“STUDY OF PULMONARY FUNCTION IN PATIENT WITH TYPE 2 DIABETES MELLITUS”

By

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Dissertation submitted to BLDE University, Vijayapur.

In partial fulfilment of the requirements for the award of the degree of

DOCTER OF MEDICINE

IN

GENERAL MEDICINE

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Dr. SUMA RAMA GOPAL GANGISETTY

LIST OF ABBREVIATIONS USED

DM	Diabetes Mellitus
PFT	Pulmonary Function Test
FEV_1	Forced Expiratory Volume in one second
FVC	Forced Vital Capacity
FEV_1/FVC	FEV_1 Expressed as a percentage of the FVC
FBS	Fasting Blood Glucose
PPBS	Post Prandial Blood Glucose
HbA_1C	Glycated Haemoglobin
FRC	Functional Residual Capacity
VC	Vital Capacity
RV	Residual Volume
VT	Tidal Volume
IC	Inspiratory Capacity
TLC	Total Lung Capacity
ERV	Expiratory Reserve Volume
G6P	Glucose 6 Phosphate
ACTH	AdrenoCorticotropic Hormone
BMI	Body Mass Index
AGEs	Advanced Glycosylated End Products

ABSTRACT

Background:

Diabetes mellitus (DM) is multisystem disease involving many organs of the body. It is well known to affect systems like kidneys, eyes, nerves, vessels and heart due to its microvascular and macrovascular complications. It has been reported that lung capacities are also reduced in DM. We tried to evaluate the involvement of lungs in diabetes mellitus in Indian population in present study.

Objective

To evaluate the pulmonary function tests in patients with type 2 diabetes mellitus and its association with duration of the disease.

Methodology:

This study was undertaken in patients admitted to B.L.D.E.U's ShriB.M.Patil Medical College Hospital and Research Centre, Vijayapur between November 2015 to July 2017. A total of 73 cases of type 2 diabetes mellitus were taken after satisfying the inclusion and exclusion criteria and 73 non diabetic patients of same age and gender ($\pm$5) as of cases were taken as controls and compared with duration of type 2 diabetes mellitus.

Summary:

The number of subjects in the present study was 146. Majority of patients were in the age group of 50-59. Out of 146 subjects 73 were diabetics and 73 were non diabetics. Total of 60 females were included in study and males were 86.The mean BMI in diabetic group was 23.3 and in controls 22.4. Effect of diabetes mellitus on spirometry values

explored a reduction in mean FVC was 24.1, FEV_1 was reduced by 28.4 ml and FEV_1/FVC had increased by 0.1 in diabetics compared to their age, gender and BMI matched controls. The parameters show a restrictive pattern in diabetics.

Effect of duration of diabetes on spirometry values was assessed, in subjects with duration of diabetes more than 10 years the values were seen to increase linearly than in those with duration of 5 years. The possible explanation is that effect of diabetes on lung function will be more in those with diabetes more than 10 years.

Relation of glycemic status and spirometric values was explored, a reduction in FVC and a reduction in FEV_1 was noted in subjects with FBS of 200-300mg/dl compared to those with FBS of 90-110 mg/dl. In subjects with HbA1c >8.0 a decrease in FVC was noted compared to those with HbA1c of 4-6%, however no significant changes in FEV_1 was noted with HbA_1C. No significant decrease in spirometry values were noted in relation to PPBS values. As seen from the above values it is confirmed that high blood sugars reduce the lung capacity of ventilation.

Conclusion:

The present study has explored the relation between the diabetes mellitus and spirometry values. This study has considered comparison among diabetics and non-diabetics in relation to FVC, FEV_1 and FEV_1/FVC and concludes that restrictive pattern is seen in diabetics and spirometry values were low in patients with diabetics.

This study has proved that type 2 Diabetes Mellitus patients with duration more than 10 years are more affected than duration less than 10 years and have restrictive pattern when compared to their age, gender and BMI matched controls. In females, there

is more restriction in lung volumes when compared to males of type 2 diabetes of same duration.

The association between glycaemic status and spirometry values shows reduced values in group of subjects with high fasting blood sugars and high HbA1c values however no such effect was seen in relation to PPBS.

As the duration of diabetes increases, the restrictive profile of lung volumes is more prominent. Spirometry remains a cost effective, a simple non-invasive diagnostic tool and its judicious use can give a signal for patients to improve glycemic control.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

INTRODUTION

Diabetes mellitus is a metabolic disorder as a result of insulin deficiency. Its of two types. Deficiency of insulin leads to type 1 diabetes whereas type 2 is due to insulin resistance leading to inadequate compensatory insulin secretion.

Diabetes mellitus causes multiple complications and affects the CVS, neural, renal, liver, skin, elastic fibers and collagen.[1] Thus it is a multisystem disorder affecting multiple organs.[1] The incidence of diabetes is on rise especially in urban areas, the reasons being life style changes coupled with rapid urbanisation.[2]

Diabetes is risk factor for micro vascular complications like nephropathy, retinopathy and neuropathy. It is also cause for coronary disease, peripheral vascular disease and cerebrovascular disease.

The microvascular complications appear early, within 5 to 10 years and macro-vascular complications appear within 15 to 20 years from the onset of diabetes.[3] It is possible to significantly delay the occurrence of complications and thereafter the progression of diabetes is detected early.

Histopathological changes in diabetic lungs are thickened pulmonary capillary and alveolar epithelial basal lamina. Thus there is decreased lung volume and impaired diffusion due to thickened basement membrane.[4] Non - enzymatic glycosylation of connective tissue especially basement membrane of lung in diabetics is the most possible mechanism for lung abnormality.[4] This globally prevalent disease needs to be completely understood so that effective prevention and treatments are carried out.

Spirometry is a pulmonary function test (PFT). It

- Classifies lung function into obstructive or restrictive pattern.
- Assists in the early diagnosis of lung damage.

- Monitor the therapeutic efficacy.

The spirometric parameters Forced Expiratory Volume in 1 sec (FEV_1) and Forced Vital Capacity (FVC) are emerging risk factors in diabetics.[5] The objective of this study is to describe significance of spirometry in diabetics and its role in routine assessment of diabetic patients.

The pulmonary function in diabetes is not extensively documented, hence this study.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

1) To record pulmonary function tests in type 2 diabetes mellitus patients.
2) To record pulmonary function tests in matched control group.
3) To study and evaluate the impact of type 2 diabetes mellitus on pulmonary functions in patients by comparing it with control groups.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

AN OVERVIEW OF DIABETES MELLITUS

Historical review of diabetes mellitus

A polyuric state similar to diabetes mellitus was described over 3500 years ago and the word “diabetes” came from the Greek word for a Syphon’. The sweet taste of diabetic urine was recognized in 1st Millennium. Later in the year 1776 Mathew Dobson stated that diabetes as a systemic condition and not a disease of the kidney and diabetic urine and serum tasted sweet. John Rollo added Mellitus’ (honeyed) in 18th century. Chevreul in 1815 identified excess sugar in diabetes as glucose. In 1840 Claude Bernard showed that glucose was normally present in the body and is stored in the liver as glycogen and secreted into the blood stream during fasting. In 1864 Ma Eduard Von Jaeger- defined Diabetic retinopathy. In 1869 Marchal de Calvi identified the association of neuropathy with diabetes mellitus. Paul langerhans explained the production of an internal secretion, which regulated glucose metabolism.[5]

In 1880 Etienne Lancereaux sub divided on clinical grounds into, diabetic maiqre (leen subject) and diabetic obese gras (obese).The same year Stephan Mackenzie and Edward Nettle described specific lesions (micro aneurysm and new vessels). In 1885 Frederick Pavy explained symptoms of neuropathy with diabetes. In 1889 Oskar Minkowski and Josef Von Mering demonstrated role of pancreas in diabetes by producing diabetes in a dog by pancreatectomy.[5]

In 1893 Gustave Laguesse suggested pancreatic islets produced internal secretion that regulated glucose metabolism During 1900, 1920 George Zuelzer and Nicolas pauluco attempted to isolate insulin.

Introduction :

Diabetes mellitus is emerging as the chronic non-communicable disease of concern in developing countries with changing environs, urbanization and altered lifestyles, diabetes is also increasingly identified as a major cause of morbidity and mortality.

Furthermore, Indians have high ethnic susceptibility for developing diabetes at a younger age group and develop vascular complications earlier and more frequently during the natural progression of the disease.

Definition:

Diabetes mellitus is a group of metabolic disease characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. The chronic hyperglycemia of diabetes is associated with long term damage, dysfunction and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels.

Diabetes is worldwide in distribution and the incidence is rising through the world. However the prevalence of both varies considerably in different parts of the world. Etiological classification of Diabetes Mellitus:[6]

1. Type 1 Diabetes Mellitus:
    a. Idiopathic
    b. Immune mediated
2. Type 2 Diabetes mellitus:
3. Other Specific types:

A. Genetic defects of beta cell function:
    1. Chromosome 12 HNF – 1 α (MODY – 3)

2. Chromosome 7, glucokinase (MODY – 2)
3. Chromosome 20, HNF – 4 α (MODY – 1)
4. Mitochondrial DNA

B. Genetic defects in insulin action:
1. Type A insulin resistance
2. Leprechaunism
3. Rabson-mendenhall syndrome
4. Lipotrophic diabetes

C. Diseases of exocrine pancreas:
1. Pancreatitis
2. Trauma / Pancreatectomy
3. Neoplasia
4. Cystic fibrosis
5. Hemochromatosis
6. Fibrocalculouspancreatopathy

D. Endocrinopathies:
1. Acromegaly
2. Cushings syndrome
3. Glucagonoma
4. Pheochromocytoma
5. Hyperthyroidism
6. Somatostinoma
7. Aldosteronoma

E. Drug or Chemical related:

1. Pentamidine
2. Nicotinic acid
3. Glucocorticoids
4. Thyroid hormones
5. Thiazides
6. Beta-adrenergic agonists
7. Alpha-interferon

F. Infections:

1. Congenital rubella
2. Cytomegalovirus

G. Uncommon factors of immune mediated diabetes:

1. Stiff Man syndrome
2. Anti – insulin receptor antibodies

H. Other genetic syndromes:

1. Down’s syndrome
2. Klinefelter’s syndrome
3. Turner’s syndrome
4. Wolfram’s syndrome
5. Friedreich’s syndrome
6. Huntington’s chorea
7. Laurence – Moon biedl syndrome
8. Myotonic dystrophy

I. Gestational diabetes mellitus

TYPE-2 DIABETES:

Characterized by insulin resistance and usually relative insulin deficiency. Ketoacidosis occurs rarely. Patients have increased risk of developing micro and macro vascular complications.[7]

Genetics:

Multifactorial etiology.

Genetic factors are more important in the etiology of type 2 than Type 1 diabetes.

Environmental factors:

Life Style:

Overeating combined with under activity and obesity.

Obesity increases resistance to the action of insulin.

Malnutrition in Utero:

May damage beta cell development, predisposing to type 2 diabetes later in life.

Age:

It is predominantly a disease of the middle aged and elderly affecting 10% of the population over the age of 65.

PATHOGENESIS:[8]

Insulin Resistance:

Resistance to insulin action and increased glucose production are invariable in obese and non-obese patients with type 2 diabetes. Insulin resistance is due to :

1. Excessive amount of circulating antagonists
2. Abnormal insulin molecule
3. Target tissue defects.

Type 2 diabetes mellitus is often associated with hypertension, obesity, and hyperlipidemia (metabolic syndrome or syndrome X) which predisposes to cardiovascular disease.

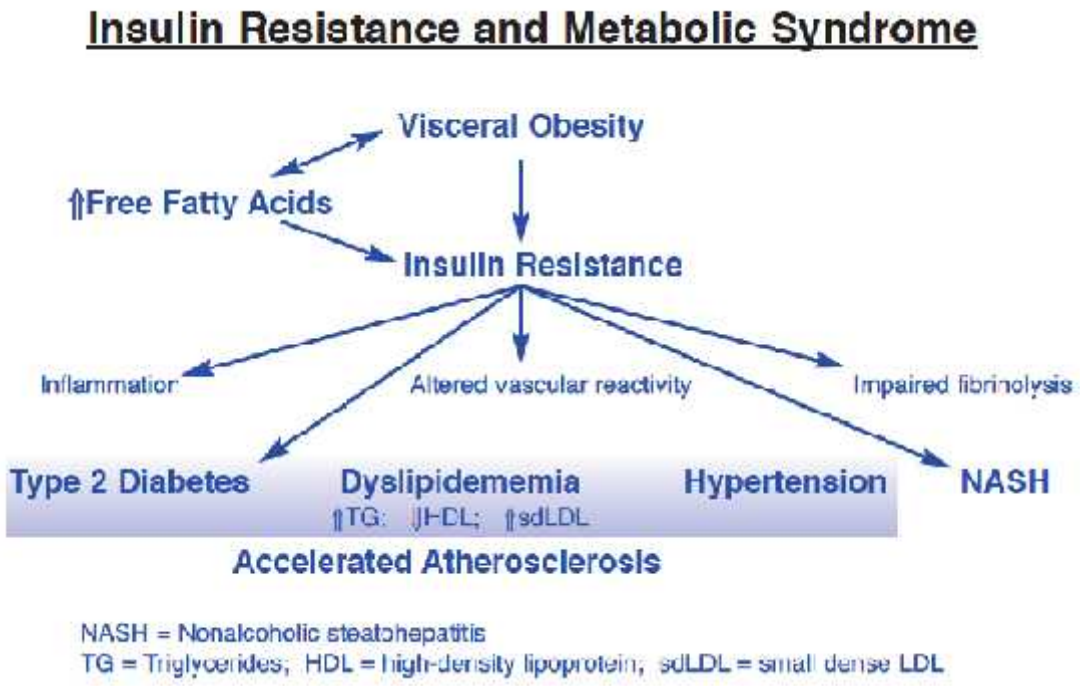
BETA CELL FAILURE:

There is atrophy of the normal islet cells with amyloid deposition, particularly islet epithelial cells are typical of type 2 diabetes. Alpha cells are maintained.

Insulin resistance tends to raise blood glucose. There is a decline in insulin generation when the maximal insulin release has been exceeded.

METABOLIC DISTURBANCE IN DIABETES:

The hyperglycemia of diabetes results in decreased anabolic and increased catabolic effects. Also there is end organ resistance to insulin.



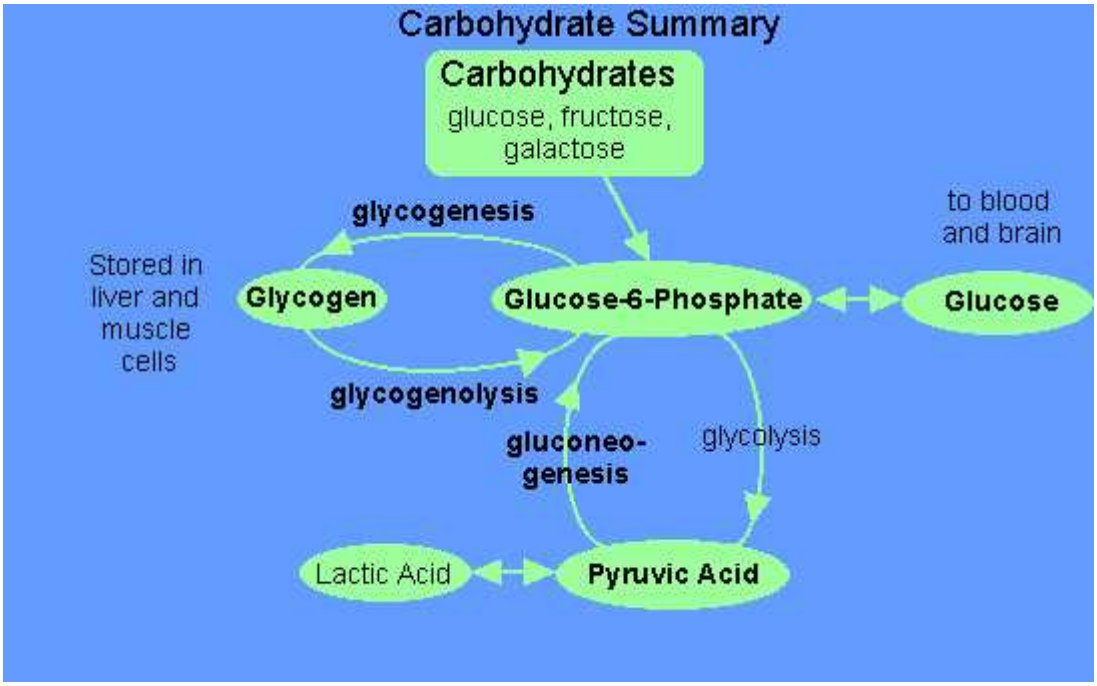
Regulation of blood glucose levels:

Blood glucose homeostasis is very important for human survival. Glucose level is finely and effectively regulated because it is essential to have a continuous supply of glucose to brain as it does not store glucose. RBC and renal medulla are also dependant on glucose for their fuel needs.

All ingested carbohydrates in diet are converted to glucose. Gluconeogenesis converts ingested protiens into glucose.[9] Lactate is taken by erythrocytes and skeletal muscles and converted via gluconeogenesis to glucose.[9]

The liver responds to elevated or reduced blood glucose levels is the liver. liver produces glucose and releases into circulation. Alpha cells release glucagon when blood glucose is low.[9] Beta cells release insulin when blood glucose is high.

Growth hormone and ACTH increase blood glucose by inhibiting uptake by extra hepatic tissues.[10] Glucocorticoid inhibits glucose uptake and increases blood glucose levels.. Epinephrine causes glycogenolysis to produce glucose.[10]



Glucose Metabolism in Diabetes mellitus:

In diabetes mellitus, leads to increased hepatic glucose output. Liver glycogen stores are mobilised, then hepatic gluconeogenesis is used to produce glucose. Insulin deficiency also impairs non-hepatic tissue Utilization of glucose. In particular in adipose tissue and skeletal muscle, insulin stimulates glucose uptake. Reduced glucose uptake by peripheral tissues in turn leads to a reduced rate of glucose metabolism. In addition, the level of hepatic glucokinase is regulated by insulin.[10] Therefore, a reduced rate of glucose phosphorylation in hepatocytes leads to increased delivery to the blood. The combination of increased hepatic glucose production and reduced peripheral tissues metabolism leads to elevated plasma glucose levels. When the capacity of the kidneys to absorb glucose is surpassed, glycosuria ensues. Glucose is an osmotic diuretic and an increase in renal loss of glucose is accompanied by loss of water and electrolytes, termed polyuria. The result of the loss of water leads to the activation of the thirst mechanism (polydipsia).[10] The negative caloric balance, resulting from the glycosuria and tissue catabolism as well as failure of hypothalamic regulation leads to an increase in appetite and food intake.[10]

Diabetes and its effects on respiratory system:

Chronic hyperglycemia leads to multiple complications in diabetes. How this causes complications is not very clear. Few theories have been suggested in this regard.

