"A STUDY OF PULMONARY FUNCTIONS OF WOMEN AT DIFFERENT TRIMESTERS OF PREGNANCY IN BLDEU'S SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL"

By

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DISSERTATION SUBMITTED TO THE BLDE UNIVERSITY, BIJAPUR

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of the requirements for the degree of

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IN

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Under the guidance of

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I **Dr. ANITA TELI,** here by solemnly declare that this dissertation entitled "**A STUDY OF PULMONARY FUNCTIONS OF WOMEN AT DIFFERENT TRIMESTERS OF PREGNANCY IN BLDEU'S SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL."** is a bonafide and genuine research work carried out by me under the guidance of **Dr. ASHA DHARWADKAR** MD Professor, Department of Physiology, B.L.D.E.U'S Shri B. M. Patil Medical College, Hospital and Research Centre, Bijapur.

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Date: **Dr ANITA TELI.**

Place: Bijapur

LIST OF ABBREVIATIONS USED

(In alphabetical order)

BP - Blood Pressure

BMI - Body Mass Index

BSA - Body Surface Area

bpm - beats per minute

cpm - cycles per minute

DBP - Diastolic blood pressure

DI - Dysponeic Index in %

ERV -Expiratory Reserve Volume in L

FVC -Forced Vital Capacity in L

FEV1 -Forced Expiratory Volume at the end of first second in L

FEV1% -Percentage of Forced Expiratory Volume in one second in %

FEF25-75% -Forced Expiratory Flow during 25-75% of Expiration in L/sec

FEF 25% (L/s)

FEF 50% (L/s)

FEF 75% (L/s)

HR - Heart rate

Ht - Height

IRV - Inspiratory Reserve Volume in L

IC -Inspiratory Capacity in L

MEP -Maximum Expiratory Pressure in mmHg

MV -Minute Ventilation - TV × RR in L/min

MVV -Maximum Voluntary ventilation in L/min

PR - Pulse Rate

PEFR -Peak Expiratory Flow Rate in L/sec

RR – Respiratory Rate

SBP - Systolic blood pressure

TV -Tidal Volume in L

Wt - Weight

ABSTRACT

Background & Objectives : Pregnancy is characterized by profound changes in the function of virtually every regulatory system in the human body. The events in pregnancy elicit one of the best examples of selective anatomical, physiological & biochemical adaptation that occur during pregnancy & profound changes in respiratory physiology is a part of the same process. Thus this study is designed to evaluate the pulmonary function tests in 1^{st}, 2^{nd} and 3^{rd} trimesters of pregnancy & compare them with non-pregnant control group.

Methods : A cross-sectional study is carried in 200 healthy women in the age range of 19-35 years attending BLDEA's Shri B M Patil Medical College, Hospital and Research Centre, Bijapur. The subjects are distributed in four groups, i.e control (non-pregnant) group and 1^{st} , 2^{nd} &3^{rd} trimester pregnant groups. Number of subjects in each group is 50. We have recorded various physical, physiological & respiratory parameters in control and study groups. Mean $\pm$ SD of all groups are compared for statistical significance by 'Z' test

Results: There is gradual significant increase in Respiratory rate in all trimesters of pregnancy . There is significant decrease in FVC, FEV1, FEV1%, PEFR, FEF25 75%, FEF25%, FEF50%, FEF75% in all trimesters of pregnancy with maximum decrease in 1^{st} trimester. There is significant decrease in PEFR & MEP in all trimesters of pregnancy with maximum decrease in 2^{nd} trimester & insignificant decrease in IRV & IC also. There is insignificant increase in MV with significant decrease in MVV thereby reducing DI in all trimesters of pregnancy.

Conclusion: The changes in pulmonary function are attributed to major adaptations in the maternal respiratory system. These changes may also be influenced by the mechanical pressure of enlarging gravid uterus, elevating the diaphragm &

restricting the movements of lungs thus hampering the forceful expiration & decrease in 1^{st} trimester might be due to decline in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor & due to sensitization of respiratory centre due to progesterone.

This knowledge of pulmonary function changes during pregnancy may be helpful in the prevention of gestational complications associated with an inadequate maternal respiratory adaptation.

Key words : Pregnancy, FVC, PEFR, MEP, MVV, DI

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INTRODUCTION

Pregnancy is characterized by profound changes in the function of virtually every regulatory system in the human body. The events in pregnancy elicit one of the best examples of selective anatomical, physiological & biochemical adaptation that occur during pregnancy & profound changes in respiratory physiology is a part of the same process[1] .The changes in the respiratory physiology [2] are due to increasing size of the fetus with advancing gestation which constitutes a mechanical impediment to normal process of ventilation[3]& due to hormone Progesterone which increases ventilation by increasing respiratory centre sensitivity to carbondioxide as a result the tidal volume and minute ventilation is increased [4-6].

. The physiological adaptation of the pregnant woman involve the circulatory, respiratory, digestive, renal, endocrine & metabolic systems. Their precise knowledge allows the clinician to verify the extent of the adaptation in pregnant women & helps to avoid unnecessary treatment of physiology changes misinterpreted as pathological changes in reference to pre pregnancy standards[7].

The knowledge of the expected or desired changes in pulmonary parameters is fundamental in understanding of how the disease states affect pregnancy & vice versa[8] . Also, information regarding status of pulmonary function is essential for assessment of fitness for anaesthesia[9] .

The pulmonary function tests are age old tests but time tested parameters for assessing respiratory health of a person. These tests are important for clinical, diagnostic & prognostic values as well as for research work purposes too. Till today, plenty of

works have been done to assess the pulmonary function in health as well as in diseases such as asthma, tuberculosis, ascites etc.[10]

Respiratory problems are common in pregnancy and it is worth noting that in the most recent Confidential Enquiry into Maternal Deaths (1994–96), 53.7% of direct deaths were as a result of respiratory problems excluding seven other deaths from indirect causes. Some women will have pre-existing conditions such as asthma, tuberculosis, cystic fibrosis, and less commonly restrictive lung diseases or lung transplant. Others may have an acute illness like pneumonia, pneumothorax, or more serious conditions such as pulmonary embolism or adult respiratory distress syndrome (ARDS) complicating pregnancy[11].

The serial testing initiated early in pregnancy permits valid interpretation of pulmonary function changes with advance in gestation. The respiratory changes are adaptive in nature. In order to evaluate any respiratory ailment during pregnancy, an accurate knowledge of the physiological changes in pulmonary function during normal pregnancy is necessary The changes in maternal pulmonary function tests during pregnancy have been reported.[12]

The above reviews reveal that there is a sizeable proportion of evidence indicating relationship between pregnancy & respiratory functions from various parts of the world. Although some workers have already studied pulmonary function tests in women during pregnancy in some parts of our country[13], there are very few reports involving subjects of South Indian origin in this field. This warrants study on influence of pregnancy on pulmonary functions involving subjects of South Indian origin (Karnataka).

OBJECTIVE OF THE STUDY

1. Aim of this study is to evaluate the changes in the pulmonary functions of women in the age group of 19-35 yrs at 1^{st}, 2^{nd}& 3^{rd} trimesters of pregnancy & compare them with that of healthy non-pregnant age matched controls.

REVIEW OF LITERATURE

MATERNAL ADAPTATIONS TO PREGNANCY

Physiological Changes during pregnancy:

The anatomical, physiological and biochemical adaptations to pregnancy are profound. Many of these changes begin soon after fertilization and continue throughout gestation.[14]

Changes in the cardiovascular system :

During pregnancy and the puerperium there are remarkable changes involving the heart and the circulation. The most important changes in cardiac function occur in the first eight weeks of pregnancy.[15]

- **Blood volume:** During pregnancy a great deal of new maternal tissue is synthesized, especially in the uterus and the breasts. These areas increase the size of the vascular bed. The blood volume increases during pregnancy to fill the enlarged vascular bed. There is also redistribution of blood[15].

The plasma volume and red cell mass both increase in proportional to the duration of gestation to about 1000 mL and 250 mL respectively above non-pregnant value. The total increase in blood volume is about 25-30% but the percentage increase of plasma is almost 50% while that of red cells is only 18%. This shows that there is a much greater increase in plasma than in cells, which is a fundamental feature of pregnancy[15].

This hemodilution results in “physiological anemia”. The hematocrit falls from 40-42% to about 34% in the pregnant women. The relative dilution of blood in pregnancy

serves a useful purpose in lowering the viscosities so allowing more efficient perfusion of the placenta[15].

- **Cardiac Output :**

The demands for an increased flow of blood are met mainly by increasing the cardiac output. In the average non pregnant woman, this output is about 4.5 litres per minute. At the eighth month of pregnancy this rises to about 5.5 L.[15]

The output rises to a peak in the middle of pregnancy and then slowly decline thereafter though it still remains 1 L/min above the non pregnant values.[15] The decline in cardiac output in late pregnancy might be because of postural changes. In the supine position, the large uterus often impedes cardiac venous return. It can decrease to about 20% less in supine position as compared to the lateral recumbent position.[14]

- **Heart rate :**

Cardiac output depends on the heart rate and on the output of the ventricles at each beat, that is the stroke volume.

The resting pulse rate increases as the pregnancy advances.

Non-pregnancy → 70 beats/min

Early pregnancy → 78 beats/min

End of pregnancy → 85 beats/min

The heart rate increases 10-15 beats per minute more than the pre - pregnant state[15].

There is an increase in both stroke volume and heart rate. The stroke volume increases to 10% more than the non-pregnant value and heart rate increase is more of the order of 20%[15].

During the whole course of pregnancy, in the early months of pregnancy, the stroke volume rises rapidly to a peak and then declines whilst the pulse rate slowly increases. So that two mechanisms of increasing the cardiac output have varying importance at the extremes of pregnancy.[15]

An unusual feature of pregnancy is the A-V oxygen difference. It is less in the first six months of pregnancy than in the non pregnant women and only at term the A-V difference is greater[15].

A-V oxygen difference :

Non pregnant → 46 mL oxygen / L

1st trimester → 42 mL oxygen / L

II trimester → 44 mL oxygen / L

III trimester → 48 mL oxygen / L [15]

- **Arterial Blood Pressure :**

In normal pregnancy, the blood pressure in the first few months is similar to that for the non-pregnant woman. In the middle 3 months, however, the blood pressure tends to fall on an average by about 3-5 mm Hg. But sometimes the blood pressure drop may be of the order of 20-30 mm Hg , though the patients seem not to suffer at all from this.

In the last 3 months of pregnancy the blood pressure slowly rises again until it comes back to the normal non-pregnant level.[15]

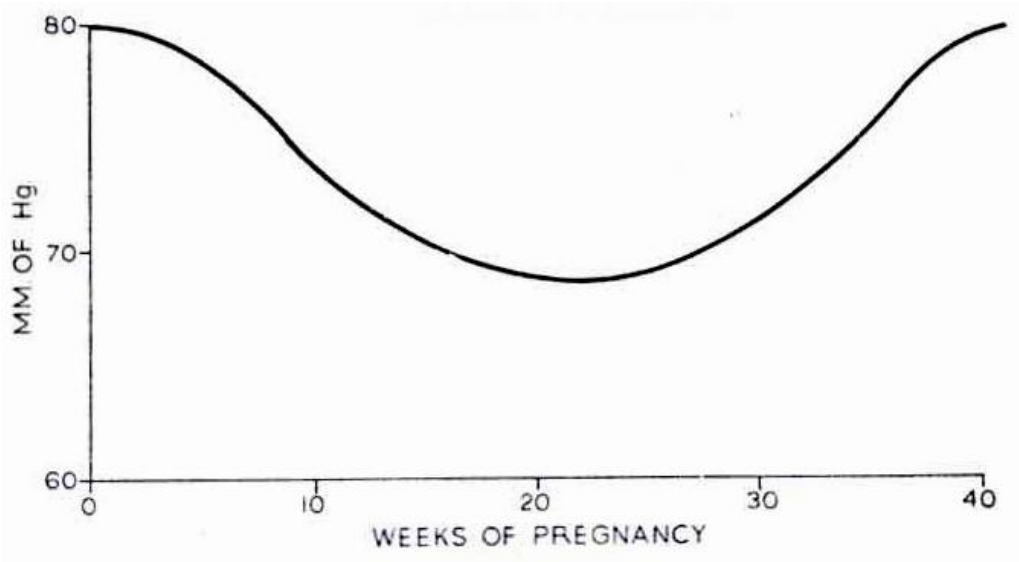


Fig. 1 : Blood pressure changes during pregnancy

The antecubital venous pressure remains unchanged during pregnancy, but in the supine position the femoral venous pressure rises steadily from 8 cm H_2O to 24 cm H_2O at term. These alterations contribute to dependent edema, varicose veins in the legs and hemorrhoids.[14]

Endocrine systems:

The endocrine environment undergoes important modifications during pregnancy, due to placental hormonal production and to the functional changes that the endocrine glands show. There is an increased production of oestrogen, progesterone etc. There is an increased amount of Adrenocorticotrophic hormone, which accounts for the rise in circulating free and total cortisol.[16]

Renal system

The renal circulation is particularly affected during normal pregnancy. Both renal plasma flow and glomerular filtration rate increase to 40–80% above normal in humans[17].

Weight gain :

There is marked increase in body weight averaging about 12.5 kgs during the whole period.[14]

Hyperthermia :

The skin temperature increases during pregnancy from 31^0C in first trimester to 33^0C in third trimester.[14]

Respiratory system:

Respiratory function in pregnancy is of special importance since the life of fetus depends primarily upon its oxygen supply. The diaphragm rises about 4cm during pregnancy. The subcostal angle widens appreciably as the transverse diameter of the thoracic cage increases about 2cm. The thoracic circumference increases about 6cm. These anatomical changes begin before the size of uterus can have an effect .[15]

Apart from a decrease in functional residual capacity (FRC) secondary to a decrease in the expiratory reserve volume, pregnancy does not affect the lung volumes. This fall in FRC begins from the fifth month of pregnancy and by term the FRC is reduced by 10%–20%[18]. Large airway function is not usually impaired by pregnancy, and forced expiratory volumes and their ratios are unaffected. The total pulmonary resistance

may be decreased due to relaxation of the smooth muscle in the tracheobronchial tree under hormonal influence[19].

In very early stage of pregnancy, the corpus luteum secrete 17- hydroxyl progesterone. Following development of trophoblast, progesterone is synthesized and secreted in increasing amount from the placenta. The placenta can utilize cholesterol as a precursor derived from the mother for the production of pregnenolone and ultimately progesterone. The average levels of plasma progesterone at 12th week, 28th week and term approximate 25 ng/ml, 80 ng/ml and 180 ng/ml respectively. After delivery , the plasma progesterone decreases rapidly and is not detectable after 24 hours [20].

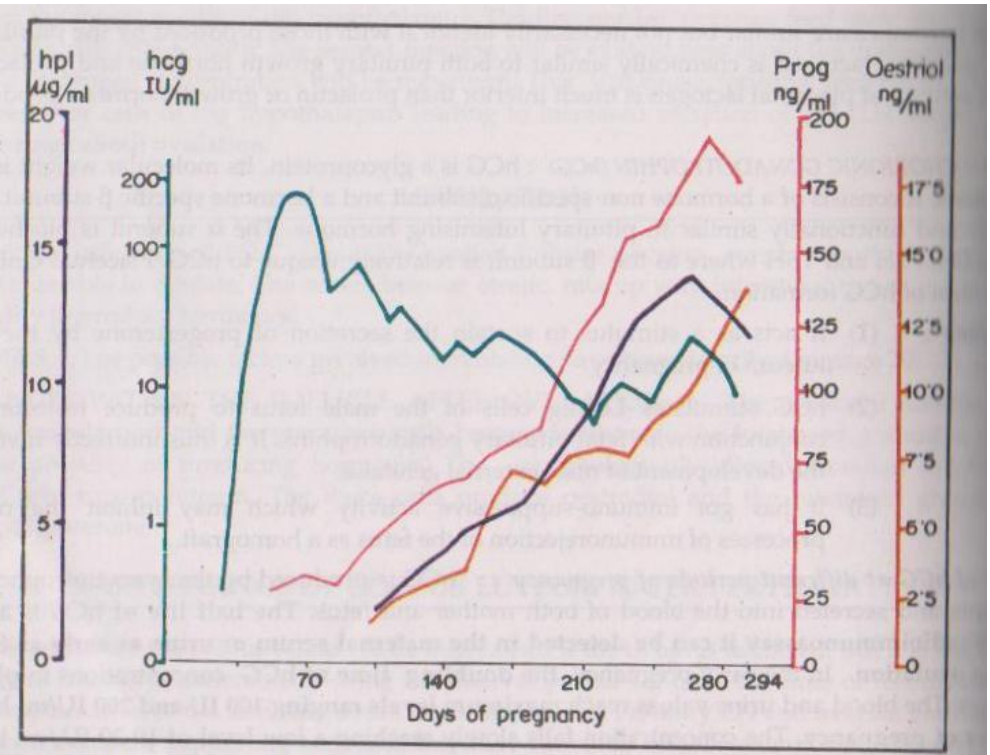


Fig. 2: Mean serum levels of placental hormones during pregnancy as measured by radioimmunoassay

Progesterone increases ventilation by increasing respiratory centre sensitivity to carbondioxide as a result the tidal volume and minute ventilation is increased. This results in a decrease in arterial and alveolar carbon dioxide pressure[4-6.]

Many human and animal studies have found that the administration of a synthetic progesterone (either medroxyprogesterone acetate or chlormadinone acetate) alone and in combination with conjugated estrogen, consistently increases both resting and exercise VE (MV) with attendant reductions in $PaCO_2$, $P_{ET}CO_2$ (end tidal) and $P_{CSF}CO_2$ (cerebrospinal fluid)[5,6,21,22].

Pulmonary function : At any stage of normal pregnancy the amount of oxygen delivered into the lungs by the increase in tidal volume clearly exceeds the oxygen need imposed by the pregnancy. Moreover the total oxygen carrying capacity increases appreciably during normal pregnancy, as does cardiac output [14].

PREGNANCY-INDUCED CHANGES in respiratory control and acid-base regulation have been studied extensively in the resting state. These include increases in minute ventilation (VE), tidal volume, and alveolar ventilation and a reduction in arterial PCO_2 ($PaCO_2$) [23-26]. In accordance with conventional acid-base theory, these changes are accompanied by renal excretion of bicarbonate , resulting in a state of partly compensated respiratory alkalosis (arterial pH . 7.43–7.47) [24,27]. These effects appear in the first trimester and may promote placental gas exchange before development of an effective fetal circulatory system [27.]

The maximum breathing capacity and forced or timed vital capacity are not altered appreciably. The functional residual capacity and the residual volume of air are

decreased as the consequence of the elevated diaphragm. Lung compliance is unaffected by pregnancy. Airway conductance is increased and total pulmonary resistance is decreased.[14]

The peak expiratory flow rate (PEFR) is considered a surrogate for the forced expiratory volume in 1 second (FEV1). PEFR is an objective measure of airflow resistance in the lungs and has been advocated for monitoring the efficacy of treatment in patients with asthma [28-31]. PEFR is the largest expiratory flow achieved with a maximally forced effort from a position of maximal inspiration[32]. It is usually attained within the initial 100 ms of forced expiration, and prolonging the expiratory phase is not necessary for accurate measurement[33]. In a normal population, variation in PEFR is largely the result of age, sex, race, height, weight, body surface area, and smoking [34,35]. PEFR also is dependent on effort and respiratory muscle strength as well as patient motivation.

- **Oxygen consumption:**

Studies made on oxygen consumption during pregnancy suggest that at term, the mother is using about 50-60 mL more oxygen per minute than she is in the non-pregnant state.

Oxygen is needed for the products of conception and also for increased work by the heart, lungs and possibly the kidneys.

Hytten and Leitch (1964) have made an ingenious calculation and suggested the following.[15]

Wks of pregnancy	Increment of oxygen consumption (mL/min)
10 weeks	5.6
20 weeks	13.0
30 weeks	21.7
40 weeks	27.6

- **Pulmonary function Tests :**

Pulmonary function tests permit accurate reproducible assessment of the functional state of the respiratory system and allow quantification of the severity of disease, thereby enabling early detection as well as assessment of the natural history and response to therapy[36].

Information regarding pulmonary function in normal women during pregnancy is necessary for better antenatal care, in assessment of fitness for anaesthesia and the progress of pre-existing lung disease[9]

- **Pulmonary Function Testing:** The pulmonary function tests are age old, but time tested parameters for assessing respiratory health of a person. These tests are important for clinical, diagnostic and prognostic values[36].

Classification of pulmonary function tests[37]: pulmonary function tests can be classified into following groups:

1. Ventilatory function tests,
   i. Measurement of various lung volumes & capacities,
   ii. Measurement of dead space,
   iii. Measurement of compliance
   iv. Measurement of airway resistance.
2. Tests of diffusion,
3. Tests of ultimate purpose of respiration
4. Tests during exercise .

Uptil now, plenty of work has been done to assess the pulmonary function tests in health as well as in diseases[10]. This work is intended to study the effect of pregnancy on Computerized Spirometric Pulmonary function tests measuring the following Static & dymamic lung volumes and capacities :

Volumes[36] :

1) Tidal Volume (TV) : It is the volume of air breathed in or out during quiet respiration. Normal value: 500 ml.
2) Inspiratory Reserve Volume (IRV): It is the maximum volume of air which can be inspired after complete normal tidal inspiration. Normal value: 2000 to 3200 ml.
3) Expiratory Reserve Volume (ERV) : It is the maximum volume of air which can be expired after a normal tidal expiration. Normal value : 750 to 1000 ml.

Capacities :

1) Inspiratory Capacity (IC) : It is the maximum volume of air which can be inspired after complete tidal expiration. Normal value: 2500 to 3700 ml.

IC = TV + IRV

2) Expiratory Capacity (EC) : It is the maximum volume of air which can be expired after complete tidal inspiration. Normal value: 1250 to 1500 ml.

EC = TV + ERV

3) Vital Capacity (VC) : It is the maximum volume of air which can be expired from lungs by forceful efforts followed by a maximal inspiration. Normal value: 4.8L in males and 3.2 L in females.

