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Study Of Lung Function Parameters In Diabetic Patients.

Bhanudas S Karale[1], Sunita G Nighute[2], Sudha S Karadkhedkar[3], and Mukund B Kulkarni[4]*.

[1]Assistant Professor, Department of Physiology, Dr. VVPF's MC & H, Ahmednagar, Maharashtra, India.
[2]Professor & Head, Department of Physiology, Dr. VVPF's MC & H, Ahmednagar, Maharashtra, India.
[3]Professor & Head, Department of Physiology, Dr. SCGMC & H, Nanded, Maharashtra, India.
[4]Associate Professor, Department of Physiology, Dr. SCGMC & H, Nanded, Maharashtra, India.

ABSTRACT

Diabetes mellitus (DM) is associated with numerous complications, including respiratory impairments. This study aimed to evaluate the impact of Type-2 diabetes mellitus (T2DM) on pulmonary function parameters. A cross-sectional study compared 50 non-smoking T2DM patients with 50 age- and sex-matched non-diabetic controls. Anthropometric measurements and pulmonary function tests (PFTs) were conducted using standardized techniques and equipment. Statistical analysis included Mann-Whitney U test and Student's t-test. While basic anthropometric characteristics were similar between groups, diabetic patients exhibited significantly lower forced expiratory volume in one second (FEV1), forced expiratory volume in three seconds (FEV3), peak expiratory flow rate (PEFR), and maximal voluntary ventilation (MVV) compared to controls ($p<0.05$). Effect sizes indicated moderate to very large effects of T2DM on these parameters. T2DM is associated with significant impairments in various PFT parameters, suggesting compromised lung function in diabetic individuals. Early detection and management of respiratory impairments are crucial in diabetic care.

Keywords: Type-2 diabetes mellitus, pulmonary function tests, respiratory impairments.

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Corresponding author

INTRODUCTION

The relationship between diabetes mellitus and pulmonary function has increasing attention due to their intertwined pathophysiological mechanisms and clinical implications. Diabetes, characterized by chronic hyperglycemia, has been associated with various respiratory complications, impacting lung function parameters. Understanding these associations is crucial for comprehensive patient management and may offer insights into potential therapeutic interventions. While the exact mechanisms linking diabetes to pulmonary dysfunction remain under investigation, proposed pathways include chronic inflammation, oxidative stress, microvascular damage, and autonomic neuropathy. Studies exploring lung function parameters in diabetic patients have yielded conflicting results, necessitating further investigation to elucidate the precise nature of this relationship [1-6].

METHODOLOGY

Our cross-sectional study compared lung function parameters between 50 non-smoking diabetic patients and 50 age- and sex-matched healthy non-diabetic controls. Participants were recruited from relatives of diabetic patients visiting the outpatient department of a tertiary care center over one year. Subjects aged 35-55 years of both sexes were included, with systematic random sampling employed to mitigate selection bias. Exclusions comprised subjects below 35 or above 55 years, smokers, individuals with acute or chronic respiratory disease, and those with major neuropathy or cardiac conditions like IHD or RHD.

Anthropometric measurements including age, height, weight, and body mass index (BMI) were recorded using standardized techniques. A preliminary clinical examination was conducted to exclude any underlying medical issues. Pulmonary function tests (PFTs) were performed using computerized medspiror equipment manufactured by Chandigarh, following standard laboratory protocols. FVC, FEV1, FEV3, PEFR, and MVV were measured in a quiet laboratory setting between 8 am and 11 am to minimize emotional and psychological stress. Subjects received detailed instructions and demonstration before testing, with nose clips applied during maneuvers. Tests were repeated at least three times, and the best results were analyzed.

Inclusion criteria

- Patients of type-2 diabetes with age group 35-55 years.
- Controls of same age group with that diabetic patient.
- Patients of diabetes with different duration.

Exclusion criteria

- Subjects who smoke.
- Subjects suffering from acute or chronic respiratory diseases.
- Subjects suffering from major neuropathy.
- Subjects suffering from major cardiac diseases like IHD, hypothyroidism, hyperthyroidism, cerebrovascular accidents, etc.

RESULTS

Total numbers of male and female cases included in study are 68% and 32% respectively.

Total numbers of male and female controls included in study are 68% and 32% respectively.