First theory: Hyperglycemia causes raised intracellular glucose which in turn increases advanced glycosylation end products (AGEs). These attach themselves to the proteins within the cell and thus cause cross linking of advanced proteins like collagen. All these processes hasten ageing of the cell and cause premature

atherosclerosis and also reduced GFR in the kidney.[6] This theory is supported by fact that there is positive correlation between blood glucose level and AGE products.[6]

Second theory: Normal glucose undergoes breakdown via glycolysis. There is alternative pathway when glucose levels increase. Enzyme aldose reductase converts excess glucose into sorbitol which interferes with cell free radical scavenging and thus leads to increased reactive oxygen species and cell damage.[6]

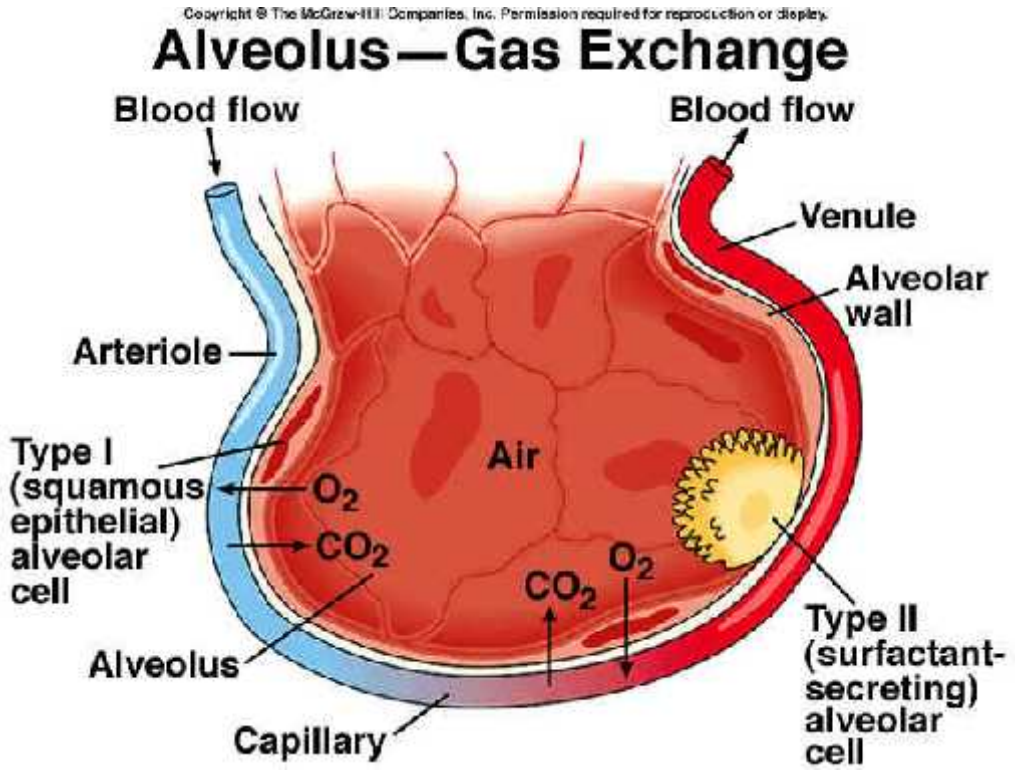
Third theory: increased glucose leads to overproduction of diacylglycerol and activation of protein kinase C. This protein kinase causes alteration of gene transcription of multiple proteins like collagen and fibronecin.[6]

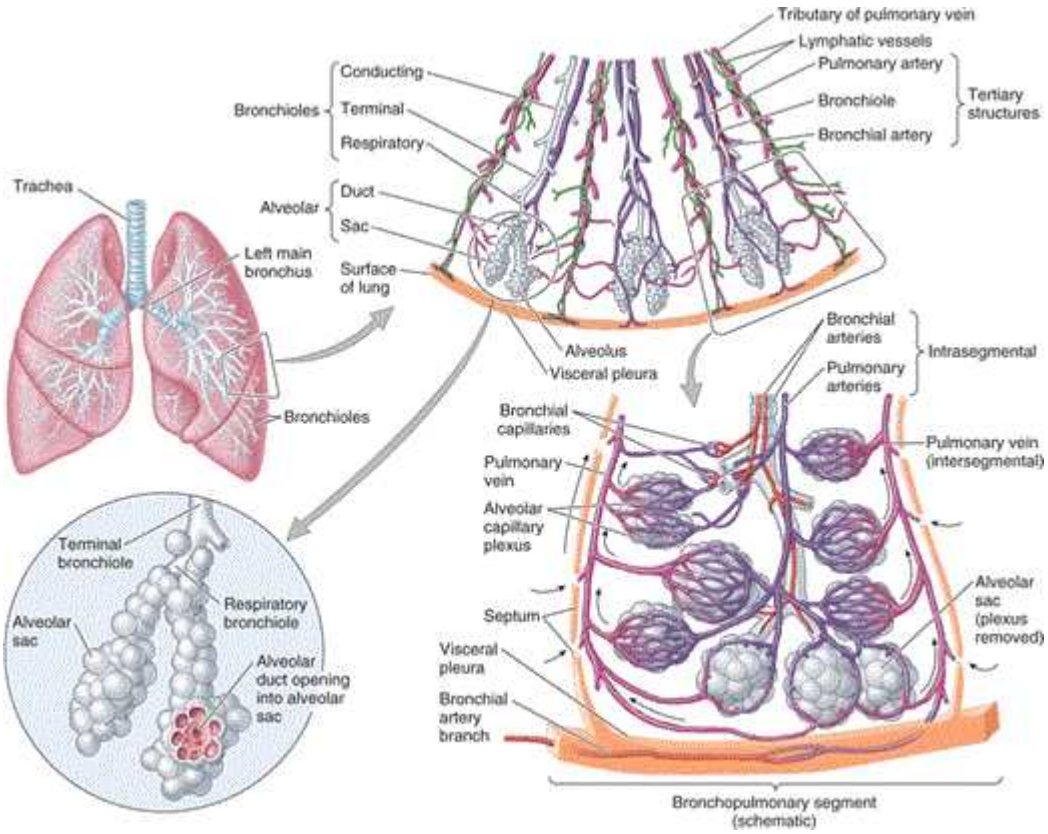
Fourth theory: raised glucose levels enters the hexosamine pathway and leads to increased production of fructose 6 phosphate. Normally this acts as starting product for proteoglycan proteins which forms the extra cellular matrix. Now the increased level may lead to change in gene expression of TGF-B or plasminogen activator inhibitor I.[6]

Role of growth factors in diabetes:

- Vascular endothelial growth factor A (VEGF-A) is increased in retinopathy.[6]
- Increase in TGF beta leads to collagen thickening of glomerular basement membrane in nephropathy.[6]
- Miscellaneous factors like EGF , ILGF I , GH , FGF ,PDGF etc have roles to play in increased complications in diabetes.[6]

Diabetes mellitus causes abnormalities in pulmonary microvasculature and connective tissue leading to lung function abnormalities like decreased VC, TLC, compliance of lung etc. Modification of the surfactant function is also known to occur[11]





The diabetic lungs are also prone to infections and complications such as Pneumothorax, plugging of airways, pulmonary edema, pulmonary effusion and respiratory failure due to electrolyte imbalance.[11]

History of pulmonary function tests:

In 1680 G.A.Borelli measured the inspiratory volume of lung.[12,13] Jurin.J- measured 650ml tidal volume and 3610 ml of maximal expiration in 1718. Bernouli.D described the method of measuring expired volume in 1749. John Hutchinson named subdivisions of the lung volumes and described the methods for measuring them in 1852. Later in 1854 Wintrich developed modified spirormeter and concluded that height, weight and age determine vital capacity. In 1860 N.Grehant calculated the volume of gas (FRC). In 1882 Zuntz gave the formulation of pulmonary dead space. In 1890 Christian Bohr explained the equation for calculating respiratory dead space in terms of gases in alveolar and expired air.[12,13] In the year 1894 Loewy determined dead space to be 140 ml.

Lavoisier and Seguin measured lung volume during late 18thcentury. At the beginning of 19th century Humphrey Day described indirect measurement of lung volumes.[12,13] Haldane and Priestly explained alveolar sampling technique in 1905.Knipping H.W introduced a standardized method of spirometry in 1929. Camphell et al presented light weight peak flow meter in 1974.

BRONCHIAL AND PULMONARY ANATOMY: [14, 15]

The lungs are well protected within the thoracic cage. The bifurcation of trachea corresponds to angle of Louis.

The inspired air is warmed by uptake of water vapour as it passes through the upper respiratory tract. It then reaches the trachea and through the bronchioles, respiratory bronchioles and alveolar ducts it finally enters the alveoli.

The Tracheo-bronchial tree:

The tracheal and bronchial walls contain cartilage and smooth muscle. The tracheobronchial walls contain ciliated epithelium and mucus, serous glands which are conspicuously absent in bronchioles and terminal bronchioles. However, their walls are made of smooth muscle predominantly. Cilia extend from trachea upto respiratory bronchioles.

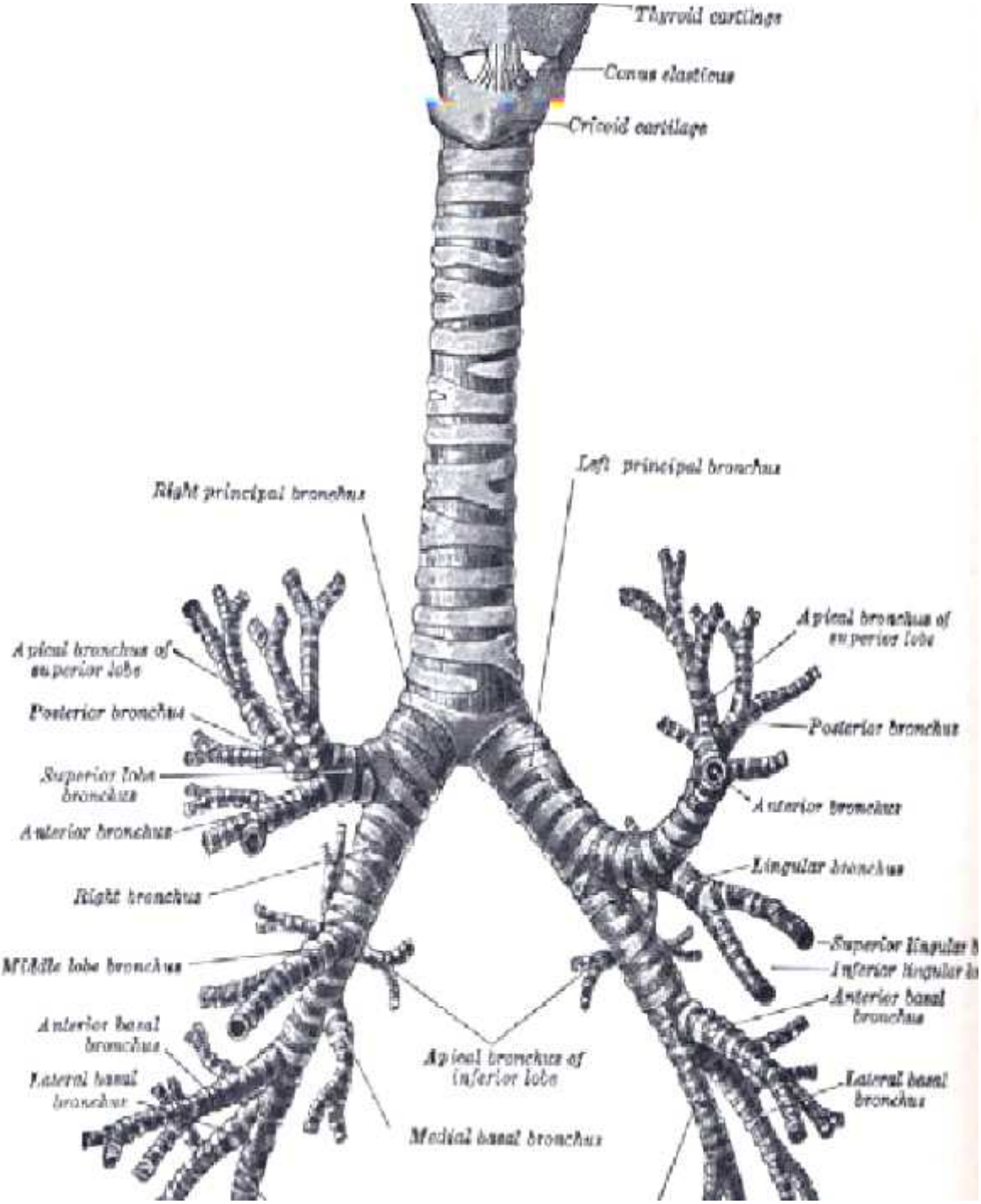
Autonomic nervous system supplies the bronchial and bronchiolar walls through muscarinic receptors.

There are adrenergic beta 1 and beta 2 receptors in the bronchial epithelium, smooth muscle and in mast cells. Receptors on cholinergic endings and ganglia inhibit acetylcholine release. In humans, the beta-2 receptors predominate and cause bronchodilation and decreased bronchial secretion.

The Terminal Airways:

The airway extends from the trachea upto alveolar sacs. There are total of twenty three divisions in airway, the first sixteen are the conducting system of the airways. (bronchi and bronchioles). The remaining form the transitional and respiratory system (upto the alveoli). The alveoli are surrounded by pulmonary capillaries and are sites for gaseous exchange.

The alveoli contain type I and type II cells. Type 1 cells are thin and are lining cells. Type II cells are thick and secrete surfactant.


Thyroid cartilage
Conus elasticus
Cricoid cartilage
Left principal bronchus
Right principal bronchus
Apical bronchus of superior lobe
Posterior bronchus
Superior lobe bronchus
Anterior bronchus
Right bronchus
Middle lobe bronchus
Anterior basal bronchus
Lateral basal bronchus
Apical bronchus of inferior lobe
Medial basal bronchus
Apical bronchus of superior lobe
Posterior bronchus
Anterior bronchus
Lingular bronchus
Anterior basal bronchus
Lateral basal bronchus

PULMONARY PHYSIOLOGY [16] :

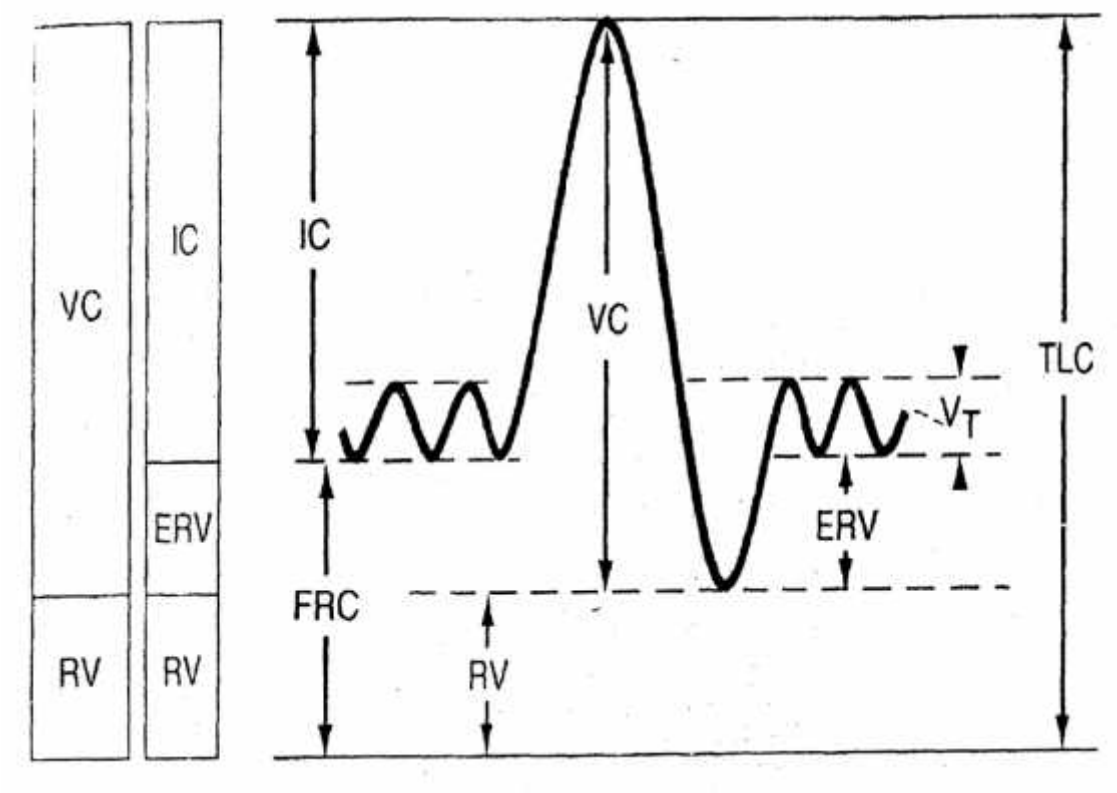


Figure 1 Lung volumes shown by block diagram

VC = VITAL CAPACITY

RV = RESIDUAL VOLUME

FRC= FUNCTIONAL RESIDUAL CAPACITY

VT = TIDAL VOLUME

TLC = TOTAL LUNG CAPACITY

IC = INSPIRATORY CAPACITY

IRV = INSPIRATORY RESERVE VOLUME

Lung volumes:[17,18]

Tidal volume: The volume of air inhaled into the lungs during each inspiration at rest.

Inspiratory reserve volume: The air volume inspired with a maximal inspiratory effort in excess of the tidal volume.

Expiratory reserve volume: The volume of air exhaled by forced expiratory effort after passive expiration.

Residual volume: The volume of air left in lungs after a maximal expiratory effort.

The vital capacity: The largest amount of air that can be expired after a maximal inspiratory effort.

Respiratory minute volume: The volume of air inspired per minute.

Maximal Voluntary Ventilation: It is the maximum amount of air that moves in and out of the lungs voluntarily in 1 minute.

1) **FEV_1:** It is the volume of air expired in the first second of maximal expiration after a maximal inspiration.
2) **FVC:** It is the maximum volume of air that can be exhaled during a forced manoeuvre.
3) **FEV_1/FVC:** It gives a clinically useful index of air flow limitation.

Pulmonary/ Lung Function Tests:

Pulmonary function tests (PFTs) is a group of tests that are performed to measure lung function.[19] PFTs include lung volume measurement, spirometry, diffusion capacity for carbon monoxide[20], and arterial blood gases.[21]

They are used in patient management and are a part of general tests in occupational, sports medicine, respiratory and public health screening. The results of PFT's are interpreted to standard values.[19]

Volume time curve and the flow volume loop graphs are initially interpreted. It involves identifying pattern as obstructive, restrictive or mixture of both. Also grading of severity is done. Automated spirometry systems necessitate clinical correlation and physician assessment.

Conventional spirometry is abnormal well before clinical abnormality is detected.

Factors affecting the lung functions:

Physiological:[22,23]

- Age, height, gender, BMI, weight
- Pregnancy, ethnicity, exercise, posture
- Activity
- Geographical location
- Time of day, season and climate
- Diet (Over and undernutrition)

Environmental:[22]

- Air pollution
- Occupational exposure
- Smoking history & duration.

Pathological:[24,25]

- ❖ Coronary artery disease
- ❖ Chronic obstructive pulmonary disease (COPD)
- ❖ Diabetes mellitus.
- ❖ Interstitial lung disease
- ❖ Other hormonal disorders
- ❖ Neuromuscular disorders like Guillain barre syndrome or Myasthenia gravis

SPIROMETRY TEST:

It is a screening test. It is the first study to be performed when patient presents to the clinician. The test can be administered in the settings like physicians chamber, emergency and inpatient settings.

Spirometry Indications:[26]

Diagnostic indications:

For symptoms like:

- ❖ Dyspnoea
- ❖ Cough
- ❖ Orthopnea
- ❖ Wheezing
- ❖ Phlegm production

For signs like:

- ❖ Cyanosis

- Chest deformity
- Crackles
- Diminished inspiratory and expiratory sounds
- Over inflation

Abnormal lab tests:

- Hypoxemia and Hypercapnia
- Abnormal radiograph of chest
- Polycythemia

At risk person screening:

- Smokers
- Subjects with occupational exposure.

Routine examinations

- For preoperative risk assessment.
- For prognosis in lung transplant patients.
- Health status assessment for enrolment in programs with strenuous physical activity.

Monitoring of:[26]

- Bronchodilator therapy
- Management of congestive heart failure
- Steroid treatment for asthma, interstitial lung disease.

To describe course of diseases which also affect the lungs:

- ❖ Neuromuscular diseases
- ❖ Cardiac diseases
- ❖ Guillain-Barre syndrome
- ❖ Congestive heart failure

For monitoring pulmonary toxic drugs.

Disability / Impairment evaluation:

As a part of rehabilitation program in

- ❖ Vocational
- ❖ Industrial
- ❖ Legal problems
- ❖ Insurance evaluation
- ❖ Government compensation programs

Public Health programs:

- ❖ Comparing populations from different environments
- ❖ Epidemiologic surveys
- ❖ Derivation of reference equations

In normal subjects, VC, SVC, and FVC are equal. In disease of small airways, the expiratory SVC > FVC.

A spirometry measures airflow by a flow-sensing device .[2]

Table 1 : Flow sensing devices

Volume	Flow Sensing (Pneumotach)
Water	Hot-wire
Dry	Turbine
Bellows	Fleisch
Rolling seal	Screen

Types of Spirometers:

A spirogram is a graph of either flow/volume or volume/time tracing. Various values can be derived from this like airflow (FEV_1), exhaled volumes like FVC.

The measurements are expressed in litres for volumes or in litres per second. Spirogram helps distinguish obstructive from restrictive causes as airflows are decreased in obstructive disease whereas air volumes are reduced in restrictive diseases.[27]

FEV_1**:**

- Most widely used parameter.
- Reduced in both obstructive & restrictive diseases, however it is disproportionate reduction in obstructive diseases and normal or increased in restrictive disease.
- Represents large and medium-sized airways.
- Occurs at 75% - 85% of FVC in normal flow volume loop.

FVC:

- FVC is a measure of lung volume.
- Decreased in diseases where lungs are smaller (restrictive) like pulmonary fibrosis, pleural effusion, neuromuscular disease and kyphoscoliosis.
- Pseudo restriction can occur in setting of large lungs hyper inflated due to severe airflow obstruction and air trapping, as in emphysema. Therefore FVC is not a reliable indicator of total lung capacity especially in airflow obstruction.

Flow Volume and Volume Time Trace:

- Used for establishing the technical adequacy of test.
- Help in localising anatomic location of airflow obstruction.

Flow Volume loop

The shape of graph provides clue to location of airflow disease (large / small airways).

