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# A Study of Pulmonary Functions in Punjabi Type-2 Diabetics and Non-Diabetics

**Navkaran Shergill and Ashok Kumar**

## Abstract

**Aim:** To observe pulmonary functions in Punjabi type-2 diabetics and non-diabetics. **Material and methods:** Fifty diabetic and fifty non-diabetics in the age range of 40-60 years voluntarily participated. The spirometery was performed to observe forced vital capacity (FVC), Forced Expiratory volume in 1 second (FEV1), (FEV1/FVC) and peak expiratory flow rate (PEF).**Results:** The mean age, height, weight, and BMI of type 2 diabetics and non-diabetics was 52.58 ± 4.70 years & 48 ± 4.72 years, 172.08 ± 6.30cm & 172.56 ± 7.44 cm, 70.36 ± 9.16 kg & 80.55 ± 9.41 kg and 23.74 ± 2.68kg/$m^2$ & 27.17 ± 3.71 kg/$m^2$. The mean FVC, FEV1, FEV1/FVC and PEF of type-2 diabetics and non-diabetics was 3.95 ± 0.59 liters & 4.59 ± 0.89 liters, 3.43 ± 0.50 liters & 3.83 ± 0.83 liters, 87.12 ± 5.12 % & 83.44 ± 0.81 %, 8.73 ± 1.22 liters/sec & 9.85 ± 1.69 liters/sec respectively. **Conclusion:** It was concluded that the various pulmonary function variables were reduced in Punjabi type-2 diabetics than non-diabetics. The reduced pulmonary functions in diabetics may be due to microangipathy of the alveolar capillary network in the lungs.

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## Introduction

According to international diabetic federation (IDF, 2015) the population of diabetics in India is six crore and ninty one lakhs, which is second to China which have nine crore and eighty four lakh people suffering from diabetes. According to an estimate by IDF presently thirty eight crore and two lakh people are living with diabetes in world and this will increase to fifty nine crore and two lakhs by 2035, a drastic 55% increase in diabetic population. Diabetes mellitus is reaching potentially epidemic proportions in India, so it is often called as diabetic capital of the world. There is geographical variation in pulmonary functions of patients with type 2 diabetes in India. The level of morbidity and mortality due to diabetes and its potential complications are enormous and pose significant healthcare burdens on both families and society (Kaveeshwar and Cornwall, 2014). Neuropathy, retinopathy, nephropathy and cardiovascular dysfunctions as complications are common in diabetes mellitus. These complications are basically caused by micro-vascular damage which has a central role in the pathophysiology of type 2 diabetes (Bowden *et al*, 2010; Murea *et al*, 2012). Pulmonary complications of the type 2-diabetes are ignored, despite the presence of large

capillary network in the lungs. The alveolar capillary network in the lung is a large micro-vascular unit and may be affected by microangiopathy in type 2 diabetics (Sandler 1990). Airflow limitation is a predictor of death in type 2-diabetes after adjusting for other recognized risk factors (Davis *et al*, 2004). Spirometry is widely used pulmonary function test (PFT). It is simple reliable, valid and powerful tool that assess, differentiate, follow-up and manage patients with pulmonary disorders. It typically assesses the lung volumes and flows, and is ideally suited to describe the effects of obstruction or restriction of lung function (Ruppel 1997). Now days, it is regarded as an integral component of any respiratory medical surveillance programme. PFT has assumed a key role in epidemiological studies investigating the incidence, natural history and causality of lung disease (McKay *et al*, 1984). Spirometry is essential for diagnosing respiratory illness, assessing their severity, determining response to treatment and tracking patient's progress over time (Jenkinsa 2009). Its utility was further recognized when its application was high lightened in diabetic patients (Meo *et al*, 2006). In Diabetes mellitus (DM) pulmonary functions have been studied very frequently in developed countries but in developing countries like India few studies were conducted regarding pulmonary function abnormalities. Type-2 diabetes is becoming very common in North Indian population and it is therefore very important to study the possible interaction between type-2 diabetes mellitus and pulmonary lung functions. Therefore, the present study was conducted to observe pulmonary lung functions of male Punjabi type-2 diabetics and non-diabetics.

**Material and Methods**

The present study was conducted on 100 male subjects in the age range of 40 to 60years, out of which 50 were type 2 diabetics (already diagnosed by physician) and 50 non-diabetics with same age range. Details of the study were explained to each participant and signed consent was obtained from the participants. American diabetes association criteria was used to include subjects in the study, according to which a fasting glucose level of at least 7.0 mmol/L (126 mg/dL); non fasting glucose level of at least 11.1mmol/L (200 mg/dL); current use of anti-diabetic medications and a positive response to the question "has a doctor ever told you that you have diabetes (sugar in the blood)?" After taking the anthropometric data, the pulmonary function test was carried out as per the procedure recommended by American Thoracic Society (ATS) by using spirometer. Spirometer was ISO (9001:2000) certified spiroexcel of medicad company. The subjects were encouraged to practice the spirometry maneuver before doing the pulmonary function test. The test was repeated three times at every 10 minute interval and the best out of three readings were taken into consideration. The result of two groups was compared with each other and the data was analyzed using the Statistical Package for Social Sciences (SPSS) version 20. All data was presented in mean, standard deviation, absolute and percent difference between two groups. Independent t-test was used to find the level of significant differences in the means of the outcome measures: age, height, weight, BMI, FVC, FEV1, FEV1/FVC and PEF between the groups. The level of significance was $p<0.05$.