VC = TV + IRV + ERV

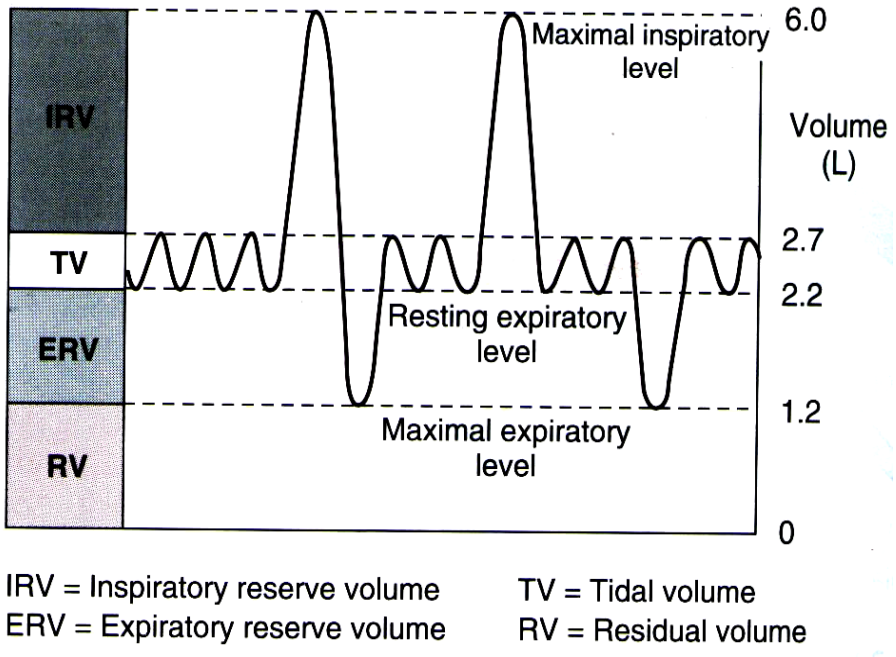


Fig. 3 : Spirogram[38]

Dynamic lung volumes and capacities :

1) Forced Vital Capacity (FVC) :

This is the maximum volume of air which can be breathed out as forcefully and as rapidly as possible following a maximum inspiration. Thus, forced vital capacity is exactly similar to vital capacity except that there is a special stress on rapid forceful and complete exhalation .

2) Timed Vital Capacity (TVC)

If vital capacity is recorded on a kymograph (spirograph) at known speed, volume of air expired can be timed. This is TVC.

Components of TVC :

i. FEV_1 : Forced expiratory volume at the end of 1st second i.e., volume of FVC expired in first second of exhalation. Normally 80% of FVC.

ii. FEV_2 : Forced expiratory volume at the end of 2nd second i.e., volume of FVC expired in first 2 seconds of exhalation. Normally 95% of FVC.

iii. FEV_3 : Forced expiratory volume at the end of 3rd second i.e., volume of FVC expired in first 3 seconds of exhalation. Normally 98-100% of FVC.

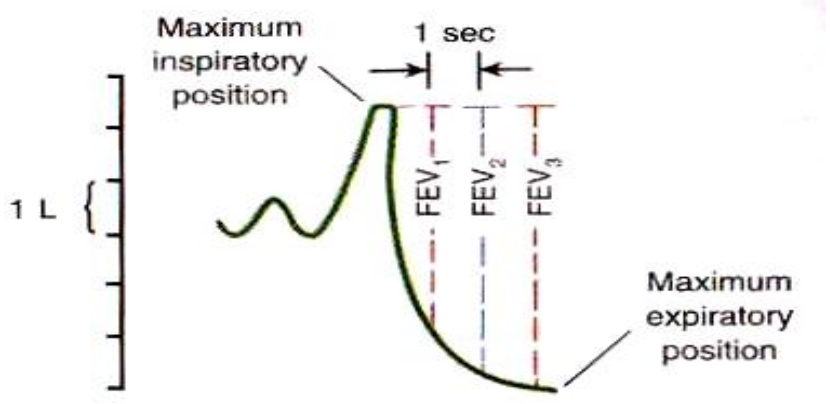


Fig. 4: Timed vital capacity record

2) Mean Forced Expiratory Flow during 25-75% of expiration (FEF 25-75%) :

This is the mean expiratory flow rate during middle 50% of FVC. It is a sensitive indicator of small airway disease where most of chronic obstructive pulmonary diseases start. Normal value – 300 liters per minute.

3) Minute Ventilation (MV) or Pulmonary Ventilation (PV) :

This is the volume of air expired or inspired by the lungs in one minute.

PV = TV X RR per min

= 0.5L X 12

Normal value – 6 L / minute.

4) Peak Expiratory Flow Rate (PEFR) : This is the expiratory flow rate during the peak of FVC. Normal: 400-450 L / minute.

5).Maximum Voluntary Ventilation (MVV) : It is the largest volume of air that can be moved in and out of the lungs in one minute by maximum voluntary efforts. Normal: 120-170 liters / minute.

6). **Dyspnoeic index (DI)** : refers to breathing reserve percentage of MVV. Breathing reserve is the difference between MVV & MV. Normal value – 70-95% & DI <60% is dyspnoea[37].

6). **FEV1/FVC ratio (FEV1%)** [39]: **$\underline{FEV_1/FVC}$** (FEV1%) is the ratio of FEV_1 to FVC In healthy adults this should be approximately 75–80%. In obstructive diseases (asthma, COPD, chronic bronchitis, emphysema) FEV_1 is diminished because of increased airway

resistance to expiratory flow and the FVC may be decreased (for instance by premature closure of airway in expiration). This generates a reduced value (<80%, often ~45%). In restrictive diseases (such as pulmonary fibrosis) the FEV_1 and FVC are both reduced proportionally and the value may be normal or even increased as a result of decreased lung compliance. A derived value of FEV1% is FEV1% predicted, which is defined as FEV1% of the patient divided by the average FEV1% in the population for any person of similar age, sex and body composition.

Forced Expiratory Flow (FEF) is the flow (or speed) of air coming out of the lung during the middle portion of a forced expiration. It can be given at discrete times, generally defined by what fraction of the functional vital capacity (FVC). The usual intervals are 25%, 50% and 75% (FEF25, FEF50 and FEF75). It can also be given as a mean of the flow during an interval, also generally delimited by when specific fractions remain of FVC, usually 25–75% (FEF25–75%). Average ranges in the healthy population depend mainly on sex and age. Values ranging from 50-60% and up to 130% of the average are considered normal [39].

MMEF or **MEF** stands for maximal mid expiratory flow and is the peak of expiratory flow as taken from the flow-volume curve and measured in liters per second. It should theoretically be identical to peak expiratory flow (PEF), which is, however, generally measured by a peak flow meter and given in liters per minute.[39]

FEF 25–75% or 25–50% gives an indication of what is happening in the lower airways. It is a more sensitive parameter and not as reproducibles as the others. It is a useful serial

measurement because it will be affected before FEV, so can act as an early warning sign of small airway disease. In small airway diseases such as asthma this value will be reduced, it could be more than 65% less than expected value[39].

Procedure : Spirometry requires that the nose is pinched off as the patient breathes through a mouthpiece attached to the spirometer. The patient is instructed on how to breathe during the procedure. Three breathing maneuvers are practiced before recording the procedure, and the highest of three trials is used for evaluation of breathing. This procedure measures air flow by electronic or mechanical displacement principles, and uses a microprocessor and recorder to calculate and plot air flow[40].

Purpose: Spirometry is the most commonly performed pulmonary function test (PFT). The test can be performed at the bedside, in a physician's office, or in a pulmonary laboratory. It is often the first test performed when a problem with lung function is suspected. Spirometry may also be suggested by an abnormal x ray, arterial blood gas analysis, or other diagnostic pulmonary test result. The National Lung Health Education Program recommends that regular spirometry tests be performed on persons over 45 years old who have a history of smoking. Spirometry tests are also recommended for persons with a family history of lung disease, chronic respiratory ailments, and advanced age. Spirometry measures ventilation, the movement of air into and out of the lungs. The spirogram will identify two different types of abnormal ventilation patterns, obstructive and restrictive[40].

Common causes of an obstructive pattern are cystic fibrosis, asthma, bronchiectasis, bronchitis, and emphysema. These conditions may be collectively referred to by using the acronym CABBE. Chronic bronchitis, emphysema, and asthma result in dyspnea (difficulty breathing) and ventilation deficiency, a condition known as chronic obstructive pulmonary disease (COPD). COPD is the fourth leading cause of death among Americans[40].

Common causes of a restrictive pattern are pneumonia, heart disease, pregnancy, lung fibrosis, pneumothorax (collapsed lung), and pleural effusion (compression caused by chest fluid)[40].

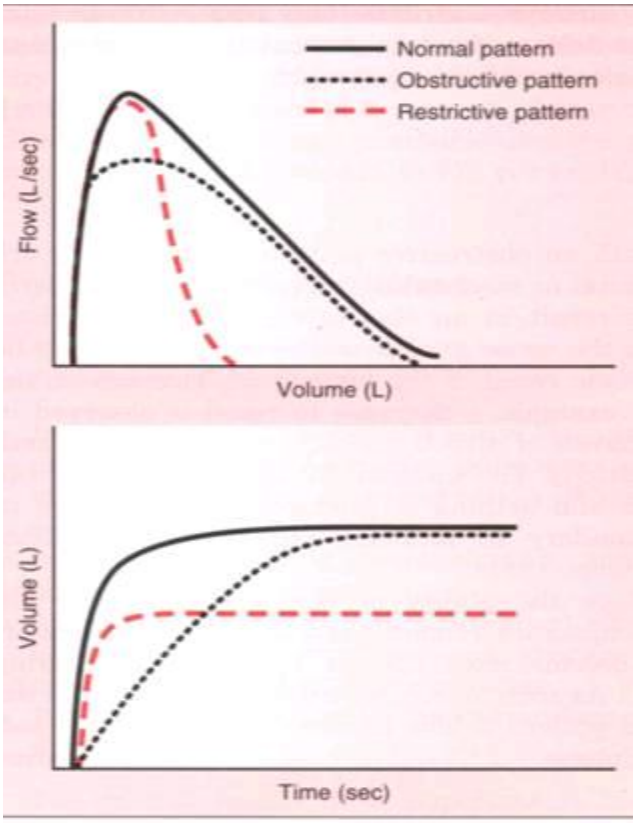
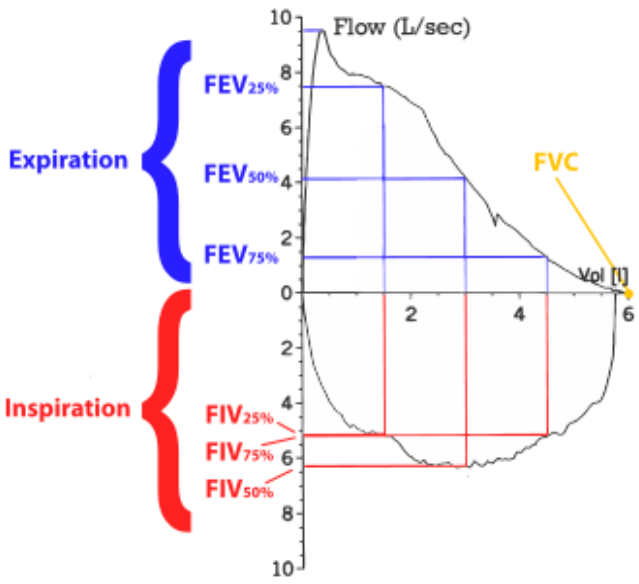


Fig : 5 Spirographs showing obstructive & restrictive pattern

Obstructive and restrictive patterns can be identified on spirographs using both "y" and "x" axis. Volume (liters) is plotted on the y-axis versus time (seconds) on the x-axis. A restrictive pattern is characterized by a normal shape showing reduced volumes for all parameters. The reduction in volumes indicates the severity of the disease. An obstructive pattern produces a spirogram with an abnormal shape. Inspiration volume is reduced. The volume of air expelled is normal but the air flow rate is slower, causing an elongated tail to the FVC.

Fig 6 : Flow volume spirogram



A flow-volume loop spirogram is another way of displaying spirometry measurements. This requires the FVC maneuver followed by a forced inspiratory volume (FIV). Flow rate in liters per second is plotted on the y-axis and volume (liters) is plotted on the x-axis. The expiration phase is shown on top and the inspiration phase on the bottom.

The flow-volume loop spirogram is helpful in diagnosing upper airway obstruction, and can differentiate some types of restrictive patterns [40].

Some conditions produce specific signs on the spirogram. Irregular inspirations with rapid frequency are caused by hyperventilation associated with stress. Diffuse fibrosis of the lung causes rapid breathing of reduced volume, which produces a repetitive pattern known as the penmanship sign. Serial reduction in the FVC peaks indicates air trapped inside the lung. A notch and reduced volume in the early segments of the FVC is consistent with airway collapse. A rise at the end of expiration is associated with airway resistance[40].

Spirometry is used to assess lung function over time, and often to evaluate the efficacy of bronchodilator inhalers such as albuterol. It is important for the patient to refrain from using a bronchodilator prior to the evaluation. Spirometry is performed before and after inhaling the bronchodilator. In general, a 12% or greater improvement in both FVC and FEV-1, or an increase in FVC by 0.2 liters, is considered a significant improvement for an adult patient[40].

Precautions: The patient should inform the physician of any medications he or she is taking, or of any medical conditions that are present; these factors may affect the validity of the test. The patient's smoking habits and history should be thoroughly documented. The patient must be able to understand and respond to instructions for the breathing maneuvers. Therefore, the test may not be appropriate for very young, unresponsive, or physically impaired persons[40].

Spirometry is contraindicated in patients whose condition will be aggravated by forced breathing, including[40]:

- hemoptysis (spitting up blood from the lungs or bronchial tubes)
- pneumothorax (free air or gas in the pleural cavity)
- recent heart attack
- unstable angina
- aneurysm (cranial, thoracic, or abdominal)
- thrombotic condition (such as clotting within a blood vessel)
- recent thoracic or abdominal surgery
- nausea or vomiting

The test should be terminated if the patient shows signs of significant head, chest, or abdominal pain while the procedure is in progress.

Spirometry is dependent upon the patient's full compliance with breathing instructions, especially his or her willingness to extend a maximal effort at forced breathing. Therefore, the patient's emotional state must be considered[40].

Preparation: The patient's age, gender, and race are recorded, and height and weight are measured before the procedure begins. The patient should not have eaten heavily within three hours of the test. He or she should be instructed to wear loose-fitting clothing over the chest and abdominal area. The respiratory therapist or other testing personnel should explain and demonstrate the breathing maneuvers to the patient. The patient should

practice breathing into the mouthpiece until he or she is able to duplicate the maneuvers successfully on two consecutive attempts[40].

After care : In most cases, special care is not required following spirometry. Occasionally, a patient may become lightheaded or dizzy. Such patients should be asked to rest or lie down, and should not be discharged until the symptoms subside. In rare cases, the patient may experience pneumothorax, intracranial hypertension, chest pain, or uncontrolled coughing. In such cases, additional care directed by a physician may be required[40].

Normal results : The results of spirometry tests are compared to predicted values based on the patient's age, gender, and height. For example, a young adult in good health is expected to have the following FEV values[40]:

- FEV-0.5—50-60% of FVC
- FEV-1—75-85% of FVC
- FEV-2—95% of FVC
- FEV-3—97% of FVC

In general, a normal result is 80–100% of the predicted value. Abnormal values are [40] :

- mild lung dysfunction—60–79%
- moderate lung dysfunction—40–59%
- severe lung dysfunction—below 40%

The pulmonary function tests can be used to assess the ventilatory functions of the lungs.

Assessment of restrictive and obstructive ventilatory defects.

i) Measurement of static and dynamic lung volumes and capacities by spirometer.

ii) Measurement of airway resistance.

Results can be interpreted as [41]:

Obstructive lung disease	**Restrictive lung disease**
High TLC	Decreased TLC
Low FEF_{25-75}	Normal FEF_{25-75}
VC normal/increased	Decreased VC
FEV_1 decreased	FEV_1 normal
FEV_1 /FVC decreased	FEV_1 / FVC normal
MVV decreased	MVV normal
Residual volume increased	Residual volume decreased

All these lung volumes and capacities can be measured by spirometry with the exception of residual volume and functional residual capacity.

Fig :7 Spiroexel instrument

Spirometry is the most widely used pulmonary function test. It records the amount of air breathed in and out and the rate at which this process takes place. The device used in this test is a spirometer, a long piece of tubing with a mouth piece at one end and a recording device at the other. Spirometry reveals degree of obstruction and restriction of the airway.[41]

In order to evaluate any respiratory ailment during pregnancy, an accurate knowledge of the physiological changes in pulmonary functions during normal pregnancy is necessary. The changes in maternal pulmonary function tests during pregnancy have been reported.

In a longitudinal study of antenatal changes in lung function tests and importance of postpartum exercise in their recovery on 50 pregnant women beginning from third month of gestation and 50 age and height matched non-pregnant control subjects, It was concluded that there were adaptive changes in lung functions during antenatal period[13].

In a study on Incentive spirometry and PEFR in 1st,2nd&3rd trimesters of pregnancy on 70 healthy pregnant women, it was concluded that (i). there was a significant decrease in PEFR during 2nd trimester, but during 3rd trimester PEFR did not change significantly .(ii)There were no significant changes in inspired volume during different trimesters.(iii)There was gradual decrease in chest expansion during pregnancy but the changes were not significant when values were compared for 1st, 2nd and 3rd trimesters. (iv)There was no correlation of PEFR with height, BMI, or chest expansion. (v) Chest expansion was negatively correlated with inspired volume in 1st and 2nd trimesters[42].

A study on lung function & breathing parameters during pregnancy on 51 pregnant women aged 26.6 +/- 4.9 years and 40 healthy women(control) showed that respiratory resistance values increased during pregnancy & both FEV1 & FEV1% & FEV values remained at the same level which may reflect the influence of the autonomous nervous system on the respiratory tract at that time[12.]

A study on respiratory function in pregnancy at sea level & at high altitude on Peruvian women with singleton pregnancies was conducted. The study comprised of 122 pregnant women living at sea level & 192 living at 4300 m altitude in the Peruvian Andes. At each location, 19 non-pregnant women were also studied. It was concluded that the effect of pregnancy on the respiratory function of healthy women was influenced by altitude of residence.[43]

A study was conducted on evaluation of respiratory function in healthy women in the last month of uncompleted pregnancy on 31 pregnant women at a mean gestational age of 37.72 weeks. In 24 individuals, the test was repeated after delivery. It was concluded that (i) Vital Capacity in the last month of pregnancy did not differ from

values after delivery & in the control group. (ii) Tidal Volume was increased & Expiratory Reserve Volume remained unchanged. (iii) Minute Ventilation recorded at rest in pregnancy increased despite decreased breathing rate, where as Maximum Voluntary Ventilation was lower than after delivery & in the control group, evidencing reduced breathing reserve. (iv) Chief forced expiratory parameters remained unchanged in pregnancy.[44]

In the study, Forced Vital Capacity (FVC) was recorded in 100 women in the age group of 25 to 35 years were selected in Dhaka city. Out of this, 25 were healthy non-pregnant women as control subjects. The study group comprised of 25 women each in 1st, 2nd & 3rd trimesters of pregnancy. FVC was significantly lower in 3rd trimester of pregnancy than that of non pregnant women.[45]

A study of PEFR in 57 women during each trimester of pregnancy & postpartum showed that there was no change in PEFR with pregnancy & advancing gestation [46].

A study of PEFR in 100 women with age ranged from 25- 35 years divided into 25 healthy non pregnant women as control group & 25 pregnant women in each trimester of pregnancy as study group. Study was conducted in department of physiology in Dhaka Medical College from July 2004 to June 2005. PEFR was significantly lower in both 2nd & 3rd trimesters of pregnancy than that of non- pregnant women. There were no statistically significant difference of PEFR between the non-pregnant and 1st trimester; between the 1st trimester and 2nd trimester; and between the 2nd trimester and 3rd trimester of pregnant women [45].

Peak expiratory flow rates were measured in the standing, sitting, and supine positions in 38 healthy pregnant women at 4-week intervals starting at less than 10 weeks until delivery and again at 6 weeks postpartum. Peak expiratory flow rate declined significantly throughout gestation in all positions However, the rate of decline for the supine position was higher than for standing and sitting positions respectively [47].

A cross sectional study was done on 238 pregnant women to determine the changes in the vital capacity & PEFR in Sri Lankan women. Subjects were divided according to their period of gestation. For each group mean predicted value & the mean observed value were calculated & the difference in these two values were compared among each group. There was no significant difference in FVC, FEV1/FVC & PEFR among eight groups depending on the period of gestation [48].

The study was conducted on 100 pregnant women in third trimester of uncomplicated pregnancy (test group) & 100 age matched non- pregnant women(control group) in the age group of 25- 35 years. Pulmonary function test parameters FVC, FEV1 PEFR & FEF 25- 75% were recorded. All parameters except FEV1/FVC ratio were found to decline in test group as compared to the control group [49].

A study of ventilatory functions in 115 pregnant women & 20 control subjects was done. Spirometric performance was reduced in all three trimesters when compared to controls, although values were within physiological limits [9].

A study of pulmonary functions in 75 pregnant women, 25 each in all trimesters & 25 non- pregnant women as control group, showed highly significant decline in FVC, FEV1 & MVV during different trimesters of pregnancy as compared to controls[50].

A study of pulmonary function tests in 65 pregnant women, only 2nd & 3rd trimesters women were considered for study, 33 subjects were in the 2nd trimesters & 32 subjects were in the 3rd trimester. FVC was decreased in 3rd trimester as compared 2nd trimester, PEFR & FEV1 do not change significantly in pregnancy [19].

MATERIALS AND METHODS

A cross sectional study was conducted in the Department of Physiology, Shri B.M.Patil Medical College, Hospital and Research Centre, Bijapur. Duration of the study was one year from December 2009 to May 2011.

The study was undertaken to determine the pulmonary function changes in 1^{st}, 2^{nd} & 3^{rd} trimesters of pregnancy. The observations were compared with age matched healthy non pregnant women

Method of Collection of data:

Study Group: 150 pregnant women in the age group of 19-35yrs who were attending the OPD of OBGy of Shri B.M. Patil Medical College were included in the study group. The study group was in turn divided into 3 subgroups. Each sub group was comprising of 50 women in first, second and third trimesters of pregnancy.

Control Group: It was comprising of apparently healthy age matched 50 non pregnant women.

The nature and purpose of the study were explained to the subjects who had volunteered for the study. From each participant an informed consent was obtained. A proforma was used to record the relevant information from each selected individual who had fulfilled inclusion criteria. The subjects who had exclusion criteria were dropped from the study. A thorough physical & systemic examination of each subject was done (in particular, cardiovascular and respiratory system). Recordings were taken during morning hours between 9 am to 12 Noon.

SAMPLE SIZE:

- As per literature on ". Lung function and breathing regulation parameters during pregnancy by Kolarzyk E, Szot WM, Lyszczarz J ,Arch Gynecol Obstet 2005 J" the average value of FEV1 is found to be 81 to 85. Then, the allowable range of error will be d = 4
- Again, as per previous studies, the value of SD of FEV1 is approximately 14.[12]
- With 95% confidence, the size of sample estimated will be

$$n = \frac{4\sigma^2}{d^2}, \text{ where } \sigma = 14(\text{ SD}) \qquad d = 4$$

$$n = \frac{4\times14\times14}{4\times4} = 49 \approx 50$$

- Hence, size of sample will be 50. Thus, 50 pregnant women will be included in each trimester[51].
- 50 non-pregnant age matched subjects will be taken as control group.

Inclusion Criteria

Apparently healthy subjects of Indian origin were included in the study. The apparent health status of the subject were determined through thorough clinical examination and history taking.