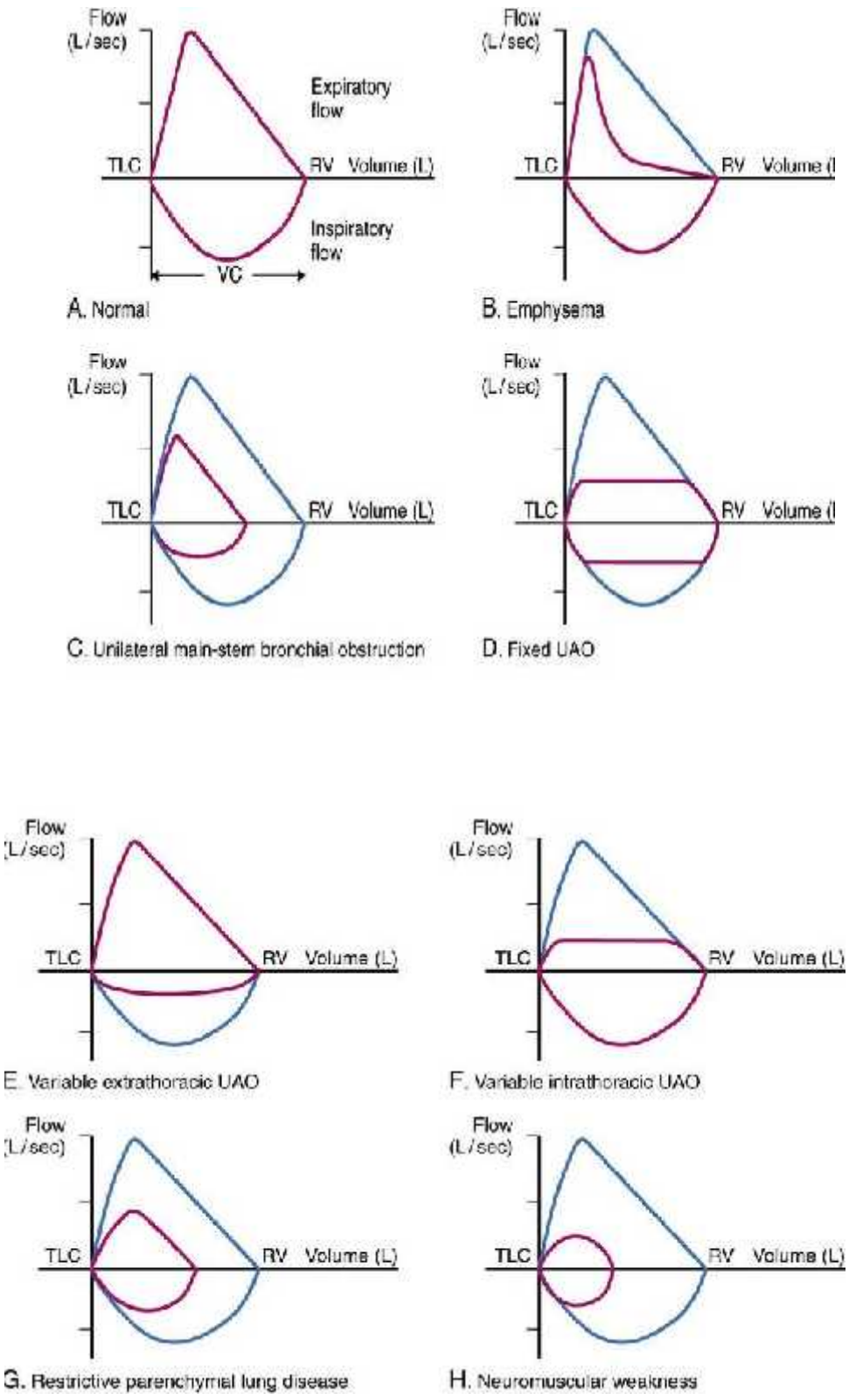


Figure 2 Flow volume loops

A variety of parameters like maximal mid expiratory flow (MMEF) or forced expiratory flow (FEF) at 25% to 75% vital capacity reflects small airways.[28,29] other

tests include single breath N2 test and frequency dependent dynamic lung compliance. American Thoracic Society does not recommend their use for detecting small airways disease.[12]

Lung Volumes:

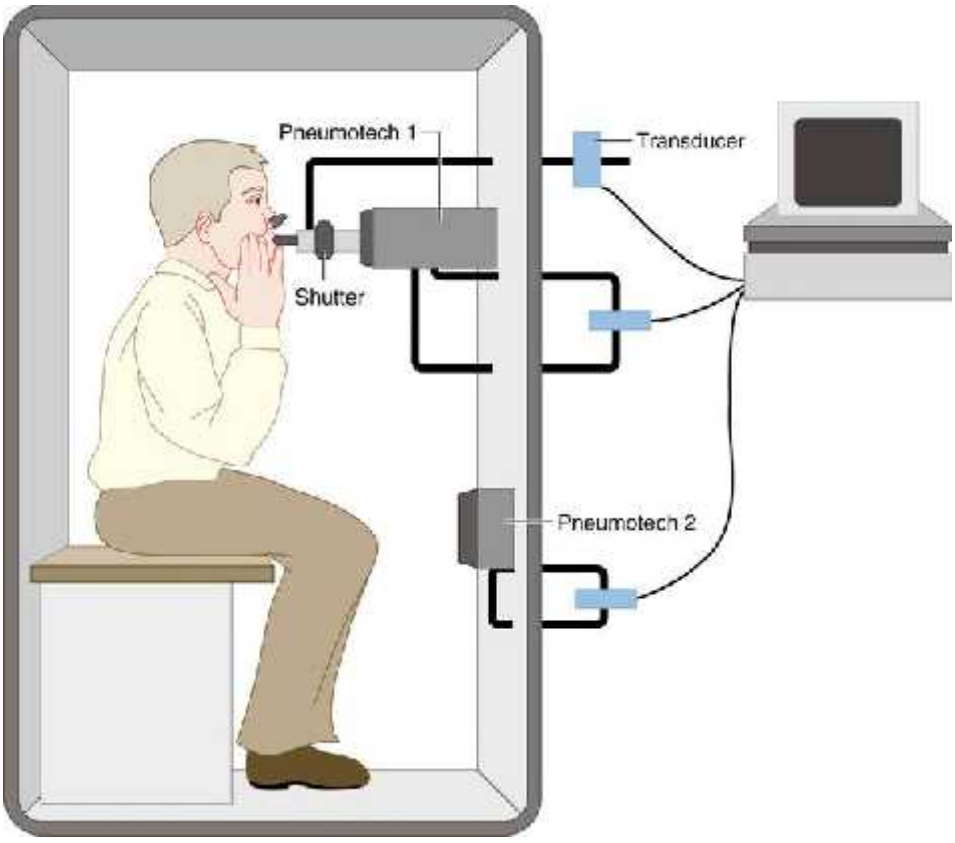
Spirometry quantifies exhaled volume and vital capacity but not residual volume. Therefore FRC & TLC cannot be measured as residual volume is not quantified. Other methods are required to measure total lung capacity such as gas dilution technique and body plethysmography for FRC.

Gas dilution techniques:

- Measures all air in the lungs.
- widely used
- Uses either open-circuit or closed-circuit.
- Procedure

1) Closed-circuit helium dilution technique: a known volume and concentration of helium is inhaled followed by 10 minutes waiting time. The final exhaled helium concentration noted. Residual volume is calculated as proportion to the unknown volume of air in the patients chest. The measured volume is FRC.
2) Nitrogen-washout technique: Initially patient inhales 100% oxygen. Therefore nitrogen in the lungs washes out. Volume and concentration of exhaled nitrogen is measured. FRC is calculated as difference in volume and concentration of inhaled and exhaled nitrogen.

❖ Limitation: cannot measure air within non communicating bullae. Hence underestimates total lung capacity in patients with emphysema



➢ Body plethysmography:

- Based on Boyle's law (At constant temperature, the volume of gas is inversely proportional to pressure).
- Advantage is it can measure the total air volume in the chest including air within the bulla unlike nitrogen washout technique.
- Limitations: Complex equipment. Cumbersome as patient sits in a closed space.
- Procedure: A patient sits in enclosed box with a known quantity of air. Patient exhales with open glottis against a closed shutter. The pressure

changes in inverse proportion to chest volume air. The volume represents the lung volume (FRC).

Measurement of inspiratory capacity, vital capacity and expiratory reserve volume is done after FRC is measured and finally RV and TLC are calculated.

Equipment:

The recommendations regarding spirometry and diffusing capacity are provided by American Thoracic Society such as acceptability & reproducibility criteria [30].

Acceptability / Reproducibility Criteria for Spirogram[30]

Spirogram Acceptable Criteria:

Artefact free:

- Early termination or cut off
- Cough in 1st second.
- Leak
- Obstructed mouthpiece
- Not a steady effort

Good/Proper start:

- Extrapolated volume < 5% FVC or 150 millilitres
- Time for peak expiratory flow < 120 milliseconds

Good/acceptable exhalation:

- Six seconds of exhalation
- The subject cannot continue to exhale.

- ❖ Reasonable amount of time.
- ❖ volume time map plateau

Repeatable Criteria:

After 3 acceptable spirograms, check for

- ❖ Are 2 largest FVC, FEV_1 volumes approximately < 200 ml difference between the 2 measured volumes?
- If yes the test section is done.
- If no continue testing.

Table 2: Equipment Quality Control Summary

Test	Minimum Interval	Action
Volume	Daily	3L syringe check
Leak	Daily	3 cm H_20 constant pressure for 1 mm
Linearity	Quarterly Weekly (flow spirometers)	l-L increments with a calibrating syringe measured over the entire volume range (flow spirometers simulate several different flow ranges)

Standards of Spirometer:

Volume spirometer:

- ❖ Volume accuracy within 50 ml compared to test.
- ❖ Accommodate volumes of up to 7 L
- ❖ Accumulate volume for greater than 30 sec

Flow sensing spirometer:

- Accuracy within 200 ml/seconds.

Both need:

- Routine checks and Regular maintenance

Normal equations:

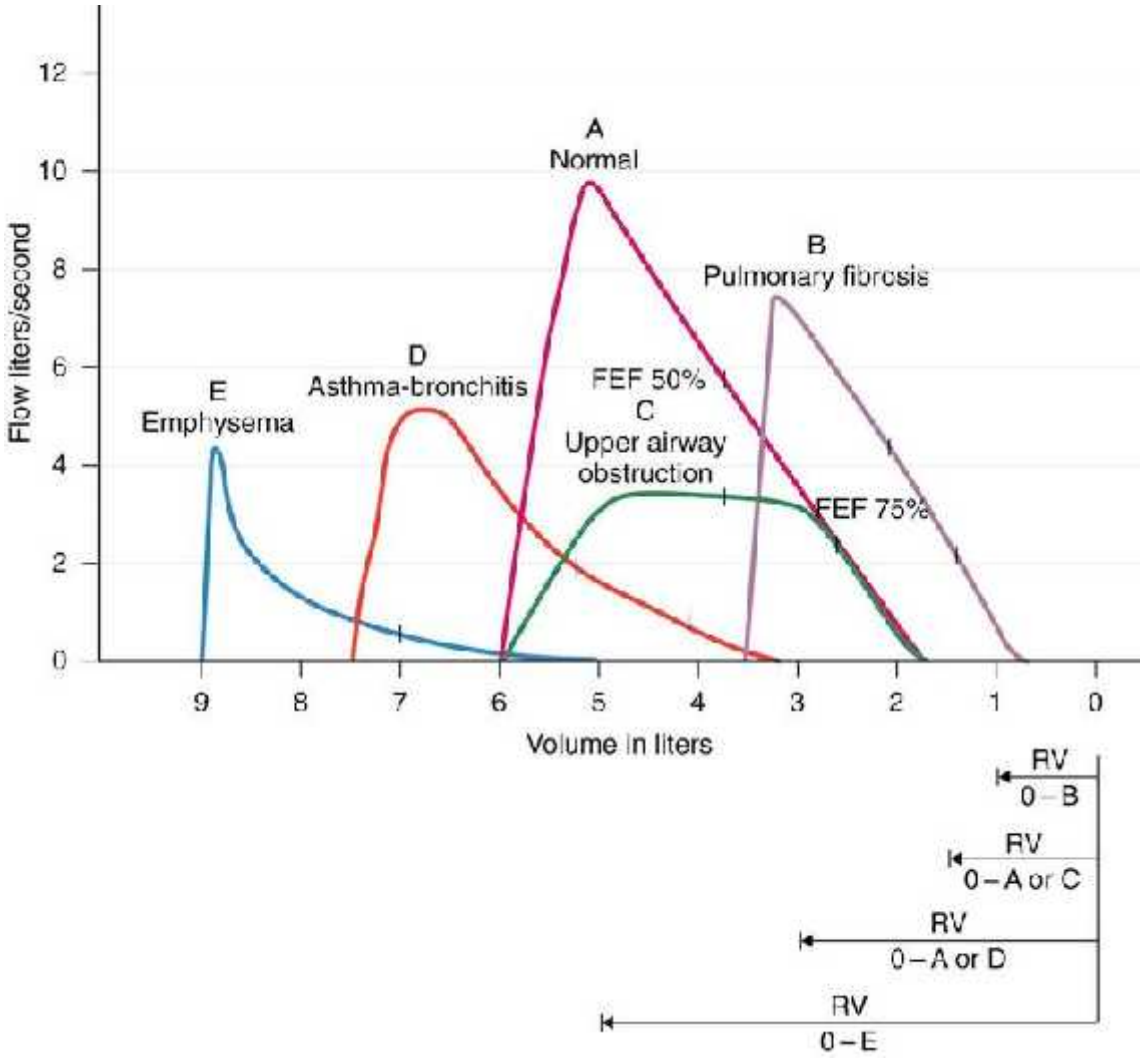
Height, gender, age, weight and race influence lung parametres[31,32]. Lower most 5% of the population is considered abnormal[31,32]. Reference standards like Morris and colleagues[33], Crapo and colleagues[34], Knudson and Colleagues[23], and the National Health and Nutrition Examination Survey (NHANES III)[31] are based on similar age, height, and race.

Obstructive & Restrictive Diseases:

Respiratory diseases can be classified:

Obstructive disorders: They have airflow obstruction with increased lung volumes and air trapping.

Restrictive disorders: They have increase in overall stiffness of the lungs with reduced lung volumes and decreased compliance.



Lung Diseases

Obstructive Diseases

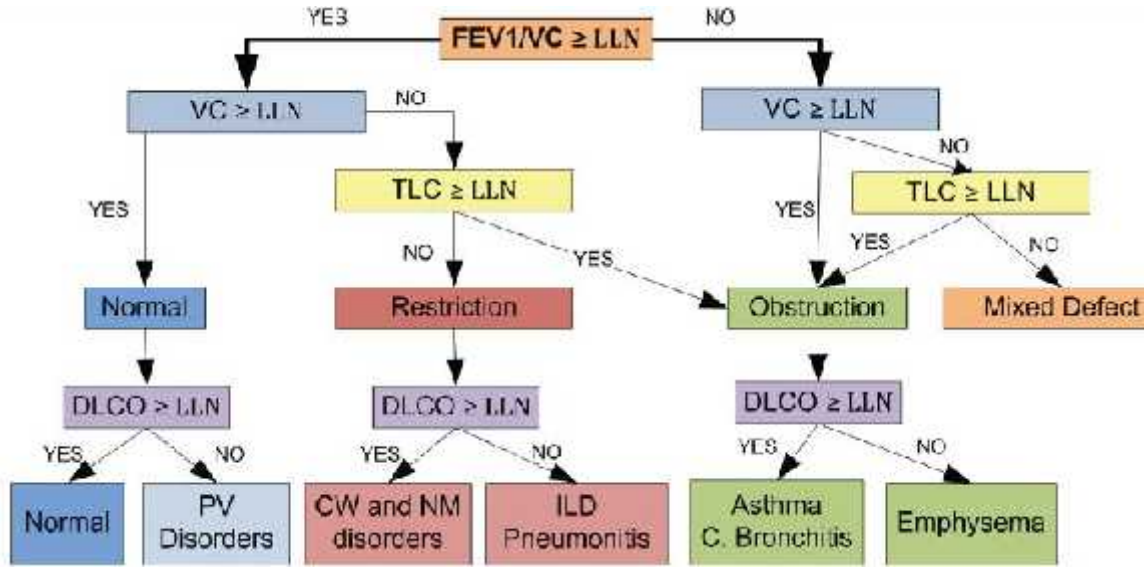
- Asthma
- COPD
- Cystic fibrosis
- Chronic obstructive bronchitis
- Asthmatic bronchitis

Restrictive Diseases:

- ❖ Idiopathic pulmonary fibrosis
- ❖ Congestive heart failure
- ❖ Thoracic deformities
- ❖ Beryllium disease
- ❖ Neuromuscular diseases
- ❖ Interstitial pneumonitis
- ❖ Sarcoidosis
- ❖ Infectious inflammation (e.g., histoplasmosis, mycobacterium infection)

After spirogram is plotted, the study is classified as normal or abnormal. FVC, FEV_1 and FEV_1/FVC are calculated.[35] If FEV_1/FVC is below normal, airflow obstruction exists. If FEV_1/FVC is above normal, it is not obstructive pathology.

Once airflow obstruction is established, then albuterol is inhaled and spirogram is repeated after 15 minutes to establish bronchodilator responsiveness.



Spirometry procedure:

- Patient is seated. If anxious, reassurance is to be done.
- Breathe in completely and seal the lips around the mouth piece.
- Force the air out and empty the lungs. Normal breathing is continued after that.
- Exhalation must be > 6 seconds and can take up to 15 seconds.
- Both FVC and FEV_1 should be the largest value of 3 satisfactory curves and values in these 3 curves must not vary by more than 5% / 100 ml.

Indications of spirometry in diabetic patients:[36,37]

Diagnostic:

1) Mandatory monitoring of lung functions every alternate year in diabetics.
2) History of cigarette smoking, tobacco chewing with cough. chest pain, dyspnoea or wheezing in diabetic patients.
3) Diabetic patients with abnormal laboratory tests such as ABG and chest radiograph.
4) Evaluate the effect of diabetes mellitus on pulmonary function.
5) Screen all diabetic patients during their first visit.
6) Screen all the diabetic patients with abnormal HBA1C and fasting blood glucose.
7) Assessment of pre-operative risk before surgery in those diabetics.

Monitoring:

1) Assess the therapeutic intervention related to respiratory illness in diabetic patients.

2) Describe other diseases involving lung..

3) Monitoring of diabetic patients exposed to occupational/industrial hazardous agents

Disability evaluation:

1) As a part of a rehabilitation program.

2) As part of an insurance evaluation.

3) As part of social security and legal reasons.

Contraindications of Spirometry in diabetic patients:

1) Hemoptysis of known origin.

2) Present history of any abdominal or thoracic surgery.

3) Present history of glaucoma or any eye surgery.

4) Recent history of severe chest pain, unstable angina or myocardial infarction, thoracic aneurysrns / pneurnothorax.

Relative contraindications are patients with a history of HIV / hepatitis B / hepatitis C (because of high risk of transmission of infection. However, spirometrv can be performed after taking high standard sterilizing measures).

Review' of other works:

Walter ER et al. studied association of hyperglycemic conditions and lung function.[38] This study was conducted by Spirometric assessment in 87 members of Framingham and found that PFT's like FEV_1, FVC and their ratio was deteriorating.[38]

Collins survey Spirometer and the predicted pulmonary function test as determined by the coefficients of regression of pulmonary function test on age, sex and body habitus. The diabetes and hyperglycemia correlated with lower FVC was

lower by 109 ml, FEV_1 was lower by 27 ml and FEV_1/FVC was higher by 1.5% in the diabetics compared to non diabetics.

Lange P. studied 11,763 subjects of which 284 were diabetic and had mild impairment of lung function. It was observed that impairment was more in patients on insulin than those on oral hypoglycemic drugs / diet modification.[39]

Davis A Wendy et al published "Glycemic exposure is associated with reduced pulmonary function test in Type 2 diabetes". In this study 495 Type-2 diabetics were studied between 1993 - 94 by community based cohort study and 7 yrs later pawas restudied for FVC, FEV I. VC & PEF corrected for btps and showed that there was about ten percent reduction compared to normal predicted values for that particular demographic parameters like gender and age. The values declined annually (FVC of 68ml, FEV_1 of 71ml , VC of 84ml/year and PEF of 171/ml.[19]

Malcolm sander reported "Lung is a 'target organ' in diabetes mellitus" and that there was pulmonary angiopathy in the form of thickened alveolar epithelial and pulmonary capillary membrane.There was impaired pulmonary function in form of decreased lung volumes and impaired diffusion capacity.[4]

Davis TM et al concluded that decreased pulmonary function is associated with Type-2-DM . The study involved 421 subjects. Demographic variables like age, sex and height were collected. It was seen that mean reduction of 9.5% was noted in diabetics compared to normal population. There was association of lung function tests with duration of diabetes but not with HbAlc.[40]

Sreeja C.K et al in their study pulmonary function tests in patients with Diabetes mellitus in 20 Type 2 Diabetes mellitus and 20 Type 1 Diabetes mellitus and 40 subjects as controls. There was a significant reduction in FEV_1 /FVC% in both

diabetes groups. The decrease in FFV1/FVC% in both the groups might be due to the poor lung compliance. TLC was lower in diabetes mellitus group because of alteration in collagen and elastin.[41]

Benbassat CA et al studied pulmonary function in Diabetics. The study was conducted in diabetics in 27 patients. The FEV_1, FVC, and MEF were normal but the residual volumes and TLC ratio was raised mildly. Residual volumes and TLC ratio was raised more in type 1 compared to type 2. There was no correlation between the PFT and duration of disease in this study.[3]

Dr. Mohankumar and Dr.S.Arulmozhi studied pulmonary complications in elderly diabetics. They found that TLC , lung volume and compliance are reduced along with reduction in airflows and acceleration of aging process. The diffusion capacity of carbon monoxide is reduced in case of pulmonary microangiopathy in diabetes mellilus.[11]

MATERIAL AND METHODS

MATERIALS AND METHODS

SOURCE OF DATA:

Patients visiting medicine OPD and patients admitted at IPD of _____ _____during the period of December 2015 to July 2017 were taken for study considering the inclusion and exclusion criteria.

TYPE OF STUDY :

It is Hospital based cross sectional study.

METHOD OF COLLECTION OF DATA:

Information was collected through prepared proforma for each patient

Sample Size:

With anticipated mean difference of FEV_1/FVC ratio as 0.119 between case and control and anticipated standard deviation as 0.2,[42] Minimum sample size per case and control is 73 with 90% power and 5% level of significance.

Total sample size: 73 + 73 = 146 using statistical formula:

$$n= \frac{(Z_\alpha+Z_\beta)^2\times 2 \times SD^2}{MD^2}$$

Zα=Z value at the level of significance =99%

Zβ=Z value at the level of significance =90%

MD= Anticipated mean difference

SD= Anticipated standard difference

Sampling Method: Simple random sampling.

