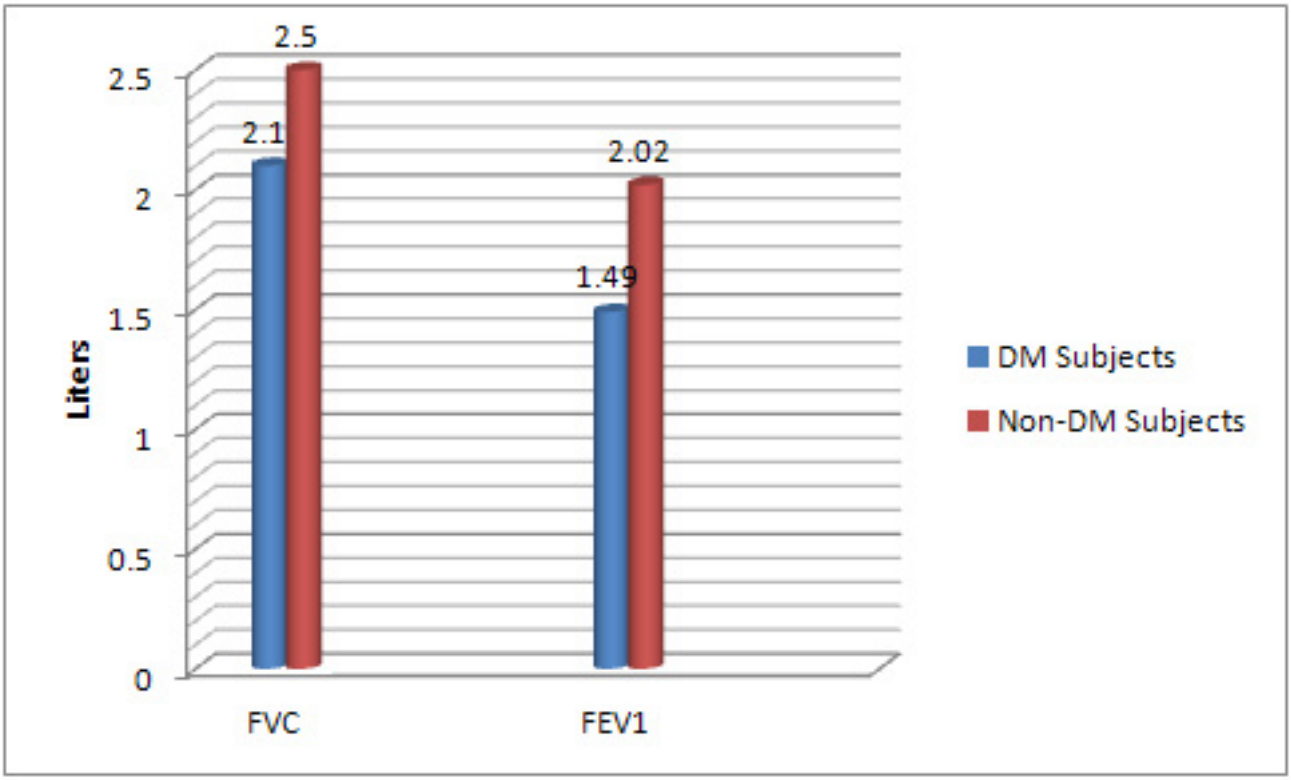
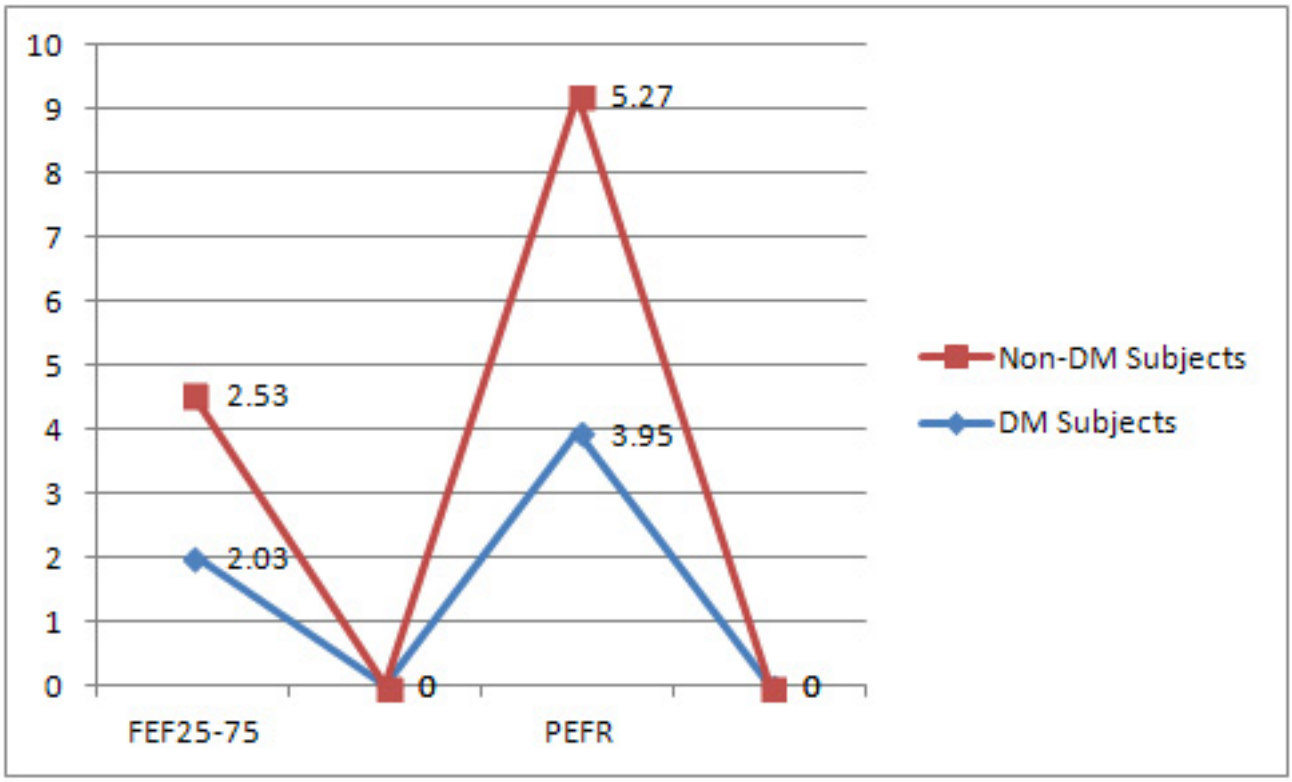


