Comparison of Pulmonary Function Test in Controlled and Uncontrolled Type 2 Diabetes Mellitus Patients in Pakistan

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Abstract

Objective: Compare Pulmonary function test in controlled and uncontrolled type 2 diabetes mellitus patients.

Material and Methods: This case control study was conducted in outpatient department of chest department of the university of Lahore teaching hospital Lahore from 14 march 2016 to 14 september 2016 with IRB number ref-IMBB/BBBC/16/264. After approval of IRB. All patients and controls who fulfil selection criteria were considered in this research. Informed consent was taken from every patient. Demographic profile (name, age, sex, contact no.) was obtained. Only those patients whose fasting blood sugar were >126 mg/dl or random blood sugar >200 mg/dl were selected. The HbA1c was also estimated in order to differentiate between controlled (<7) and uncontrolled diabetes (>7).

Results: In this study, no statistically significant difference was seen between mean ranks for FVC [Group-A:86.91, Group-B: 74.00 & Group-C: 83.59], FEV1 [Group-A:88.44, Group-B: 80.56 & Group-C: 75.50] and FEF (25-75) [Group-A:87.53, Group-B: 80.73 & Group-C:76.23] among the study group. However, FEV/FVC significantly differ across the groups. i.e. [Group-A:98.18, Group-B: 109.41 & Group-C: 36.91]. Multiple comparison test showed that no statistical difference was seen for FEV/FVC between Group-A and in Group-B patients. However, between Group-A and Group-C and Group-B and Group-C statistically significant difference was seen.

Conclusion: Results of this study showed that uncontrolled diabetes adversely effects pulmonary function and causes significant lung function impairment.

Keywords: Type 2 diabetes, Pulmonary function test, Controlled diabetes, Uncontrolled diabetes, HbA1c

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Introduction

There is a large impact on society and burden due to Diabetes mellitus which is the most common chronic endocrine disorder, affecting people of industrialized Western countries, Africa, Asia, South America and Central America.[1,2] Diabetes mellitus is a huge health problem in world with its rising prevalence with more than 18,000,000 people all over the world and would be 36,600,000 people with DM by the year 2030.[3] In Type 2 diabetes mellitus (T2DM) marked morbidity and mortality is reported in underdeveloped and developed countries.[4] Diabetes mellitus is a debilitating and chronic disease. Its complications give rise to macro and microvascular diseases which affect heart, blood vessels, eyes, kidney, nerves and also pulmonary system. There may be a relationship between reduced lung function and DM.[5]

Pulmonary complications of diabetes mellitus (DM) are not established. According to few researches

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pulmonary functions are normal but some report variability in them. Few researches reports that spirometry is not important in diabetic individuals Some studies have shown abnormal spirometric values in diabetic patient. Also duration and control over blood glycemic level carries impact on our lung functions.[6]

According to a study, significant difference in FVC in control (89.36 ± 9.71) and diabetic subject (77.97 ± 12.99), p-value < 0.005. FEV1 was also statistically higher in control subjects (88.03 ± 6.69) if compared with diabetic patients (78.98. ± 14.09). It reported insignificant difference between FEV1 / FVC (111.36 ± 10.62) in controls and 112.83 ± 9.35 in diabetic patients, p-value > 0.005. However, other spirometric parameters (PEFR, PEF), were also significantly different in diabetic patients and controls, p-value < 0.05.[7]

Another study states that the mean FEV1, FEV1/FVC%, PEF, FEF 25–75%, values were decreased in diabetic patients (p-value <0.05) compared to non-diabetic patients. Uncontrolled diabetic patients also show low values than controlled diabetic patients.[8]

The rationale of this study is to see impact of diabetes mellitus on lung function as no local study is available and we have planned to take diabetic patients with controlled and un-controlled diabetes and these two groups will be compared with aged and gender matched healthy controls as well. Moreover, we will also see impact of duration of diabetes mellitus and BMI.