Statistical Analysis:

All characteristics were summarized descriptively. For continuous variables, the summary statistics of N, mean, standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries. Chi-square (χ^2)/ Freeman-Halton Fisher exact test was employed to determine the significance of differences between groups for categorical data. The difference of the means of analysis variables between two independent groups was tested by unpaired t test. Bivariate correlation analysis using Pearson's correlation coefficient (r) was used to test the strength and direction of relationships between the interval levels of variables. If the p-value was < 0.05, then the results were considered to be statistically significant otherwise it was considered as statistically insignificant.

Statistical Software:

Data were analyzed using SPSS software v.23.0. and Microsoft office.

Inclusion Criteria:

All patients presenting to OPD and patients from IPD at _____ _____who are proved cases of type 2 diabetes mellitus.

Exclusion Criteria:

Previous history of lung disease

Respiratory infections at the time of test

Smokers

History of being admitted during past six months with respiratory symptoms

History of cardiovascular illness

INVESTIGATIONS

After history and examination, investigations are done:

Complete blood counts

Blood urea

Serum creatinine

Fasting blood sugar

Post-prandial blood sugar

HbA_1C

X ray chest (PA view)

Spirometry

PROTOCOL

After selection of diabetics and controls and obtaining consent, careful screening for exclusion criteria was done. Age, height, weight, body mass index were recorded. The blood sample taken for needed investigations.

The performance of the pulmonary function test was demonstrated. The subjects and controls were made to undergo pulmonary function test using the computerized Spirometer. The FVC, FEV_1, FEV_1/FVC were recorded and the best of the 3 readings taken into account. PPBS estimation was done after 2 hours after food intake.

After all the parameters were recorded. Finally the master chart was prepared.

RESULTS

RESULTS

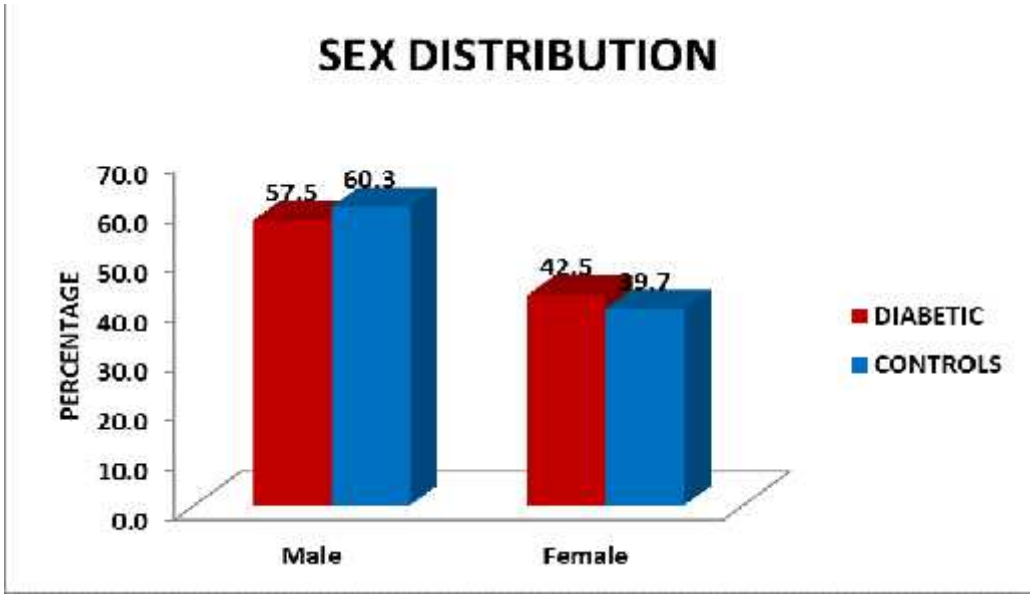
A total of 146 patients were included in the present study 73 of them were type 2 diabetics diagnosed by W H O criteria and the other 73 were non diabetic patients based on history as controls.

Among the 73 subjects in the diabetic group, 42 were males and the other 31 were females. In the control group, 44 were males and 29 were females out of the 73. The patients in both case and control groups were matched by age and gender(± 5).

TABLE 3: DISTRIBUTION OF SEX BETWEEN CASES AND CONTROLS

SEX	DIABETIC		CONTROLS		p value
	N	%	N	%	
Male	42	57.5	44	60.3	0.737
Female	31	42.5	29	39.7	
Total	73	100.0	73	100.0	

FIGURE 3: DISTRIBUTION OF SEX BETWEEN CASES AND CONTROLS



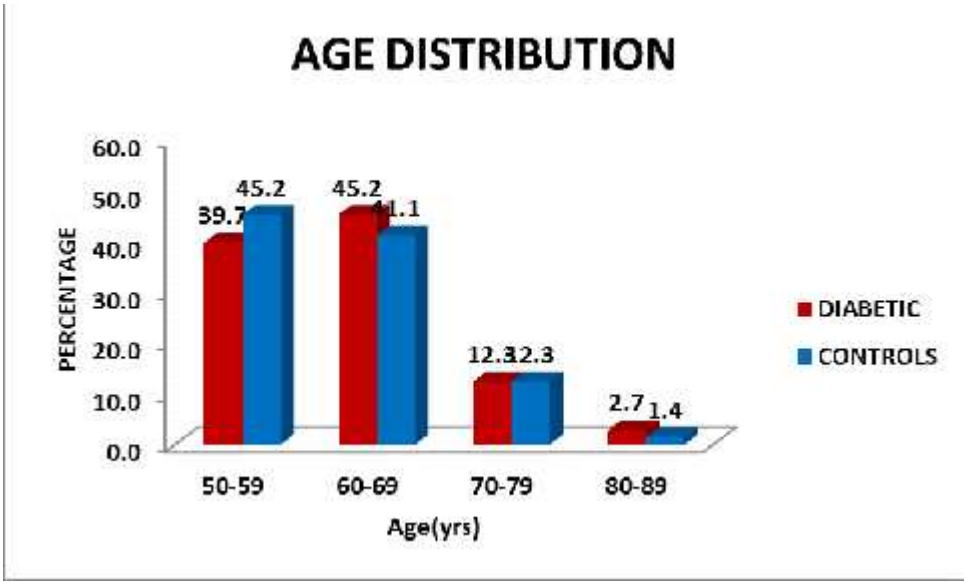
Males forming 57 to 60 % and females 40 to 43 % of the total in each group. Subjects in case and control groups were matched according to age groups. Highest number of subjects were in age group of 50 - 59 years making 42.50 % of the total. Least number of subjects belonged to age group of 80 - 89 years about 3.94% of total.

The mean age among study group was 61.8 years and control groups was 59.7 years. Oldest subject among both the groups was 80 years and youngest subject among both groups was 50 year old.

TABLE 4: DISTRIBUTION OF AGE BETWEEN CASES AND CONTROLS

AGE (years)	DIABETIC		CONTROLS		p value
	N	%	N	%	
50-59	29	39.7	33	45.2	0.865
60-69	33	45.2	30	41.1	
70-79	9	12.3	9	12.3	
80-89	2	2.7	1	1.4	
Total	73	100.0	73	100.0	

FIGURE 4: DISTRIBUTION OF AGE BETWEEN CASES AND CONTROLS

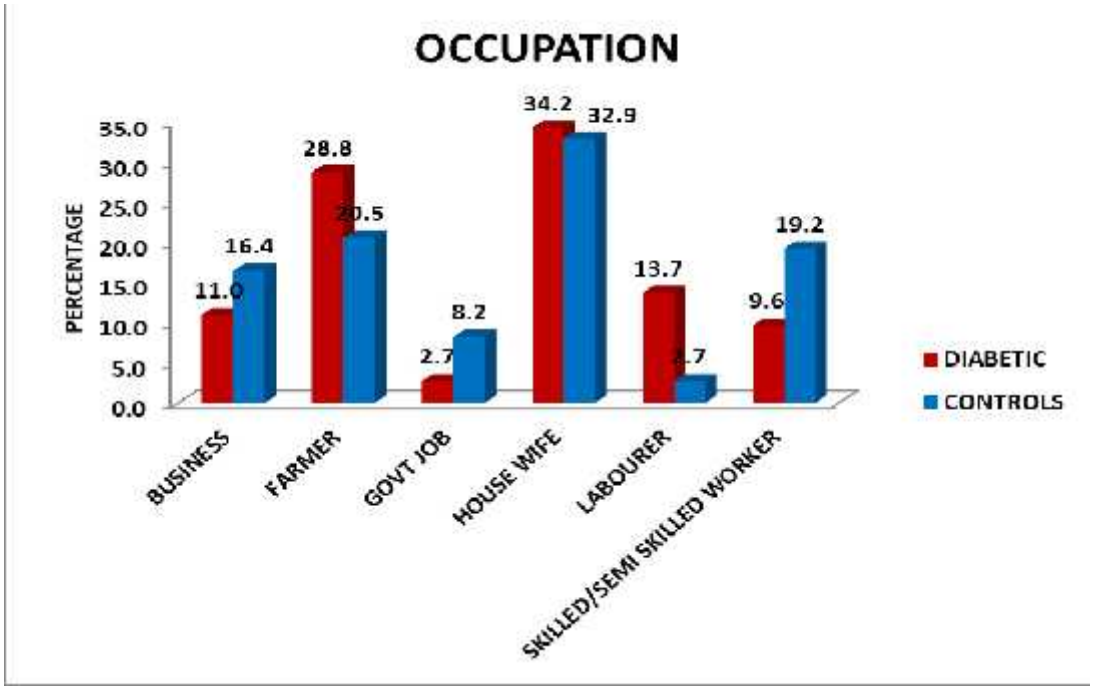


Present study showed wide variations in occupations of cases and controls. Housewives constituted predominant group in both cases and controls followed by farmers in both. There was no statistically significant difference in occupations of cases and controls.

TABLE 5: DISTRIBUTION OF OCCUPATION BETWEEN CASES AND CONTROLS

OCCUPATION	DIABETIC		CONTROLS		p value
	N	%	N	%	
BUSINESS	8	11.0	12	16.4	0.043*
FARMER	21	28.8	15	20.5	
GOVT JOB	2	2.7	6	8.2	
HOUSE WIFE	25	34.2	24	32.9	
LABOURER	10	13.7	2	2.7	
SKILLED/SEMI SKILLED WORKER	7	9.6	14	19.2	
Total	73	100.0	73	100.0	

FIGURE 5: DISTRIBUTION OF OCCUPATION BETWEEN CASES AND CONTROLS



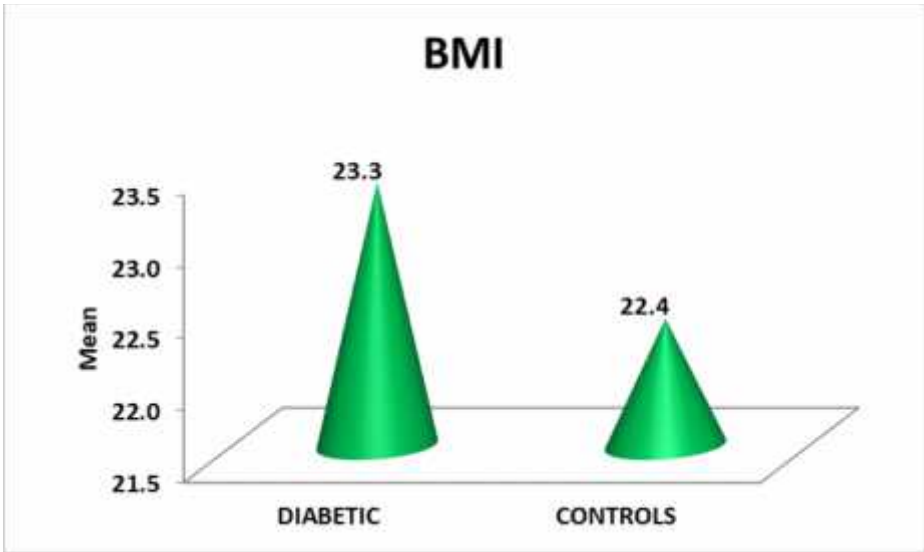
Body mass index (BMI) of cases and controls were compared and the mean among study group was 23.3 as compared to controls which was 22.4 with a p value of 0.121 which was not statistically significant.

The range of BMI in diabetic group was 14.8 to 37.2 whereas in controls it ranged from 17.0 to 32.0

TABLE 6: COMPARISON OF MEAN BMI BETWEEN CASES AND CONTROLS

Variables	DIABETIC		CONTROLS		p value
	Mean	SD	Mean	SD	
BMI (kg/m^2)	23.3	4.3	22.4	2.9	0.121

FIGURE 6: COMPARISON OF MEAN BMI BETWEEN CASES AND CONTROLS



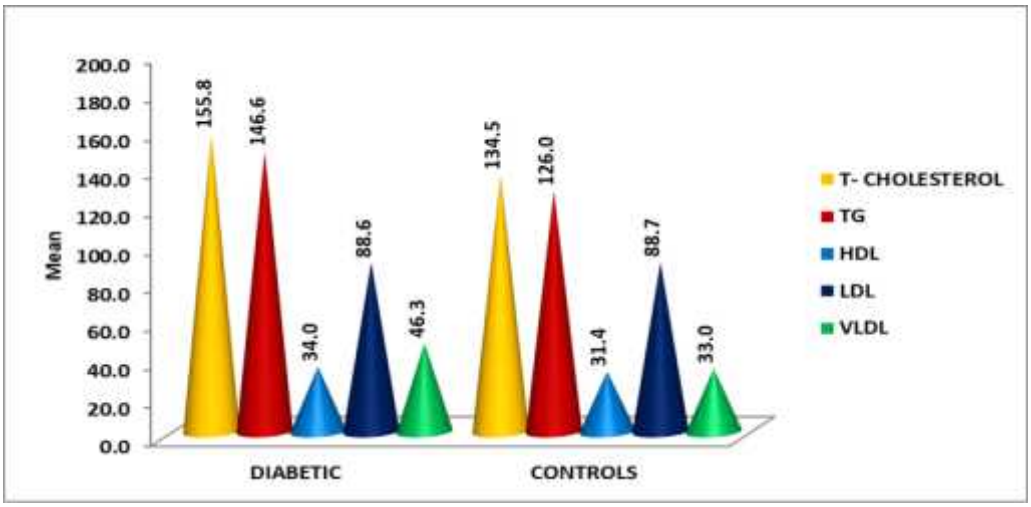
Lipid profile was compared between the cases and controls with regard to total cholesterol, triglycerides, HDL, LDL & VLDL. The mean total cholesterol level among study group was 155.8 as compared to controls which was 134.5 with a p value of <0.001 which was statistically significant. The mean triglyceride level among study group was 143.6 as compared to controls which was 126.0 with a p value of 0.046 which was not statistically significant. The mean HDL level among study group was 34.0 as compared to controls which was 31.4 with a p value of 0.065 which was not statistically significant. The mean LDL level among study group was 88.6 as compared to controls which was 88.7 with a p value of 0.977 which was not statistically significant. The mean VLDL level among study group was 46.3 as compared to controls which was 33.0 with a p value of 0.01 which was not statistically significant.

TABLE 7: COMPARISON OF MEAN LIPID PROFILE BETWEEN CASES AND CONTROLS

Variables (mg/dl)	DIABETIC		CONTROLS		p value
	Mean	SD	Mean	SD	
T- CHOLESTEROL	155.8	36.8	134.5	26.0	<0.001*
TG	146.6	82.0	126.0	31.3	0.046
HDL	34.0	9.1	31.4	7.8	0.065
LDL	88.6	38.0	88.7	22.1	0.977
VLDL	46.3	36.7	33.0	23.4	0.01

Note: *means significant at 5% level of significance (p<0.05)

FIGURE 7: COMPARISON OF MEAN LIPID PROFILE BETWEEN CASES AND CONTROLS



FBS among cases and controls were compared which shows a mean FBS value of 147.3 mg/dl in diabetic group as compared to a mean value of 83.5 mg/dl in controls with p value of <0.001 which is highly significant.

Post Prandial blood sugars showed highly significant difference among both groups with mean of 201.6 among diabetic group and 118.1 among controls with p value of <0.001 which is highly significant.

FBS in diabetic group ranged from 83 mg% to 247 mg% whereas in controls ranged from 70 mg% to 123 mg%.

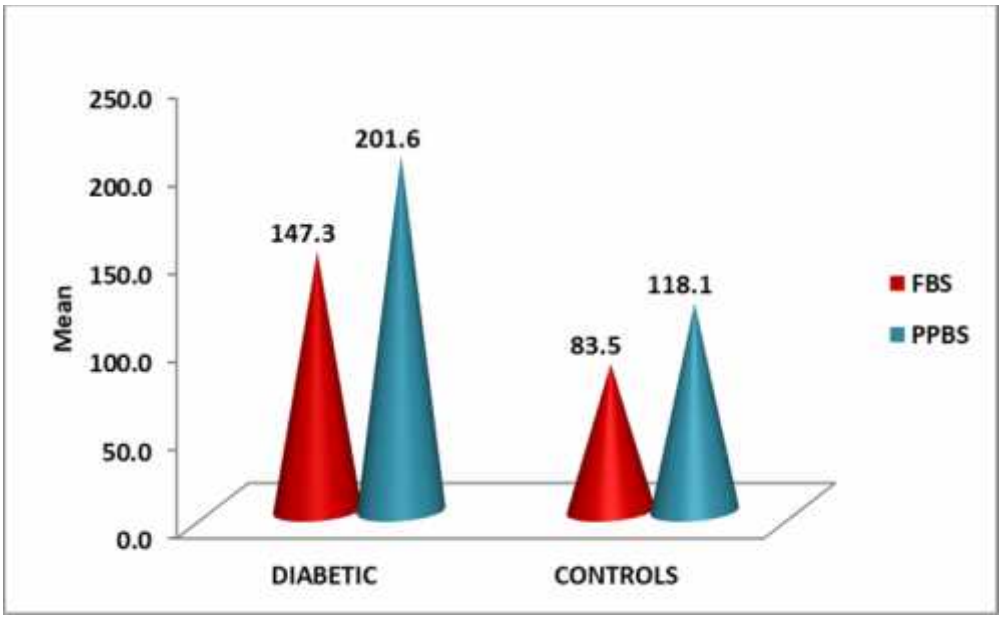
PPBS in diabetic group ranged between 71 to 333 mg% as against range of 90 to 144 mg% in control group.

TABLE 8: COMPARISON OF MEAN FBS/PPBS BETWEEN CASES AND CONTROLS

Variables (mg/dl)	DIABETIC		CONTROLS		p value
	Mean	SD	Mean	SD	
FBS	147.3	55.4	83.5	14.1	<0.001*
PPBS	201.6	64.4	118.1	14.3	<0.001*

Note: *means significant at 5% level of significance (p<0.05)

FIGURE 8: COMPARISON OF MEAN FBS/PPBS BETWEEN CASES AND CONTROLS

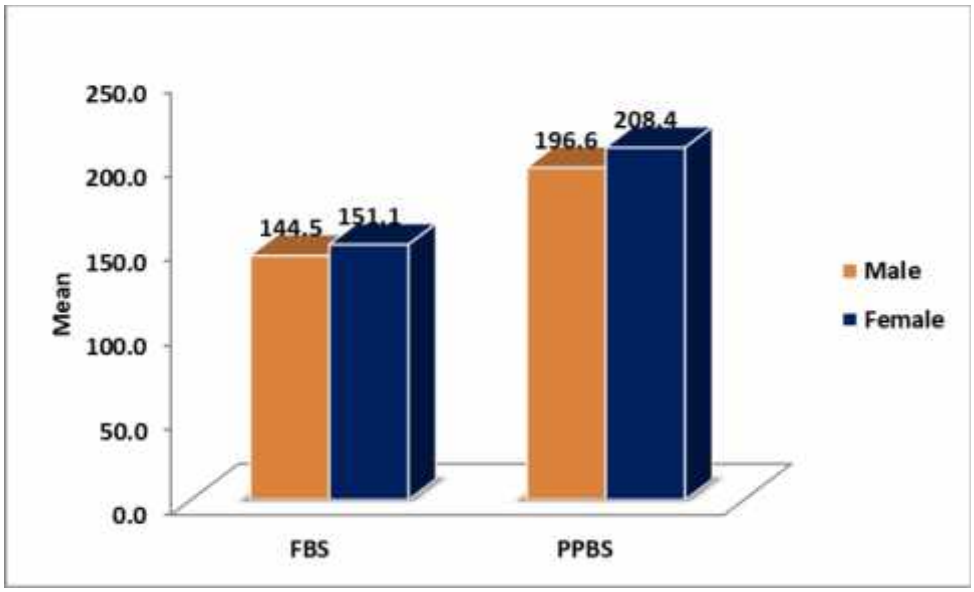


FBS / PPBS were compared between males and females. Mean FBS was 144.5 in males whereas in females it was 151.1. Mean PPBS among males was 196.6 whereas among females it was 208.4. However this difference among gender was not clinically significant.