Figure 2: Mean Forced Expiratory Flow between 25% to 75% (FEF_{25-75}) and (Peak Expiratory Flow Rate) PEFR compared between Diabetes Mellitus (DM) and non-DM Subjects (Control group) in Litres/second.



Discussion

Our study showed that there was a highly significant difference between mean values of FVC, FEV1, FEV_1/FVC, PEFR and FEF 25-75% (i.e. $p<0.05$) in patients with type 2 DM and Controls (non-diabetic) group. In a similar study conducted by Shravya Keerthi et al the mean FVC, FEV_1, FEV1/FVC%, PEFR, FEF 25-75% values were reduced in subjects with type 2 DM (p value <0.05) compared to non-diabetics (9). This study is in relation to our study. Similar to our study Gregory L. Kinney et al found a remarkable reduction in FVC, FEV1 with type 2 diabetes (10). Anasuma et al and Lange et al have also discovered that FEV_1 and FVC are decreased in patients with type 2 diabetes mellitus than in normal control subjects (11, 12). Unlike our study, Benbassat et al in his study published in 2001 titled "pulmonary function in patient with diabetic mellitus" stated no changes in lung function tests in diabetic and non diabetic patients. But, he had very few study subjects, (27) and the mean age group was also less (48 years) (13). Yamane et al, in their study found that decreased vital capacity independently predicts the onset of type 2 diabetes mellitus. It is also recommended that vital capacity is attributed to an important risk factor for developing insulin resistance and diabetes mellitus (14).

Conclusion

The present study concludes that the lung is a major target organ for damage in type 2 diabetes mellitus and the disease is responsible for reduced lung functions.

Acknowledgement

I am very grateful to all the participants and all the members of department of Physiology, Kathmandu Medical College for helping me to carry out this study and fellow members for their valuable suggestions and support.

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