Material and Methods

This case control study was conducted in outpatient department of chest department of the university of Lahore teaching hospital Lahore from 14 march 2016 to 14 september 2016 with IRB number ref-IMBB/BBBC/16/264. Cases were divided into 2 groups. Group-A, Patients with controlled diabetes mellitus, Group-B, Patients with uncontrolled diabetes mellitus. Group-, Healthy age and gender matched individuals that were taken from attendants from patients enrolled in Group-A and Group-B. A sample of 162 (54 subjects in each group) will be considered in this research. Calculation of sample size is done by using expected FVC as 89.36 ± 9.71 in control and 77.97 ± 12.99 in diabetic patients.6 We used 95% confidence level and 95% power of study at 5% type-I error using following formula.

$$n = \frac{\{(\delta_1^2 + \delta_2^2) \times (Z_1.\alpha_{/2} + Z_{1-\beta})^2\}}{|\mu_2 - \mu_1|^2}$$

Here

- $Z_{1-\alpha/2}$ = Standardized Level of significance = 95%
- $Z_{1-\beta}$ = Power of test = 95%
- μ_1 = Mean FVC in controls groups = 89.366
- μ_2 = Mean FVC in diabetic patients = 77.976
- δ_1 = Standard deviation of FVC in control group = 9.716
- δ_2 = Standard deviation of FVC in diabetic patients = 12.996

Patients of both genders having age range of 18-40 years with confirmed diabetes mellitus type II (BSF>126mg/dl and BSR>200mg/dl). Diabetics with cough, sputum, or dyspnoea. Diabetics do smoking also who already had history of CAD or cerebrovascular accident (CVA). Diabetic patients having other chronic systemic or metabolic disorder will not be included in the study. All 162 patients/ controls (54 n each groups) that fulfil selection criteria were enrolled in the study. Informed consent was obtained from each patient. Demographic profile (name, age, sex, contact no.) was also taken. Only those patients whose fasting blood sugar was >126 mg/dl or random blood sugar >200 mg/dl will be selected. The HbA1c was also estimated in order to differentiate between controlled (<7) and uncontrolled diabetes (>7).

PFTs of all individuals was done. The controls and patients undergone spirometric evaluation as follows.

Spirometric parameters will contain

- Forced vital capacity (FVC) in litres,
- Forced expiratory volume in 1 second (FEV1) in litres
- FEV1/FVC in percentage (%),
- Forced expiratory flow during 25% of FVC (FEF25), 50% of FVC (FEF50) and FVC 75% of FVC (FEF75) and Peak expiratory flow rate (PEFR).

For all these parameters percentage of predicted values for the respective age, height, and weight was taken into consideration. All data was collected on predefined proforma (attached) by researcher herself. After approval of IRB .Data was collected and entered and analyzed through Statistical package for social science (SPSS) version 21. Quantitative variables like age, weight, height, BMI, FVC, FEV1, FEV1/FVC, FEF25-75and PEFR was presented in form of mean ± S.D. Qualitative data like gender,

Mean age of patients in Group-A and in Group-B was 37.17±3.45 and 37.31±3.92 year. While in Group-C mean age of participants was 38.00±1.78 years respectively.

Results

In Group-A, 41(75.9%) male and 13(24.1%) female patients were included while in Group-B 26(48.1%) male and 28(51.9%) females patients were included. In Group-C, 35(64.8%) male and 19(35.2%) female participants were included.

Mean height of patients in Group-A and in Group-B was 153.96±16.76 and 159.77±10.94 cm. Mean weight of patients in Group-A and in Group-B was 66.07±13.48 and 75.04±15.12 kg. While mean height and weight of participants in Group-C was 136.72±9.53 cm and 54.26±9.22 kg respectively.

Group-A: Patients with controlled diabetes mellitus

Group-B: Patients with uncontrolled diabetes mellitus

Group-C: Healthy age and gender matched individuals

Mean BMI of patients in Group-A and in Group-B was 27.71±2.47 and 29.55±6.60. While in Group-C mean BMI of participants was 28.80±1.94 respectively.

Group-A: Patients with controlled diabetes mellitus

Group-B: Patients with uncontrolled diabetes mellitus

Group-C: Healthy age and gender matched individuals

Mean duration of disease in Group-A and in Group-B patients was 6.20±4.37 and 10.59±6.95 respectively.