TABLE 9: FBS and PPBS BETWEEN MALES AND FEMALES IN DIABETIC CASES

Variables (mg/dl)	Male		Female		p value
	Mean	SD	Mean	SD	
FBS	144.5	51.9	151.1	60.3	0.621
PPBS	196.6	59.9	208.4	70.3	0.442

FIGURE 9: FBS/PPBS BETWEEN MALES AND FEMALES IN DIABETIC CASES



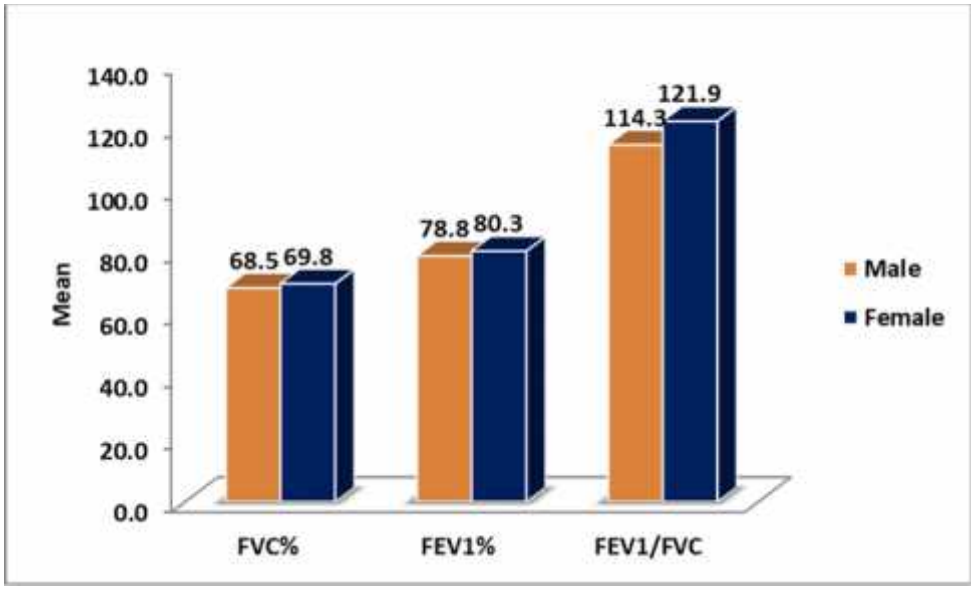
FEV_1, FVC & FEV_1/FVC were compared between males and females. FEV_1 & FVC were statistically insignificant. However Mean FEV_1/FVC was 114.3 in males whereas in females it was 121.9 in females with a p value of 0.018 which was significant.

TABLE 10: FVC, FEV_1 AND FEV_1/FVC BETWEEN MALES AND FEMALES IN DIABETIC CASES

Variables	Male		Female		p value
	Mean	SD	Mean	SD	
FVC%	68.5	18.6	69.8	17.5	0.533
FEV_1%	78.8	24.2	80.3	23.9	0.789
FEV_1/FVC%	114.3	13.7	121.9	12.6	0.018*

Note: *means significant at 5% level of significance (p<0.05)

FIGURE 10: FVC, FEV_1 AND FEV_1/FVC BETWEEN MALES AND FEMALES IN DIABETIC CASES



Mean PPBS among males was 196.6 whereas among females it was 208.4. However this difference among gender was not clinically significant.

HbA1c in diabetic group was high with mean of 8.4 as compared to non diabetic group with mean of 4.8 with p value of <0.001 which is highly significant.

Among diabetics HbA1c ranged from 4.5 to 11.7 whereas in control group ranged from 3.6 to 6.0.

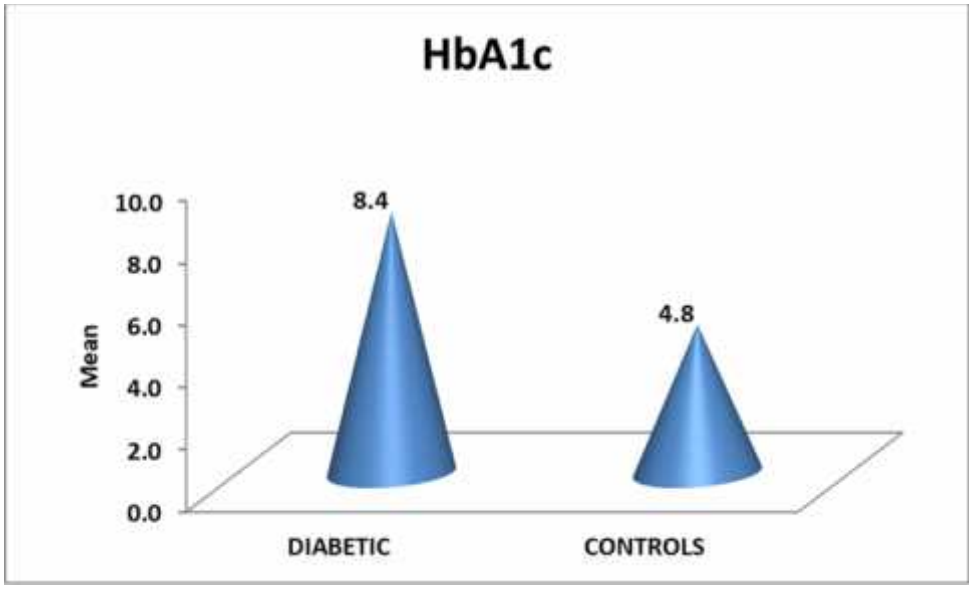
HbA1c mean value was 7.3 among males compared to 7.6 in female diabetics. However, this was not significant as P value was 0.391

TABLE 11: COMPARISON OF MEAN HbA1c BETWEEN CASES AND CONTROLS

Variables	DIABETIC		CONTROLS		p value
	Mean	SD	Mean	SD	
HbA1C (%)	8.4	8.6	4.8	0.6	<0.001*

Note: *means significant at 5% level of significance (p<0.05)

FIGURE 11: COMPARISON OF MEAN HbA1C BETWEEN CASES AND CONTROLS



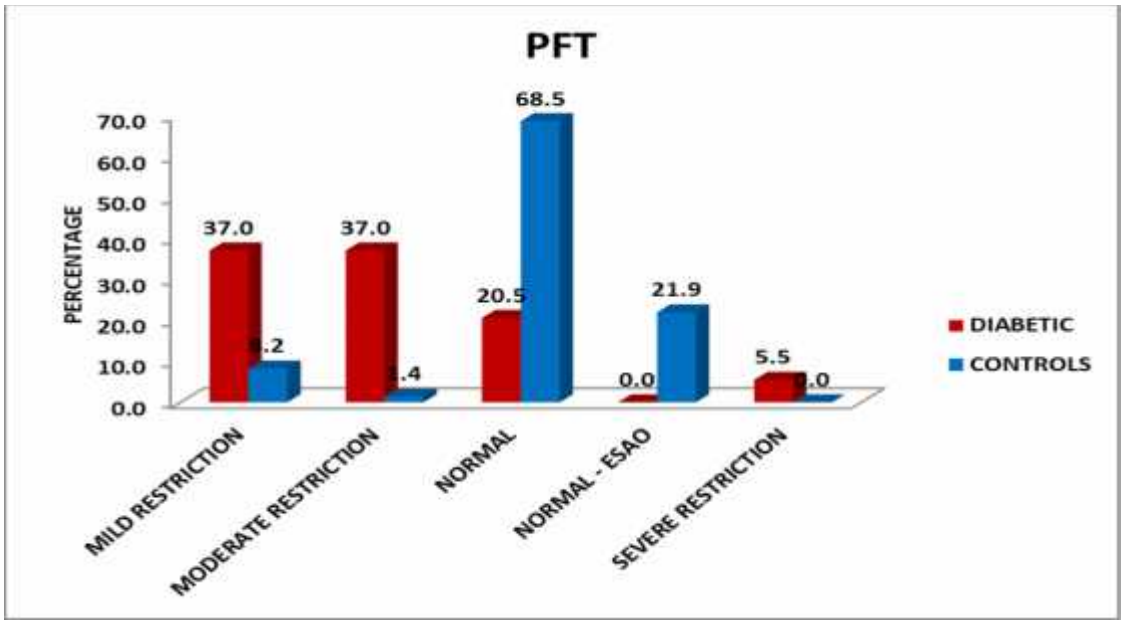
Distribution of pulmonary function tests between cases and controls was studied which revealed restrictive type of ventilatory impairment with p value <0.001 which was significant. The PFT patterns were classified as mild, moderate, severe restriction, normal, normal with early sign of airway obstruction (ESAO). Majority of cases showed mild and moderate restrictive pattern (37 % each) while majority of controls showed normal PFT's (50% of total). Significantly, there was no diabetic noted with ESAO.

TABLE 12: DISTRIBUTION OF PFT BETWEEN CASES AND CONTROLS

Pulmonary function test	DIABETIC		CONTROLS		p value
	N	%	N	%	
MILD RESTRICTION	27	37.0	6	8.2	<0.001*
MODERATE RESTRICTION	27	37.0	1	1.4	
NORMAL	15	20.5	50	68.5	
NORMAL – ESAO	0	0.0	16	21.9	
SEVERE RESTRICTION	4	5.5	0	0.0	
Total	73	100.0	73	100.0	

Note: *means significant at 5% level of significance (p<0.05)

FIGURE 12: DISTRIBUTION OF PFT BETWEEN CASES AND CONTROLS



There was no significant difference observed in mean values of FEV_1 and FVC between males and females. However, mean FEV_1/FVC in males was 114.3 compared to females which was higher at 121.9 and was significant as p value was 0.018.

FVC among diabetics was low with a mean of 67.4 as compared to controls with mean of 91.5 with p value of <0.001 which is statistically significant.

The range of FVC in diabetic group was from 35 to 106 which is lesser than range in controls from 55 to 151.

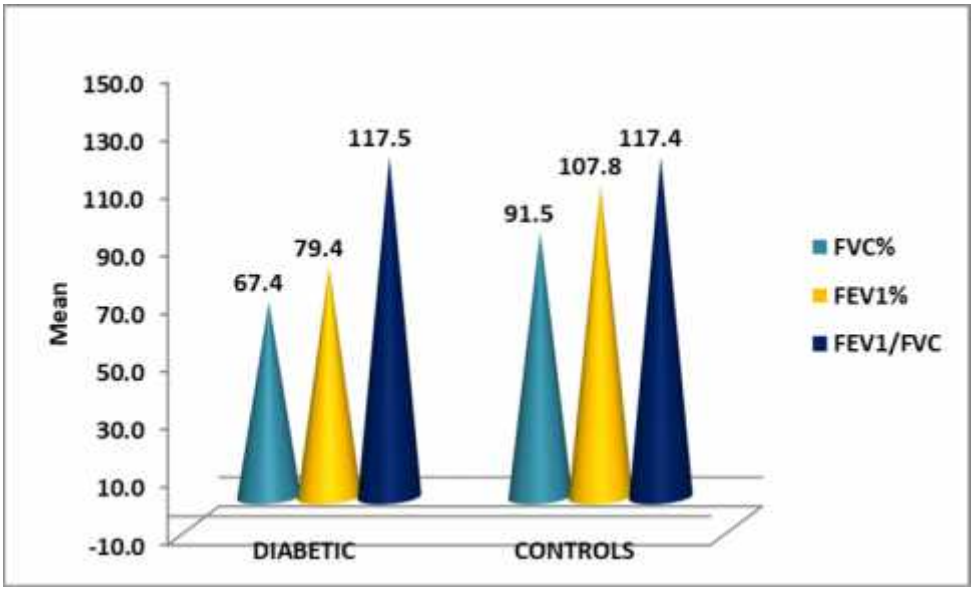
FEV_1 was reduced in cases with mean of 79.4 compared to controls with mean of 107.8 with a p value of <0.001 being statistically significant.

TABLE 13: COMPARISON OF MEAN FVC, FEV_1 AND FEV_1/FVC BETWEEN CASES AND CONTROL

Variables	DIABETIC		CONTROLS		p value
	Mean	SD	Mean	SD	
FVC%	67.4	18.0	91.5	14.8	<0.001*
FEV1%	79.4	23.9	107.8	25.5	<0.001*
FEV1/FVC	117.5	13.7	117.4	13.6	0.961

Note: *means significant at 5% level of significance (p<0.05)

FIGURE 13: COMPARISON OF MEAN FVC, FEV_1 AND FEV_1/FVC BETWEEN CASES AND CONTROLS



FEV_1 ranged from 48 to 126 in diabetic group compared to a range of 48 to 270 in controls. FEV_1/ FVC was higher in diabetic group with mean value of 117.5 as compared with controls with mean value of 117.4.

FEV_1/ FVC ranged from 86 to 134 in diabetics compared to 86 to 179 in controls.

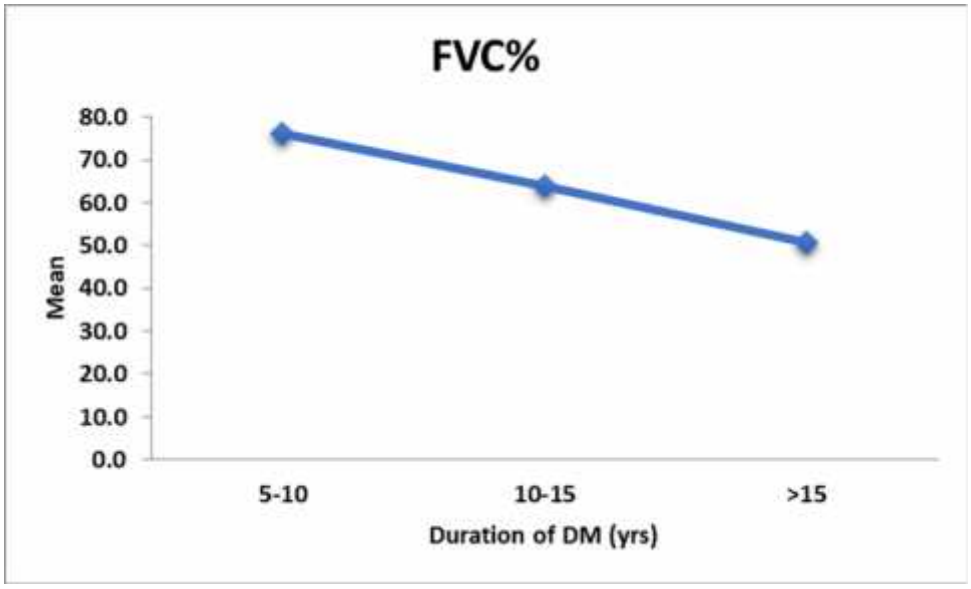
Mean FVC value was higher in diabetics with duration of diabetes between 5 - 10 years as compared to those with diabetes between 10 - 15 years and more than 15 years with a p value of <0.001 suggestive of high statistical significance.

TABLE 14: FVC% ACCORDING TO DURATION OF DM(YRS)

Duration of DM(yrs)	FVC%		p value
	Mean	SD	
5-10	76.0	17.3	<0.001*
10-15	63.9	10.8	
>15	50.8	19.8	
Total	67.4	18.0	

Note: *means significant at 5% level of significance (p<0.05)

FIGURE 14: FVC% ACCORDING TO DURATION OF DM(YRS)



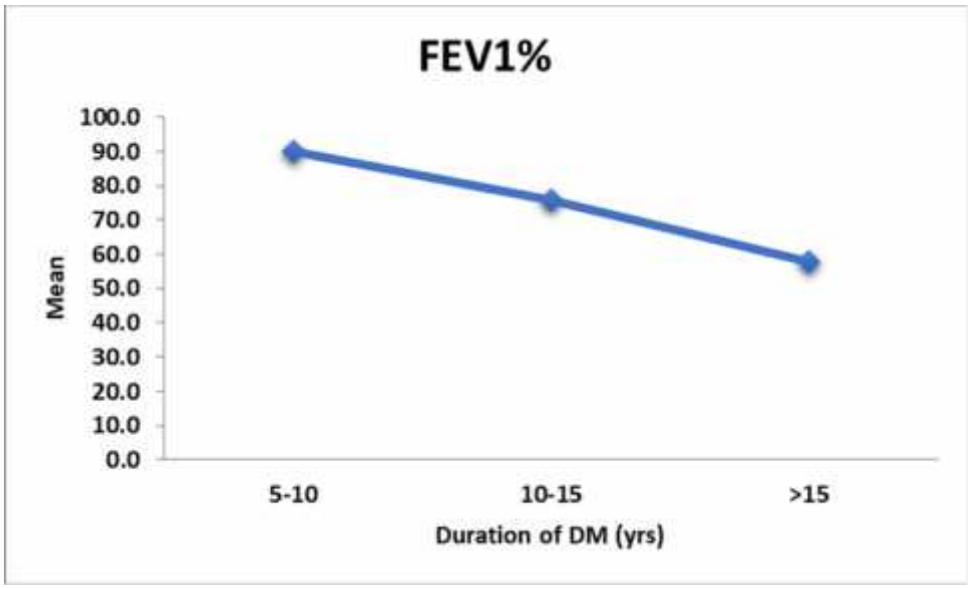
Mean FEV_1 value was higher in diabetics with duration of diabetes between 5 - 10 years as compared to those with diabetes between 10 - 15 years and more than 15 years with a p value of <0.001 suggestive of high statistical significance. There was a inverse linear relationship between mean FEV_1, FVC with duration of disease.

TABLE 15: FEV_1 % ACCORDING TO DURATION OF DM (YRS)

Duration of DM (yrs)	FEV1%		p value
	Mean	SD	
5-10	89.9	24.4	<0.001*
10-15	75.8	16.1	
>15	57.8	21.5	
Total	79.4	23.9	

Note: *means significant at 5% level of significance (p<0.05)

FIGURE 15: FEV_1 % ACCORDING TO DURATION OF DM (YRS)



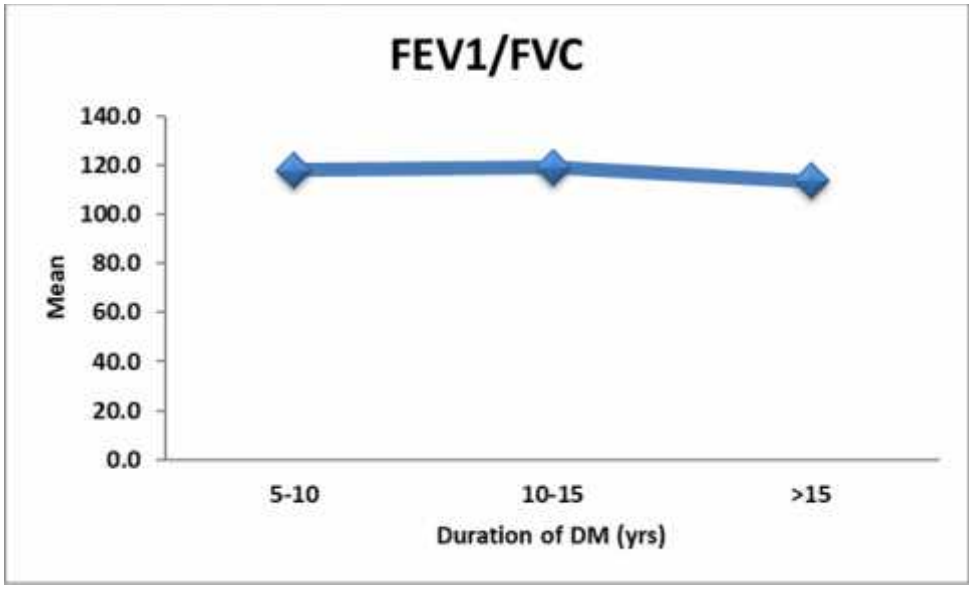
FEV_1/FVC was less in diabetics with duration of >15 years compared to diabetics of 5 – 10 years and 10 – 15 years which was not statistically significant.

With increase in FBS there was a decrease in mean FVC although statistically not significant.

TABLE 16: FEV_1/FVC ACCORDING TO DURATION OF DM (YRS)

Duration of DM (yrs)	FEV_1/FVC		p value
	Mean	SD	
5-10	117.9	11.7	0.52
10-15	118.9	13.6	
>15	113.5	18.8	
Total	117.5	13.7	

FIGURE 16: FEV_1/FVC ACCORDING TO DURATION OF DM(YRS)



FEV_1 decreased with increase in FBS however not significant statistically.

FVC mean values increased with increase in PPBS values in diabetics although statistically insignificant.

Mean FEV_1 showed rising trend with higher PPBS values although statistically insignificant.

Mean FEV_1/FVC values showed increasing trend with rising FBS, PPBS values, however not significant statistically.

TABLE 17: CORRELATION OF BMI WITH FVC, FEV_1 AND FEV_1/FVC AMONG DIABETIC

PFT	BMI	
	Pearson Correlation Coefficient	p value
FVC%	0.15	0.205
FEV1%	0.168	0.155
FEV1/FVC	0.209	0.076

TABLE 18: CORRELATION OF FBS WITH FVC, FEV_1 AND FEV_1/FVC AMONG DIABETIC

PFT	FBS	
	Pearson Correlation Coefficient	p value
FVC%	-0.073	0.539
FEV_1%	-0.058	0.628
FEV_1/FVC	0.107	0.37

TABLE 19: CORRELATION OF PPBS WITH FVC, FEV_1 AND FEV_1/FVC AMONG DIABETIC

PFT	PPBS	
	Pearson Correlation Coefficient	p value
FVC%	0.023	0.85
FEV_1%	-0.02	0.865
FEV_1/FVC	-0.015	0.9

HbA1C level was correlated with multiple parameters like lipid profile (Total cholesterol, triglycerides, HDL, LDL, VLDL) and PFT's (FEV_1, FVC, FEV_1/FVC). Only total cholesterol showed statistically significant (p value < 0.001) correlation among lipid profile. Both FEV_1 & FVC showed statistically significant (p value < 0.001) correlation whereas FEV1/FVC showed no such correlation.

Increase in FVC mean values was seen with rising HbA1c values. Mean FEV_1 values showed raising trend over the HbA1c values. FEV_1/FVC mean values showed a rising trend with increase in HbA1c values.

TABLE 20: CORRELATION OF HbA1c WITH LIPID PROFILE, FVC, FEV_1 AND FEV_1/FVC AMONG DIABETIC

Variables	Pearson correlation coefficient	p value
TOTAL CHOLESTEROL (mg/dl)	0.329	<0.001*
TG (mg/dl)	0.196	0.018*
HDL (mg/dl)	0.239	0.004*
LDL (mg/dl)	0.026	0.751
VLDL (mg/dl)	0.148	0.074
FVC%	-0.456	<0.001*
FEV_1%	-0.351	<0.001*
FEV_1/FVC	0.119	0.151

* Correlation is significant at the 0.05 level (2-tailed).

