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Research Article

EVALUATION OF PULMONARY DYSFUNCTION AMONG PERSONS WITH TYPE 2 DIABETES IN TRINIDAD

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ABSTRACT

To determine the prevalence of pulmonary dysfunction among persons with type 2 diabetes mellitus (T2DM) using spirometry, and to determine the relationship between pulmonary dysfunction and duration of diabetes, glycaemic control (HbA1c), BMI, age, gender, ethnicity and associated systemic dysfunctions. Data was obtained from 93 persons with type 2 diabetes from various clinics in Trinidad via face to face spirometric testing and also by gathering data from their personal medical files. Variables measured include FEV_1, FVC, FEV_1/FVC, and FEF_{25-75}. The durations of diabetes of the 93 patients ranged from 0.4 years to 35 years. The majority of patients indicated diabetes duration within the ranges of 0-5 years and 5-10 years, and 3 had duration of 25 years or more. There were no significant differences between the means of the spirometry ratios (FEV_1/FVC, FEV_1, FVC, and FEF_{25-75}) for the five year interval ranges of diabetes duration. Approximately 60% (56) of the patients had normal pulmonary function and 40% (37) of the patients had pulmonary dysfunction. The majority of patients were found to have restrictive pulmonary dysfunction, and only 2% presented with obstruction. Within the BMI classes, 5% of the patients were underweight, 36% were normal, 33% were overweight and 26% were obese. There was a significant difference between the means of underweight and overweight patients for FEV_1/FVC ratios at alpha level ($p<0.05$). The mean difference between underweight and overweight FEV_1/FVC ratios was 11.20 with a standard error of 3.4634. At alpha level ($p<0.05$) there was no significant correlation between the spirometry variables and the duration of Diabetes or the BMI of the sample. Under one-half of persons with Type 2 Diabetes Mellitus display a restrictive spirometric profile and there are significant differences in FEV_1/FVC ratios among underweight and overweight persons.

Keywords: Spirometry, diabetes, BMI.

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INTRODUCTION

Trinidad and Tobago has the most persons with diabetes per capita in the Western Hemisphere and is also the fifth country in the world with the most persons with diabetes per capita.[1] Reports of lung transfer capacity for CO and postmortem histopathological studies support the notion that the lung is a target organ for diabetic microangiopathy, in both type 1 and type 2 diabetes mellitus.[2] Diabetes Mellitus can cause reduced pulmonary elastic recoil, impaired pulmonary diffusion, impaired alveolar gas exchange,decreased respiratory muscle strength, diaphragmatic paralysis, pulmonary hypertension, pulmonary infections and pulmonary tuberculosis.[3] Furthermore, reduced lung function may be present before the clinical recognition of diabetes or insulin resistance, suggesting that the lung may be involved in the pathogenesis of diabetes.[4] Diabetes duration has more influence on

pulmonary functions than glycemic control, but obesity and vascular disease may also be contributors.[5]

Spirometry is the classic pulmonary function test, which measures the volume of air inspired or expired as a function of time using a spirometer.[6] Type 2 Diabetes Mellitus is associated with a restrictive pattern of respiratory abnormality. As the duration of diabetes increases the restrictive profile is more prominent[7]. It has been reported that impaired Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 s (FEV_1) are emerging novel risk factors for Type 2 Diabetes Mellitus. Thus, it is interesting to consider that reduced lung function may be present before the clinical recognition of diabetes or insulin resistance, suggesting that the lung may be involved in the pathogenesis of diabetes.

We have therefore hypothesized that long standing Type 2 Diabetes Mellitus may cause neuropathy, affecting respiratory muscles, which will in turn be reflected in spirometric data. With this study we seek to determine the relationship between the duration of Type 2 Diabetes Mellitus and Pulmonary Dysfunction using Spirometry. We hope that the data obtained will facilitate further exploration into how Spirometry may be used as part of a management system for Type 2 Diabetes Mellitus.