**Results**

Table 1 shows that the mean age, height , weight and BMI of type 2 diabetics and non-diabetics was 52.58 ± 4.70 years & 48 ± 4.72 years, 172.08 ± 6.30cm & 172.56 ± 7.44 cm, 70.36 ± 9.16 kg & 80.55 ± 9.41 kg and 23.74 ± 2.68kg/$m^2$ & 27.17 ± 3.71 kg/$m^2$ respectively. Further, it was found that mean age of type 2 diabetics was more than non-diabetics (Table 1). In other words, an absolute and percent difference of age of type 2 diabetics and non-diabetics was 4.5 years and 4.5% and this difference was statistical significant (Table 3). It was found that mean body weight of non-diabetics was more than type 2 diabetics. An absolute and percent difference of weight of non-diabetics and type 2 diabetics was 10.2 kg and 6.7% and this difference was statistical significant (Table 3).Similarly, the BMI of non-diabetics was more than type 2 diabetics. An absolute and

percent difference of BMI of non-diabetics and type 2 diabetics was 3.4kg/$m^2$ and 6.7% and this difference was statistically significant (Table 3).

**Table 1: Mean ± SD of anthropometric variables of type-2 diabetic and non-diabetic**

| Variable(s) | Group 1 (Type-2 Diabetic) | Group 2 (Non-diabetic) | Absolute difference | Percentage difference |
|---|---|---|---|---|
| **Age (years)** | **52.58±4.70** | **48±4.72** | **4.58** | **4.5** |
| **Height (cm)** | **172.08±6.30** | **172.56±7.44** | **-.48** | **0.13** |
| **Weight (kg)** | **70.36±9.16** | **80.55±9.41** | **-10.20** | **6.75** |
| **BMI (kg/$m^2$)** | **23.74±2.68** | **27.17±3.71** | **-3.42** | **6.71** |

The mean Forced vital capacity (FVC), Forced expiratory volume in 1sec (FEV 1), FVC/FEV1 (%), Peak expiratory flow liters/sec (PEF) of type 2 diabetics and non-diabetics was 3.95 ± .59 & 4.59 ± .89 liters, 3.43 ± .50 & 3.83 ± .83 liters, 87.12 ± 5.12 & 83.44 ± .81 %, 8.73 ± 1.22 & 9.85 ± 1.69 liters/sec respectively. Further it was found that the mean FVC of non-diabetics was more than type-2 diabetics (Table 2). Also an absolute and percent difference of FVC of type-2 diabetics and non-diabetics was .63 and 7.3% and this difference was statistically significant (Table 3). Similarly, the mean FEV 1 & PEF of non-diabetics was more than type-2 diabetics and absolute and percent difference was .40 & 5.5% and 1.1 & 6.0% respectively, and this difference was statistically significant (Table 3). It was also found that the mean FEV1/FVC of type-2 diabetics was more than non-diabetics (Table 2) and also the absolute and percent difference was 3.6 and 2.1% and this difference was also statistically significant (Table 3).

**Table 2: Mean ± SD of Pulmonary Function variables of type-2 diabetic and non-diabetics**

| Variable(s) | Group 1 (Type-2 diabetics) | Group 2 (Non-diabetics) | Absolute difference | Percentage difference |
|---|---|---|---|---|
| **FVC (L)** | **3.95±.59** | **4.59±.89** | **-.63** | **7.37** |
| **FEV1 (L)** | **3.43±.50** | **3.83±.83** | **-.40** | **5.5** |
| **FEV1/FVC (%)** | **87.12±5.12** | **83.44±.81** | **3.68** | **2.15** |
| **PEF (L/s)** | **8.73±1.22** | **9.85±1.69** | **-1.12** | **6.02** |

**FVC- Forced vital capacity; FEV1-Forced expiratory volume in 1 sec; FEV1/FVC- Ratio of Forced expiratory volume in 1 sec by Forced vital capacity; PEF- Peak expiratory volume**