Exclusion Criteria

The Following Subjects were excluded from the study.

1. Subjects with acute respiratory infection in the previous three months.
2. Subjects with chronic respiratory infection including asthma
3. Subjects with history or clinical signs of cardiovascular diseases.

4. Subject with history of diabetes mellitus, hypertension.
5. Subjects with history of tobacco consumption in any form.
6. Subjects with history of alcohol intake.
7. Subjects with any endocrine disorders.
8. Subjects with obesity.
9. Subjects with moderate to severe anemia.

Following parameters were recorded in each subject:

A .Record of physical Anthropometry of subjects

1) Height (in centimeters): this was measured with subject without footwear nearest to 0.1 cm.
2) Weight (in kilograms): subjects were measured in standardized machine with minimum clothing nearest to 0.1 Kg
3) Body surface area in square meters using Dubois nomogram.
4) Body Mass Index in kilograms/ meter^2 using Quetelet Index.

B. Record of physiological parameters

1). Pulse Rate- It is expressed as Beats Per Minute at Radial artery.

2).Blood Pressure (SBP and DBP) – It is measured by mercury sphygmomanometer in mmHg

3).Respiratory Rate- It is recorded by inspection and palpation of chest and abdomen & is expressed as cycles/minute (cpm).

C. Record of pulmonary function parameters : The subject will be well informed about the procedure. Consent will be taken from each subject before recording .For each test, three readings will be taken. The highest reading will be taken for calculation. All tests will be recorded in a sitting posture at room temperature, in morning hours.

The following pulmonary parameters are recorded by Computerized Spiropac (Medicad) [52]

1. FVC (Forced Vital Capacity in L)

2. FEV1 (Forced Expiratory Volume at the end of first second in L)

3. FEV1% (Percentage of Forced Expiratory Volume in one second in %)

4. PEFR (Peak Expiratory Flow Rate in L/sec)

5. FEF25-75(Forced Expiratory Flow during 25-75% of Expiration in L/sec)

6. FEF 25% (L/s)

7. FEF 50% (L/s)

8. FEF 75% (L/s)

9. TV (Tidal Volume in L)

10. IRV (Inspiratory Reserve Volume in L)

11. ERV (Expiratory Reserve Volume in L)

12. IC (Inspiratory Capacity in L)

13.MEP (Maximum Expiratory Pressure in mmHg) - Recorded by using modified Black's apparatus.

14. MV (Minute Ventilation = TV × RR in L/min) [53]

15. MVV (Maximum Voluntary ventilation in L/min)

16. DI {Dyspneic index = [(MVV-MV)/MVV]×100}[37]

Fig 8 : Recording of lung functions by spiroexcel instrument in control group

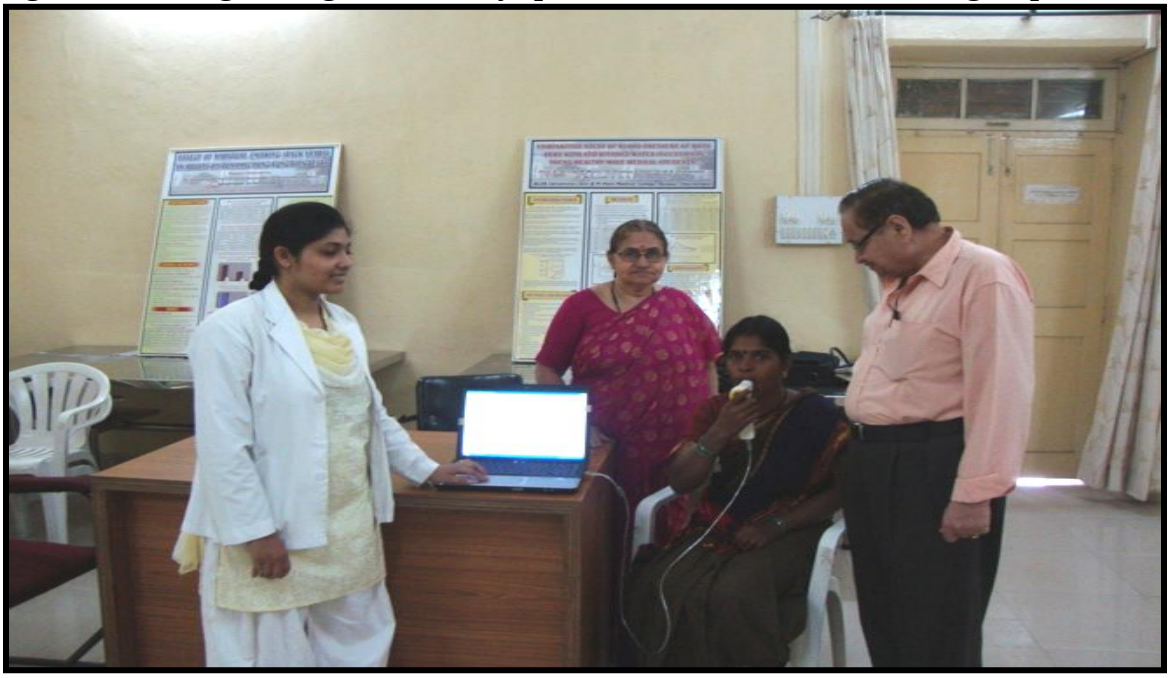


Fig 9 : Recording of lung functions by spiroexcel instrument in study group

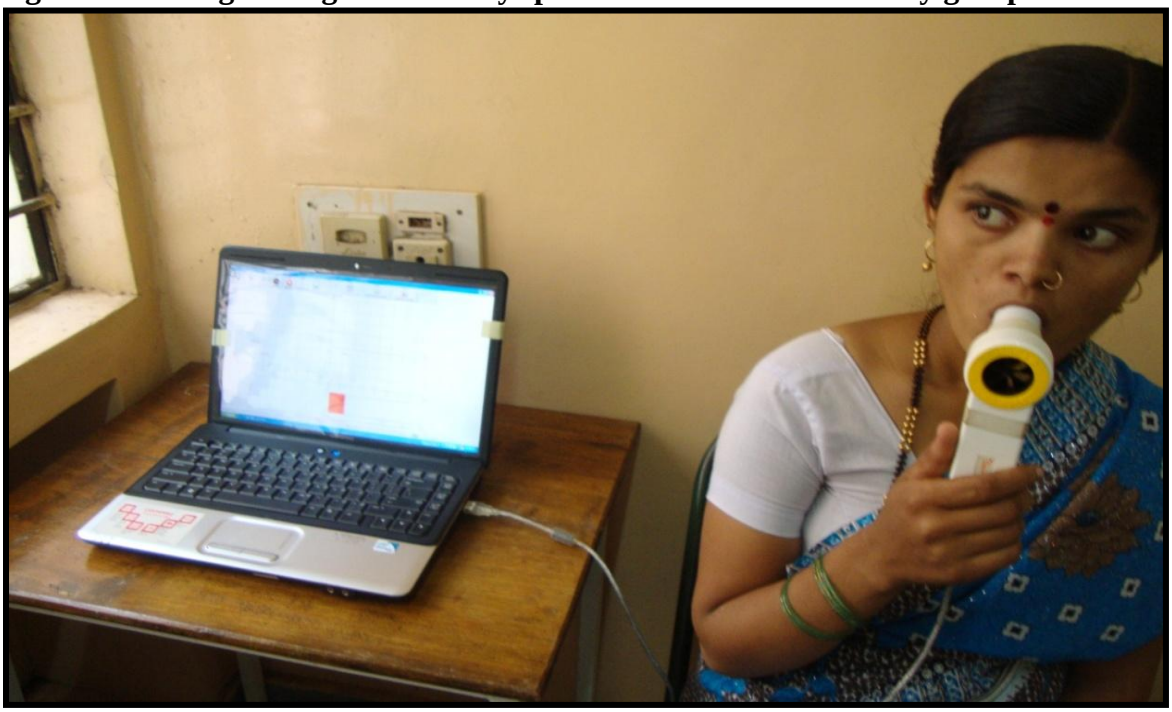


Fig 10: Pulmonary function test recording of Pregnant women in control group

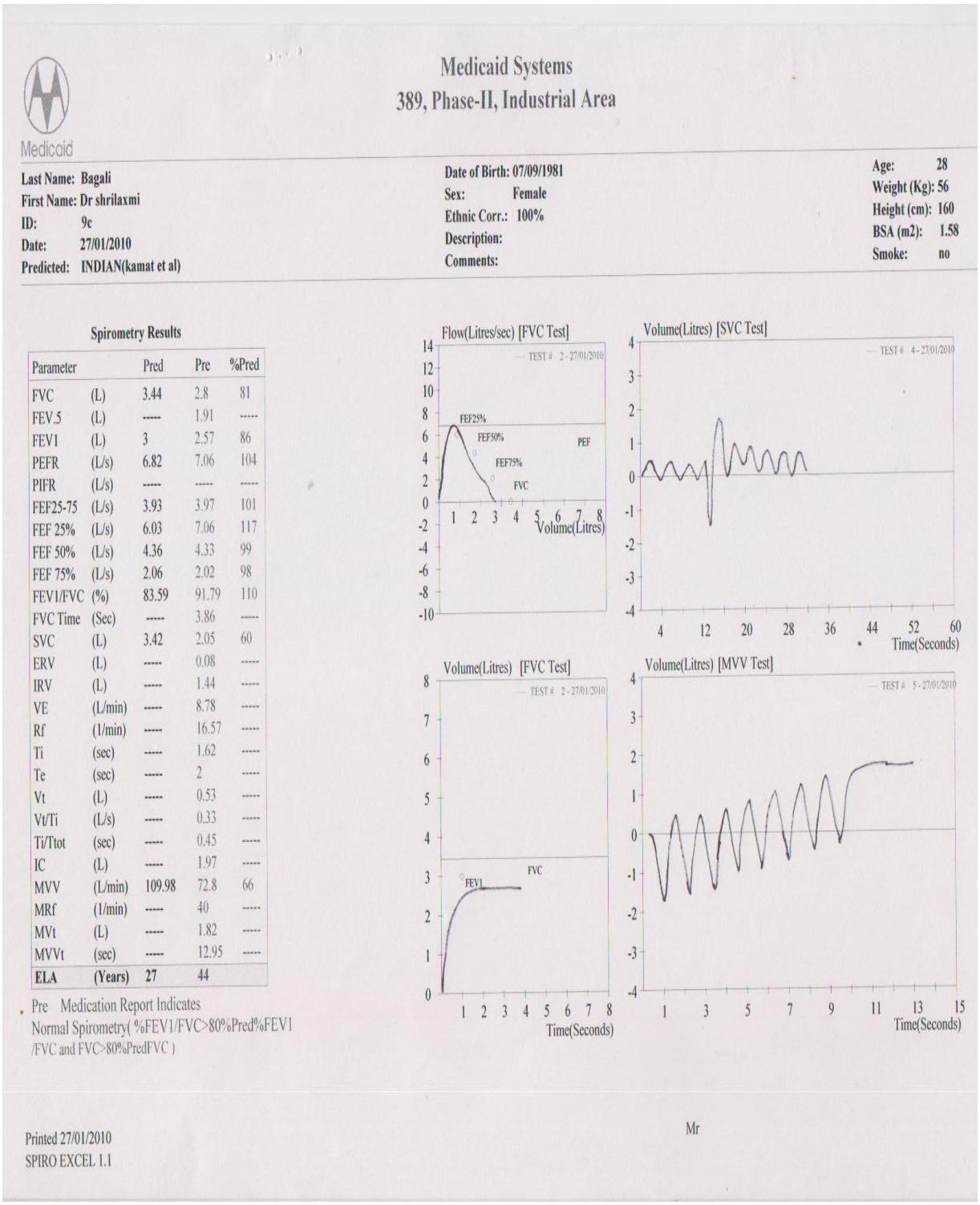
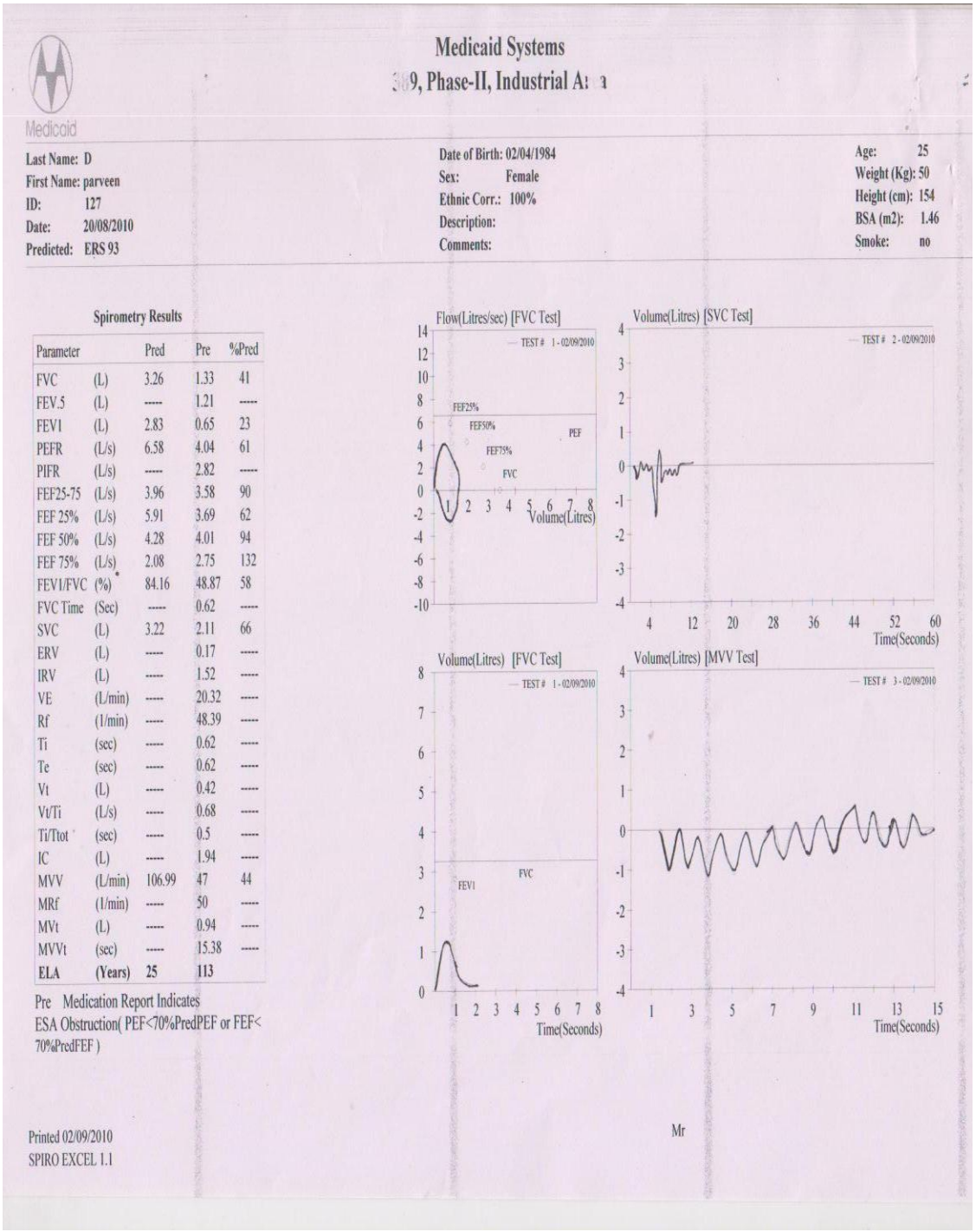


Fig 11: Pulmonary function test recording of Pregnant women in 1st trimester



Medicaid Systems
369, Phase-II, Industrial A[illegible]

Medicaid

Last Name: D
First Name: parveen
ID: 127
Date: 20/08/2010
Predicted: ERS 93

Date of Birth: 02/04/1984
Sex: Female
Ethnic Corr.: 100%
Description:
Comments:

Age: 25
Weight (Kg): 50
Height (cm): 154
BSA (m2): 1.46
Smoke: no

Spirometry Results

Parameter		Pred	Pre	%Pred
FVC	(L)	3.26	1.33	41
FEV.5	(L)	-----	1.21	-----
FEV1	(L)	2.83	0.65	23
PEFR	(L/s)	6.58	4.04	61
PIFR	(L/s)	-----	2.82	-----
FEF25-75	(L/s)	3.96	3.58	90
FEF 25%	(L/s)	5.91	3.69	62
FEF 50%	(L/s)	4.28	4.01	94
FEF 75%	(L/s)	2.08	2.75	132
FEV1/FVC	(%)	84.16	48.87	58
FVC Time	(Sec)	-----	0.62	-----
SVC	(L)	3.22	2.11	66
ERV	(L)	-----	0.17	-----
IRV	(L)	-----	1.52	-----
VE	(L/min)	-----	20.32	-----
Rf	(1/min)	-----	48.39	-----
Ti	(sec)	-----	0.62	-----
Te	(sec)	-----	0.62	-----
Vt	(L)	-----	0.42	-----
Vt/Ti	(L/s)	-----	0.68	-----
Ti/Ttot	(sec)	-----	0.5	-----
IC	(L)	-----	1.94	-----
MVV	(L/min)	106.99	47	44
MRf	(1/min)	-----	50	-----
MVt	(L)	-----	0.94	-----
MVVt	(sec)	-----	15.38	-----
ELA	**(Years)**	**25**	**113**	

Pre Medication Report Indicates
ESA Obstruction(PEF<70%PredPEF or FEF< 70%PredFEF)

Flow(Litres/sec) [FVC Test]
TEST # 1 - 02/09/2010
FEF25%
FEF50%
PEF
FEF75%
FVC
Volume(Litres)

Volume(Litres) [SVC Test]
TEST # 2 - 02/09/2010
Time(Seconds)

Volume(Litres) [FVC Test]
TEST # 1 - 02/09/2010
FVC
FEV1
Time(Seconds)

Volume(Litres) [MVV Test]
TEST # 3 - 02/09/2010
Time(Seconds)

Printed 02/09/2010
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Fig 12: Pulmonary function test recording of Pregnant women in 2nd trimester

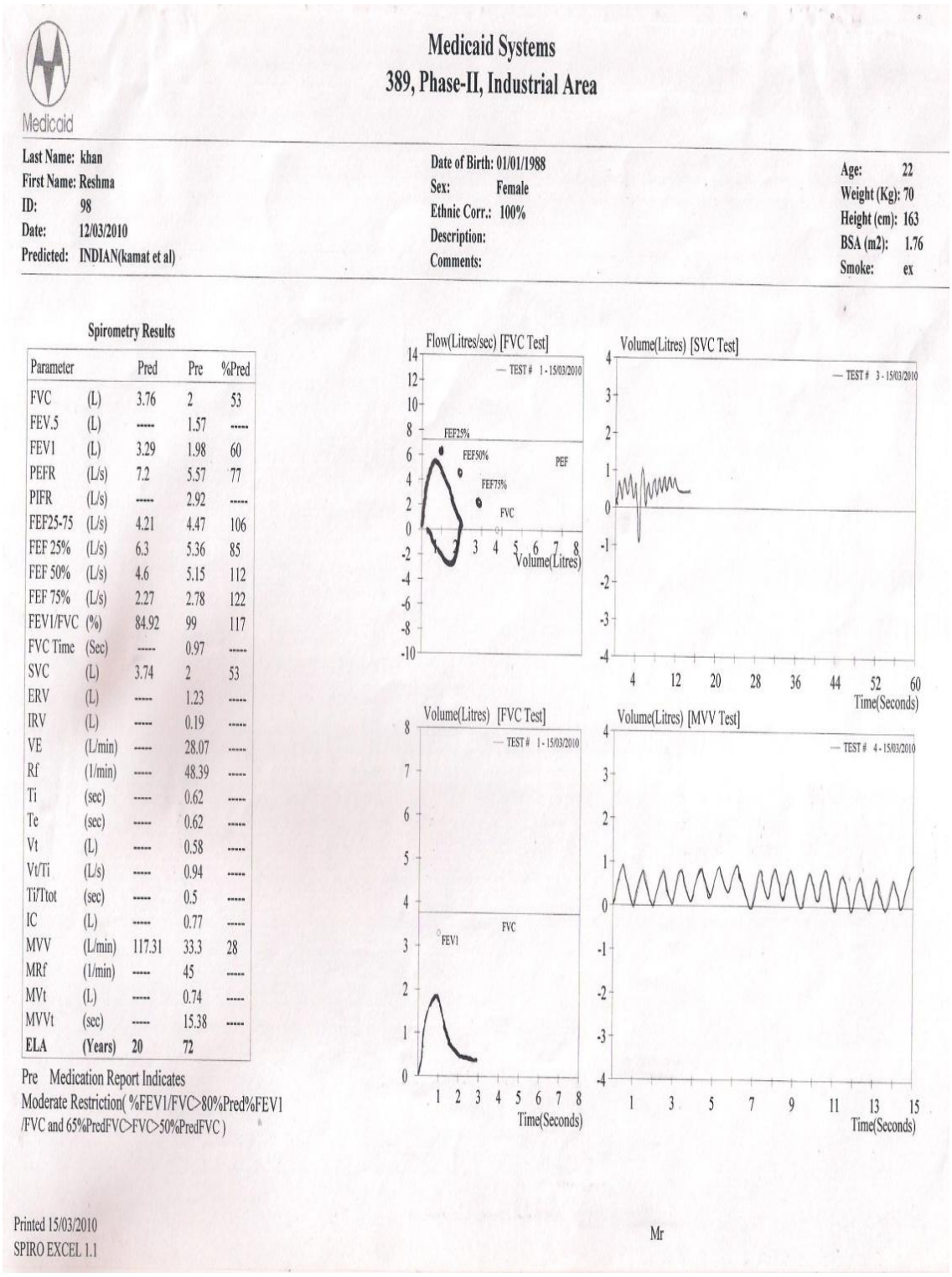


Fig 13: Pulmonary function test recording of Pregnant women in 3rd trimester

Medicaid

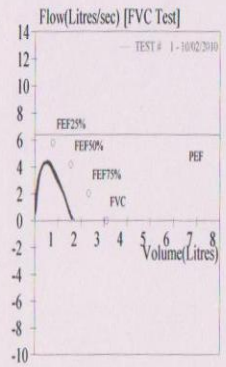
Medicaid Systems
389, Phase-II, Industrial Area

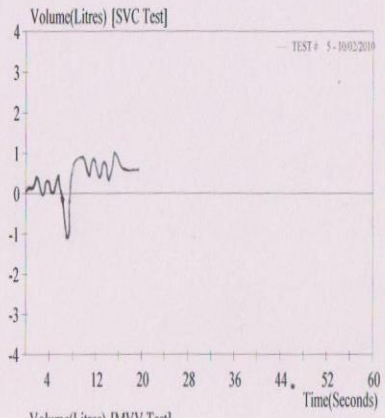
Last Name: Suresh	**Date of Birth:** 10/10/1983	**Age:** 27
First Name: Manjula	**Sex:** Female	**Weight (Kg):** 60
ID: 50	**Ethnic Corr.:** 100%	**Height (cm):** 151
Date: 09/02/2010	**Description:**	**BSA (m2):** 1.56
Predicted: INDIAN(kamat et al)	**Comments:**	**Smoke:** ex

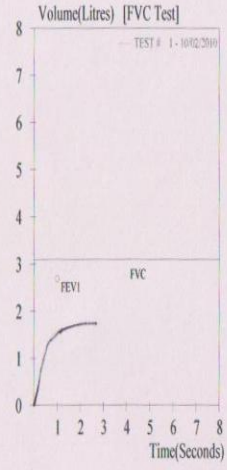
Spirometry Results

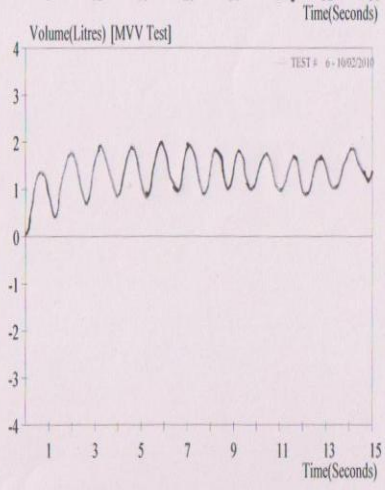
Parameter		Pred	Pre	%Pred
FVC	(L)	3.1	1.82	59
FEV.5	(L)	-----	1.29	-----
FEV1	(L)	2.69	1.66	62
PEFR	(L/s)	6.38	4.49	70
PIFR	(L/s)	-----	-----	-----
FEF25-75	(L/s)	3.89	3.1	80
FEF 25%	(L/s)	5.79	4.32	75
FEF 50%	(L/s)	4.18	3.57	85
FEF 75%	(L/s)	2.02	1.65	82
FEV1/FVC	(%)	83.97	91.21	109
FVC Time	(Sec)	-----	2.22	-----
SVC	(L)	3.05	1.68	55
ERV	(L)	-----	0.11	-----
IRV	(L)	-----	1.25	-----
VE	(L/min)	-----	14.02	-----
Rf	(1/min)	-----	43.8	-----
Ti	(sec)	-----	0.75	-----
Te	(sec)	-----	0.62	-----
Vt	(L)	-----	0.32	-----
Vt/Ti	(L/s)	-----	0.43	-----
Ti/Ttot	(sec)	-----	0.55	-----
IC	(L)	-----	1.57	-----
MVV	(L/min)	103.78	51.5	50
MRf	(1/min)	-----	50	-----
MVt	(L)	-----	1.03	-----
MVVt	(sec)	-----	15.38	-----
ELA	**(Years)**	**27**	**68**	

Pre Medication Report Indicates
Moderate Restriction(%FEV1/FVC>80%Pred%FEV1 /FVC and 65%PredFVC>FVC>50%PredFVC)









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STATISTICAL ANALYSIS

The results were expressed as Mean ± SD. Z test was used for comparison between control and study groups in consultation with statistician.