MATERIALS AND METHODS

This was a prospective cohort study in which data was gathered from 93 subjects via face-to-face spirometric testing and by gathering data from their personal medical files. Even though over 1000 patients were seen, due to the extensiveness of our exclusion criteria and the incomplete patient records (no HbA1c and other informations) of some candidates, only 93 patients were selected for use in the study. Members of the general public attending lifestyle clinics at various health centres across Trinidad were selected at random as subjects for this study within the following criteria: Type 2 diabetics over the age of 18, of any ethnicity, without pre-existing pulmonary problems, who did not smoke, were not pregnant, did not live or work in an area with great exposure to smoke, dust or fumes and who met the safety requirements to perform spirometric testing.

The data recorded via the spirometer included the subject's FEV_1, FVC, FEV_{25-75} and FEV_1/FVC values. Whereas data recorded from patient files included the patient's age, sex, duration of diabetic condition, medications, HbA_{1c} readings (where available), waist circumference, height and weight and subsequently BMI. SPSS analysis software package 16 was used for descriptive and inferential statistical analysis of the collected data. The Pearson's correlation was used to test the strength of association between both the duration of Diabetes and the B.M.I. of the sample and each of the four recorded spirometry variables; FEV_1, FVC, FEV_1/FVC RATIO and FEF $_{25-75}$. Since PEFR is an effort dependent parameter, it was not included in our analysis and a more reliable marker FEV_1 was preferred'. The duration of Diabetes of the sample was divided into groups based on five year intervals and one-way ANOVA testing was used to compare the variance between the means of these groups for each of the four recorded spirometry variables. The BMI values of the sample were divided into groups based on the W.H.O. classification of BMI classes and one-way ANOVA testing was used to compare the variance between the means of the classes for each of the four recorded spirometry variables. Additionally the Bonferonni Post-Hoc analysis was then carried out to determine the specific B.M.I. classes which had significant variances between their FEV_1/FVC ratio means at alpha level ($p < 0.05$).

Table 1: Means ± SE for Spirometry Variables According To BMI Classes

BMI class	N	Spirometric variables			
		FEV_1/FVC RATIO	**FEV_1**	**FVC**	**FEF $_{25-75}$**
Underweight	5	77.2 ±6.2*	91.0±4.8	95.0±5.3	82.0 ±19.6
Normal	33	85.6 ±1.30	85.7 ±2.4	80.7±2.5	94.30±4.5
Overweight	31	88.40 ±1.0*	87.39±2.8	80.81±2.9	92.0±3.6
Obese	24	84.1±1.3	79.42 ±3.1	77.50±3.2	83.3 ±6.7