FIGURE 17: CORRELATION OF HbA1c WITH FVC AMONG DIABETIC CASES

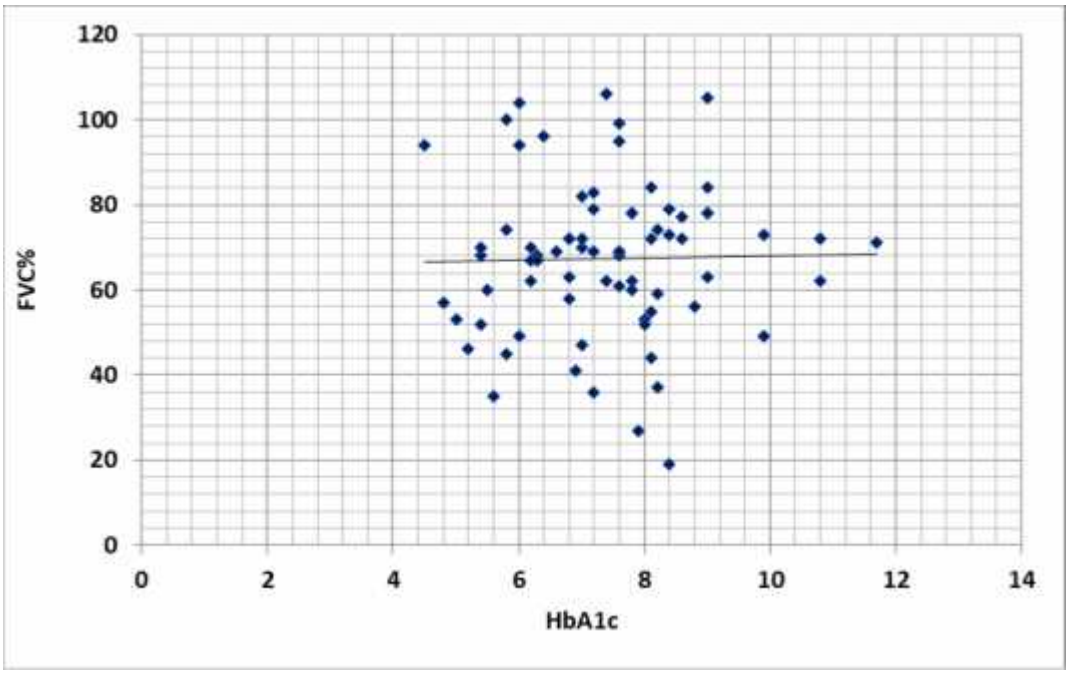


FIGURE 18: CORRELATION OF HbA1c WITH FEV_1 AMONG DIABETIC CASES

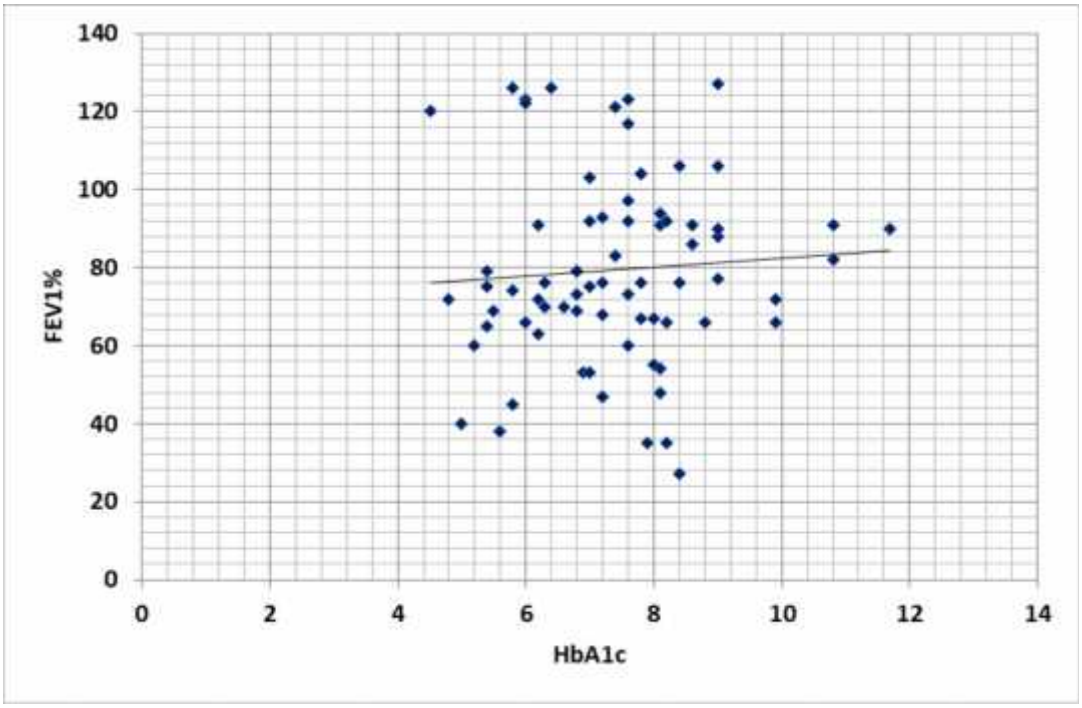
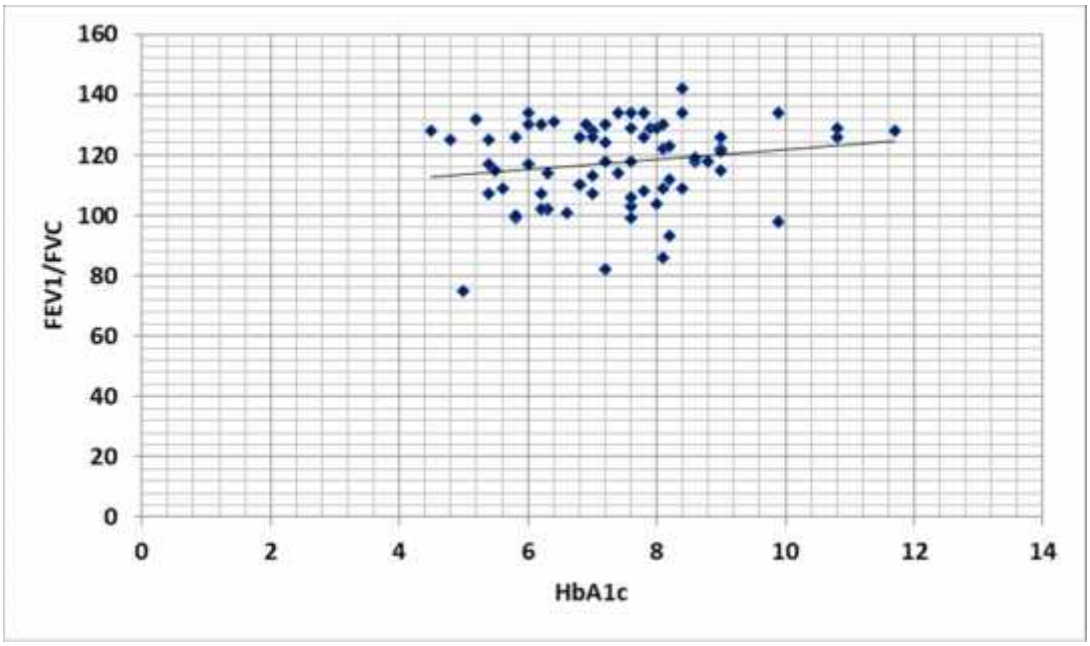


FIGURE 19: CORRELATION OF HbA1c WITH FEV_1/FVC AMONG DIABETIC CASES



DISCUSSION

6. DISCUSSION

Present study was undertaken to assess pulmonary function of patients with type 2 diabetes mellitus in comparison to subjects without diabetes. Many large studies have consistently demonstrated reduced pulmonary functions in patients with Diabetes Mellitus.

Out of the total 146 patients studied 73 were diabetic subjects and 73 were non diabetics. The number of male and female patients were almost same in both diabetic and non diabetic groups. Hence there was no significant difference among diabetics and non diabetics with reference to the gender of patients.

The age wise distribution of patients was matched in both case and controls. Age group of 50 - 59 was the largest.

In the study by Ortiz Aguirre A R[43] it was observed that pulmonary function test values decrease with increase in age. Therefore age acts as a confounding factor and thus it is removed in this study by age matched subjects in case and control groups.

Comparison of patients with reference to body mass index showed no significant difference in diabetic and non diabetic group of patients. Mean value of FVC was low in both case and control groups in subjects with low BMI compared to those with higher BMI values. The mean FEV_1 and FEV_1/FVC showed no significant difference in diabetic and non diabetics with reference to BMI.

Crapo et al[34] concluded that BMI in diabetic patients with target organ damage was high compared to those subjects without target organ damage. These subjects with target organ damage with high BMI had reduced mean pulmonary function parameters. The present study shows no significant difference in BMI values among

diabetic and non diabetics nullifying BMI as one of the confounding factors. The present study is in agreement with this study and the inference drawn is similar. The mean value of FVC in diabetic group is less compared to those in control group. Present study has a p value <0.001 which is statistically significant. The study proves the hypothesis of reduced FVC in diabetics compared to their age, sex and BMI matched controls.

Table 21: Comparison of FVC with other studies among diabetics and controls:

STUDY	DIABETICS	CONTROLS	p VALUE
D L Klein[30]	2.79	3.19	<0.0001
Sultan[44]	3.68	3.74	>0.05
Mohammad irfan et al[45]	2.46	2.82	0.01
Sanjeev verma et al[46]	2.12	2.45	0.008
Dharwadkar A[47]	1.742	1.877	0.33
Present study	2.25	2.92	<0.001

The present study is in agreement with Walter.E. Robert et al who studied the relationship between diabetes mellitus and pulmonary function and showed a decrease in FVC by 109m1 in diabetes mellitus.[38] Davis M.E. Timothy studied the pulmonary function and its association with Type-2 diabetes mellitus and showed an average decrease of 9.5% in FVC of diabetics[48].

In diabetes mellitus thickening of the alveolar epithelium and pulmonary capillary basal lamina occurs leading to pulmonary micro angiopathy and reduced

pulmonary elastic recoil caused by nonenzymatic glycoslation of the connective tissue which reduces the FVC in diabetics[4].

Table 22: Comparison of FEV_1 with other studies among diabetics and controls:

STUDY	DIABETICS	CONTROLS	p VALUE
O L Klein[30]	1.16	1.68	0.000
Sultan[44]	3.12	3.13	>0.05
Muhammad irfan[45]	2.04	2.29	0.04
Sanjeev verma[46]	1.93	2.20	<0.008
Dharwadkar A[47]	1.16	1.68	0.000
Present study	2.15	2.32	<0.001

The present study is in agreement with the previous studies in comparing FEV_1 among diabetic and non diabetics. The mean values of FEV_1 are low in diabetic group of subjects compared to controls.

The present study is in agreement with Walter.E. Robert et al who studied the relationship between diabetes mellitus and pulmonary function and showed a decrease in FEV_1 by 27m1 in diabetic subjects.[38] Davis M.E. Timothy studied the pulmonary function and its association with Type-2 diabetes mellitus and showed an average decrease of 9.5% in FEV_1 of diabetics.[48]

In diabetes mellitus thickening of the alveolar epithelium, pulmonary capillary basal lamina leading to pulmonary micro angiopathy and reduced pulmonary elastic recoil caused by non enzymatic glycoslation of the connective tissue which reduces the FEV_1 in diabetics[4].

Table 23: Comparision of FEV_1/FVC with other studies among diabetics and controls:

STUDY	DIABETICS	CONTROLS	p VALUE
Sultan[44]	0.8514	0.84	>0.05
Muhammad Irfan[45]	0.819	0.814	0.69
Sanjeev verma[46]	0.90	0.90	>0.05
Present study	0.85	0.863	0.961

Asanuma et al.,[49] Lange et al.,[39] reported that FVC and FEV_1 were reduced in subjects with diabetes when compared to control subjects. The present study is in agreement with previous studies which have shown marginally high values of FEV_1 / FVC in diabetic subjects when compared to age, sex and BMI matched controls.

Mahadeva m et al.[50] found that spirometric values consistently lower in diabetics compared to non-diabetics. However it is statistically significant in forced vital capacity but not in FEV_1/FVC. In our study it is significant in both.

The present study is in agreement with Walter.E. Robert et al. who studied the relationship between diabetes mellitus and pulmonary function and showed a 1.5% increase in the FEV_1/FVC with a P value <0.05% which is statically significant thus suggesting a restrictive pattern of ventilatory impairment.

Our observations are in agreement with Lange et al.[39] who reported that both IDDM and NIDDM are associated with slight reduction in FVC. The reduction was

more pronounced in diabetic subjects treated with insulin. Similar observations were quoted in all age groups by Lange et al.[39] in Copenhagen city heart study.

Table 24:Comparison of Effect of duration of Diabetes mellitus on FVC:

STUDY	DURATION OF DIABETES	FVC	p VALUE
Present study	5 – 10 years	2.30	<0.001
	10 – 15 years	2.23	<0.001
	> 15 years	2.22	<0.001
Sultan	<5 years	3.68	Not significant
	5 – 12 years	3.16	0.021
	> 12 years	3.11	0.002

Table 25: Comparison of Effect of duration of Diabetes Mellitus on FEV_1 :

STUDY	DURATION OF DIABETES	FEV_1	p VALUE
Present study	5 – 10 years	2.10	<0.001
	10 – 15 years	2.19	<0.001
	> 15 years	2.16	<0.001
Sultan	<5 years	3.12	>0.005
	5 – 12 years	2.74	>0.005
	> 12 years	2.53	0.0001

Acceleration of aging process in the connective tissue of the lungs and interference with the connective tissue cross links and presence of nonenzymatic glycoslation and modification of alveolar surfactant action causes reduction in FVC[4].

In the present study although diabetic subjects had low FVC compared to controls, the group of diabetics with diabetes mellitus more than 15 years had lower FVC than in those with duration of 5 – 10 years and 10 – 15 years.

Mahadeva et al concluded that effect on FVC was more pronounced in diabetics with increase in duration of more than 5 years and was concordance in our study.[50]

Masmoudi and Zouari concluded that pulmonary volumes impairments are slightly more marked with diabetes mellitus duration especially after 10 years. The hypothesis that relative stable respiratory function may be explained by a better metabolic control.[51] Barrette-Connor E et al.[52] who found that pulmonary function in older adults is altered in subjects with diabetes mellitus with duration more than 10 years.

Our results are on par with those of Lange P who found that the decrease of ventilator capacity is more marked at the beginning of diabetes mellitus[39]. Davis.A. Wendy et al who studied the glycemic exposure and associated reduced pulmonary function in type 2 diabetes found a decrease in FVC at an annual rate of 68ml/ year and FEVI at an annual rate of 71 ml / year[19].

Table 26: Comparison of FBS, PPBS and HBA_1C with other studies

STYDY	FBS	PPBS	HBA1c
Sanjeev sinha[52]	197.9	275.5	8.7
Agarwal A S[53]	172	232	8.89
Present study	147.2	203	8.4

In study by Mahadeva et al.[50] as duration of diabetes increases there was decline of FVC and FEV_1. Poor diabetic control was associated with poor lung function. Inverse relation between HbA1c FEV1/FVC and FVC was noted. Our study has noted similar results.

Review of literature suggested that there was increased cross-linkage formation between polypeptides of collagen in pulmonary connective tissue which decrease in FVC and hence responsible for restrictive respiratory defects.

Recently Nakajima et al[55] reported reduced FVC and normal FEV_1/FVC and concluded that impaired restrictive pulmonary function but not the obstructive pattern might be associated with metabolic disorders and metabolic syndrome in a severity dependant manner. The possible explanation of restrictive type of pulmonary impairment is non-enzymatic glycosylation of pulmonary collagen leading to accumulation of advanced glycosylation end products and resulting in increased cross-link formation.

In the present study FBS and HbA1c values share a direct relation with the FVC and FEV_1 values. In our study decreasing trend in FVC and FEV_1 with high fasting sugars and HbA1C was noted however PPBS values showed a linear relation with the spirometric values.

The present study is in agreement with Walter. E. Rohert et al who studied the relationship of FBS to Pulmonary function and found a decrease in FVC with increasing quartile of blood glucose with a P value of 0.04 which is significant.[55] Relationship between FBS and FEV_1 was analyzed and found a decrease in FEV_1 with increasing quartile of blood glucose with a P value of 0.03 which was significant.

The FEV_1/FVC values in the present study showed a rising trend with FBS linearly. This is in agreement with Framingham heart study wherein association of glycemic status and lung functions was studied and results were a larger decrease in FVC than FEV_1 resulted in high FEV_1/FVC in diabetic subjects suggestive of restrictive pattern.

Slight increase in FEV_1/FVC with increasing quartile of blood glucose with a P value 0.65 which was significant suggesting a restrictive pattern of ventilatory impairment was shown in the study by Walter E.Robert.[38]

A large Danish cross-sectional population study Lange P (1989) showed a negative association between plasma glucose & both FVC & FEV_1 [39]. In a small scale six years study by Ramiriez L.C. et al (1991) demonstrated that intensive treatment by subcutaneous insulin injection improved both FVC & FEV_1 percentage predicted values.[56]

SUMMARY AND CONCLUSIONS

SUMMARY

The number of subjects in the present study was 146. Majority of patients were in the age group of 50-59. Out of 146 subjects 73 were diabetics and 73 were non diabetics. Total of 60 females were included in study and males were 86.The mean BMI in diabetic group was 23.3 and in controls 22.4. Effect of diabetes mellitus on spirometry values explored a reduction in mean FVC was 24.1, FEV_1 was reduced by 28.4 ml and FEV_1/FVC had increased by 0.1 in diabetics compared to their age, gender and BMI matched controls. The parameters show a restrictive pattern in diabetics.

Effect of duration of diabetes on spirometry values was assessed, in subjects with duration of diabetes more than 10 years the values were seen to increase linearly than in those with duration of 5 years. The possible explanation is that effect of diabetes on lung function will be more in those with diabetes more than 10 years.

Relation of glycemic status and spirometric values was explored, a reduction in FVC and a reduction in FEV_1 was noted in subjects with FBS of 200-300mg/dl compared to those with FBS of 90-110 mg/dl. In subjects with HbA1c >8.0 a decrease in FVC was noted compared to those with HbA1c of 4-6%, however no significant changes in FEV_1 was noted with HbA_1C. No significant decrease in spirometry values were noted in relation to PPBS values. As seen from the above values it is confirmed that high blood sugars reduce the lung capacity of ventilation.

CONCLUSION

The present study has explored the relation between the diabetes mellitus and spirometry values. This study has considered comparison among diabetics and non-diabetics in relation to FVC, FEV_1 and FEV_1/FVC and concludes that restrictive pattern is seen in diabetics and spirometry values were low in patients with diabetics.

This study has proved that type 2 Diabetes Mellitus patients with duration more than 10 years are more affected than duration less than 10 years and have restrictive pattern when compared to their age, gender and BMI matched controls. In females, there is more restriction in lung volumes when compared to males of type 2 diabetes of same duration.

The association between glycaemic status and spirometry values shows reduced values in group of subjects with high fasting blood sugars and high HbA1c values however no such effect was seen in relation to PPBS.

As the duration of diabetes increases, the restrictive profile of lung volumes is more prominent.

Spirometry remains a cost effective, a simple non-invasive diagnostic tool and its judicious use can give a signal for patients to improve glycemic control.

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ANNEXURE I

ETHICAL CLEARANCE CERTIFICATE:

ANNEXURE II

INFORMED CONSENT FORM:

TITLE OF RESEARCH: "STUDY OF PULMONARY FUNCTION TESTS IN PATIENTS OF TYPE 2 DIABETES MELLITUS"

GUIDE : _____

P.G.STUDENT : _____

All aspects of this consent form are explained to the patient in the language understood by him or her.

PURPOSE OF STUDY:

I have been informed that the purpose of this study is to assess PULMONARY FUNCTION TESTS in type 2 diabetes mellitus.

PROCEDURE:

I understand that I will undergo detailed history and clinical examination and investigations

BENEFITS:

I understand that my participation in this study will have no direct benefit tome other than the potential benefit of treatment which is planned to prevent further morbidity and mortality in me.

CONFIDENTIALITY:

I understand that the medical information produced by the study will become a part of hospital record and will be subjected to confidentiality and privacy regulation of hospital. If the data is used for publication the identity will not be revealed.

REQUEST FOR MORE INFORMATION :

I understand that I may ask for more information about the study at any time.

REFUSAL OR WITHDRAWAL OF PARTICIPATION :

I understand that my participation is voluntary and I may refuse to participate or withdraw from study at any time.

(Signature of Guardian) (Signature of patient)

STUDY SUBJECT CONSENT FORM:

I confirm that _____ has explained to me the purpose of this research, the study procedure that I will undergo and the possible discomforts and benefits that I may experience, in my own language.

I have been explained all above in detail in my own language and I understand the same. I agree to give my consent to participate as a subject in this research project.

SIGNATURE OF PARTICIPANT DATE

ANNEXURE III

PROFORMA

Name:	CASE NO:
Age:	OP/IP NO:
Sex:	DOA:
Religion:	DOD:
Occupation:	
Address:	

Presenting complaints with duration:

History of presenting complaints:

Past History:

Family History:

Personal History:

Treatment History:

General Physical Examination

Pallor:	Present/absent
Icterus:	Present/absent
Cyanosis:	Present/absent
Clubbing:	Present/absent
Generalized lymphadenopathy:	Present/absent
Odema:	Present/absent

Vitals

PR: bpm

BP: mm of mercury (mm hg)

RR: cpm

Temp: C

Weight: Kilograms

Height: Meters

BMI: kg/m^2

SYSTEMIC EXAMINATION.