A ‘p’ value of 0.05 or less was considered as statistically significant.

RESULTS

AGE:

Mean Age ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters were 24 ± 5.8, 25 ± 4.4, 25±0.36 and 26 ± 3.4 yrs respectively. (Table 1)

HEIGHT:

Mean Height ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters were 159 ± 5.06, 151 ± 16, 155±5.2 and 155± 5.3cms respectively. (Table 1)

WEIGHT:

Mean Weight ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters were 50 ± 9.6, 52 ± 7.1, 55±7.1 and 60 ± 9.2 Kgs respectively. (Table 1)

BMI:

Mean BMI ± SD of control, pregnant women in 1st , 2nd and 3rd trimesters were 23.19 ± 3.5, 21.93 ± 3.86, 22.4±3.79 and 24.73 ± 3.08 kg/m^2respectively.(Table 1)

BSA:

Mean BSA ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters were 1.61 ± 0.14, 1.49 ± 0.13, 1.5±0.1 and 1.58 ± 0.13 m^2 respectively. (Table 1)

PULSE RATE:

Mean Pulse rate ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters were 76 ± 9.4, 89 ± 10, 77 ± 5.5 and 78 ± 7.7 beats/ min respectively (Table 2).

SYSTOLIC BLOOD PRESSURE (SBP):

Mean SBP ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters were 118.66±4.40, 115.60 ± 7.67, 109 ± 5.68 and117.56 ± 7.94 mm Hg respectively (Table 2). There is decrease in systolic blood pressure in all the trimesters of pregnancy when compared to control group. Maximum decrease is in 2nd trimester (Table 2).

DIASTOLIC BLOOD PRESSURE (DBP):

Mean DBP ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters were 74.32 ± 4.75, 73.36 ± 5.97, 66.52± 5.68 and 75.60 ± 7.41 mm Hg respectively (Table 2). There is decrease in diastolic blood pressure in all the trimesters of pregnancy when compared to control group. Maximum decrease is in 2nd trimester (Table 2).

PULSE PRESSURE (PP):

Mean PP ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters were 44.34 ± 5.47, 42.44 ± 7.81, 43.20 ± 5.33 and 42.44 ± 8.33 mm Hg respectively (Table 2).

MEAN ARTERIAL BLOOD PRESSURE (MAP):

Mean MAP ± SD of control, pregnant women in 1st , 2nd and 3rd trimesters were 88.94 ± 5.72, 88.32 ± 5.80, 80.9 ± 4.19 and 89.45 ± 7.26 respectively(Table 2). There was a statistically significant decrease in MAP in 2nd (p=0.001) trimester of pregnancy when compared to non pregnant women (Table 2) ,1st & 3rd trimester of pregnancy.

RESPIRATORY RATE (CPM):

Mean RR ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 16 ±3, 22 ± 3, 23 ± 4.3 and 26 ± 3.7 cpm respectively(Table 2). There is statistically very highly significant gradual increase in RR from 1st to 3rd trimester as compared to control (p=0.001) (Table 6).

SPIROMETRIC LUNG VOLUMES

FORCED VITAL CAPACITY(FVC) in Litres:

Mean FVC ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 2.50±0.39, 1.87 ± 0.37, 1.85 ± 0.39 and2.19 ± 2.0 liters respectively (Table 3). There is a statistically very highly significant decrease in FVC in 1st (p=0.001) , 2nd (p=0.001) & 3rd (p=0.001) trimesters of pregnancy when compared to control group (Table 6). However , there is statistically significant increase in FVC of 3rd trimester (p=0.01) as compared to 2nd trimester of pregnancy (Table 11).

FORCED EXPIRATORY VOLUME at the end of 1st second (FEV1) in Litres:

Mean FEV1 ± SD of control, pregnant women in 1st, 2nd and 3rd trimesters are 2.24 ± 0.39, 1.56 ± 0.49, 1.69 ± 0.39 and1.78 ± 0.32 liters respectively (Table 3). There is a statistically very highly significant decrease in FEV1 in 1st (p=0.001) , 2nd (p=0.001) & 3rd (p=0.001) trimesters of pregnancy when compared to non pregnant women (Table 6). Similarly, there is a statistically highly significant decrease in FEV1 in 1st trimester (p=0.005) when compared to 3rd trimesters of pregnancy (Table 11).

FEV1% (Forced Expiratory Volume expressed as percentage of vital capacity in the 1st second):

Mean FEV1% ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 91.94 ± 3.68 %, 86.55 ± 17.55 %, 92.09 ± 10.91 % and 90.32 ± 10.33 % respectively (Table 3). There is decrease in FEV1 in 1st & 3rd trimesters of pregnancy compared to non pregnant women (Table 6) & the decrease is statistically significant in 1st (p=0.001)(Table 11).

PEAK EXPIRATORY FLOW RATE (PEFR) in Liters/sec:

Mean PEFR ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 5.86 ± 1.16, 4.26 ± 1.28, 4.41 ± 1.35 and5.02 ±1.26 liters respectively (Table 4). There is a statistically very highly significant decrease in PEFR in 1st (p=0.001) , 2nd (p=0.001) & 3rd (p=0.001) trimesters of pregnancy when compared to non pregnant women (Table 7). Maximum decrease is in 1st trimester. (Table 10).

FORCED EXPIRATORY FLOW DURING 25-75% 0F EXPIRATION (FEF25-75%) in Liters/sec : Mean FEF25-75% ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 3.82 ± 0.7, 3.24 ± 0.86, 3.34 ± 0.92 and3.62 ±0.98 liters respectively (Table 4). There is a statistically significant decrease in FEF25-75% in 1st ,2nd & 3rd trimesters of pregnancy when compared to non pregnant women (Table 7). Maximum decrease is seen in 1st trimester only.(Table 10).

(FEF25%) in Liters/sec:

Mean FEF25% ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 5.81 ± 1.16, 4.06 ± 1.25, 4.22 ± 1.38 and4.86 ±1.18 liters respectively (Table 4). There is a statistically very highly significant decrease in FEF25% in 1st (p=0.001), 2nd (p=0.001) & 3rd (p=0.001) trimesters of pregnancy when compared to non pregnant women (Table 7). Maximum decrease is seen in 1st trimester.(Table 10).

(FEF50%) in Liters/sec :

Mean FEF50% ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 4.33 ± 0.83, 3.63 ± 1.15, 3.73 ± 1.06 and4.20 ±1.12 liters respectively (Table 4). There is a statistically very highly significant decrease in FEF50% in 1st (p=0.001) and 2nd (p=0.001) & insignificant decrease in 3rd trimesters of pregnancy when compared to

non pregnant women (Table 7). Maximum decrease is seen in 1st trimester only. (Table 10).

(FEF75%) in Liters/sec :

Mean FEF75% ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 2.17 ± 0.58, 2.18 ± 0.75, 2.26 ± 0.68 and2.25 ±0.75 liters respectively (Table 4). There is insignificant variation in FEF75% in all the groups .(Table 7,10).

TIDAL VOLUME in Liters :

Mean TV ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 0.84 ± 0.41, 0.72 ± 0.95, 0.57 ± 0.23 and 0.58 ±0.24 liters respectively (Table 5). There is a gradual decrease in TV of 1st ,2nd & 3rd trimesters of pregnancy when compared to non pregnant women (Table 8) & the decrease is maximum in 2nd trimester(Table 9).

INSPIRATORY RESERVE VOLUME in Liters:

Mean IRV ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 1.02 ± 0.60, 0.78 ± 0.47, 0.75 ± 0.54 and 0.92 ±0.55 liters respectively (Table 5). There is a statistically highly significant decrease in IRV in 1st (p=0.012) and 2nd (p=0.008) trimesters of pregnancy & insignificant decrease in 3rd trimester of pregnancy when compared to non pregnant women (Table 8,9).

EXPIRATORY RESERVE VOLUME in Liters:

Mean ERV ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 0.17 ± 0.15, 0.16 ± 0.14, 0.20 ± 0.21 and 0.25 ±0.33 liters respectively (Table 5). There is a statistically insignificant variation in ERV in 1st , 2nd & 3rd trimesters of pregnancy when compared to non pregnant women (Table 8). However there is significant increase in ERV of 3rd trimester to 1st trimester of pregnancy (Table 9).

INSPIRATORY CAPACITY in Liters:

Mean IC ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 1.82 ± 0.82, 1.47 ± 0.95, 1.27 ± 0.7 and 1.43 ±0.6 liters respectively (Table 5). There is a statistically significant decrease in IC in 1st (p=0.024), 2nd (p=0.001) &3rd trimesters of pregnancy when compared to non pregnant women (Table 8). Maximum decrease in IC is seen in 2nd trimester of pregnancy (Table 9).

MAXIMUM EXPIRATORY PRESSURE in mmHg:

Mean MEP± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 36.08 ± 14.13, 31.9 ± 9.35, 29.48 ± 10.33 and 35.76 ±12.6 liters respectively (Table 5). There is a statistically significant decrease in MEP in 1st (p=0.041) , 2nd (p=0.004) & 3rd trimesters when compared to control group (Table 8). Maximum decrease in MEP is seen in 2nd trimester of pregnancy (Table 9).

MINUTE VENTILATION in L/min :

Mean MV ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 13.34 ± 7.54, 13.68 ± 8.10, 13.28 ± 7.33 and 14.43 ±5.85 liters respectively (Table 12). However values are having insignificant variation (Table 13).

MAXIMUM VOLUNTARY VENTILATION in L/min :

Mean MVV ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 71.39 ± 20.63, 40.92 ± 13.79, 41.72 ± 16.16 and 41.46 ±15.72 liters respectively (Table 12). There is a statistically significant decrease in MVV in all trimesters (p=0.002) when compared to control group with maximum decrease in 1sttrimester (Table 13).

DYSPNOEIC INDEX in percentage :

Mean DI ± SD of control & pregnant women in 1st, 2nd and 3rd trimesters are 79.35 ± 13.82, 61.84 ± 27.89, 49.98 ± 55.03 and 56.66 ±31.57 liters respectively

(Table 12). There is a statistically significant decrease in DI in all trimesters (p=0.002) when compared to control group with maximum decrease in 2nd trimester (Table 13).

Table 1: Mean ± SD and level of significance of Age and Anthropometric Parameters of subjects in Control and Study Groups

PARAMETERS	CONTROL	1ST TRIMESTER		2ND TRIMESTER		3RD TRIMESTER	
	Mean ± SD	Mean ± SD	P value	Mean± SD	P value	Mean± SD	P value
Age (yrs)	24 ± 5.8	25 ± 4.4	0.183	25±0.36	0.244	26± 3.4	0.032*
Height (cms)	159 ± 5.06	151 ± 16	0.001***	155±5.2	0.001***	155± 5.3	0.001***
Weight (kg)	59 ± 9.6	52 ± 7.1	0.001***	55±7.1	0.007**	60 ± 9.2	0.342
BMI (kg/m^2)	23.19 ± 3.5	21.93 ± 3.86	0.045*	22.4±3.79	0.139	24.73 ± 3.08	0.010**
BSA (Sq m)	1.61 ± 0.14	1.49 ± 0.13	0.001***	1.5±0.1	0.001***	1.58 ± 0.13	0.091

Table 2: Mean ± SD and Range of Physiological Parameters of subjects in Control and Study groups

PARAMETERS	CONTROL	1ST TRIMESTER	2NDTRIMESTER	3RDTRIMESTER
	Mean± SD	Mean ± SD	Mean ± SD	Mean ± SD
PR(beats/min)	76± 9.4	89 ± 10 (p=0.054*)	77±5.5 (p=0.167)	78 ± 7.7 (p=0.053*)
SBP (mm Hg)	118.66±4.4	115.60±7.67 (p=0.0146*)	109.56±5.68 (p=0.001***)	117.56±7.94 (p=0.17)
DBP (mm Hg)	74.32±4.75	73.36 ± 5.97 (p=0.378)	66.52± 5.68 (p=0.001***)	75.60 ± 7.41 (p=0.441)
PP (mm Hg)	44.34±5.47	42.44 ± 7.81	43.20 ± 5.33	42.44 ± 8.33
MAP (mm Hg)	88.94±5.72	88.32 ± 5.80	80.90± 4.19 (p=0.001)	89.45 ± 7.26
RR(cpm)	16±3	22±3	22±4.3	26±3.7

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 3: Mean ± SD of FVC, FEV1 & FEV% of subjects in Control and Study groups

PARAMETERS	CONTROL	1ST TRIMESTER	2ND TRIMESTER	3RD TRIMESTER
	Mean± SD	Mean ± SD	Mean ± SD	Mean ± SD
FVC(L)	2.50± 0.39	1.87±0.37 (p=0.001***)	1.85±0.39 (p=0.001***)	2.19± 2.0(p=0.001***)
FEV1(L)	2.24± 0.39	1.56±0.49 (p=0.001***)	1.69±0.39 (p=0.001***)	1.78±0.32(p=0.001***)
FEV1(%)	91.94± 3.68	86.55±17.55 (p=0.017**)	92.09±10.91 (p=0.482)	90.32± 10.33(p=0.150)

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 4 Mean ± SD of PEFR,FEF25-75,FEF25%,FEF50% & FEF75% of subjects in Control and Study groups

PARAMETERS	**CONTROL**	**1ST TRIMESTER**	**2ND TRIMESTER**	**3RD TRIMESTER**
	Mean± SD	Mean ± SD	Mean ± SD	Mean ± SD
PEFR(L/s)	5.89± 1.16	4.26±1.28 (p=0.001***)	4.41±1.35 (p=0.001***)	5.02± 1.26(p=0.001***)
FEF25-75(L/s)	3.82± 0.7	3.24±0.86 (0.001***)	3.34±0.92(0.002**)	3.62±0.98(p=0.120)
FEF25%(L/s)	5.81± 1.16	4.06±1.25 (p=0.001***)	4.22±1.38 (p=0.001***)	4.86± 1.18(p=0.001***)
FEF50%(L/s)	4.33± 0.83	3.63±1.15 (p=0.001***)	3.73±1.06 (p=0.001***)	4.20± 1.12(p=0.259)
FEF75%(L/s)	2.17± 0.58	2.18±0.75 (p=0.490)	2.26±0.68(p=0.250)	2.25± 0.75(p=0.283)

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 5: Mean ± SD of TV, IRV, ERV, IC & MEP of subjects in Control and Study groups

PARAMETERS	CONTROL	1ST TRIMESTER	2ND TRIMESTER	3RD TRIMESTER
	Mean± SD	Mean ± SD	Mean ± SD	Mean ± SD
TV(L)	0.84± 0.41	0.72±0.95 (p=0.205)	0.57±0.23 (p=0.001***)	0.58± 0.24(0.001***)
IRV(L)	1.02± 0.60	0.78±0.47 (p=0.012*)	0.75±0.54 (p=0.008**)	0.92±0.55(p=0.199)
ERV(L)	0.17± 0.15	0.16±0.14 (p=0.346)	0.20±0.21 (p=0.183)	0.25± 0.33(p=0.064)
IC(L)	1.82± 0.82	1.47±0.95 (p=0.024**)	1.27±0.7 (p=0.001***)	1.43± 0.6(p=0.004**)
MEP(mmHg)	36.sss08± 14.13	31.9±9.35 (p=0.041*)	29.48±10.33 (p=0.004**)	35.76± 12.6(p=0.458)

Table 6: Test of Significance for Respiratory Parameters Using Z Statistics between Control and Study groups

PARAMETERS	CONTROL & 1ST TRIMESTER		CONTROL & 2ND TRIMESTER		CONTROL & 3RD TRIMESTER	
	Z-Value	P-Value	Z-Value	P-Value	Z-Value	P-Value
RR(CPM)	10.34	0.001***	10.33	0.001***	15.49	0.001***
FVC	-8.242	0.001***	-8.158	0.001***	-7.177	0.001***
FEV1	-7.852	0.001***	-7.307	0.001***	-6.717	0.001***
FEV1%	-2.124	0.017**	0.051	0.48	-1.045	0.15

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 7: Test of Significance for Respiratory Parameters Using Z Statistics between Control and Study groups

PARAMETERS	CONTROL & 1ST TRIMESTER		CONTROL & 2ND TRIMESTER		CONTROL & 3RD TRIMESTER	
	Z-Value	P-Value	Z-Value	P-Value	Z-Value	P-Value
PEFR(L/s)	-6.652	0.001***	-5.870	0.001***	-3.608	0.001***
FEF25-75(L/s)	-3.724	0.001***	-2.921	0.002**	-1.183	0.12
FEF25%(L/s)	-7.237	0.001***	-6.217	0.001***	-4.047	0.001***
FEF50%(L/s)	-3.461	0.001***	-3.128	0.001***	-0.655	0.259
FEF75%(L/s)	0.038	0.490	0.684	0.250*	0.585	0.283

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 8: Test of Significance for Respiratory Parameters Using Z Statistics between Control and Study groups

PARAMETERS	CONTROL & 1ST TRIMESTER		CONTROL & 2ND TRIMESTER		CONTROL & 3RD TRIMESTER	
	Z-Value	P-Value	Z-Value	P-Value	Z-Value	P-Value
TV(L)	-0.834	0.205	-4.011	0.001***	-3.882	0.001***
IRV(L)	-2.253	0.012***	-2.400	0.008*	-0.851	0.199
ERV(L)	-0.409	0.349	0.916	0.183	1.531	0.064
IC(L)	-1.985	0.024***	-3.665	0.001***	-2.693	0.004**
MEP(mmHg)	-1.744	0.041	-2.665	0.004**	-0.119	0.458

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 9: Test of Significance for Respiratory Parameters Using Z Statistics between Trimesters

PARAMETERS	1^{ST}TRIMESTER&2^{ND}TRIMESTER		1^{ST}TRIMESTER&3^{RD}TRIMESTER		2^{ND}TRIMESTER&3^{RD}TRIMESTER	
	Z-Value	P-Value	Z-Value	P-Value	Z-Value	P-Value
TV(L)	1.05	0.148	1.001	0.160	-0.143	0.446
IRV(L)	0.31	0.380	-1.427	0.079	-1.626	0.05*
ERV(L)	-1.26	0.105	-1.777	0.039*	-0.816	0.210
IC(L)	1.20	0.116	0.223	0.415	-1.273	0.103
MEP(mmHg)	1.23	0.112	-1.732	0.042*	-2.713	0.003**

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 10: Test of Significance for Respiratory Parameters Using Z Statistics between Trimesters

PARAMETERS	1^{ST}TRIMESTER&2^{ND}TRIMESTER		1^{ST}TRIMESTER&3^{RD}TRIMESTER		2^{ND}TRIMESTER&3^{RD}TRIMESTER	
	Z-Value	P-Value	Z-Value	P-Value	Z-Value	P-Value
PEFR(L/s)	-0.56	0.293	-2.969	0.002**	-2.323	0.01*
FEF25-75%(L/s)	-0.60	0.276	-2.081	0.019*	-1.456	0.07
FEF25%(L/s)	-0.61	0.273	-3.269	0.001***	-2.468	0.007**
FEF50%(L/s)	-0.45	0.328	-2.499	0.006**	-2.147	0.016*
FEF75%(L/s)	-0.57	0.289	-0.488	0.317	0.053	0.482

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 11: Test of Significance for Respiratory Parameters Using Z Statistics between Trimesters

PARAMETERS	1^{ST}TRIMESTER&2^{ND}TRIMESTER		1^{ST}TRIMESTER&3^{RD}TRIMESTER		2^{ND}TRIMESTER&3^{RD}TRIMESTER	
	Z-Value	P-Value	Z-Value	P-Value	Z-Value	P-Value
RR(CPM)	-1.46	0.073	-5.511	0.001***	-3.412	0.001***
FVC(L)	0.19	0.431	-2.022	0.02*	-2.146	0.016*
FEV1(L)	-1.39	0.083	-2.586	0.005**	-1.260	0.105
FEV1%	-1.87	0.031*	-1.307	0.098	0.802	0.213

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 12 : Mean ± SD of MV& MVV of subjects in Control and Study groups