*. Significantly different at $p < 0.05$

Figure 1: Sample distribution of the duration of diabetes in 5 year intervals

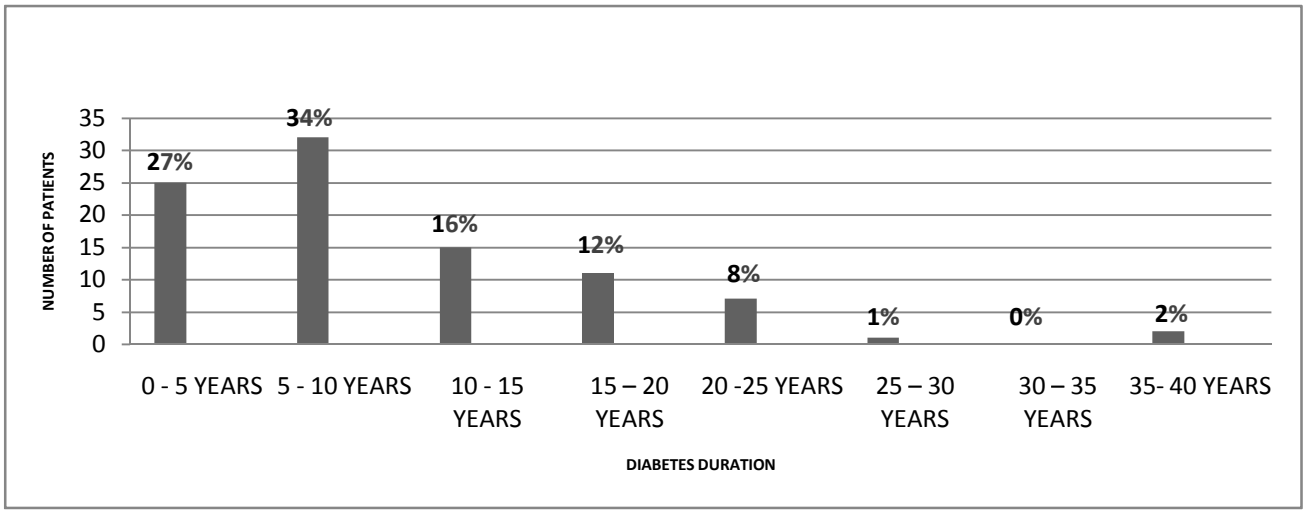


Figure 2: showing sample distribution by pulmonary function

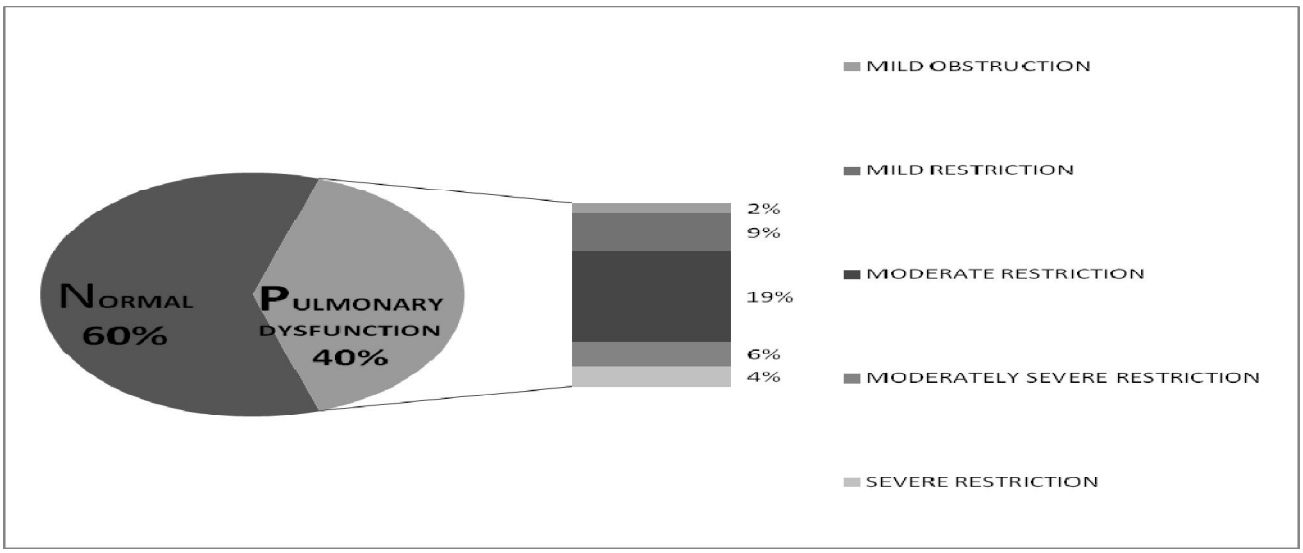
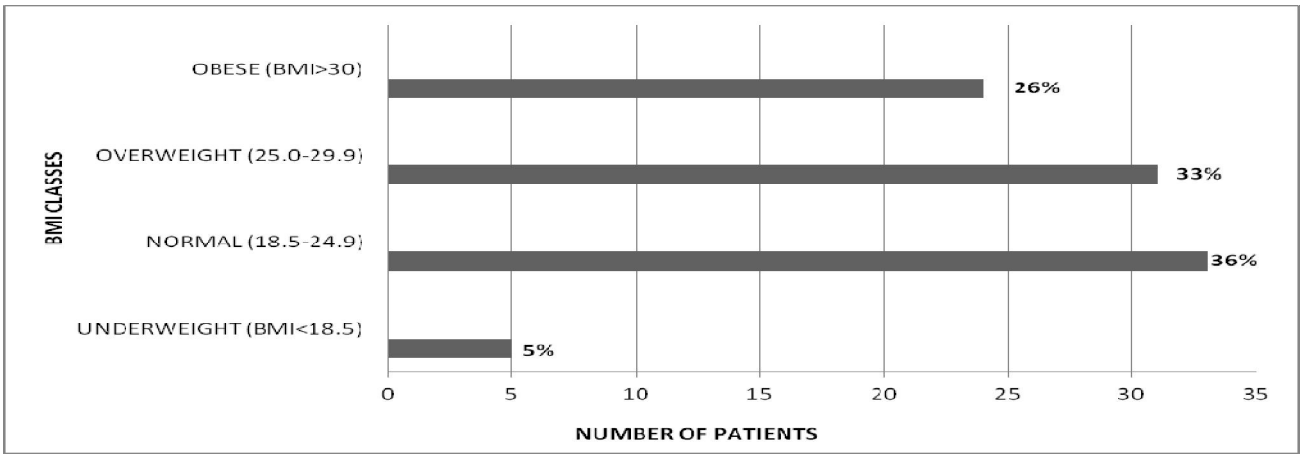