- Cardiovascular system
- Respiratory system
- Per abdomen
- Central nervous system

INVESTIGATIONS

PATHOLOGY	
1.)Complete blood count:	
Hb	gm/dl
Total count	Cells/cumm
Differential count Neutrophils	%
Lymphocytes	%
Eosinophils	%
Basophils	%
Monocytes	%
2.) ESR	At the end of 1^{st} hour.
3.) Urine Routine	
Sugar	
Albumin	
Cell type	
Cell count	

BIOCHEMISTRY

1)Fasting Blood sugar	
2)Postprandial Blood sugar	
3)LIPID PROFILE	
Total Cholesterol	
Triglycerides	
HDL-Cholesterol	
LDL-Cholesterol	
VLDL-Cholesterol	
4)GLYCOSYLATED HEMOGLOBIN	

CHEST X RAY:

SPUTUM EXAMINATION:

SPIROMETRY

Other relevant investigations will be done when required:

CONCLUSION:

SIGNATURE

DATE:

KEY TO MASTER CHART:

NAME	:	Name of Patient
GROUP	:	1 – Case
		2 – Control
SEX	:	M – Male
		F – Female
PR	:	Pulse Rate
RR	:	Respiratory Rate
BP	:	Blood Pressure
Ht	:	Height
W	:	Weight
BMI	:	Body Mass Index
DURATION	:	Duration of DM
TC	:	Total count
HB	:	Hemoglobin
ESR	:	Erythrocyte Sedimentation Rate
URINE- R	:	Urine Routine Examination
T-CH	:	Total Cholesterol
TG	:	Triglyceride
HDL	:	High Density Lipoprotein
LDL	:	Low Density Lipoprotein
VLDL	:	Very Low Density Lipoprotein
HBA1C	:	Glycated Hemoglobin
FBS	:	Fasting Blood Sugar
PPBS	:	Post Prandial Blood Sugar

CXR	:	Chest X Ray
FVC	:	Forced Vital Capacity
FEV_1	:	Forced Expiratory Volume In One Second
FEV_1/FVC	:	FEV_1 Expressed as percentage Of FVC
PFT	:	Pulmonary Function Test
NA	:	Not Applicable

MASTER CHART

S.NO	NAME	IP. NO.	GROUP	AGE (YEARS)	SEX	OCCUPATION	PR (BPM)	BP (mm/Hg)	RR (CPM)	HEIGHT(M)	WEIGHT(KG)	BMI Kg/m2	DURATION OF TYPE 2 DM	TC (Cells/cmm)	HB (gm %)	ESR (mm/1st hr)	Sr.CREATININE (mg/dl)	URINE- R	T- CHOLESTEROL (mg/dl)	TG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)	HBA1C (mg/dl)	FBS (mg/dl)	PPBS (mg/dl)	CHEST X RAY (PA view)	FVC%	FEV1%	FEV1/FVC	PFT
1	DAYANAND S ATNUR	38314/15	1	50	M	FARMER	88	140/80	16	1.56	68	27.94	10	7450	13.6	30	0.6	SUGAR 1+, ALBUMIN TRACES	268	286	29	181	57.2	9	247	224	NORMAL	63	77	122	MODERATE RESTRICTION
2	GORAKNATH K K	40624/15	1	65	M	FARMER	76	120/70	18	1.53	50	21.35	8	7620	12	10	0.8	SUGAR 1+, ALBUMIN TRACES	112	179	42	34	35.8	8.1	127	268	NORMAL	55	48	86	MODERATE RESTRICTION
3	HARNA BAI	40380/15	1	65	F	HOUSEWIFE	84	140/80	18	1.57	93	37.72	10	9470	10.1	15	0.6	SUGAR 1+, ALBUMIN TRACES	159	340	32	57	62	9	201	333	NORMAL	78	88	126	MILD RESTRICTION
4	DUNDAWWA HALADAH	40921/15	1	62	F	HOUSEWIFE	86	130/80	16	1.5	47	20.88	6	8100	9	20	0.8	NORMAL	160	120	35	58	70	5.2	106	120	NORMAL	46	60	132	MODERATE RESTRICTION
5	MAMTAZ DASTAGIR B	41321/15	1	67	f	HOUSE WIFE	90	120/70	16	1.51	49	19.29	20	8630	15.4	10	0.8	NORMAL	156	207	30	116	41	5.6	125	137	NORMAL	35	38	109	MODERATE RESTRICTION
6	JANA BAI	41337/15	1	60	F	HOUSEWIFE	78	120/70	14	1.52	35	15.15	15	8460	9.2	15	1.2	SUGAR 1+, ALBUMIN TRACES	180	160	30	84	140	7.8	300	320	NORMAL	62	67	108	MODERATE RESTRICTION
7	BASAPPA P	41886/15	1	68	M	SHOP OWNER	90	140/80	18	1.6	55	21.48	9	6810	12	10	1.2	SUGAR NORMAL, ALBUMIN TRACES	158	120	21	67	31	4.5	83	90	NORMAL	94	120	128	NORMAL
8	BASSAGONDAPPA BELA	331/16	1	77	M	FARMER	76	150/80	18	1.55	50	20.81	15	5140	13.6	20	1.6	NORMAL	180	110	20	48	100	8	210	262	NORMAL	53	55	104	MODERATE RESTRICTION
9	VIMALABAI BILGI	553/16	1	72	F	HOUSEWIFE	90	140/80	16	1.56	72	29.58	15	11280	11.6	30	1.2	NORMAL	260	130	24	110	130	6.8	230	264	NORMAL	63	69	110	MODERATE RESTRICTION
10	DATTU LIMKAR	734/16	1	50	M	DRIVER	86	130/90	18	1.64	40	14.87	10	12120	10.3	45	3.6	NORMAL	130	110	38	106	120	5.8	85	110	NORMAL	45	45	99	MODERATE RESTRICTION
11	MAHADEVI M	89/16	1	60	F	HOUSE WIFE	60	140/80	16	1.59	59	23.3	8	8200	10.9	16	0.6	NORMAL	180	134	62	109	32	7.8	144	210	NORMAL	78	104	134	MILD RESTRICTION
12	CHANDRABAGA PATIL	705/16	1	74	F	HOUSEWIFE	80	110/70	16	1.56	67	27.53	11	5450	10	10	0.6	NORMAL	159	347	32	58	69.4	5.5	111	188	NORMAL	60	69	115	MODERATE RESTRICTION
13	KRISHNA BASAPPA BIR	751/16	1	55	M	LABOUR	82	130/80	18	1.6	64	25	6	7400	10.3	15	0.9	NORMAL	139	100	31	88	20	6.8	82	120	NORMAL	72	79	110	MILD RESTRICTION
14	MAHADEV LAXMAN IN	1374/16	1	60	M	FARMER	82	160/70	16	1.7	57	19.72	20	4350	9.2	13	1	NORMAL	130	85	36	110	120	7.9	180	116	NORMAL	27	35	129	SEVERE RESTRICTION
15	CHAND BASHA MANGU	2637/16	1	60	M	COOK	84	140/90	18	1.54	56	23.61	16	8368	10.4	10	1.1	NORMAL	190	674	34	21	135	9.9	286	300	NORMAL	73	72	98	MILD RESTRICTION
16	MAHADEVI S K	4890/16	1	55	F	HOUSEWIFE	84	130/80	16	1.5	48	21.33	12	4740	12.2	30	0.6	NORMAL	141	79	29	96	15.8	11.7	161	230	NORMAL	71	90	128	MILD RESTRICTION
17	KAMALA S S	5086/16	1	54	F	MAID	86	150/80	18	1.48	48	22	6	11700	13.3	20	0.9	SUGAR 2%	192	116	41	128	23	9	276	192	NORMAL	105	127	121	NORMAL
18	IRAPPA N K	6656/16	1	65	M	FARMER	78	130/70	16	1.55	58	24.1	11	8600	10.6	10	1.1	SUGAR 1%	160	130	26	111	18	7	245	310	NORMAL	70	75	107	MILD RESTRICTION
19	MALAKAJAPPA C R	7416/16	1	66	M	FARMER	82	110/70	14	1.64	60	23.07	15	5920	15.6	10	0.8	NORMAL	157	105	31	105	21	8.1	128	170	NORMAL	44	54	122	SEVERE RESTRICTION
20	MALLAPA C K	8352/16	1	60	M	FARMER	68	140/90	18	1.62	64	25	6	10200	13.7	10	0.8	SUGAR 1.5%, ALBUMIN TRACES	120	201	30	147	24	8.1	152	182	NORMAL	84	91	109	NORMAL
21	RAGHU Y M	8902/16	1	60	M	FARMER	70	140/70	18	1.67	58	20.7	21	12570	12.3	15	1.1	ALBUMIN TRACES	157	145	23	90	31	7.2	121	280	NORMAL	83	68	82	MILD RESTRICTION
22	ISMAIL	9273/16	1	70	M	FARMER	78	120/90	16	1.72	78	26.89	20	10780	12.7	10	2.2	ALBUMIN TRACES	165	118	30	111	23	5.4	148	180	NORMAL	52	65	125	MODERATE RESTRICTION
23	HANUMANTH J G	119069/16	1	56	M	FARMER	76	Nov-70	16	1.58	57	22.8	8	7620	12.5	30	1.2	ALBUMIN TRACES	160	120	52	28	90	8.6	180	210	NORMAL	72	86	118	MILD RESTRICTION
24	SARUBAI R D	11115/16	1	65	F	HW	78	130/80	16	1.49	52	23.42	12	4460	13.7	30	0.6	SUGAR 1.5%, ALBUMIN TRACES	186	120	38	120	18	9.9	210	320	NORMAL	49	66	134	MODERATE RESTRICTION
25	SHARANAPPA Y	11955/16	1	70	M	FARMER	86	160/80	18	1.63	54	20.32	18	10090	13.8	15	0.8	ALBUMIN TRACES	160	110	34	76	118	8.8	93	210	NORMAL	56	66	118	MODERATE RESTRICTION
26	PRABHAVATI A N	14155/16	1	54	F	HW	86	130/80	18	1.58	64	25.63	6	9750	12.4	40	0.9	SUGAR 2%	100	65	34	53	13	9	220	360	NORMAL	84	106	126	NORMAL
27	SHANKAR C	14589/16	1	55	M	DRIVER	88	150/90	16	1.61	50	19	8	11140	14.7	10	0.7	ALBUMIN TRACES	160	182	38	98	116	6.3	168	244	NORMAL	68	70	102	NORMAL
28	DARAKABAI C G	72415/16	1	58	F	HW	76	130/70	18	1.5	55	25.78	11	9350	12.3	16	0.6	NORMAL	150	79	31	103	14	8.2	130	216	NORMAL	59	66	112	MODERATE RESTRICTION
29	ARJUN P	15751/16	1	58	M	FARMER	84	140/70	18	1.62	55	21.2	7	10000	13.2	13	0.9	ALBUMIN TRACES	157	105	31	105	21	6.8	180	216	NORMAL	72	79	110	NORMAL
30	SHANTA BAI	168526/16	1	54	F	HOUSE WIFE	76	140/90	18	1.48	50	23	8	9550	9.9	16	0.8	NORMAL	195	126	43	106	25.2	5.8	86	130	NORMAL	100	126	126	NORMAL
31	MALLAPPA NAILODI	15821/16	1	65	F	CLERK	96	160/80	16	1.7	68	23.5	13	5400	8	30	1.4	ALBUMIN TRACES	155	90	32	106	20	6.8	130	210	NORMAL	58	73	126	MODERATE RESTRICTION
32	L GOULI	15857/16	1	58	M	LABOURER	70	140/90	14	1.5	45	20	14	8350	12	60	0.6	ALBUMIN TRACES	160	79	34	96	18	7.2	76	130	NORMAL	69	76	124	MODERATE RESTRICTION
33	SHANTABAI M	168526/16	1	65	F	HOUSE WIFE	74	160/80	14	1.41	77	38	12	8640	12	15	0.9	ALBUMIN TRACES	116	153	26	102	18	7.8	180	216	NORMAL	60	76	126	MODERATE RESTRICTION
34	KASHI BAI D	16209/16	1	68	F	HW	82	160/80	16	1.55	64	26.63	12	7540	11.6	20	1.1	SUGAR 1.5%, ALBUMIN TRACES	185	110	39	124	22	10.8	262	199	NORMAL	72	91	126	MILD RESTRICTION
35	SHARANGOUDA G	16507/16	1	58	M	FARMER	78	160/100	18	1.55	51	21.22	12	9430	11.6	17	0.9	ALBUMIN TRACES	116	130	44	78	16	6.2	118	125	NORMAL	62	63	102	MODERATE RESTRICTION
36	MALLAPPA N S	16599/16	1	53	M	LABOURER	88	130/80	16	1.73	65	21.71	8	4500	7.7	30	0.8	ALBUMIN TRACES	155	96	35	100	19	4.8	103	210	NORMAL	57	72	125	MODERATE RESTRICTION
37	ARUNA P	17391/16	1	63	F	HW	84	120/70	14	1.55	64	26.6	8	6850	6	10	0.9	NORMAL	160	102	30	100	22	6	88	71	NORMAL	94	123	130	NORMAL
38	ABDUL KHADER V	185293/16	1	60	M	LABOURER	70	100/60	16	1.47	28	13	16	7620	9.2	18	1.6	SUGAR .5% ALBUMIN TRACES	106	130	28	30	16	8.2	110	180	NORMAL	37	35	93	MODERATE RESTRICTION
39	LALSAHEB M N	195233/16	1	66	M	FARMER	74	130/90	16	1.7	60	20.7	14	7860	14.9	10	0.6	NORMAL	189	65	58	118	13	10.8	242	306	NORMAL	62	82	129	MODERATE RESTRICTION
40	SANGAYYA H	203055/16	1	65	M	FARMER	78	130/70	16	1.72	68	23	7	7650	12.8	20	1.2	NORMAL	108	130	30	97	22	7.6	164	230	NORMAL	95	123	129	NORMAL
41	BHEEMARAYA B B	19149/16	1	80	M	BUSINESS	90	110/70	16	1.69	53	18.55	24	9970	9.9	11	0.8	ALBUMIN TRACES	130	110	42	76	18	8.4	230	254	NORMAL	19	27	142	SEVERE RESTRICTION
42	KAREPPA B J	19959/16	1	55	M	COOK	76	150/80	18	1.68	59	20.1	8	12870	13.3	10	0.6	ALBUMIN TRACES	160	110	44	76	22	8.6	162	216	NORMAL	77	91	119	MILD RESTRICTION
43	VISHWANATH G	211740/16	1	73	M	FARMER	84	140/70	16	1.7	66	22.8	22	6890	13.2	12	1	SUGAR 1% ALBUMIN TRACES	132	168	30	106	20	7.6	180	246	NORMAL	61	60	99	MODERATE RESTRICTION
44	MANGALA S	20164/16	1	55	F	HW	78	120/70	16	1.57	56	22.7	8	7620	11.6	15	0.7	NORMAL	140	110	40	128	30	80	112	126	NORMAL	52	67	129	MODERATE RESTRICTION
45	SURESH S S	20829/16	1	50	M	SHOP OWNER	84	130/70	16	1.63	56	21.07	11	6940	15.8	30	0.6	ALBUMIN TRACES	160	110	42	110	32	7.2	103	84	NORMAL	79	93	118	MILD RESTRICTION
46	SIDDAPPA S B	20224/16	1	76	M	FARMER	72	160/80	18	1.65	50	18.4	18	8700	11.1	10	0.6	ALBUMIN TRACES	160	130	48	100	28	7.6	110	168	NORMAL	68	97	103	MILD RESTRICTION
47	HANUMANTH SS	18638/16	1	51	M	FARMER	78	150/90	16	1.7	60	20.76	6	10600	13.9	5	1.4	NORMAL	140	126	32	111	18	6.4	116	132	NORMAL	96	126	131	NORMAL
48	MALLAGOWDA M	229809/16	1	55	M	BUSINESS	80	130/80	18	1.72	68	23	6	9210	14.1	10	1.1	ALBUMIN TRACES	120	170	30	104	24	5.8	156	230	NORMAL	74	74	100	NORMAL
49	MALAMMA M	229843/16	1	65	F	HOUSE WIFE	76	130/70	16	1.6	58	22.7	11	7680	12.6	10	0.8	SUGAR 1% ALBUMIN TRACES	153	230	28	76	22	6.9	153	180	NORMAL	41	53	130	MODERATE RESTRICTION
50	PANCHAKSHRI S G	22467/16	1	53	M	LABOURER	86	160/80	18	1.73	60	20.04	8	6380	13.7	15	0.6	ALBUMIN TRACES	118	92	38	18	72	5.4	116	152	NORMAL	68	79	117	MILD RESTRICTION
51	SIDDAPPA RUDRAPPA	22390/16	1	65	M	FARMER	84	130/80	18	1.68	60	21.25	16	7820	14.3	30	0.6	NORMAL	156	112	40	18	38	7.4	130	162	NORMAL	62	83	134	MODERATE RESTRICTION
52	ASHOK C	237242/16	1	59	M	PAINTER	76	130/90	16	1.56	68	28	7	7650	9.6	15	0.8	SUGAR 1% ALBUMIN TRACES	130	120	24	68	22	8.4	138	210	NORMAL	73	76	109	NORMAL
53	YELAPPA PAKIRAPPA B	23449/16	1	60	M	LABOURER	76	150/80	16	1.65	57	21	11	13500	12.5	25	1.3	ALBUMIN TRACES PUS CELLS - 20 - 25	160	130	30	28	72	6.2	84	130	NORMAL	70	91	130	MILD RESTRICTION