Table 1: *BMI of Cases & Controls*

	Body Mass Index		
	Group-A	**Group-B**	**Group-C**
N	**54**	**54**	**54**
Mean	27.71	29.55	28.8
SD	2.47	6.6	1.94
Min	20.1	17.5	28.2
Max	33.2	43.19	36.7

Table 2: *Descriptive statistics for duration of disease*

	Duration of disease		
	Group-A	**Group-B**	**Group-C**
N	**54**	**54**	
Mean	6.34	10.52	
SD	4.35	6.85	**N/A**
Min	1	1	
Max	18	25	

Table 3: *Descriptive statistics for FEV/FVC*

	FEV/FVC		
	Group-A	**Group-B**	**Group-C**
N	**52**	**55**	**52**
Mean	0.89	0.92	0.79
SD	0.079	0.046	0.006
Mean Rank	98.18	109.41	36.91
Min	0.79	0.79	0.775
Max	0.97	0.99	0.8
p-value[(a)]	**0**	**0**	**0**
p-value[(b)]		**0**	

P-value is 0.000 which is significant

Discussion

Diabetes mellitus is a noteworthy, quickly developing general social insurance issue. Its occurrence is increasing, and carries with it long haul complications 81. Constant hyperglycemia of diabetes mellitus is related with proceeding harm, dysfunction, and lack of different organs working, particularly the eyes, kidneys, nerves, heart, lungs and veins. Diabetes mellitus is a hopeless long lasting sickness, including various frameworks, and with wrecking complexities which wind up in serious

inabilities and death.[12]

Spirometry is a basic, dependable, legitimate and capable apparatus that can be utilized to observe, separate, manage and oversee patients with respiratory issue. Diabetes mellitus is a noteworthy general social insurance issue with expanding occurrence and long haul entanglements and is a main source of disease and death. Diabetes mellitus is related with proceeding with harm, dysfunction and lack of different organs function, including the lungs. Consequently, when the subject of the administration of diabetes mellitus emerges, doctors ought to know about the span of the issue of respiratory intricacies, and must consider the lung as being as genuine as different complications of diabetes mellitus.[13]

The impaired lung capacities (FVC and FEV1) mirrors a causative role by the lungs in creating diabetes, then streamlining the patency of the lungs through stopping of smoking, shirking of aggravations and lethal introduction, control of basic airway irritation and the advancement of physical action appear justified. Undoubtedly, it appears time is needed to add the spirometer to the apparatuses accessible for checking diabetes mellitus and its critical sequelae. Besides, doctors should completely use Spirometry in the administration of diabetes mellitus.

Conclusion

Results of this study showed that uncontrolled diabetes adversely effects pulmonary function and causes significant lung function impairment.