Table 1: Basic Characteristic/ Anthropometric parameters

Basic Parameters	Case (n=50) Mean ± S.D.	Control (n=50) Mean ± S.D.	Significance p value
Age in years	45.60 ± 6.47	45.9 ± 6.34	0.8007MW
Sex	M: 68 % F: 32 %	M: 68 % F: 32 %	1.0000MW
Height in cm	163.7 ± 7.523	163.8 ± 7.72	0.8281MW
Weight in kg	66.96 ± 11.28	67.62 ± 11.38	0.771t
BMI	24.98 ± 3.6	25.19 ± 3.83	0.4993MW
Inference	Samples are age, sex, height, weight and BMI matched (P>0.05) i.e. non-significant.		

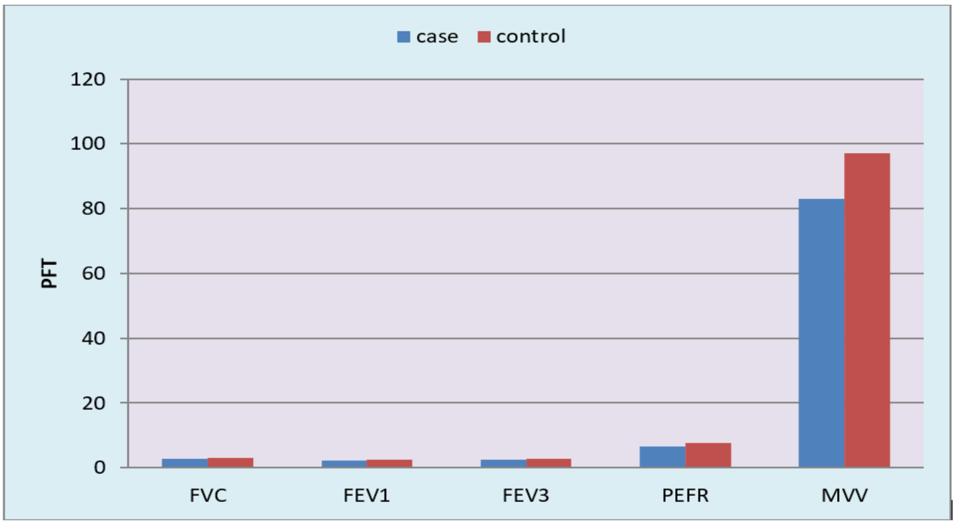
MW: Mann-Whitney U test
t: Student's 't' test

Table 2: Effect of Type-2 diabetes mellitus on pulmonary function test

Pulmonary Function Test (PFT L/min)	Case (n=50)		Control (n=50)		P value	Cohen's Effect size (d)
	Range	Mean (SD)	Range	Mean (SD)		
FVC l	1.00-4.00	2.30 ± 0.86	2.0 - 3.0	2.54 ± 0.44	0.0910**	0.35ME
FEV 1	1.00 - 3.00	.62 ± 0.67	1.0 - 3.0	1.84±0.42	0.0221*	0.39ME
FEV 3	1.00 - 3.00	2.0 ± 0.72	2.0-3.0	2.56±0.50	0.0001*	0.90LE
PEFR	2.0 -12.00	6.02 ± 2.3	1.0 - 10.0	7.02±1.89	0.0054*	0.48ME
MVV	55 - 102	82.36 ± 12.94	84.0-115.0	96.74±6.62	0.0001*	1.39VLE

*Significant at 5 % level of significance
** Non-significant at 5 % level of significance
ME: Mild Effect
LE: Large Effect
VLE: Very Large Effect
(The effect size by Cohen's d has been computed to find the effect of diabetes on PFT parameters.)
(Mann-Whitney Test use for p value)

Graph 1: Effect of Type-2 diabetes mellitus on pulmonary function test



The effect of Type-2 diabetes mellitus on different parameters of pulmonary function test is shown in the **table 2** and **graph 1**. The Student't' test has been used to find the significance difference of PFT parameters between healthy control and Type-2 DM groups. The Mann Whiteny U test a non-parametric test is used to find the significance difference of FEV1/ FVC ratio between cases and Controls. The effect size by Cohens d has been computed to find the effect of diabetes on PFT parameters.