S.NO	NAME	IP. NO.	GROUP	AGE (YEARS)	SEX	OCCUPATION	PR (BPM)	BP (mm/Hg)	RR (CPM)	HEIGHT(M)	WEIGHT(KG)	BMI Kg/m2	DURATION OF TYPE 2 DM	TC (Cells/cmm)	HB (gm %)	ESR (mm/1st hr)	Sr.CREATININE (mg/dl)	URINE- R	T- CHOLESTEROL (mg/dl)	TG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)	HBA1C (mg/dl)	FBS (mg/dl)	PPBS (mg/dl)	CHEST X RAY (PA view)	FVC%	FEV1%	FEV1/FVC	PFT
56	SAJA BAI GAYAKWAD	27289/16	1	65	F	HOUSE WIFE	82	130/80	16	1.44	40	20	12	5510	12	15	0.6	ALBUMIN TRACES	113	120	15	82	22	5	79	110	NORMAL	53	40	75	MODERATE RESTRICTION
57	BASAPPA JAMKHANDI	290533/16	1	68	M	FARMER	80	150/90	18	1.68	50	18.1	12	7620	11.2	12	1.1	SUGAR 1% ALBUMIN TRACES	120	201	30	147	24	7.6	130	180	NORMAL	69	73	106	MILD RESTRICTION
58	SARUBAI A M	29776/16	1	65	F	HOUSE WIFE	82	130/70	18	1.49	52	23.4	13	5970	10.1	16	0.8	ALBUMIN TRACES	118	158	30	92	22	6	180	282	NORMAL	49	66	134	MODERATE RESTRICTION
59	MAHADEVI M KASTURI	370679/16	1	66	F	HOUSE WIFE	84	140/80	16	1.59	59	23.3	9	7630	11	10	0.6	SUGAR + , ALBUMIN TRACES	206	160	30	90	38	7.8	116	230	NORMAL	78	104	134	MILD RESTRICTION
60	RUMANA DODAMANI	386734/16	1	58	F	TAILOR	88	140/80	16	1.64	56	20.8	8	5830	10.8	15	0.6	ALBUMIN TRACES	130	180	30	58	62	8.2	130	210	NORMAL	74	92	123	MILD RESTRICTION
61	GOWRAWA T M	40938/16	1	60	F	HOUSE WIFE	106	110/70	18	1.6	64	25	12	5760	11.1	5	1.1	PUS CELLS PLENTY	182	170	66	110	28.2	8.4	123	188	NORMAL	79	106	134	MILD RESTRICTION
62	MAIMUNA B M	4324/17	1	55	F	HOUSE WIFE	88	140/70	20	1.6	70	27	7	9260	10.6	15	0.7	NORMAL	140	130	32	116	34	8.1	146	260	NORMAL	72	94	130	MILD RESTRICTION
63	SAIFAN BEE B	5040/17	1	80	F	HOUSE WIFE	88	140/70	14	1.45	57	27.1	20	9540	11.9	40	0.8	ALBUMIN TRACES	140	158	32	28	56	7.2	200	242	NORMAL	36	47	130	SEVERE RESTRICTION
64	BASSAMMA N G	7063/17	1	58	F	JOB	90	140/80	18	1.41	50	25.1	6	7300	13.9	25	0.7	NORMAL	120	110	22	18	60	6.6	105	180	NORMAL	69	70	101	MILD RESTRICTION
65	PRABHAKAR	113663/17	1	70	M	SHOP OWNER	76	150/80	18	1.66	75	27.21	15	9200	12	15	1.2	ALBUMIN TRACES	180	130	20	86	124	7	150	216	NORMAL	82	103	126	MILD RESTRICTION
66	VIREESH LINGA	113664/17	1	58	M	BUSINESS	82	100/70	16	1.66	86	31.2	8	8020	11	10	1	ALBUMIN TRACES	170	132	23	88	127	6.2	110	184	NORMAL	67	72	107	MILD RESTRICTION
67	MANGALA SK	10985/17	1	58	F	MAID	84	120/70	18	1.45	67	31.9	8	11700	12.2	8	0.9	ALBUMIN TRACES	230	161	42	155	32	6.3	79	201	NORMAL	67	76	114	MILD RESTRICTION
68	SHANTA BHAI PP	11871/17	1	65	F	MAID	88	140/80	18	1.46	65	30	9	6650	10.7	15	0.8	ALBUMIN TRACES	255	260	32	171	52	7	90	110	NORMAL	47	53	113	MODERATE RESTRICTION
69	ASHOK J L	141496/17	1	60	M	LABOURER	80	130/70	16	1.68	63	22.3	7	6682	13	15	0.8	SUGAR 1%	169	158	28	96	33	7.6	180	266	NORMAL	99	117	118	NORMAL
70	BHAGIRATI I TOTTAPA	15581/17	1	58	M	EX ARMY	78	150/90	18	1.68	60	21.3	8	8950	11.6	15	1	PUS CELLS PLENTY	110	148	30	98	22	7.4	80	138	NORMAL	106	121	114	NORMAL
71	NEELAMMA M S	16205/17	1	62	F	HOUSE WIFE	78	140/80	16	1.6	70	27.3	13	6190	13.8	20	0.6	SUGAR 2%	179	149	41	108	29	9	100	261	NORMAL	78	90	115	MILD RESTRICTION
72	RAMESH S A	17428/17	1	56	M	BUSINESS	70	130/90	18	1.61	58	23	6	9420	12.9	25	0.9	SUGAR 1%, ALBUMIN TRACES	222	115	43	156	23	6	130	260	NORMAL	104	122	117	NORMAL
73	IRAPPA KK	20313/17	1	65	M	FARMER	76	150/80	18	1.55	58	24.1	13	11860	12.7	40	0.9	ALBUMIN TRACES	156	130	36	28	70	5.4	85	149	NORMAL	70	75	107	MILD RESTRICTION
74	ABDUL RAZAK	35737/15	2	65	M	JOB	68	140/90	16	1.53	54	23.1	NA	9360	11	15	0.7	NORMAL	110	140	28	98	20	5	84	118	NORMAL	98	100	102	NORMAL
75	DEVAKI PADAGANUR	37064/15	2	55	F	JOB	70	140/90	16	1.57	54	22	NA	6750	8	10	0.8	NORMAL	132	163	28	108	30	5	78	130	NORMAL	106	127	119	NORMAL
76	VIJAYA S N	432439/15	2	51	F	OFFICER	76	140/80	16	1.6	55	21.5	NA	7430	10.8	15	0.7	NORMAL	130	116	30	98	21	4.8	92	120	NORMAL	84	100	119	MILD RESTRICTION
77	AMEERMA K	438509/15	2	68	F	HOUSE WIFE	88	160/100	18	1.5	63	28	NA	8820	10.6	15	0.9	ALBUMIN TRACES	126	110	32	110	23	5.4	70	136	NORMAL	107	128	121	NORMAL
78	SHANMUGARAJ K	456549/15	2	52	M	BUSINESS	76	140/80	16	1.82	55	20.4	NA	7980	13.4	15	0.8	ALBUMIN TRACES	130	154	34	108	24	4.3	90	128	NORMAL	94	95	101	NORMAL
79	AYAPPA M	40498/15	2	68	M	VENDOR	88	130/70	16	1.52	48	20.8	NA	9850	12.8	15	1	NORMAL	118	148	26	99	20	4	78	110	NORMAL	102	128	125	NORMAL
80	LAXMAN KOLAKAR	41325/15	2	58	M	DRIVER	78	148/80	18	1.56	78	32	NA	6320	12	10	0.8	ALBUMIN TRACES	130	110	30	62	78	5.2	72	90	NORMAL	108	124	114	NORMAL
81	BASAPPA SANGAPPA P	41886/15	2	68	M	FARMER	82	120/70	16	1.6	55	21.48	NA	10790	12.1	15	1.2	NORMAL	120	158	21	67	31	4.5	83	144	NORMAL	94	120	128	NORMAL
82	BASAPPA CHANDAPPA	42133/15	2	60	M	FARMER	78	130/70	16	1.57	56	22.7	NA	6120	14.7	10	1.1	ALBUMIN TRACES	130	158	22	68	32	3.6	90	120	NORMAL	100	129	128	NORMAL
83	RAJESH K	117/16	2	58	M	FARMER	92	130/90	18	1.62	60	22.8	NA	7500	8.9	10	1	NORMAL	180	136	23	116	40	5	76	116	NORMAL	86	96	111	NORMAL
84	SHANMUKAPPA S	446/16	2	68	M	BUSINESS	84	130/80	16	1.56	48	20	NA	10430	14.5	18	0.8	NORMAL	141	129	44	71	25	4.5	84	110	NORMAL	98	99	101	NORMAL
85	KRISHNA BIRADAR	751/16	2	50	M	POLICE	80	130/80	18	1.55	55	23	NA	7400	10.3	15	0.9	ALBUMIN TRACES	139	100	31	88	20	4	82	110	NORMAL	85	99	116	NORMAL
86	SIDAPPA NAGANUR	1495/16	2	50	M	DRIVER	82	130/80	18	1.58	56	22.4	NA	13170	14.8	25	0.7	NORMAL	143	123	31	87	24	5	76	98	NORMAL	101	102	102	NORMAL
87	GORAKNATH D J	4343/16	2	55	M	FARMER	84	130/70	16	1.53	50	21	NA	8870	12	16	0.8	PUS CELLS 6-10	110	138	30	108	20	4	76	126	NORMAL	55	48	86	MODERATE RESTRICTION
88	LOKESH	56010/16	2	50	M	CARPENTER	86	140/80	16	1.7	58	20.1	NA	5780	10.8	18	0.6	NORMAL	130	158	32	108	30	4.6	100	130	NORMAL	100	129	128	NORMAL
89	KAMALA S	5229/16	2	54	F	HOUSE WIFE	78	140/70	18	1.48	48	22	NA	8240	10.3	14	0.6	NORMAL	136	140	30	80	16	4.8	86	106	NORMAL	106	127	121	NORMAL
90	KAMALABAI	5334/16	2	60	F	HOUSE WIFE	76	140/80	18	1.5	58	25.7	NA	9360	11.8	15	0.8	NORMAL	120	98	26	98	18	4.8	84	120	NORMAL	98	108	110	MILD RESTRICTION
91	SHANU R I	6241/16	2	56	F	HOUSE WIFE	72	110/70	20	1.48	36	17	NA	5360	12.9	8	0.7	NORMAL	122	154	22	65	30	5	90	106	NORMAL	90	108	120	NORMAL
92	MALLAPPA KALEBAG	6718/16	2	62	M	DRIVER	80	140/80	18	1.63	60	23	NA	6290	15.1	10	0.7	NORMAL	216	103	25	50	40	5	90	120	NORMAL	84	91	109	NORMAL
93	KANTAVA	8069/16	2	55	F	HOUSE WIFE	76	120/70	16	1.56	58	23.8	NA	9000	12	10	1.2	NORMAL	140	108	38	96	30	4	82	119	NORMAL	101	129	127	NORMAL
94	VITTHAL	9424/16	2	57	M	FARMER	82	120/70	16	1.55	50	21	NA	6520	15.2	10	0.6	NORMAL	100	86	23	59	17	5	70	120	NORMAL	88	109	124	NORMAL
95	KAMALA BAI	9869/16	2	62	F	HOUSE WIFE	98	140/80	16	1.52	60	26	NA	10660	11.2	10	0.7	ALBUMIN TRACES	140	130	30	70	25	5.4	104	98	NORMAL	105	119	113	NORMAL
96	KAMALABAI MURGEPP	10382/16	2	53	F	HOUSEWIFE	86	150/80	18	1.65	65	24	NA	8100	12.4	20	0.7	ALBUMIN TRACES PUS CELLS - 25-30	110	100	38	60	82	5.6	88	126	NORMAL	81	96	119	NORMAL - ESAO
97	HANUMANT	11479/16	2	55	M	CARPENTER	82	130/80	16	1.57	48	19.5	NA	8030	16.4	5	1	NORMAL	98	130	28	90	17	5	78	110	NORMAL	105	119	113	NORMAL
98	TASNEEM R	153671/16	2	56	F	HOUSEWIFE	90	160/90	16	1.6	52	20.3	NA	7340	11	10	0.9	NORMAL	130	106	34	98	24	4	70	128	NORMAL	87	100	114	NORMAL
99	SHANTABAI	15758/16	2	50	F	HOUSEWIFE	76	140/90	18	1.48	50	23	NA	9550	6.9	16	0.6	ALBUMIN TRACES	195	126	43	106	25	5.8	86	110	NORMAL	100	126	126	NORMAL
100	NINGAPPA BHIMAPPA	16314/16	2	76	M	FARMER	76	150/70	18	1.6	54	21.1	NA	5960	11.6	10	0.8	NORMAL	114	87	18	78	17	4.3	81	116	NORMAL	88	114	128	NORMAL
101	PARUSHURAM	16496/16	2	52	M	SHOP OWNER	88	130/100	18	1.52	52	22	NA	5710	16	30	1	ALBUMIN TRACES	120	102	28	50	18	5.4	123	160	NORMAL	88	109	123	NORMAL
102	CHANAPPA B	17795/16	2	58	M	BUSINESS	70	150/80	18	1.64	54	20.1	NA	7680	12.2	15	0.9	ALBUMIN TRACES	130	160	44	128	30	5	78	122	NORMAL	67	77	116	MILD RESTRICTION
103	KASAPPA K	18209/16	2	70	M	FARMER	88	160/90	14	1.7	62	21.5	NA	10870	13.7	25	1.1	ALBUMIN TRACES	116	98	28	76	24	5	80	106	NORMAL	69	90	130	MILD RESTRICTION
104	BASAPPA A PANJI	18380/16	2	72	M	FARMER	86	160/80	16	1.63	50	19	NA	7010	12.7	30	0.8	ALBUMIN TRACES	137	80	28	93	16	6	103	116	NORMAL	89	118	133	NORMAL - ESAO
105	BAHURAMMA G	19390/16	2	70	F	HOUSE WIFE	84	160/80	16	1.55	40	17	NA	5000	8.9	16	0.7	NORMAL	141	120	36	60	20	4.4	95	116	NORMAL	94	129	137	NORMAL
106	TAYAWWA JHAMKHAN	19571/16	2	60	F	HOUSE WIFE	72	150/70	16	1.49	46	21	NA	7240	10.1	12	0.8	ALBUMIN TRACES	116	130	30	46	32	4.2	76	106	NORMAL	88	102	116	NORMAL
107	MAMTAZ B P	19843/16	2	57	F	HOUSE WIFE	84	150/80	18	1.51	55	24.1	NA	7860	11	15	1	NORMAL	130	158	30	111	19	4.5	78	117	NORMAL	85	113	132	NORMAL
108	SUBHASCHANDRA G	21620/16	2	60	M	FARMER	82	160/80	18	1.64	55	20.4	NA	13130	11.5	30	1.5	ALBUMIN TRACES	138	110	36	50	30	5.4	80	92	NORMAL	97	104	108	NORMAL - ESAO
109	ABDUL H	21640/16	2	60	M	CARPENTER	86	120/70	16	1.6	66	25.78	NA	9760	12.1	15	1	NORMAL	146	90	30	92	30	4.8	84	130	NORMAL	108	119	110	NORMAL
110	MALLAMA GURANNA F	21645/16	2	60	F	HOUSE WIFE	76	120/80	18	1.6	54	21.1	NA	8630	12	10	1.1	NORMAL	150	110	36	80	30	5.2	96	118	NORMAL	87	107	122	NORMAL - ESAO
111	SHANKAR B	195381/16	2	50	M	CONSTRUCTION WORKER	90	140/70	16	1.6	52	20.3	NA	7620	12.2	15	0.8	ALBUMIN TRACES	113	90	23	80	42	4.6	70	108	NORMAL	85	100	117	NORMAL
112	IRAWWA DUNDAPPA K	22540/16	2	72	F	FARMER	76	164/80	18	1.5	52	23.1	NA	7300	11.8	18	1.1	NORMAL	130	100	38	52	16	5	68	102	NORMAL	151	270	179	NORMAL - ESAO

S.NO	NAME	IP. NO.	GROUP	AGE (YEARS)	SEX	OCCUPATION	PR (BPM)	BP (mm/Hg)	RR (CPM)	HEIGHT(M)	WEIGHT(KG)	BMI Kg/m2	DURATION OF TYPE 2 DM	TC (Cells/cmm)	HB (gm %)	ESR (mm/1st hr)	Sr.CREATININE (mg/dl)	URINE- R	T- CHOLESTEROL (mg/dl)	TG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)	HBA1C (mg/dl)	FBS (mg/dl)	PPBS (mg/dl)	CHEST X RAY (PA view)	FVC%	FEV1%	FEV1/FVC	PFT
114	JAKAPPA TIPPANABYAK	23116/16	2	71	M	FARMER	96	176/80	18	1.63	54	20.3	NA	8900	12	10	1	NORMAL	128	95	32	52	90	6	90	110	NORMAL	84	112	133	NORMAL
115	IRAYYA SANTAMAYYA (	23400/16	2	65	M	SHOP OWNER	88	150/90	16	1.63	58	22	NA	12610	12	10	2.4	NORMAL	140	116	30	48	70	5.2	90	130	NORMAL	85	108	127	NORMAL - ESAO
116	BANOOBI GUPURSAB N	24142/16	2	50	F	HOUSE WIFE	60	130/90	18	1.63	59	22	NA	12000	13.4	20	0.8	NORMAL	169	154	26	72	34	4.2	101	117	NORMAL	89	111	124	NORMAL
117	YALLAPPA P CHAMBAR	25001/16	2	55	M	SECURITY GUARD	84	140/90	18	1.65	68	25	NA	4310	14.5	20	0.9	ALBUMIN TRACES	140	120	30	106	32	4.5	78	106	NORMAL	100	125	125	NORMAL
118	SHANTHABAI S S	25120/16	2	65	F	HOUSE WIFE	78	130/80	16	1.41	77	33	NA	6870	13.9	15	0.8	ALBUMIN TRACES	100	156	32	110	14	4.8	102	128	NORMAL	85	108	127	NORMAL - ESAO
119	MAHADEVI Y	299140/16	2	63	F	HOUSE WIFE	94	140/70	16	1.53	56	23.9	NA	5670	11.2	18	0.8	NORMAL	140	170	30	111	30	5.2	91	130	NORMAL	84	102	121	NORMAL
120	KASAPPA B	28954/16	2	60	M	WATCHMAN	80	150/90	16	1.75	62	20.24	NA	9820	15.5	20	0.7	ALBUMIN TRACES	170	136	34	105	22	4.2	70	138	NORMAL	100	124	124	NORMAL
121	PANCHAKSHRI S G	32651/16	2	58	M	LABOURER	60	140/90	16	1.68	64	22.7	NA	5970	14.2	10	0.8	ALBUMIN TRACES	125	114	26	68	20	5	116	121	NORMAL	68	79	117	NORMAL - ESAO
122	TUKARAM	35082/16	2	60	M	PLUMBER	88	120/70	18	1.65	48	19	NA	5290	9	10	0.6	ALBUMIN TRACES	120	146	36	110	22	4	90	108	NORMAL	98	103	105	NORMAL
123	UMA M	35523/16	2	50	F	BANK JOB	84	140/90	18	1.47	58	27	NA	9400	13	5	0.8	NORMAL	112	130	28	62	34	5.2	80	96	NORMAL	82	99	120	NORMAL - ESAO
124	ANJARIMAN JAIN	381157/16	2	80	M	BUSINESS	84	160/80	18	1.7	79	24.7	NA	10350	14	30	1.2	ALBUMIN TRACES	108	130	26	96	32	4.2	72	130	NORMAL	69	61	89	MILD RESTRICTION
125	SANGAPPA	526/17	2	65	M	FARMER	92	140/90	14	1.59	42	17	NA	9840	11.8	10	0.8	NORMAL	92	130	43	111	27	5	78	136	NORMAL	70	82	117	NORMAL - ESAO
126	HAJISAB NADAF	2451/17	2	58	M	CARPENTER	88	150/60	16	1.52	46	20	NA	6060	9.7	15	0.7	ALBUMIN TRACES	130	150	22	120	30	4	76	120	NORMAL	109	120	110	NORMAL
127	SAIDABAI NADAF	2975/17	2	59	F	TAILOR	74	130/70	16	1.56	54	22.2	NA	6730	12.6	30	0.8	NORMAL	120	92	20	100	18	4	68	130	NORMAL	98	92	91	NORMAL - ESAO
128	MADHU G	48227/17	2	53	F	HOUSE WIFE	70	120/70	16	1.54	52	21.9	NA	11400	8.5	15	0.6	NORMAL	130	116	30	88	30	4.8	110	130	NORMAL	88	110	137	NORMAL
129	BASAMMA P	5722/17	2	65	F	HOUSE WIFE	80	130/70	16	1.58	52	21	NA	14030	12.4	20	1	ALBUMIN TRACES	150	110	22	108	30	4	90	140	NORMAL	106	116	109	NORMAL
130	GEETA DHUBALI	6455/17	2	60	F	HOUSE WIFE	76	160/80	18	1.6	66	25.7	NA	5670	11.5	15	0.6	ALBUMIN TRACES	192	92	63	110	18	4.6	84	142	NORMAL	107	115	102	NORMAL
131	NAGARATNA GM	113662/17	2	58	F	HOUSE WIFE	84	140/90	12	1.6	67	26	NA	7230	11.2	10	0.6	ALBUMIN TRACES	120	110	40	80	24	4.8	80	92	NORMAL	73	93	129	NORMAL
132	VISHWANATH GM	113661/17	2	58	M	OFFICER	86	160/80	18	1.69	64	22.4	NA	7620	13.6	15	1.1	ALBUMIN TRACES	146	116	28	80	33	4.8	72	110	NORMAL	60	70	116	NORMAL
133	SHIVANAND S H	130664/17	2	53	M	ACCOUNTANT	82	130/90	16	1.58	60	24	NA	7520	11.2	10	1	NORMAL	192	118	30	98	18	5	102	130	NORMAL	100	116	116	NORMAL
134	VADAMALAYAN K	115017/17	2	52	M	CLERK	80	140/96	18	1.6	68	26.5	NA	7850	15.3	5	0.8	NORMAL	198	224	29	124	44	5.4	92	132	NORMAL	90	110	122	NORMAL
135	MAHESH A	114614/17	2	55	M	TEACHER	78	150/90	16	1.69	60	22.1	NA	4520	14.6	20	0.8	ALBUMIN TRACES	118	60	35	71	12	5	86	90	NORMAL	98	91	93	NORMAL - ESAO
136	SANGANAGOWDA N B	14192/17	2	75	M	BUISINESS	88	130/80	18	1.58	46	18.4	NA	4100	8.2	30	2.8	NORMAL	160	130	34	98	32	4	80	130	NORMAL	104	110	105	NORMAL
137	TARABAI M	15730/17	2	55	F	HOUSE WIFE	76	140/70	18	1.59	60	24	NA	7850	12	17	0.7	NORMAL	145	108	32	100	26	4	84	104	NORMAL	88	82	93	NORMAL- ESAO
138	SIDDU LAXMAN H	17070/17	2	55	M	BUSINESS	68	130/80	16	1.68	62	21.9	NA	8740	13.6	15	1.5	PUS CELLS PLENTY	185	247	19	116	49	6	90	116	NORMAL	106	116	109	NORMAL
139	BABU R PATIL	17335/17	2	56	M	SECURITY GUARD	84	130/70	16	1.7	60	20.8	NA	8190	9	30	1.3	ALBUMIN TRACES, PUS CELLS 8-10	140	180	28	120	30	5	78	120	NORMAL	84	100	119	NORMAL - ESAO
140	ARJUN SURYAVANSHI	19128/17	2	57	M	WORKER	80	130/80	18	1.58	58	23.2	NA	5860	11.9	30	1.6	ALBUMIN TRACES	112	100	28	56	62	4	70	96	NORMAL	122	117	96	NORMAL - ESAO
141	PRABHAKAR B M	21224/17	2	60	M	BUSINESS	60	130/70	16	1.64	60	22.3	NA	7050	15.4	5	1.4	NORMAL	130	168	34	106	30	5	10	88	NORMAL	74	95	128	NORMAL
142	TOTAPPA P M	21346/17	2	77	M	FARMER	86	150/80	14	1.6	47	18	NA	8860	13	10	0.6	NORMAL	128	140	30	102	30	4.8	82	116	NORMAL	70	83	118	NORMAL - ESAO
143	BABAJANI N	226252/17	2	54	F	HOUSE WIFE	80	140/70	16	1.6	66	25.8	NA	6010	15.8	5	0.8	ALBUMIN TRACES	175	100	59	96	20	4.2	80	138	NORMAL	83	94	113	NORMAL
144	YENKAWWA B M	22502/17	2	70	F	HOUSE WIFE	78	130/80	18	1.47	43	20	NA	8560	9.2	20	1	ALBUMIN TRACES	108	126	36	98	28	5	80	118	NORMAL	73	93	129	NORMAL
145	SHRISHAIL N K	23486/17	2	55	M	FARMER	76	130/90	18	1.65	60	24	NA	10740	15.2	10	1	NORMAL	201	157	45	124	31	5	86	130	NORMAL	85	98	115	NORMAL
146	SAIRABANU J	238695/17	2	53	F	HOUSE WIFE	78	140/80	16	1.56	59	24.2	NA	8720	10.9	15	0.8	NORMAL	123	100	38	98	21	4	80	116	NORMAL	82	98	119	MILD RESTRICTION