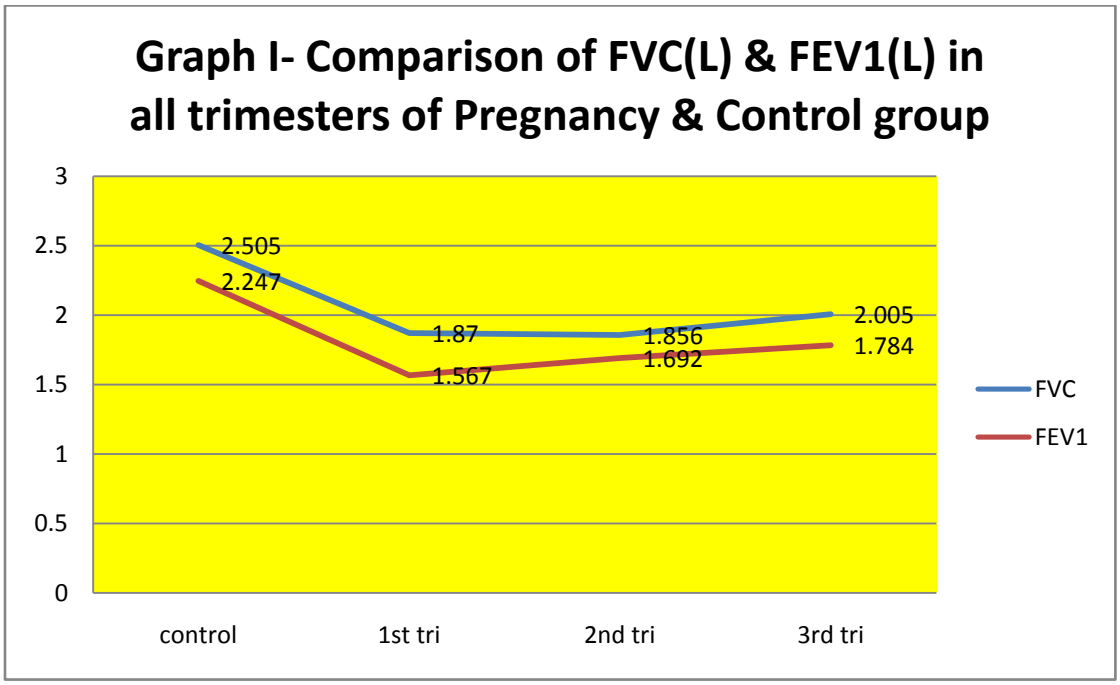
PARAMETERS	CONTROL	1^{ST} TRIMESTER	2^{ND} TRIMESTER	3^{RD} TRIMESTER
	Mean± SD	Mean ± SD	Mean ± SD	Mean ± SD
MV(L/min)	13.34± 7.54	13.68 ± 8.10	13.28 ± 7.23	14.43± 5.58
MVV(L/min)	71.39 ± 20.63	40.92 ± 13.79 (p=0.002**)	41.72 ± 16.16 (p=0.002**)	41.46±15.72 (p=0.002**)
DI (%)	79.35± 13.82	61.84 ± 27.89 (p=0.002**)	49.98 ± 55.03 (p=0.002**)	56.66 ± 31.57 (p=0.002**)

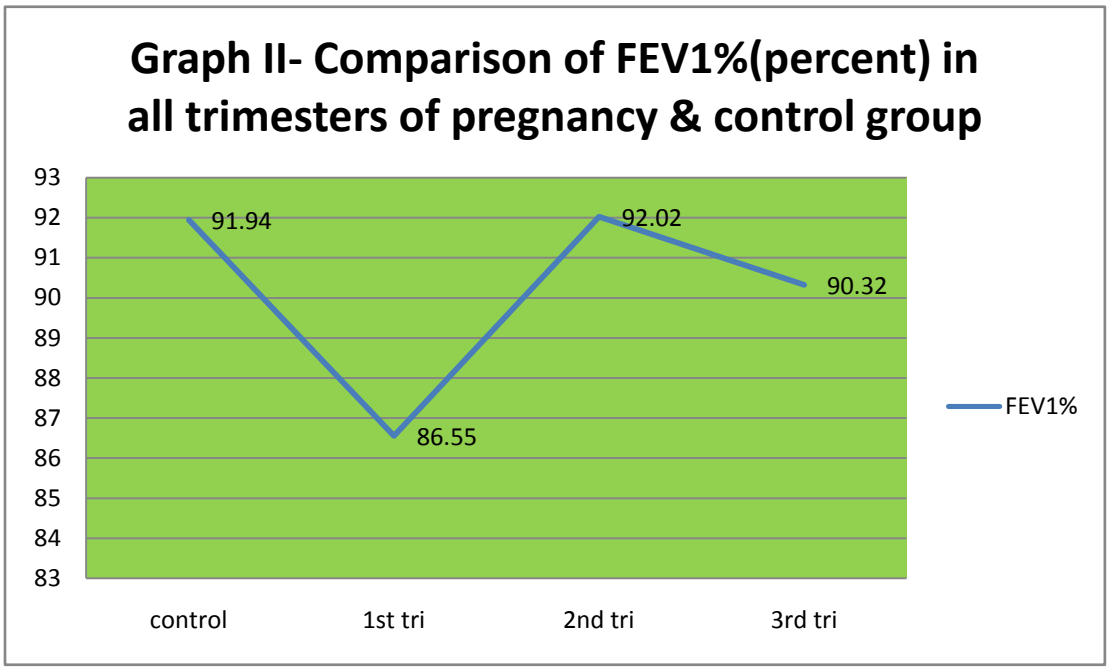
p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

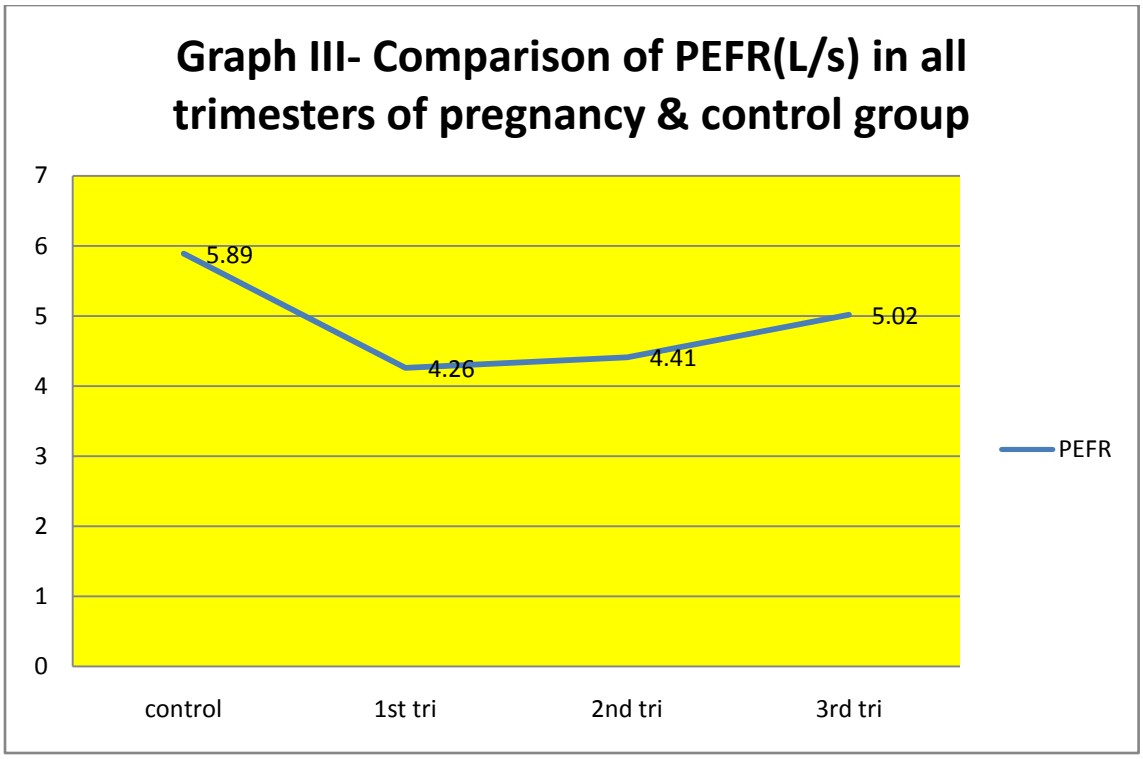
Table 13 : Test of Significance for Respiratory Parameters Using Z Statistics between Control and Study groups

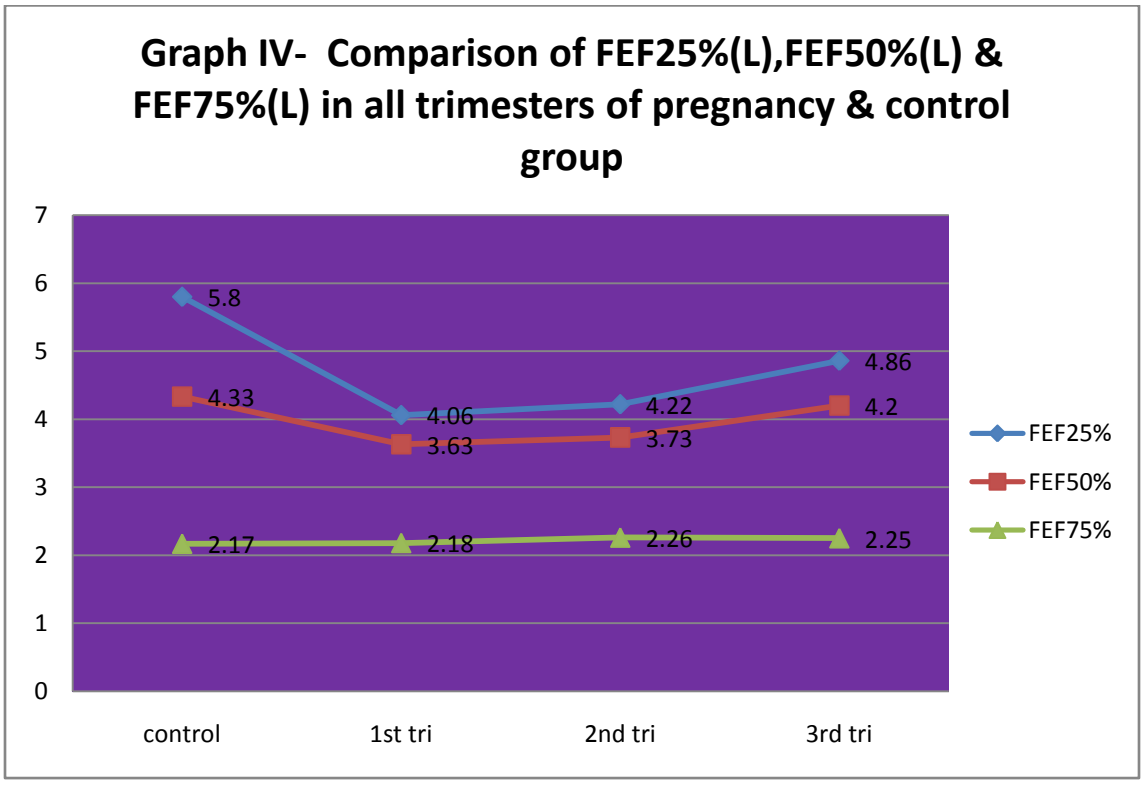
PARAMETERS	CONTROL & 1ST TRIMESTER		CONTROL & 2ND TRIMESTER		CONTROL & 3RD TRIMESTER	
	Z-Value	P-Value	Z-Value	P-Value	Z-Value	P-Value
MV	0.216	0.838	0.041	0.972	0.803	0.426
MVV	8.681	0.002**	8.006	0.002**	8.159	0.002**
DI	3.977	0.002**	3.660	0.002**	4.653	0.002**

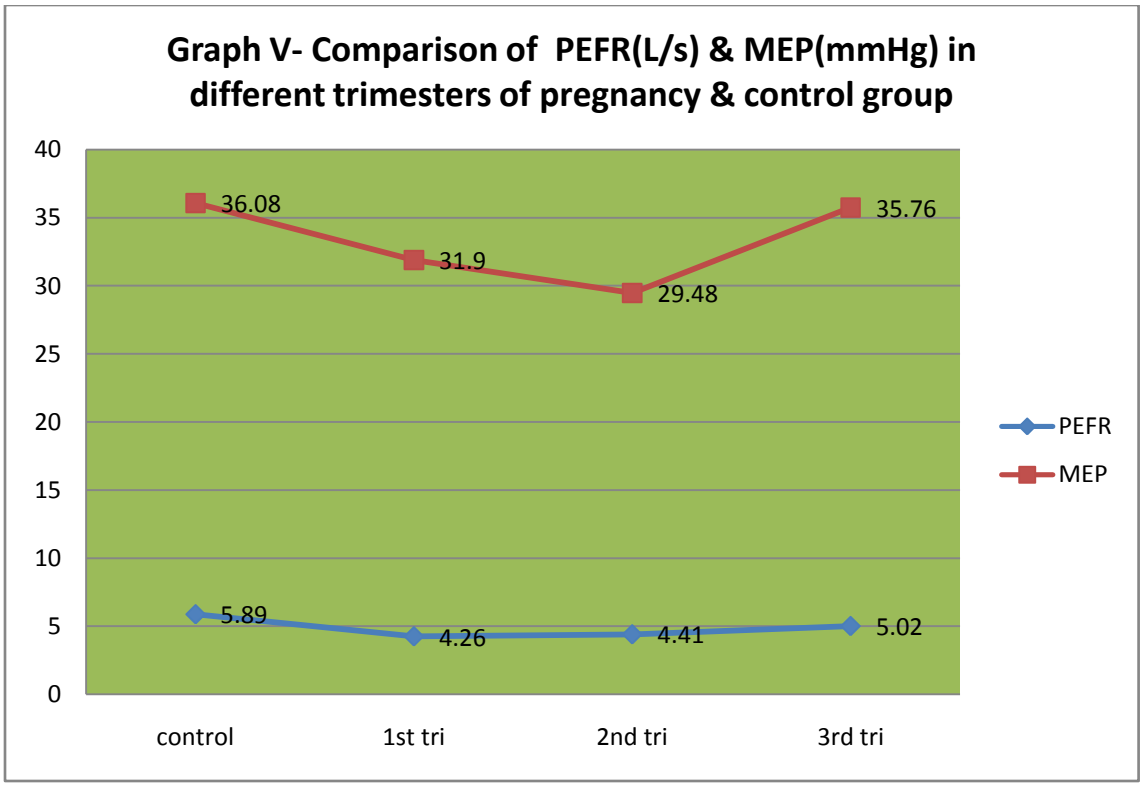
p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

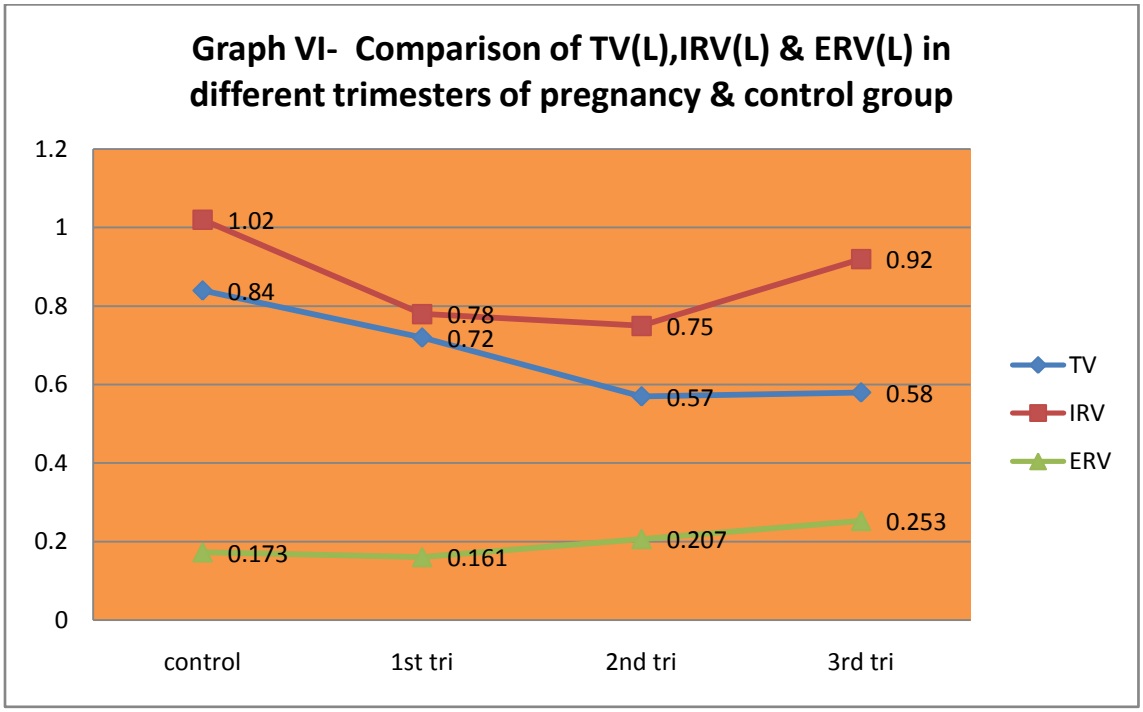

Graph I- Comparison of FVC(L) & FEV1(L) in all trimesters of Pregnancy & Control group
3
2.5
2
1.5
1
0.5
0
2.505
2.247
1.87
1.567
1.856
1.692
2.005
1.784
control
1st tri
2nd tri
3rd tri
FVC
FEV1

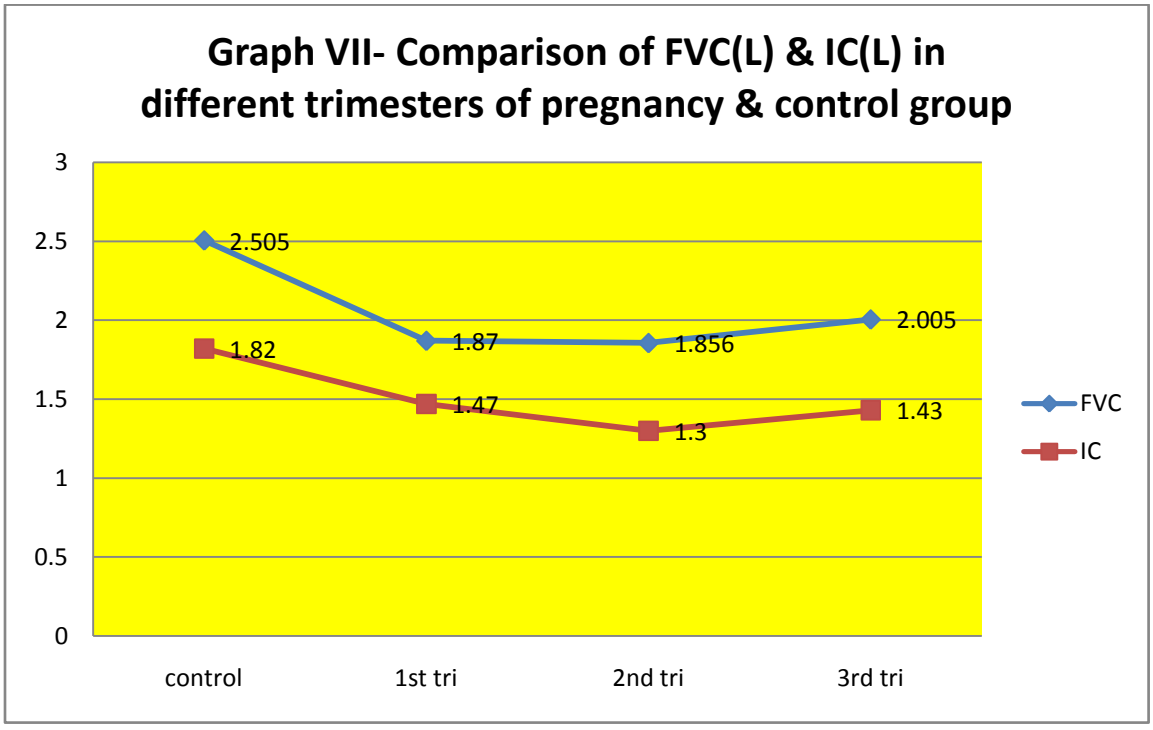

Graph II- Comparison of FEV1%(percent) in all trimesters of pregnancy & control group
93
92
91
90
89
88
87
86
85
84
83
91.94
86.55
92.02
90.32
control
1st tri
2nd tri
3rd tri
FEV1%

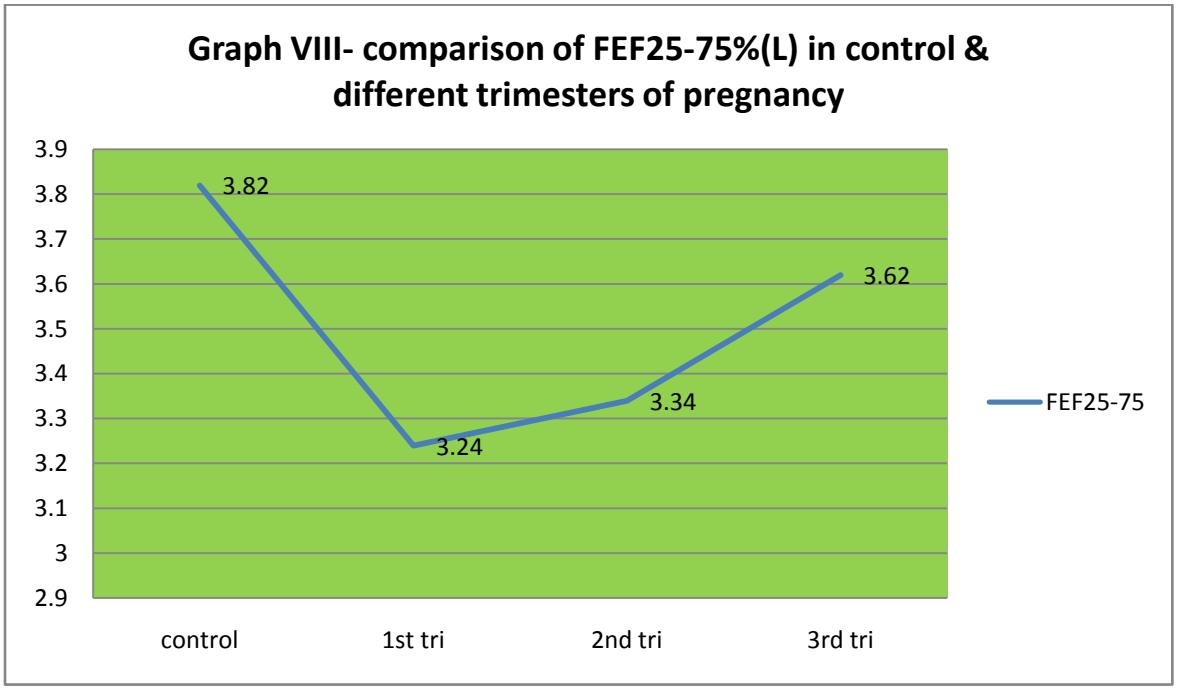

Graph III- Comparison of PEFR(L/s) in all trimesters of pregnancy & control group
7
6
5
4
3
2
1
0
5.89
4.26
4.41
5.02
control
1st tri
2nd tri
3rd tri
PEFR