**Discussion**

The result of the present study shows that the mean age of type-2 diabetics was 52.58 ± 4.70 year and non-diabetics were 48 ± 4.72 year. Further, it was found that the age of type 2 diabetics was more than non-diabetics i.e. the absolute and percent difference between two groups was 4.58 year & 4.5% which was statistically significant. In the present study, the subjects were randomly distributed in the two groups on the basis of age range of 40 to 60 years and not on age matching criteria and this may be the reason that there was a statistical significant difference in their age. The weight of non-diabetics (80.5 ± 9.4 kg) was more than type-2 diabetics (70.3 ± 9.1 kg) and this difference was statistically significant. The BMI of non-diabetics (27.1 ± 3.7 kg/$m^2$) was more than

type-2 diabetics (23.7 ± 2.6 kg/$m^2$) and this difference was statistically significant. In type 2 diabetics, the insufficient insulin prevents the body from getting glucose from the blood into the body cells to use as energy. When this occurs, the body starts burning fat and muscle (protein) for energy, causing a reduction in overall body weight. According to WHO (2006) BMI ranges are underweight: under 18.5kg/$m^2$, normal weight: 18.5 to 25kg/$m^2$, overweight: 25 to 30kg/$m^2$ and obese: over 30kg/$m^2$. In the present study, the BMI of Type-2 diabetic group was found to be in normal weight range and non-diabetic group was in overweight category.

**Table 3: Independent t-test of Anthropometric variables and pulmonary function variables**

| Variables | Mean Difference | t | Sig. (2-tailed) |
|---|---|---|---|
| **Age (years)** | **4.58** | **4.862** | **.000** |
| **Height (cm)** | **-.48** | **-.348** | **.729** |
| **Weight (kg)** | **-10.20** | **-5.489** | **.000** |
| **BMI (kg/$m^2$)** | **-3.42** | **-5.285** | **.000** |
| **FVC (L)** | **-.63** | **-4.228** | **.000** |
| **FEV1 (L)** | **-.40** | **-2.928** | **.004** |
| **FEV1/FVC (%)** | **3.68** | **3.363** | **.001** |
| **PEF (L/s)** | **-1.12** | **-3.806** | **.000** |

**Significant (p<0.05)**

**BMI- Body mass index; FVC- Forced vital capacity; FEV1-Forced expiratory volume in 1 sec;**
**FEV1/FVC- Ratio of Forced expiratory volume in 1 sec by Forced vital capacity;**
**PEF- Peak expiratory volume**

The results of the present study show, that the mean FVC in Punjabi type-2 diabetic was 3.95± 0.59 liters and Punjabi non-diabetics was 4.59 ± 0.89 liters. It was found that FVC of non-diabetics was more than type-2 diabetics and the absolute and percent difference was 0.63 liters and 7.3% which was statistically significant. The FEV 1 in type-2 diabetics was 3.43 ± 0.50 liters and non-diabetics was 3.83 ± 0.83 liters, again it was found that FEV 1 was more in non-diabetics. Further the absolute and percent difference between both groups was 0.4 liters and 5.5%, which was found to be statistically significant. The results of the present study also showed that PEF in type-2 diabetics was 8.73 ± 1.22 liters per second and non-diabetics was 9.85 ± 1.69 liters per second, further it was found that PEF was more in non-diabetics than type-2 diabetics, which was statistically significant. The FEV1/FVC in type-2 diabetics was 87.12 ± 5.12 % and in non-diabetics was 83.44 ± .81 % further it was found that FEV1/FVC was more in type-2 diabetics than non-diabetics. The percent difference between both groups was 2.15% which was found to be statistically significant. According to a study by Chhabra et al (2014) predicted values for Pulmonary lung function variables like FVC, FEV1, FEV1/FVC & PEF in normal adults from north India were 4.07±.65 liters, 3.29±.58 liters, 80.3±6.09 % and 8.01±1.5 liters per second. The FVC of Punjabi type-2 diabetics in our study was observed to be reduced as compared to these values. Further it was found that the PLF variable values of Punjabi non-diabetic group in our study were more as compared to study conducted by Chhabra et al (2014). Chronic hyperglycemia associated with the diabetic state leads to glycosylation of serum and tissue proteins and the formation of advanced glycosylation end

products. Following their deposition within tissues, the glycosylated proteins pro-inflammatory effects, that may result in pulmonary inflammation and which further causes airway damage (Nandhini R, 2010). There is over-production of mitochondrial superoxide's and ultimately a reduction in antioxidant defense resulting in increased oxidative activity associated with diabetes and hence, increased susceptibility to environmental oxidative insults, which leads to subsequent loss of lung function (Ali, 2010 ; Agarwal, 2010).

**Conclusion**

It was concluded that the various pulmonary function variables were reduced in Punjabi type-2 diabetics than non-diabetics. The reduced pulmonary functions in diabetics may be due to microangipathy of the alveolar capillary network in the lungs. Therefore a regular assessment of pulmonary function variables in type-2 diabetics is necessary, as this would be helpful in preventing further respiratory impairment and deteriorating PLF values. So, an early pulmonary rehabilitative intervention can also improve the lung functions in type-2 diabetics.

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Conflict of Interest: None Declared