Conflict of Interest *None*

Funding Source *None*

References

1. Rao GH. Management of diabetes epidemic: Global perspective. Current Trends in Diabetes. 2020 Nov 30;25.
2. Zhou B, Rayner AW, Gregg EW, Sheffer KE, Carrillo-Larco RM, Bennett JE, Shaw JE, Paciorek CJ, Singleton RK, Pires AB, Stevens GA. Worldwide trends in diabetes prevalence and treatment from 1990 to 2022: a pooled analysis of 1108 population-representative studies with 141 million participants. The Lancet. 2024 Nov 23;404(10467):2077-93.
3. Mohajan D, Mohajan HK. Obesity and its related diseases: a new escalating alarming in global health. Journal of Innovations in Medical Research. 2023 Mar 23;2(3):12-23.
4. Gurven MD, Lieberman DE. WEIRD bodies: Mismatch medicine and missing diversity. Evolution and Human Behavior. 2020 Sep 1;41(5):330-40. doi: 10.1016/j.evolhumbehav.2020.04.001
5. Diaz-Thomas AM, Golden SH, Dabelea DM, Grimberg A, Magge SN, Safer JD, Shumer DE, Stanford FC. Endocrine health and health care disparities in the pediatric and sexual and gender minority populations: an Endocrine Society Scientific Statement. The Journal of Clinical Endocrinology & Metabolism. 2023 Jul;108(7):1533-84. doi: 10.1210/clinem/dgad124
6. Raj S. Influences of the nutrition transition on chronic disease. Integrative and Functional Medical Nutrition Therapy: Principles and Practices. 2020:17-29.
7. Vogel B, Acevedo M, Appelman Y, Merz CN, Chieffo A, Figtree GA, Guerrero M, Kunadian V, Lam CS, Maas AH, Mihailidou AS. The Lancet women and cardiovascular disease Commission: reducing the global burden by 2030. The Lancet. 2021 Jun 19;397(10292):2385-438. doi: 10.1016/S0140-6736(21)00684-X
8. Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, Barengo NC, Beaton AZ, Benjamin EJ, Benziger CP, Bonny A. Global burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. Journal of the American College of Cardiology. 2020 Dec 22;76(25):2982-3021. doi: 10.1016/j.jacc.2020.11.010
9. Oluwasanya G, Omoniyi A, Qadir M, Madani k. Characterizing the Differential Health Burdens of Poor Water Quality in the Global South. Ferreira SR, Macotela Y, Velloso LA, Mori MA. Determinants of obesity in Latin America. Nature Metabolism. 2024 Mar;6(3):409-32. doi: 10.1038/s41592-024-00410-3
10. Paulino PJ, Cuthrell KM, Tzenios N. Non Alcoholic Fatty Liver Disease; Disease Burden, Management, and Future Perspectives. International Research Journal of Gastroenterology and Hepatology. 2024 Jan 4;7(1):1-3.
11. Wu Y, Fu R, Lei C, Deng Y, Lou W, Wang L, Zheng Y, Deng X, Yang S, Wang M, Zhai Z. Estimates of type 2 diabetes mellitus burden attributable to particulate matter pollution and its 30-year change patterns: a systematic analysis of data from the Global Burden of Disease Study 2019. Frontiers in Endocrinology. 2021 Aug 13;12:689079. doi: 10.3389/fendo.2021.689079

12. Adeloye D, Song P, Zhu Y, Campbell H, Sheikh A, Rudan I. Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. The Lancet Respiratory Medicine. 2022 May 1;10(5):447-58. doi: 10.1016/S2213-2600(22)00035-3
13. Zelber-Sagi S, Carrieri P, Pericàs JM, Ivancovsky-Wajcman D, Younossi ZM, Lazarus JV. Food inequity and insecurity and MASLD: burden, challenges, and interventions. Nature Reviews Gastroenterology & Hepatology. 2024 Oct;21(10):668-86. doi: 10.1038/s41575-024-00797-5
14. Kumari S, Shukla S, Acharya S. Childhood obesity: prevalence and prevention in modern society. Cureus. 2022 Nov;14(11). doi: [10.7759/cureus
15. Rajendra Santosh AB, Jones T. Tropical Oral Disease: Analysing Barriers, Burden, Nutrition, Economic Impact, and Inequalities. Frontiers in Nutrition. 2021 Nov 22;8:729234. doi: 10.3389/fnut.2021.729234
16. Nagendra L, Mondal S, Bhattacharya S. Thyroid Disorders in the Tropics. Endotext [Internet]. 2024 Jul 28. doi: 10.1056/ENDOEXT000000000
17. MBA CM, Mbanya JC. Challenges and Economic Burden of Diabetes in Africa. In: Obesity and Diabetes: Scientific Advances and Best Practice. 2020:21-34. doi: 10.1002/9781119690495.ch2
18. Gardner WM, Razo C, McHugh TA, Hagins H, Vilchis-Tella VM, Hennessy C, Taylor HJ, Perumal N, Fuller K, Cercy KM, Zoeckler LZ. Prevalence, Years Lived with Disability, and Trends in Anaemia Burden by Severity and Cause, 1990–2021: Findings from the Global Burden of Disease Study 2021. The Lancet Haematology. 2023 Sep 1;10(9):e713-34. doi: 10.1016/S2352-3026(23)00160-6
19. Joshi SR. RSSDI Textbook of Diabetes Mellitus. Jaypee Brothers Medical Publishers; 2020 Feb 28. doi: 10.5005/jp/books/18379

Authors Contribution

ZA: Conceptualization of Project
ZA: Data Collection
ZA: Literature Search
ZA: Statistical Analysis
MI: Drafting, Revision
ZA: Writing of Manuscript