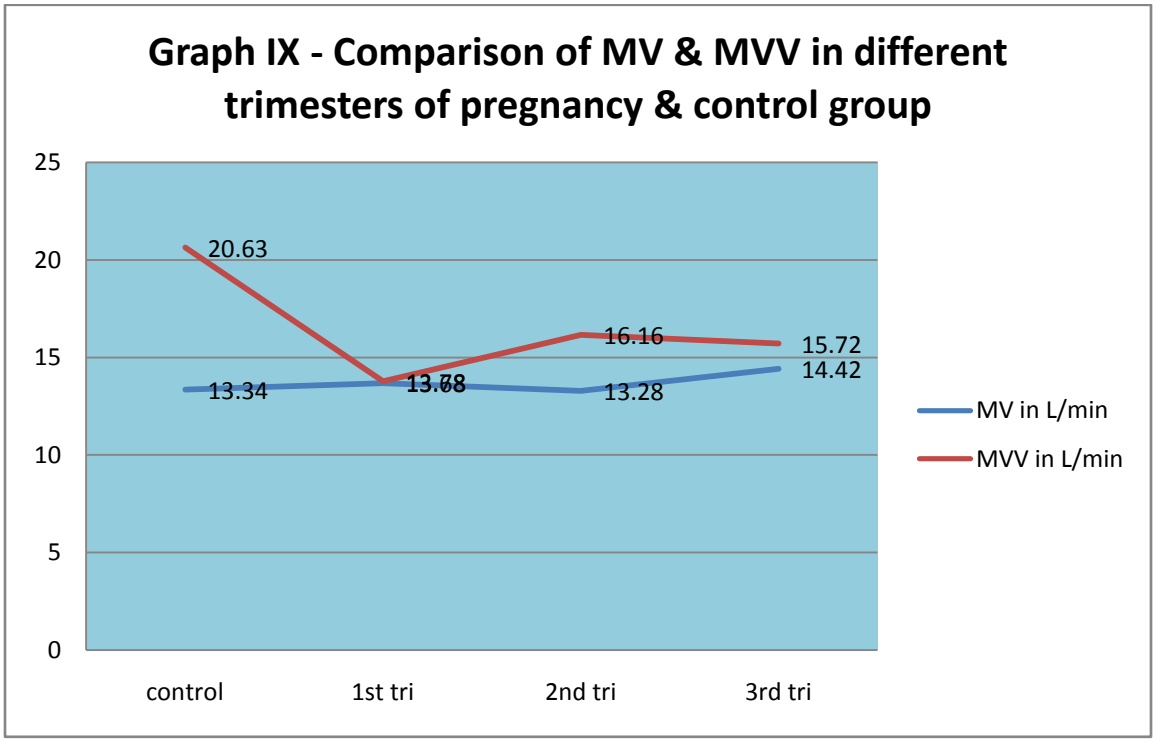

Graph IV- Comparison of FEF25%(L),FEF50%(L) & FEF75%(L) in all trimesters of pregnancy & control group
7
6
5
4
3
2
1
0
5.8
4.06
4.22
4.86
4.33
3.63
3.73
4.2
2.17
2.18
2.26
2.25
control
1st tri
2nd tri
3rd tri
FEF25%
FEF50%
FEF75%

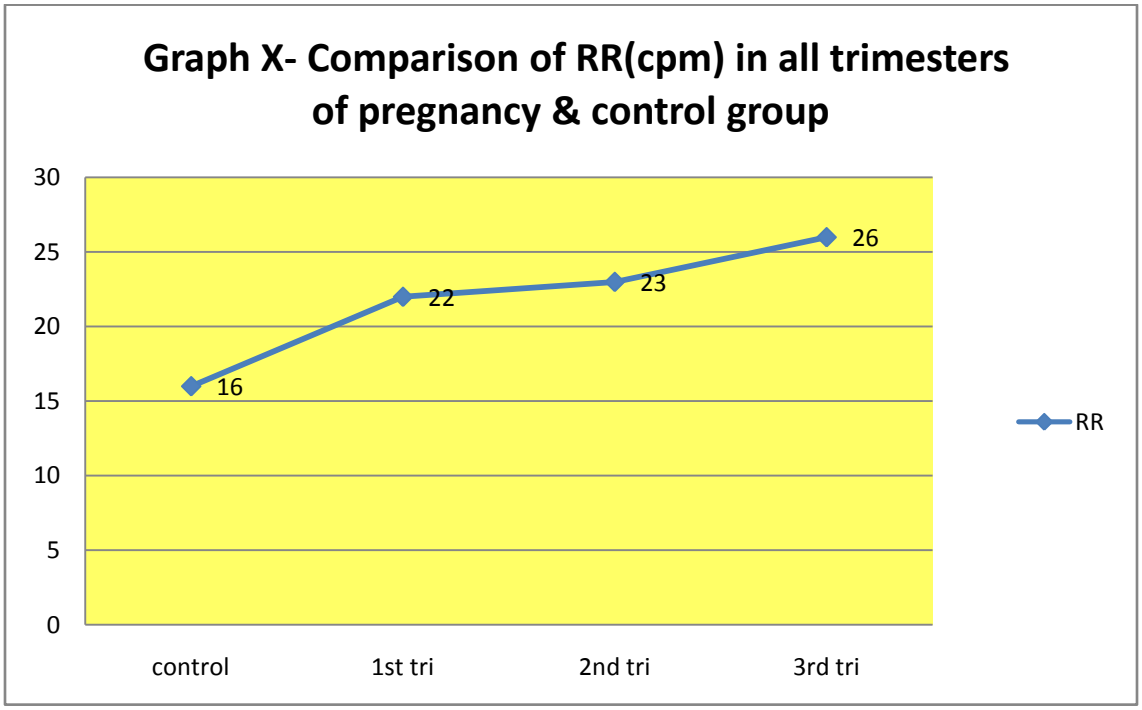

Graph V- Comparison of PEFR(L/s) & MEP(mmHg) in different trimesters of pregnancy & control group
40
35
30
25
20
15
10
5
0
36.08
31.9
29.48
35.76
5.89
4.26
4.41
5.02
control
1st tri
2nd tri
3rd tri
PEFR
MEP


Graph VI- Comparison of TV(L),IRV(L) & ERV(L) in different trimesters of pregnancy & control group
1.2
1
0.8
0.6
0.4
0.2
0
1.02
0.78
0.75
0.92
0.84
0.72
0.57
0.58
0.173
0.161
0.207
0.253
control
1st tri
2nd tri
3rd tri
TV
IRV
ERV


Graph VII- Comparison of FVC(L) & IC(L) in different trimesters of pregnancy & control group
3
2.5
2
1.5
1
0.5
0
2.505
1.87
1.856
2.005
1.82
1.47
1.3
1.43
control
1st tri
2nd tri
3rd tri
FVC
IC


Graph VIII- comparison of FEF25-75%(L) in control & different trimesters of pregnancy
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
3.82
3.24
3.34
3.62
control
1st tri
2nd tri
3rd tri
FEF25-75


Graph IX - Comparison of MV & MVV in different trimesters of pregnancy & control group
25
20
15
10
5
0
20.63
13.34
13.78
16.16
13.28
15.72
14.42
control
1st tri
2nd tri
3rd tri
MV in L/min
MVV in L/min


Graph X- Comparison of RR(cpm) in all trimesters of pregnancy & control group
30
25
20
15
10
5
0
16
22
23
26
control
1st tri
2nd tri
3rd tri
RR

DISCUSSION

A cross-sectional study was carried in 200 healthy women in the age range of 19-35 years of BLDEA's Shri B M Patil Medical College, Hospital and Research Centre, Bijapur. The subjects were distributed in four groups, i.e control (non-pregnant) group and 1^{st}, 2^{nd} &3^{rd} trimester pregnant groups. Number of subjects in each group is 50.

We have recorded various physical, physiological & respiratory parameters in control and study groups.

Physical Parameters

The age matched cross sectional study however shows significant gradual increase in height, weight, BMI & BSA from control to 3^{rd} trimester group. However the variation in the weight, BMI & BSA are attributable to the pregnancy [54].

Physiological Parameters

There is significant change in pulse rate in subjects of all trimesters by 3bpm when compared to control group.

The study revealed a significant decrease in SBP & DBP in the 2^{nd} trimester of pregnancy compared to control group and also when compared to 1^{st} and 3^{rd} trimesters of pregnancy.

As per literature from text book on physiology of human pregnancy by Hyttenn FE,Leitch I, in the normal course of pregnancy, the blood pressure during the first few months is similar to that of pre-pregnant women. During the middle 3 months of gestation, the blood pressure tends to fall by an average of 3-5mm Hg. Sometimes, the drop may be up to 20-30 mm Hg[15]

As observed by Duvekott J & collegues the blood pressure both SBP and DBP tend to fall in early pregnancy reach nadir in the second trimester of pregnancy and return towards pre-pregnant level at term. Fall in blood pressure is due to fall in systemic vascular resistance. The overall decrease in vascular tone in response to a yet unknown endocrine stimulus represents the very first adaptive change in cardiovascular system giving rise to both an increased vascular capacity and a decreased filling state. In early pregnancy, an overall decrease in vascular tone leading to a systemic vasodilatation and rise in arterial compliance. The arterial blood pressure and vascular resistance tend to normalize during the 3rd trimester of pregnancy.[55]

Respiratory parameters :

Respiratory Rate:

In our study, there is significant increase in respiratory rate from 1st trimester to 3rd trimester of pregnancy as compared to control group which is in agreement with Bernhard H Heidemann, who state that $PaCO_2$ falls and then levels off at 4.1kPa (31mmHg) by the end of the first trimester. This is caused by a 10% increase in the respiratory rate, secondary to progesterone mediated hypersensitivity to CO_2, and an increase in alveolar and minute ventilation, secondary to increased respiratory rate and tidal volume[56].

Forced vital capacity :

Our study showed significant decrease in FVC from 1st trimester to 3rd trimester as compared to control which is in agreement with other workers. The decrease in FVC is maximum in first trimester which may be attributable to hormonal changes which requires further studies.

A study of forced vital capacity in pregnant women by Dipok Kumar Sunyal and workers showed reduced FVC in all trimesters as compared to control & maximum decrease in third trimester. The decrease in FVC is attributable to the mechanical pressure of enlarging gravid uterus, elevating the diaphragm & restricting the movements of lungs thus hampering the forceful expiration[45].

A study by Deepal & workers showed no significant changes in FVC during all trimesters of pregnancy . Hormonal alteration in pregnancy causes a reduction in the tracheo-bronchial smooth muscle tone & the increasing thoracic width may be due to enlarging uterus as a result there is no impairment in large airway function throughout pregnancy[48].

FEV1:

Our study showed significant decrease in FEV1 from 1st trimester to 3rd trimester as compared to control which is in agreement with other workers. The decrease in FEV1 is maximum in first trimester which may be attributable to hormonal changes, which requires further studies.

A study by Neeraj & workers showed decrease in FEV1 in third trimester as compared to control group. The decrease in FEV1 may be due to a decline in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor. Hormonal influences also play a role in altering & compromising the FEV1[49].

In a study by Mrunal Phatak & others, there was no significant change in FEV1 & they claimed that it was due to progesterone, corticosteroids & relaxin during pregnancy which cause certain degree of bronchodilatation due relaxation of muscles[13].

FEV1% :

Our study showed significant decrease in FEV1% from 1st trimester to 3rd trimester as compared to control which is in agreement with other workers. The decrease in FEV1% is maximum in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels.

In a study by Neeraj & coworkers, there was decrease in FEV1% in third trimester as compared to control, the decrease was attributable to decrease in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor. Hormonal influences also play a role in altering & compromising the FEV1%[49].

In a study by Mrunal Phatak & others, there was no significant change in FEV1% & they claimed that it was due to progesterone, corticosteroids & relaxin during pregnancy which cause certain degree of bronchodilatation due relaxation of muscles[13]

PEFR :

Our study showed significant decrease in PEFR from 1st trimester to 3rd trimester as compared to control & maximum decrease is seen in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels.

As per studies on PEFR by Neeraj & workers , there was decrease in PEFR in third trimester & decrease was attributable to the decline in alveolar Pco_2 which acts as bronchoconstrictor. Also the decrease in PEFR could be due to lesser force of contraction of main expiratory muscles like the anterior abdominal wall muscles & internal intercostals muscles[49].

A work on PEFR by Sunyal DK et al there was decrease in PEFR in all trimesters of pregnancy which is significant in 2nd & 3rd trimesters of pregnancy. The cause for the

decrease was more likely due to lesser force of contraction of the expiratory muscles like anterior abdominal muscles & internal intercostals muscles in this state [13,57]. Moreover, progressively reduced value of PEFR in three trimesters of pregnancy may be attributed to the mechanical effects of enlarged gravid uterus reducing vertical dimension by limiting movement of diaphragm[42]. In addition some degree of obstruction to the expiratory flow, especially late in pregnancy also contributes[58]. Some studies suggest, inadequate nutrition due to morning sickness, altered eating habits associated with advancing gestation that resulted in muscular weakness & the lesser force of contraction of main expiratory muscles[46].

A study by Leo R. Brancazio & workers showed that PEFR does not change with pregnancy. Not only are the absolute mean peak expiratory flow rates similar at all four times, but the mean normalized peak expiratory flow rates (calculated by using formula PEFR (L/min) = 198.07 + 3.07 age – 0.0477 age^2 + 3.6 height) in all groups are close to unity [46].

FEF25-75%:

Our study showed significant decrease in FEF25-75% from 1st trimester to 3rd trimester as compared to control with maximum decrease in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels which requires further studies.

In a study by Rupa .M & workers the values of MMF (maximal mid expiratory flow) were significantly lower in first trimester compared to control [9].

In a study by Neeraj & workers there was decrease in the FEF25-75% in the third trimester of pregnancy. The decrease was due to decrease in alveolar Pco_2 caused by

hyperventilation which acts as bronchoconstrictor. Hormonal influences also play a role in altering & compromising the FEF25-75%[49].

FEF25%:

Our study showed significant decrease in FEF25% from 1st trimester to 3rd trimester as compared to control with maximum decrease in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels.

In a study by Savita singh & others there was decrease in FEF25% in second trimester on comparison with third trimester. The cause was assumed to be that the fetal bulk imposes a greater restriction on breathing pregnant women Indian population who are generally anthropometrically diminutive compared to their western counterparts[19].

In a study by Emilia Kolarzyk & workers showed that there is no statistical significant change in FEF25%[12].

FEF50%:

Our study showed significant decrease in FEF50% from 1st trimester to 3rd trimester as compared to control with maximum decrease in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels.

In a study by Savita singh & others there was decrease in FEF50% in second trimester on comparison with third trimester. The cause was assumed to be that the fetal bulk imposes a greater restriction on breathing pregnant women Indian population who are generally anthropometrically diminutive compared to their western counterparts[19].

In a study by Emilia Kolarzyk & workers showed no significant change in FEF50%[12].

FEF75%:

Our study showed significant decrease in FEF75% from 1st trimester to 3rd trimester as compared to control with maximum decrease in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels.

In a study by Savita singh & others there was decrease in FEF75% in second trimester on comparison with third trimester. The cause was assumed to be that the fetal bulk imposes a greater restriction on breathing pregnant women Indian population who are generally anthropometrically diminutive compared to their western counterparts.[19]

In a study by Emilia Kolarzyk & workers showed no significant change in FEF75%[12].

Tidal Volume:

Our study showed significant decrease in TV from 1st trimester to 3rd trimester as compared to control with maximum decrease in 2nd trimester.

In contrast to our study, in a study by Emilia Kolarzyk & workers, there was increase in the tidal volume in all trimester. The increase in tidal volume is due to increase in carbondioxide tension & reflected a fall in systemic arterial blood CO_2 tension[12].

IRV:

Our study showed significant decrease in IRV from 1st trimester & 2nd trimester as compared to control.

ERV:

Our study showed insignificant change in ERV from 1st trimester to 3rd trimester as compared to control.

In contrast to our study, Mrunal phatak & Kurhade showed decrease in the ERV from middle half of second trimester by approximately 20% at term. They attributed the decline in ERV observed during pregnancy might have occurred due to decreased negativity of intrapleural pressure brought about by upward displacement of diaphragm by enlarged uterus. Another important cause for the decline is attenuation or reduction in contraction power of expiratory muscles due to the stretching of the abdominal wall with the progress of pregnancy[13].

IC:

Our study showed significant decrease in IC from 1st trimester to 3rd trimester as compared to control with maximum decrease in 2nd trimester.

In contrast to our study, Mrunal phatak & Kurhade showed increase in the IC during pregnancy due to mechanical changes in thoracic cage increasing its volume [46,59]. Another possible cause is the heightened response to nervous stimuli because intensity & duration of nervous stimuli required to produce muscular contraction are shortened during pregnancy [13,60].

MEP:

Our study showed significant decrease in MEP from 1st trimester to 3rd trimester as compared to control with maximum decrease in 2nd trimester.

MV:

Our study showed insignificant increase in MV from 1st trimester to 3rd trimester as compared to control group.

Contreras et al also demonstrated that during pregnancy ventilatory drive & respiratory impedance increased with consequent stabilization of MV[61].

In contrast to our study, a study by Emilia Kolarzyk & workers showed increase in MV during pregnancy. It is worth pointing out that the increase in MV was caused by a significant increase in VT (tidal volume) [12].

A study by Aaron P & workers showed increase in MV in pregnancy may also be due to changes in osmolality , (SID)strong ion differences & angiotensin II levels, which have been implicated in the control of ventilation [62].

MVV:

Our study showed significant decrease in MVV in all trimesters as compared to control group with maximum decrease in 1st trimester.

A study by Usha Monga & Kanta Kumari, showed progressively decline in MVV during different trimesters of pregnancy. They have attributed the decline in the first trimester to morning sickness (lack of nutrition) and to lodging of trophoblast cell in the alveoli from the maternal uterine sinuses [2]. Whereas in the 2nd and 3rd trimester, it may be due to mechanical pressure of enlarging gravid uterus, elevating the diaphragm and restricting the movements of lungs [2,63] and thus hampering the forceful expiration. It may also be due to bronchoconstriction effect of decreased alveolar Pco_2 on the bronchial smooth muscles [50,64].

Dyspnoeic Index (DI):

Our study showed significant decrease in DI in all trimesters as compared to control group (DI – 79.35 ± 13.82 %) with maximum decrease in 2nd trimester.

The decrease in the DI shows that pregnant women in all trimesters are dyspnoeic[36] on exertion, but some individuals showed negative DI indicating dyspnoea at rest in all trimesters. The prevalence of individual with negative DI is maximum of 7 women in 2ndtrimester compared to 3women & 4women in 1st & 3rd trimester respectively with nil in control group.

CONCLUSION

A cross-sectional study was carried in 200 healthy women in the age range of 19-35 years of BLDEA's Shri B M Patil Medical College, Hospital and Research Centre, Bijapur. The subjects were distributed in four groups, i.e control (non-pregnant) group and 1^{st}, 2^{nd} & 3^{rd} trimester pregnant groups. Number of subjects in each group is 50.

We have recorded various physical, physiological & respiratory parameters in control and study groups. We conclude from our study that:

- There was a statistically significant decrease in SBP & DBP in all trimesters of pregnancy when compared to non pregnant women with maximum decrease in 2^{nd} trimester & decrease might be due to fall in systemic vascular resistance. The overall decrease in vascular tone in response to a yet unknown endocrine stimulus represents the very first adaptive change in cardiovascular system giving rise to both an increased vascular capacity and a decreased filling state.
- The significant increase in RR by 4 cpm might be due to sensitization of respiratory centre due to progesterone is compensated by decrease in TV ultimately maintaining the constant MV even during all trimesters of pregnancy.
- The significant decrease in FVC, FEV1, FEV1%, PEFR, FEF25-75%, FEF25%, FEF50% & FEF75% might be due to the mechanical pressure of enlarging gravid uterus, elevating the diaphragm & restricting the movements of lungs thus hampering the forceful expiration and maximum decrease in 1^{st} trimester due to decline in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor.

- The statistical significant decrease in PEFR & MEP in all trimesters might be due to decrease in expiratory muscle power.
- The statistical significant decrease in IC & IRV in all trimesters might be due to decrease in inspiratory muscle power.
- Even though normal MV tries to maintain the respiratory need of pregnancy at rest, at increased physiological needs of respiration as during any exercise the decreased MVV(along with decrease in inspiratory & expiratory muscle weakness) makes her dyspnoeic.
- To establish the cause of decrease in respiratory parameters more in first trimester of pregnancy than in 2^{nd} & 3^{rd}, further longitudinal studies are to be done on acid-base balance, hormonal assay in different trimesters to know the possible compensatory mechanism.

SUMMARY

The study entitled "A study of pulmonary function tests of women at different trimesters of pregnancy" was conducted in the Department of Physiology, BLDEU's Shri B M Patil Medical College, Hospital and Research centre, Bijapur during 2010-2011. The aim of the study was to know pulmonary function changes in pregnant women in 1st, 2nd and 3rd trimesters of pregnancy and in age matched non pregnant women and to compare the results between and within them.

The cross-sectional study was carried in 200 healthy pregnant women. The study group was in turn divided into 3 subgroups each with 50 women in first, second and third trimesters of pregnancy and 50 healthy non pregnant women in the age group of 19-35 years were selected randomly who were attending the OPD of OBGy of Shri B.M. Patil Medical College, Hospital and Research centre, Bijapur.

Evaluation of pulmonary function tests was done in consultation with statistician and the following parameters were evaluated FVC, FEV1,FEV1%, PEFR, FEF25-75%, FEF25%, FEF50%, FEF75%, TV, IRV, ERV, IC, MVV,MV, MEP, RR & BP. Mean values were compared using Z statistics. P value of 0.05 was considered as significant. It was observed & concluded that

- There was a statistically significant decrease in SBP & DBP in all trimesters of pregnancy when compared to non pregnant women with maximum dercease in 2nd trimester & decrease might be due to fall in systemic vascular resistance. The overall decrease in vascular tone in response to a yet unknown endocrine stimulus represents the very first adaptive change in cardiovascular system giving rise to both an increased vascular capacity and a decreased filling state.