DISCUSSION

The results of the study shed light on the impact of Type-2 diabetes mellitus (T2DM) on various parameters of pulmonary function tests (PFTs) compared to healthy controls.

Firstly, regarding the basic anthropometric characteristics, the study found no significant differences between the diabetic cases and controls in terms of age, sex distribution, height, weight, or body mass index (BMI). This suggests that the groups were well-matched, minimizing confounding effects related to these variables.

Moving on to the PFT parameters, several noteworthy findings emerge. The forced vital capacity (FVC), representing the maximum volume of air forcibly exhaled after maximal inhalation, showed a trend towards lower values in diabetic patients compared to controls, although this difference was not statistically significant ($p=0.0910$). However, the effect size suggests a mild effect of diabetes on FVC (Cohen's $d = 0.35$), indicating a potential clinical relevance despite the lack of statistical significance.

In contrast, the forced expiratory volume in one second (FEV1), which measures the volume of air exhaled in the first second of a forced expiration, was significantly lower in diabetic patients compared to controls ($p=0.0221$). This finding suggests a moderate effect size of diabetes on FEV1 (Cohen's $d = 0.39$), indicating a clinically relevant impairment in lung function associated with T2DM.

Similarly, the forced expiratory volume in three seconds (FEV3), representing the volume of air exhaled in the first three seconds of a forced expiration, also showed a significant decrease in diabetic patients compared to controls ($p<0.0001$). The effect size for FEV3 was large (Cohen's $d = 0.90$), indicating a substantial impact of diabetes on this parameter.

The peak expiratory flow rate (PEFR), reflecting the maximum speed of expiration, was significantly lower in diabetic patients compared to controls ($p=0.0054$). While the effect size for PEFR was moderate (Cohen's $d = 0.48$), the difference was statistically significant, suggesting a clinically relevant impairment in peak expiratory flow associated with T2DM.

Moreover, the maximal voluntary ventilation (MVV), representing the maximum volume of air that can be breathed in and out of the lungs in one minute during voluntary effort, showed a significant decrease in diabetic patients compared to controls ($p<0.0001$). The effect size for MVV was very large (Cohen's $d = 1.39$), indicating a profound impact of diabetes on this parameter.

These findings collectively suggest that T2DM is associated with impairments in various parameters of lung function, including FEV1, FEV3, PEFR, and MVV, highlighting the detrimental effects of diabetes on respiratory health. The observed reductions in these PFT parameters indicate compromised lung function in diabetic individuals, which may have clinical implications for their respiratory health and overall well-being.

The significant decrease in FEV1 and FEV3 suggests obstructive ventilatory impairment in diabetic patients, characterized by difficulty exhaling air from the lungs due to narrowing of the airways. This finding is consistent with previous research linking diabetes to obstructive lung diseases such as chronic obstructive pulmonary disease (COPD). The reduced PEFR further supports the presence of airflow limitation in diabetic patients, contributing to impaired respiratory function.

The substantial decrease in MVV in diabetic patients compared to controls indicates impaired respiratory muscle strength and endurance, which may result in reduced exercise tolerance and increased susceptibility to respiratory infections and complications. These findings underscore the importance of early detection and management of respiratory impairments in diabetic individuals to prevent disease progression and improve clinical outcomes.

Several potential mechanisms may underlie the observed impairments in lung function in diabetic patients. Chronic hyperglycemia and insulin resistance, hallmark features of T2DM, have been implicated in promoting systemic inflammation, oxidative stress, endothelial dysfunction, and microvascular complications, all of which can adversely affect lung structure and function. Additionally, diabetic neuropathy and autonomic dysfunction may contribute to respiratory muscle weakness and impaired ventilatory control, further exacerbating respiratory dysfunction in diabetic individuals [7-14].

CONCLUSION

In conclusion, the findings of this study provide valuable insights into the impact of T2DM on pulmonary function, highlighting the presence of significant impairments in various parameters of lung function in diabetic patients compared to healthy controls. These findings underscore the importance of regular monitoring of respiratory function in diabetic individuals and the implementation of targeted interventions to mitigate the adverse effects of diabetes on respiratory health. Further research is warranted to elucidate the underlying mechanisms and to develop more effective strategies for the prevention and management of respiratory complications in diabetic patients.

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