Figure 3: Sample distribution of BMI classes



RESULTS

Of these 93 patients 76 were female and 17 were male. There were 54 patients of East Indian descent (58%), 34 were of African descent (37%) and 5 were mixed (5%) (Figure 2). The mean age of the patient sample was found to be 58.4 with a standard deviation of 11.4. The duration of diabetes ranged from 0.4 years to 35 years. The majority of patients indicated diabetes duration within the ranges of 0-5 years and 5-10 years, and only 3 patients had diabetes duration of 25 years or more (Figure 1). The majority of patients found to have pulmonary dysfunction presented with restrictive pulmonary dysfunction, and only 2% presented with obstruction (Figure 2). The mean BMI was found to be 26.60 with a standard deviation of 5.60 (Figure 3). There was a significant difference between the means of underweight and overweight patients for FEV_1/FVC ratios (Table 1). The mean difference between underweight and overweight FEV_1/FVC ratios was that of 11.20 with a standard error of 3.4634E0 at $p<0.05$. There were no significant differences between the means of the spirometry ratios (FEV_1/FVC, FEV_1, FVC, and FEF_{25-75}) for the five year interval ranges of diabetes duration. At alpha level ($p<0.05$) there was no significant correlation between the spirometry variables and the duration of diabetes or the BMI of the sample.

DISCUSSION

This study showed that of a total of 93 Type 2 diabetic subjects, the majority (58%) were of East Indian descent; thereby supporting the finding that diabetes is more prevalent among East Indians than in any other ethnic group[1] within the Trinidadian population. Despite previous studies stating that abnormal lung function may precede the diagnosis of diabetes or that reduced lung volumes and airflow limitations were likely to be chronic complications of Type 2 Diabetes Mellitus, our study showed that lung function was not affected as the duration of diabetes increased, since there was no significant difference between the means of spirometry ratios for the various ranges of diabetes duration. In addition to this, no significant correlation between other spirometry variables and duration of diabetes was found. Differences in sample size and the spirometry variables used may have contributed to the contrasting results.

Our study did however show that of the 37 diabetic patients with pulmonary dysfunction, 98% of them suffered from restrictive pulmonary dysfunction; a finding supported by a study which suggests that as the duration of diabetes increases the restrictive profile becomes more prominent.[7] This study also showed that there was a significant difference between the means of underweight and overweight patients for FEV_1/FVC ratios. However there was no significant correlation between the spirometry variables and the BMI of the sample. These findings when compared to other studies seem to suggest that BMI and obesity do not have a significant effect on spirometry tests in both diabetic and non-diabetic non-smoking individuals.

CONCLUSION

Our study showed that in Type 2 Diabetes Mellitus is associated with a restrictive spirometric profile of lung dysfunction and that there is significant variance between the means of underweight and overweight patients for FEV_1/FVC ratios.

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