- The significant increase in RR by 4 cpm might be due to sensitization of respiratory centre due to progesterone is compensated by decrease in TV ultimately maintaining the constant MV even during all trimesters of pregnancy.
- The significant decrease in FVC, FEV1, FEV1%, PEFR, FEF25-75%, FEF25%, FEF50% & FEF75% might be due to the mechanical pressure of enlarging gravid uterus, elevating the diaphragm & restricting the movements of lungs thus hampering the forceful expiration and maximum decrease in 1^{st} trimester due to decline in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor.
- The statistical significant decrease in PEFR & MEP in all trimesters might be due to decrease in expiratory muscle power.
- The statistical significant decrease in IC & IRV in all trimesters might be due to decrease in inspiratory muscle power.
- Even though normal MV tries to maintain the respiratory need of pregnancy at rest, at increased physiological needs of respiration as during any exercise the decreased MVV(along with decrease in inspiratory & expiratory muscle weakness) makes her dyspnoeic.
- To establish the cause of decrease in respiratory parameters more in first trimester of pregnancy than in 2^{nd} & 3^{rd}, further longitudinal studies are to be done on acid-base balance, hormonal assay in different trimesters to know the possible compensatory mechanism.

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ANNEXURE -1

B.L.D.E.UNIVERSITY'S

SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103

INSTITUTIONAL ETHICAL COMMITTEE

Dr.Vijay.Ganjoo,
Chairperson. I.E.C.
B.L.D.E.University's
Sri.B.M.Patil Medical College,
BIJAPUR-586 103

Ethical Committee BIJAPUR-586103 OUT WARD No 66109 Date 29/10/09 Shri B. M. PATIL Med cal College

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 26-10-2009 at 03-15pm to scrutinize the Synopsis/Research projects of post graduate student/undergraduate student/Faculty members of this college from ethical clearance point of view. After scrutiny the following original/corrected & revised version Synopsis of the Thesis/Research project has been accorded Ethical Clearance.

Title A Study of pulmonary functions of women at different trimesters of Pregnancy in BLDE(U)'S, Shri. B.M. Patil Medical college Hospital.

Name of P.G /U.G. student/ Faculty member. Dr. Anita Teli
Dept of Physiology.

Name of Guide. Dr(Mrs) Asha A. Kharavadkar Prof

Dr.Vijay Ganjoo,
Chairperson,
Institutional Ethical Committee

Date:

Following documents were placed before E.C. for securitization:
1) Copy of Synopsis/Research Project.
2) Copy of informed consent form.
3) Any other relevant document/s

ANNEXURE–2

RESEARCH INFORMED CONSENT FORM

B. L. D. E UNIVERSITY, SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, BIJAPUR

RESEARCH INFORMED CONSENT FORM

Title of the Project:

"A STUDY OF PULMONARY FUNCTIONS OF WOMEN AT DIFFERENT TRIMESTERS OF PREGNANCY IN BLDEU'S SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL"

Principal investigator/ P.G.Guide's name: **DR. ASHA DHARWADKAR MD**

PROFESSOR,

DEPARTMENT PHYSIOLOGY.

1: PURPOSE OF RESEARCH: I have been informed that this study will test influence of age on cardiovascular autonomic functions. This study will be useful academically as well as for clinically to interpret ECG findings in different trimesters of pregnancy and control group.

2: PROCEDURE: I understand that, the procedure of the study will involve recording of various physiological physical parameters. The procedure will not interfere with any of my physiological parameters and they are noninvasive.

3: RISK AND DISCOMFORTS: I understand determination of ECG changes will not cause any discomfort to me and do not involve any risk to my health.

4: BENEFITS: I understand that my participation in the study may not have a direct benefit to me but this may have a potential beneficial effect in the field of electrocardiography changes in future.

5: CONFIDENTIALITY: I understand that medical information produced by this study will become part of institutional records and will be subject to the confidentiality and privacy regulation of the said institute. Information of a sensitive personal nature will not be a part of medical record, but will be stored in investigators research file and identified only by a code number. The code key connecting name two numbers will be kept in a separate secured location.

If the data are used for publication in the medical literature and for teaching purposes no names will be used and other identities such as photographs, audio and video tapes will be used only with my special written permission. I understand I may see the photographs and the video tapes and have the audio tapes before giving this permission.

6: REQUEST FOR MORE INFORMATION: I understand that I may ask more questions about the study at any time. Concerned researcher is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of this study which might influence my continued participation. If during the study or later, I wish to discuss my participation in all concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me. A copy of this consent form will be given to me to keep for careful re-reading.

7: REFUSAL OR WITHDRAWAL OF PARTICIPATION: I understand that my participation is voluntary and may refuse to participate or may withdraw my consent and discontinue participation in the study at any time without prejudice to my present or future care at this hospital. I also understand that researcher may terminate my participation in this study at any time after she/he has explained the reasons for doing so

and had helped arrange for my continued care by my physician or physical therapist if this is appropriate.

8: INJURY STATEMENT: I understand that in unlikely event of injury to me resulting directly from my participation in this study, if such injury were reported promptly, then medical treatment will be available to me, but no further compensation would be provided. I understand that by my agreement to participate in this study I am not waiving any of my legal rights.

I have explained to _____ (Patient/Relevant guardian)

the purpose of the research, procedures required and the possible risk and benefits to the best of my ability.

Investigator/ PG (Guide) Date

I confirm that _____ (Name of the P.G. Guide /Chief researcher) has explained to me the purpose of research, the study procedure that I will undergo, and the possible risk and discomforts as well as benefits that I may experience. Alternative to my participation in the study have also been to give my consent from. Therefore I agree to give consent to participate as a subject and this research project.

Participant / Guardian Date:

Witness to signature Date:

Modified from Portney L.G, Watkins M.P., in Foundation of Clinical Research, Second Edition, New Jersey, Prentice Hall Health 2000

ANNEXURE – 3

PROFORMA

BLDEU's SHRI B.M.PATIL MEDICAL COLLEGE, BIJAPUR
DEPARTMENT OF PHYSIOLOGY

A study of pulmonary functions of women at different trimesters of pregnancy in BLDEU's Shri B.M.Patil Medical College Hospital.

Name ……..Age in years……Sex……

Religion/Caste:……Address……

……

……

……

Occupation: …….

Past History: H/o of any Chronic Respiratory disorders like Asthma, COPD, H/o Smoking.

I) Physical Parameters

1. Height (cms) :
2. Weight (kgs) :
3. BMI (kg/m^2) :
4. BSA($m^{2)}$:

II) Physiological Parameters

1. Pulse Rate :
2. Blood Pressure :
3. Respiratory Rate :

III) Pulmonary Function Parameters

	I	II	III	Highest Reading
01. Vital Capacity (L)				
02. FEV1 (L)				
03. FEV1 (%)				
04 PEFR (Ltrs/s)				
05.FEF25-75				
06. FEF25%(L/s)				
07. FEF50%(L/s)				
08. FEF75%(L/s)				
09 TV(L)				
10.IRV(L)				
11.ERV(L)				
12 IC(L)				
13.MEP (mmHg)				
14. MV (L/min)				
15. MVV (L/min)				
16. DI (%)				

IV) Trimester: ……

Signature of Guide Signature of PG student Signature of HOD

ANNEXURE 4a: MASTER CHART - CONTROL GROUP

Sl.NO	Age	Ht	Wt	BMI	BSA	PR	SBP	DBP	PP	RR	FVC(L)	FEV1(L)	FEV1(%)	PEFR(L/s)	FEF25-75(L/s)	FEF25%(L/s)	FEF50%(L/s)	FEF75%(L/s)	TV(L)	IRV(L)	ERV(L)	IC(L)	MEP(mmHg)	M V	M V V	DI
1	35	165	67	24.63	1.74	80	120	70	50	12	2.25	2.11	93.78	6.11	3.54	5.93	3.69	2.08	0.7	1.23	0.22	1.93	60	8.4	57.5	85.39
2	33	150	50	22.22	1.93	74	120	82	38	14	2.43	2.33	95.88	7.56	5.01	7.56	5.9	2.73	0.56	1.29	0.28	1.85	40	7.84	83.5	90.61
3	35	147	53	24.54	1.45	70	124	88	36	12	1.53	1.44	94.12	4.34	2.61	4.34	2.98	1.33	0.37	0.05	0.03	0.42	40	4.44	47.5	90.65
4	35	162	52	19.82	1.54	78	126	84	42	16	2.02	1.93	95.54	10.09	4.96	10.09	5.87	2.89	0.75	0.84	0.62	1.59	22	12	62.25	80.72
5	26	151	49	21.49	1.93	80	120	74	46	22	2.6	2.32	89.23	5.97	3.52	5.96	3.91	1.87	1.09	1.5	0.06	2.59	70	23.98	109	78
6	27	161	56	21.62	1.58	74	118	80	38	13	2.58	2.37	91.86	6.28	4.09	6.28	4.17	2.93	0.95	1.7	0.14	2.65	40	12.35	80.4	84.63
7	35	156	69	28.4	1.69	80	120	86	34	12	2.58	2.28	88.37	5.97	3.38	5.79	3.73	1.8	1.04	1.61	0.51	2.65	30	12.48	49.5	74.78
8	26	157	58	23.58	1.58	80	120	80	40	14	2.45	2.18	88.98	6.4	3.69	6.24	4.46	1.64	0.4	0.14	0.08	0.54	20	5.6	69.65	91.95
9	28	160	56	21.88	1.58	74	120	82	38	18	3.03	2.6	96.44	7.06	5.21	7.06	5.06	3.96	2.05	1.44	0.08	1.97	50	36.9	72.8	49.31
10	26	156	52	21.4	1.5	80	120	84	36	14	2.76	2.36	89.63	6.18	3.33	6.18	3.67	1.72	0.78	1.89	0.38	2.67	30	10.92	73.2	85.08
11	35	155	64	26.67	1.63	78	120	74	46	22	2.45	2.26	92.83	6.24	4.47	6.02	5.08	2.54	0.87	1.64	0.21	2.51	30	19.14	48	60.12
12	20	147	49	22.69	1.4	76	110	78	32	13	1.98	1.83	92.47	4.98	3.33	4.98	3.6	1.9	0.31	0.02	0.06	0.33	20	4.03	90.2	95.53
13	20	162	56	21.37	1.59	17	120	82	38	12	2.31	2.12	93.39	5.42	3.82	5.41	4.32	2.19	0.45	0.74	0.03	1.52	22	5.4	48.95	88.96
14	19	162	50	19.08	1.51	75	110	74	36	14	2.49	2.29	92.71	5.86	3.58	5.86	3.75	2.04	0.9	0.98	0.06	1.83	26	12.6	77.2	83.6
15	19	155	50	20.83	1.47	74	120	82	38	12	3.23	2.78	86.07	5.96	3.81	5.93	4.56	2.56	1.23	0.82	0.13	2.05	24	14.76	79.8	81.5
16	20	164	64	24.24	1.7	74	120	80	40	15	2.53	2.33	92.12	5.29	3.67	5.25	4.06	2.17	0.31	0.08	0.08	0.33	22	4.65	94	95.05
17	35	162	80	30.53	1.85	76	110	76	34	12	2.94	2.71	92.18	8.73	4.78	8.73	5.17	2.42	1.33	1.45	0.17	2.78	60	15.96	97.9	83.69
18	19	160	65	25.39	1.68	74	120	82	38	20	2.09	1.94	94.61	4.18	3.32	4.01	3.77	2.01	0.33	0.84	0.11	1.09	60	6.6	57.6	88.54
19	19	160	66	25.78	1.69	74	120	82	38	22	3.62	2.96	83.15	6.79	3.9	6.04	4.44	2.11	0.93	2.34	0.13	3.27	46	20.46	82.2	75.1
20	19	157	86	34.96	1.86	75	120	76	44	15	3.23	2.89	91.17	8.37	5.55	8.24	7.12	2.56	0.49	0.03	0.05	0.52	50	7.35	130.35	94.36
21	20	153	54	22.22	1.5	89	106	80	26	15	2.6	2.16	88.41	4.46	3.46	4.45	4.24	2.19	1.33	1.28	0.43	2.34	24	19.95	78.3	74.52
22	19	161	53	20.46	1.55	70	92	68	24	15	2.49	2.19	90.12	6.11	3.71	6.11	4.23	1.83	1.12	1.26	0.6	2.38	22	16.8	49.75	66.23
23	20	169	65	22.73	1.75	75	106	70	36	16	2.45	2.21	91.7	5.05	3.21	4.98	3.41	1.94	0.9	1.89	0.13	2.79	48	14.4	75.15	80.83
24	20	162	68	25.95	1.73	74	120	76	44	18	2.29	2.25	99.12	6.18	4.72	6.02	5.05	3.08	0.46	0.19	0.03	0.65	20	8.28	72	88.5
25	28	160	60	23.44	1.62	74	112	78	34	12	2.56	2.25	87.89	6.88	3.7	6.74	4.53	1.63	0.86	1.04	0.09	1.9	40	10.32	85.95	87.99

Sl.NO	Age	Ht	Wt	BMI	BSA	PR	SBP	DBP	PP	RR	FVC(L)	FEV1(L)	FEV1(%)	PEFR(L/s)	FEF25-75(L/s)	FEF25%(L/s)	FEF50%(L/s)	FEF75%(L/s)	TV(L)	IRV(L)	ERV(L)	IC(L)	MEP(mmHg)	M V	M V V	DI
26	27	156	47	19.34	1.44	78	118	82	36	14	2.64	2.42	91.67	7.15	3.98	7.01	4.56	1.98	2.02	1.29	0.22	3.31	80	28.28	97	70.84
27	20	169	72	25.17	1.82	84	120	84	36	20	2.66	2.17	82.2	4.82	2.66	4.76	2.84	1.33	1.66	1.77	0.09	3.43	40	33.2	80.55	58.78
28	19	162	59	18.7	1.5	74	116	72	44	18	2.53	2.35	93.13	5.84	3.89	5.77	4.21	2.19	1.34	0.51	0.3	1.85	40	24.12	76	68.26
29	22	160	60	23.44	1.62	72	118	80	38	14	3	2.75	91.67	5.77	4.4	5.72	5.22	2.47	0.29	1.78	0.09	2.07	30	4.06	97	95.81
30	22	150	56	24.8	1.5	74	118	84	34	14	2.19	1.87	85.58	4.82	2.61	4.73	3.14	1.33	0.49	1.55	0.05	2.04	20	6.86	45.45	84.9
31	22	162	55	20.9	1.58	72	110	80	30	18	2.78	2.5	91.23	6.33	3.73	6.24	4.19	2.07	0.61	0.96	0.05	1.57	26	10.98	65.45	83.22
32	23	159	60	23.72	1.55	80	110	70	40	14	2.49	2.28	91.57	5.2	3.49	5.2	4.01	1.99	0.88	1.33	0.11	2.21	30	12.32	27	54.37
33	20	165	64	23.53	1.7	74	120	80	40	15	2.49	2.28	91.57	5.2	3.48	5.1	3.88	1.99	0.69	1.69	0.13	2.38	40	10.35	89	88.37
34	19	167	75	26.88	1.84	78	110	78	32	16	2.8	2.58	98.08	5.68	4.47	5.66	5.07	2.53	1.27	1.36	0.08	2.63	44	20.32	55.2	63.18
35	19	154	47	19.83	1.42	84	88	54	34	22	2.9	2.62	90.34	6.43	4.17	6.43	4.77	2.19	1.18	0.8	0.58	1.85	20	25.96	90.75	71.39
36	19	160	76	29.69	1.79	74	110	74	36	12	1.94	1.69	91.11	3.62	2.51	3.62	3.12	0.94	0.46	0.99	0.24	1.45	32	5.52	87.5	93.69
37	19	160	52	20.31	1.53	76	114	76	38	14	2.88	2.5	89.93	5.12	3.96	5.12	4.64	2.21	1.06	0.16	0.11	1.22	60	14.84	41.6	64.32
38	19	164	73	27.14	1.79	74	108	76	32	18	2.39	2.34	97.91	6.13	4.94	6.04	5.47	3.25	0.76	0.39	0.05	1.15	40	13.68	53.55	74.45
39	19	160	60	23.44	1.62	76	100	76	24	12	2.54	2.29	90.16	5.91	3.82	5.9	4.51	1.94	0.7	0.05	0.02	0.75	30	8.4	94.05	91.06
40	19	155	60	25	1.59	76	114	68	46	17	2.74	2.37	88.02	5.26	3.53	5.21	4	1.89	1.3	1.42	0.16	2.72	42	22.1	28.8	23.26
41	20	162	57	21.76	1.6	82	110	76	34	13	2.78	2.5	89.93	6.4	4.18	6.27	5.2	2.06	0.45	0.03	0.02	0.48	40	5.85	90	93.5
42	35	154	70	29.54	1.68	80	120	80	40	20	2.27	2.01	88.55	5.7	3.01	5.38	3.46	1.45	0.86	1.04	0.08	1.9	52	17.2	73	76.43
43	35	156	45	18.52	1.41	80	120	80	40	20	1.8	1.71	95	5.07	3.53	5.07	3.99	1.9	0.67	0.13	0.14	0.8	30	13.4	45.85	70.77
44	26	154	48	20.25	1.43	74	118	74	44	14	2.11	1.11	93.28	4.51	2.94	4.51	3.16	1.72	1.01	1.59	0.19	2.6	30	14.14	66.6	78.76
45	23	156	50	20.58	1.47	80	122	82	40	18	1.94	1.83	94.33	5.57	3.63	5.52	4.15	1.78	0.45	0.55	0.16	1	30	8.1	64	87.34
46	22	157	47	19.11	1.44	86	120	80	40	16	1.82	1.75	97.73	5.41	4.52	5.2	5.12	3.39	0.63	0.9	0.28	1.51	22	10.08	54.75	81.58
47	23	162	45	17.18	1.45	82	120	80	40	16	2.35	2.18	93.89	4.46	3.22	4.36	3.58	2.14	0.93	1.31	0.24	1.76	30	14.88	70.2	78.8
48	24	158	51	20.4	1.5	80	114	70	44	18	2.04	1.95	95.59	4.82	3.48	4.82	3.76	2.18	0.5	0.8	0.19	1.2	30	9	51.5	82.52
49	25	161	54	20.85	1.7	74	120	80	40	14	2.8	2.5	98.15	5.94	3.95	5.86	4.52	2.23	0.73	1.33	0.08	2.06	20	10.22	76	86.55
50	25	165	64	23.53	1.7	72	120	84	36	14	2.9	2.71	94.76	7.24	4.96	7.15	5.25	3.49	0.55	1.37	0.27	1.92	30	7.7	76	89.86

ANNEXURE 4b: MASTER CHART-1ST TRIMESTER OF PREGNANCY

Sl.NO	Age	Ht	Wt	BMI	BSA	PR	SBP	DBP	PP	RR	Tri	FVC(L)	FEV1(L)	FEV1(%)	PEFR(L/s)	FEF25-75(L/s)	FEF25%(L/s)	FEF50%(L/s)	FEF75%(L/s)	TV(L)	IRV(L)	ERV(L)	IC(L)	MEP(mmHg)	M V	M V V	DI
1	28	146	39	18.31	1.26	90	120	80	40	30	I	2.21	1.64	82	4.16	1.99	4.16	2.57	0.76	0.49	0.13	0.06	0.6	20	14.7	23.8	38.23
2	28	168	52	18.44	1.58	130	136	78	58	28	I	2.82	2.75	97.52	5.66	4.62	5.66	4.92	3.45	0.61	0.06	0.13	0.67	20	17.08	47	63.65
3	26	154	45	18.99	1.4	104	120	82	38	24	I	1.66	1.63	98.19	5.64	5.08	5.2	5.6	3.68	0.75	0.77	0.11	1.52	40	18	30	40
4	23	157	40	16.26	1.35	100	110	70	40	30	I	1.06	1.02	96.23	7.47	4.07	7.47	7.47	2.36	1.32	0.22	0.44	1.54	20	39.6	36.05	-9.84
5	29	161	65	25.1	1.69	74	120	80	40	30	I	2.35	2	85.11	4.54	2.73	4.54	3.03	1.39	7	0.49	0.57	7	65	29.3	22.6	-29.6
6	29	161	44	16.99	1.93	80	120	80	40	24	I	2.13	1.85	93.43	8.37	3.15	8.37	3.23	1.68	1	0.68	0.17	1.39	30	24	51	52.94
7	21	152	46	19.91	1.4	74	120	74	46	22	I	1.94	1.85	95.36	4.9	4.14	4.52	4.62	2.67	0.61	0.76	0.05	1.37	30	13.42	21.18	36.63
8	28	143	47	23.04	1.35	80	120	80	40	24	I	1.84	1.71	94.34	4.07	2.72	3.67	2.72	1.8	0.45	0.77	0.09	1.22	40	10.8	23.3	53.64
9	28	163	41	15.41	1.4	76	120	84	36	24	I	1.96	1.87	95.41	5.49	4.41	5.12	4.99	2.75	0.56	0.96	0.19	1.28	24	13.44	33.6	60
10	21	149	40	18.02	1.3	70	120	72	48	22	I	1.61	1.53	95.54	4.75	3.5	4.75	3.97	2.59	0.49	1.07	0.05	1.45	40	10.78	22.6	52.3
11	22	141	45	22.61	1.31	74	120	86	34	20	I	1.61	1.51	94.96	4.57	3.01	4.57	3.29	1.64	0.43	0.74	0.3	1.09	30	8.6	42.2	79.62
12	21	143	55	26.96	1.44	70	120	82	38	24	I	2.37	2.01	99.86	4.52	3.45	4.42	3.9	2.32	0.32	1.67	0.17	1.99	40	7.68	30.6	74.9
13	20	151	55	24.12	1.5	78	120	74	46	26	I	2.39	1.98	97.3	4.32	2.84	4.18	3.4	1.35	0.87	1.88	0.14	2.75	40	22.62	40.95	44.76
14	29	149	45	20.27	1.36	80	116	72	44	20	I	2.23	1.76	82.83	2.94	2.15	2.92	2.2	1.57	0.82	0.05	0.03	0.87	20	16.4	38.7	57.62
15	21	146	47	22.07	1.37	80	124	76	48	22	I	2.13	1.86	87.77	2.99	2.42	2.65	2.41	1.97	0.93	1.52	0.3	2.19	30	20.46	46	55.52
16	34	156	56	23.05	1.55	70	120	82	38	24	I	2.17	1.88	93.07	3.98	3.14	3.93	3.43	2.03	0.68	1.29	0.09	1.97	32	16.32	38	57.05
17	33	145	48	22.86	1.37	80	124	74	50	24	I	2.23	1.73	77.58	3.91	3.25	3.44	3.76	2.03	0.52	0.69	0.38	1.21	24	12.48	32.7	61.8
18	32	150	54	24	1.48	86	120	72	48	26	I	2.31	2.03	87.88	4.24	3.36	3.94	3.99	2.21	1.52	0.39	0.09	1.91	22	39.52	29	-37.1
19	27	151	57	25	1.52	82	120	70	50	22	I	2.35	1.92	93.2	4.37	3.27	3.15	4.15	2.43	1.58	0.16	0.09	1.74	30	34.76	45	22.84
20	26	148	42	19.18	1.32	84	120	72	48	26	I	1.98	1.85	93.43	3.75	3.22	3.58	3.54	2.27	0.6	0.54	0.11	1.14	20	15.6	30.2	48.34
21	33	153	60	25.64	1.57	76	116	86	30	22	I	2	1.91	95.5	5.51	3.98	5.49	4.44	2.36	0.72	0.99	0.3	1.71	30	15.84	47.2	66.4
22	30	53	60	25.64	1.57	74	122	70	52	24	I	1.92	1.86	96.88	5.29	3.85	5.29	4.41	2.21	0.35	0.88	0.33	1.23	30	8.4	80	89.5
23	24	153	56	23.93	1.52	82	124	82	42	20	I	1.53	1.35	88.24	3.95	3.69	3.55	3.95	3.37	0.37	0.57	0.06	0.94	40	7.4	71.5	89.65
24	21	149	50	22.52	1.43	80	116	76	40	22	I	2.02	1.88	93.07	5.59	3.67	5.46	4.55	1.69	0.39	1.4	0.08	1.79	40	8.58	52.4	83.62
25	33	150	60	26.67	1.55	76	120	86	34	20	I	2.39	2.19	91.63	5.96	4	5.94	4.97	1.94	0.6	1.18	0.03	1.78	36	12	41.2	70.87

Sl.NO	Age	Ht	Wt	BMI	BSA	PR	SBP	DBP	PP	RR	Tri	FVC(L)	FEV1(L)	FEV1(%)	PEFR(L/s)	FEF25-75(L/s)	FEF25%(L/s)	FEF50%(L/s)	FEF75%(L/s)	TV(L)	IRV(L)	ERV(L)	IC(L)	MEP(mmHg)	M V	M V V	DI
26	23	151	55	24.12	1.5	74	120	76	44	22	I	2.23	2	89.69	4.35	3.4	4.18	3.73	2.13	0.67	0.87	0.02	1.54	50	14.74	34.5	57.27
27	21	148	50	22.83	1.42	70	116	80	36	20	I	2.35	2.14	91.06	4.1	3.3	4.04	3.6	2.27	0.54	0.66	0.17	1.2	50	10.8	38	71.5
28	20	152	45	19.48	1.53	70	120	80	40	20	I	2.06	1.87	93.41	3.87	2.67	3.82	3.09	1.6	0.64	0.27	0.16	0.91	34	12.8	32.9	61.09
29	20	152	45	19.48	1.38	76	122	70	52	24	I	2.15	1.86	92.08	3.99	2.64	3.99	2.86	1.61	0.68	1.12	0.09	1.8	40	16.32	61	73.24
30	24	154	62	26.16	1.6	70	120	72	48	18	I	1.64	0.51	90.2	5.53	4.56	5.27	5.08	3.12	0.45	1.26	0.08	1.71	40	9.9	40	75.25
31	24	154	52	21.94	1.48	72	110	74	36	20	I	1.66	0.7	88	5.15	4.4	4.77	4.76	3.23	0.57	1.06	0.03	1.63	40	11.4	64	82.18
32	27	150	55	24.44	1.49	76	118	76	42	24	I	1.82	1.06	58.24	5.45	4.54	5.1	4.98	3.24	0.29	1.33	0.11	1.62	40	6.96	34.8	80
33	26	154	50	21.09	1.46	76	120	82	42	22	I	1.33	0.65	48.87	4.04	3.58	3.69	4.01	2.75	0.42	1.52	0.17	1.94	30	9.24	35.6	74.04
34	23	159	58	23.01	1.59	76	120	80	40	22	I	1.49	0.29	17.45	5.31	4.83	4.46	5.28	3.94	0.39	1.45	0.3	1.84	30	8.58	57.2	85
35	22	153	50	21.36	1.45	86	120	84	36	22	I	1.33	0.23	17.29	5.11	4.69	4	5.09	4.18	0.51	1.14	0.24	1.65	30	11.22	44.1	74.55
36	22	165	65	23.89	1.73	80	120	82	38	18	I	1.62	1.5	92.59	2.99	2.39	2.93	2.72	1.54	0.57	1.29	0.32	1.86	30	10.26	53.25	80.73
37	22	162	58	22.13	1.61	74	120	80	40	22	I	1.47	1.05	71.43	3.73	3.14	3.54	3.42	2.22	0.33	0.98	0.77	1.31	20	7.26	55.5	86.91
38	23	157	51	20.73	1.49	80	120	72	48	16	I	1.53	1.43	93.46	2.88	2.04	2.74	2.08	1.39	0.36	0.14	0.13	0.5	26	5.76	68.1	91.54
39	22	167	66	23.74	1.74	76	120	82	42	18	I	1.62	0.97	59.88	2.56	1.78	2.56	1.93	1.14	0.35	0.08	0.09	0.43	30	6.3	38.1	83.46
40	26	155	53	22.08	1.5	72	120	84	44	20	I	1.47	1.28	87.07	2.75	1.95	2.68	2.13	1.04	0.29	0.36	0.16	0.65	24	5.8	31.5	81.58
41	22	151	50	21.92	1.44	76	118	76	42	14	I	1.62	1.4	86.42	2.77	1.93	2.74	1.94	1.32	0.29	0.02	0.11	0.31	30	4.06	24.8	83.62
42	30	143	52	25.49	1.44	76	120	76	44	20	I	1.66	1.43	86.14	2.75	1.85	2.64	1.89	1.29	0.4	0.55	0.03	0.55	40	8	47.25	83.06
43	23	154	62	26.16	1.6	76	120	80	40	20	I	1.37	1.25	91.24	2.65	2.26	2.53	2.41	1.62	0.42	0.76	0.13	1.18	24	8.4	43.2	80.55
44	33	161	62	23.93	1.65	80	120	88	48	22	I	1.76	1.68	95.45	4.03	3.45	3.85	3.67	2.46	0.56	0.92	0.05	1.48	26	12.3	20.1	38.8
45	19	156	54	22.22	1.52	80	120	76	44	20	I	1.51	1.48	98.01	3.4	2.92	3.37	3.2	2.17	0.34	0.9	0.09	1.24	24	6.8	17	60
46	19	146	48	22.53	1.38	70	120	68	52	20	I	1.76	1.69	96.02	1.23	3.28	3.52	3.53	2.5	0.59	0.9	0.13	1.49	20	11.8	54.45	78.32
47	23	148	49	22.37	1.41	74	120	80	40	22	I	1.62	1.57	96.91	3.43	3.05	3.29	3.29	2.28	1	0.73	0.11	1.81	24	22	39.2	43.87
48	31	156	58	23.86	1.57	80	120	80	40	24	I	1.5	1.5	95.54	3.22	2.79	2.98	2.98	2.06	0.35	0.49	0.09	0.84	24	8.4	50.75	83.44
49	19	162	60	2.9	1.64	72	120	82	42	18	I	1.53	1.42	92.81	2.67	2.32	2.42	2.46	1.78	0.4	0.24	0.05	0.64	40	7.2	44	83.63
50	20	156	58	23.86	1.57	76	118	80	38	20	I	2.2	1.84	92.24	4.34	2.62	2.12	1.98	1.62	0.5	0.22	0.04	0.9	36	10	40.05	75.03

ANNEXURE 4c: MASTER CHART-2nd TRIMESTER OF PREGNANCY

Sl.NO	Age	Ht	Wt	BMI	BSA	PR	SBP	DBP	PP	RR	Tri	FVC(L)	FEV1(L)	FEV1(%)	PEFR(L/s)	FEF25-75(L/s)	FEF25%(L/s)	FEF50%(L/s)	FEF75%(L/s)	TV(L)	IRV(L)	ERV(L)	IC(L)	MEP(mmHg)	M V	M V V	DI
1	27	164	66	24.5	1.7	82	120	74	46	30	II	2.72	2.31	84.93	3.91	3.34	3.68	3.83	2.05	1.14	1.07	0.11	2.21	30	34.2	15.9	-115.0
2	26	162	60	22.9	1.6	80	120	74	46	32	II	2.58	2.36	91.47	7.87	4.54	7.87	5.32	2.04	0.59	1.44	0.25	2.03	30	12.98	26.55	51.11
3	33	162	60	22.9	1.6	80	120	84	36	32	II	2.27	2.15	82.64	6.53	4.45	6.45	5.47	2.37	0.8	1.5	0.14	2.3	30	29.26	22.4	-30.62
4	22	160	50	19.5	1.6	82	120	70	50	34	II	2.78	2.6	93.53	5.27	4.49	5.59	5.26	2.5	1.33	1.47	0.79	2.8	40	31.92	35.8	10.83
5	23	156	54	22.2	1.5	84	110	70	40	32	II	2.6	2.42	93.08	7.6	4.81	7.56	5.77	2.3	0.81	1.34	0.21	2.15	40	25.92	32.07	19.17
6	28	151	59	25.9	1.5	82	100	62	38	30	II	1.45	1.31	90.34	3.01	1.97	2.94	2.25	1.02	0.55	0.33	0.52	0.88	30	16.5	23.48	29.72
7	26	150	56	24.9	1.5	100	120	70	50	32	II	2.25	2.12	94.22	6.67	4.42	6.28	5.28	2.23	0.48	1.44	0.11	1.92	20	15.36	49.8	69.15
8	24	153	47	20.1	1.4	80	120	72	48	30	II	2.15	2	93.02	5.84	3.29	5.79	3.62	1.77	1.06	0.11	0.36	1.17	40	31.8	22.5	-41.33
9	29	144	40	19.3	1.3	80	124	74	50	24	II	1.84	1.69	91.85	3.72	2.79	3.72	3.13	1.63	0.78	0.8	0.16	1.58	24	18.72	7.35	154.69
10	26	152	60	26	1.6	74	118	82	36	28	II	2.29	2.22	96.94	7.69	5.21	7.69	5.92	2.73	0.57	1.33	0.05	1.9	50	15.96	10	-59.6
11	20	151	46	20.2	1.4	70	110	70	40	24	II	1.61	1.49	97.1	3.77	2.99	3.61	3.16	2.47	0.42	1.09	0.09	1.5	26	10.08	30	66.4
12	28	153	55	23.5	1.5	70	114	76	38	28	II	2.02	1.83	96.35	4.52	2.84	4.43	3.14	1.44	0.62	1.59	0.03	2.21	20	17.36	32.5	46.58
13	24	151	52	22.8	1.5	80	116	84	32	24	II	2.33	2.07	94.97	4.21	3.21	4.21	3.48	2.2	0.78	1.69	0.06	2.47	20	18.72	33.2	43.61
14	33	146	57	26.8	1.5	74	120	74	46	22	II	1.59	1.44	91.6	4.18	2.36	4.16	2.78	1.04	0.55	0.14	0.11	0.66	22	12.1	38.5	68.57
15	23	150	46	20.4	1.4	70	126	76	50	24	II	1.82	1.73	97.62	4.19	3.54	4.04	3.94	2.59	0.57	0.66	0.19	1.14	62	13.68	32.7	58.16
16	23	152	45	19.5	1.4	72	110	60	50	22	II	1.82	1.82	100	4.08	3.36	3.94	3.65	2.53	0.61	0.09	0.14	0.7	22	13.42	37.35	64.06
17	21	151	47	20.6	1.4	74	124	82	42	26	II	1.98	1.93	97.47	4.21	3.62	4.08	3.78	2.72	0.38	1.03	0.03	1.03	40	9.88	42.7	76.86
18	20	151	45	19.7	1.4	72	120	74	46	20	II	1.8	1.79	99.44	4.3	3.07	3.76	3.26	2.17	0.87	0.79	0.27	1.66	22	17.4	63	72.38
19	23	152	47	20.4	1.4	72	118	70	48	22	II	1.94	1.93	99.48	4.73	4	4.58	4.35	2.85	0.5	0.21	0.02	0.71	24	11	11.7	5.98
21	22	163	70	26.3	1.8	80	122	70	52	24	II	2	1.98	99	5.57	4.47	5.36	5.15	2.78	0.58	0.19	1.23	0.77	22	1.02	45	97.7
22	20	159	60	23.7	1.6	72	120	80	40	22	II	2.08	1.95	93.75	4.91	3.44	4.88	3.79	2.12	0.77	1.2	0.25	1.97	20	13.92	32.2	56.77
23	27	157	67	27.2	1.7	70	120	78	42	24	II	1.7	0.67	39.41	5.96	4.98	5.59	5.48	3.46	0.61	1.1	0.49	1.71	30	16.94	43.2	60.78
24	24	157	44	17.9	1.4	80	120	74	46	20	II	1.57	1.56	99.36	4.26	3.87	3.82	4.18	3.32	0.34	0.63	0.32	0.92	40	14.64	32	-30.12
25	29	155	47	19.6	1.4	78	116	74	42	22	II	1.76	1.74	99.4	4.14	3.68	3.88	3.87	2.93	0.38	0.06	0.16	0.44	44	6.8	33.3	79.57

Sl.NO	Age	Ht	Wt	BMI	BSA	PR	SBP	DBP	PP	RR	Tri	FVC(L)	FEV1(L)	FEV1(%)	PEFR(L/s)	FEF25-75(L/s)	FEF25%(L/s)	FEF50%(L/s)	FEF75%(L/s)	TV(L)	IRV(L)	ERV(L)	IC(L)	MEP(mmHg)	M V	M V V	DI
26	29	168	60	21.3	1.7	76	142	88	54	24	II	1.74	1.65	94.83	4.87	4.63	4.17	4.82	4.45	0.43	0.93	0.38	0.93	22	8.36	58.8	85.16
27	20	150	51	22.7	1.4	72	120	82	38	22	II	1.23	1.21	100.87	4.84	2.18	4.84	2.24	1.44	0.41	0.11	0.03	0.52	20	10.32	51.5	82.44
28	20	151	50	21.9	1.4	80	120	72	48	24	II	1.94	1.77	94.51	4.61	3.65	4.41	4.08	2.31	0.36	0.21	0.19	0.57	64	9.02	59.4	82.48
29	27	162	60	22.9	1.6	80	110	70	40	20	II	2	1.95	97.5	4.12	3.48	3.85	3.77	2.38	0.36	0.14	0.02	0.5	32	8.64	62	85.45
30	21	146	46	21.6	1.4	82	120	60	60	22	II	1.78	1.41	79.21	5.18	3.99	4.98	4.4	2.51	0.33	1.12	0.35	1.4	20	7.2	52	88.38
31	21	158	46	18.4	1.4	70	114	76	38	20	II	1.78	1.74	97.75	4.92	3.91	4.46	4.44	2.37	1.25	0.58	0.21	1.83	24	7.26	59	86.03
32	27	157	56	22.8	1.6	74	120	70	50	20	II	2.54	1.87	73.62	3.57	3.32	3.47	3.44	2.7	0.45	1.94	0.21	2.39	20	25	63	57.62
33	22	149	58	26.1	1.5	80	120	70	50	20	II	1.84	1.41	76.63	2.32	1.9	2.28	2.03	1.38	0.46	1.25	0.02	1.71	20	9	45	85.71
34	23	150	58	25.8	1.5	78	124	84	40	20	II	2.06	2	97.09	4.62	3.82	4.19	4.32	2.48	0.29	0.77	0.19	1.06	20	9.2	56.75	79.55
35	26	153	55	23.5	1.5	82	120	74	46	22	II	1.98	1.86	93.94	4.95	3.51	4.84	4.04	1.94	0.52	1.17	0.05	1.69	30	5.8	69	89.77
36	24	160	59	23	1.6	74	116	74	42	20	II	2.15	1.96	91.16	5.27	3.57	5.1	4.39	1.66	0.48	1.31	0.19	1.79	30	11.44	72.5	83.42
37	22	155	48	19.4	1.4	80	120	74	46	20	II	0.88	0.88	117.8	1.55	1.47	1.38	1.55	1.36	0.53	0.46	0.11	0.46	30	9.6	45	86.75
38	22	155	48	20	1.5	72	120	68	52	20	II	1.59	1.5	94.34	3.62	2.93	3.44	3.3	1.84	0.52	0.99	0.09	0.99	30	10.6	48.15	76.44
39	24	154	56	23.6	1.5	74	120	74	46	22	II	1.23	1.18	95.93	3.06	2.42	2.84	2.71	1.52	0.36	0.11	0.32	0.5	40	10.4	61.95	78.4
40	31	155	58	24.2	1.5	70	120	74	46	20	II	1.37	1.35	98.54	3.52	2.95	3.24	3.31	2.03	0.54	0.46	0.09	0.46	30	7.92	35.4	87.21
41	19	154	52	21.9	1.5	82	120	80	40	18	II	1.59	1.43	89.94	3.06	2.43	3	2.69	1.45	0.34	0.03	0.01	0.37	20	10.8	39.25	69.49
42	23	155	57	23.8	1.5	74	120	74	46	20	II	1.66	1.38	83.13	2.17	1.81	2.14	1.92	1.3	0.45	0.05	0.11	0.5	20	6.12	60.8	84.4
43	23	160	63	24.6	1.6	82	116	84	32	18	II	1.59	1.38	86.79	2.47	2.03	2.26	2.18	1.49	0.37	0.05	0.05	0.42	40	9	45	85.19
44	21	146	50	23.5	1.4	70	114	68	46	20	II	1.45	1.06	73.1	2.98	1.17	2.81	2.25	2.83	0.72	0.38	0.38	1.1	30	6.66	23.7	85.2
45	26	156	55	22.6	1.5	76	118	66	52	20	II	1.53	1.27	83.01	4.31	4	3.86	4.22	3.53	0.57	0.39	0.25	0.96	30	14.4	53.35	39.24
46	31	162	66	25.2	1.7	80	120	74	46	22	II	1.49	1.22	81.88	4.37	3.85	4	4	3.11	0.5	0.9	0.24	1.4	30	11.4	60	78.63
47	28	149	52	23.4	1.5	82	116	76	40	20	II	1.66	1.62	97.59	3.76	3.24	3.63	3.43	2.39	0.52	0.33	0.02	0.85	30	11	54.45	81.6
48	29	160	58	2.48	1.6	76	118	72	46	22	II	1.29	1.29	100	2.35	2.25	2.08	2.34	2.13	0.53	0.19	0.38	0.72	22	10.4	23.7	80.89
49	23	154	62	26.2	1.4	80	120	80	40	16	II	1.74	1.68	96.55	3.5	3.24	3.09	3.46	2.72	0.38	0.32	0.11	0.7	20	11.66	45.9	-49.19
50	28	151	57	25	1.5	74	120	84	44	22	II	1.7	1.56	91.76	4.68	3.45	4.48	3.38	2.59	0.33	0.58	0.06	0.91	22	7.26	30.6	86.75

ANNEXURE 4d: MASTER CHART-3rd TRIMESTER OF PREGNANCY

Sl.NO	Age	Ht	Wt	BMI	BSA	PR	SBP	DBP	PP	RR	Tri	FVC(L)	FEV1(L)	FEV1(%)	PEFR(L/s)	FEF25-75(L/s)	FEF25%(L/s)	FEF50%(L/s)	FEF75%(L/s)	TV(L)	IRV(L)	ERV(L)	IC(L)	MEP(mmHg)	M V	M V V	DI
1	22	160	57	22.27	1.59	82	120	70	50	32	III	2.51	2.06	82.07	4.25	2.88	3.86	3.72	1.4	0.4	1.67	0.41	2.07	20	11.2	44.5	74.8
2	25	156	55	22.63	1.53	100	120	70	50	28	III	1.68	1.61	95.83	4.3	3.27	4.23	3.73	2.01	0.47	0.58	0.39	1.05	26	13.1	46.8	71.8
3	23	156	60	24.69	1.59	82	120	70	50	32	III	1.98	1.77	89.39	3.39	2.78	3.56	3.2	3.18	0.29	0.02	0.09	0.31	30	6.38	40.15	84.1
4	29	156	69	28.4	1.69	82	120	70	50	32	III	1.94	1.79	96.3	4.8	3.24	4.52	3.62	1.68	0.34	1.04	0.09	1.38	26	7.48	55.25	86.4
5	22	153	51	21.79	1.47	80	130	70	60	34	III	2.35	2.02	85.96	4.62	2.7	4.57	2.98	1.48	1.08	0.22	0.13	1.3	20	24.8	46.5	46.8
6	31	150	49	21.78	1.42	78	120	86	46	34	III	1.55	1.44	92.9	3.67	2.69	3.56	2.93	2.36	1.12	1.17	1.34	2.16	30	25.7	24.5	5.14
7	21	156	50	20.58	1.47	88	122	72	50	28	III	2.04	1.83	89.71	4	2.82	3.91	3.29	1.61	1.06	0.06	0.68	0.06	30	29.6	46.8	36.5
8	27	155	76	31.67	1.75	80	124	94	54	36	III	1.53	1.39	90.85	3.52	2.32	3.42	2.67	2.31	1.6	0.76	0.22	2.36	30	35.2	23.8	47.8
9	30	160	75	29.3	1.78	74	122	60	62	30	III	1.61	1.51	93.79	4.03	3.15	3.85	3.68	1.93	0.55	0.9	0.14	1.45	20	16.5	31.6	47.7
10	21	157	44	17.89	1.4	70	118	74	44	22	III	1.68	1.39	93.29	3.54	2.63	3.46	3.09	1.46	0.64	0.85	0.05	1.49	60	14.0	47.5	70.3
11	20	148	43	19.63	1.33	76	124	74	50	28	III	1.68	1.66	98.81	4.61	3.41	4.54	3.98	2.15	0.46	0.6	0.19	1.06	22	12.8	52.15	75.3
12	26	166	70	26.32	1.78	84	110	80	30	28	III	2.49	2.04	83.12	3.95	2.84	3.71	3.27	1.59	0.81	1.28	0.09	2.09	22	22.6	24.6	7.8
13	26	164	67	24.91	1.73	76	126	84	42	28	III	2.23	2.07	96.28	6.21	4.87	5.74	5.53	2.9	0.62	1.42	0.06	2.04	40	17.3	65.7	73.5
14	28	153	50	21.37	1.45	78	120	84	36	26	III	1.88	1.7	92.44	5.01	2.96	4.9	3.41	1.41	0.88	0.24	0.06	0.94	22	22.8	54.4	57.9
15	26	149	69	31.08	1.63	72	130	72	58	26	III	1.49	1.35	94.74	3.85	2.83	3.85	3.15	1.51	0.41	0.13	0.05	0.51	40	10.6	20.75	48.6
16	30	159	76	30.04	1.79	96	122	60	62	24	III	2.35	2.09	99.01	5.75	4.37	5.53	4.81	2.85	0.57	1.07	0.28	1.64	22	13.6	27.6	50.4
17	24	148	47	21.46	1.38	68	130	100	30	26	III	1.72	1.44	83.72	3.5	2	3.44	2.33	0.97	0.81	0.98	0.06	1.47	20	21.0	44.1	52.2
18	33	156	65	26.75	1.65	74	126	76	50	26	III	2.13	2.02	94.84	5.96	4.21	5.76	4.99	2.28	0.6	1.48	0.02	2.08	60	15.6	23.3	33.0
19	27	154	55	23.21	1.52	70	124	82	42	24	III	1.61	1.53	95.54	4.75	3.37	4.75	3.97	2.59	0.49	1.07	0.05	1.45	40	11.7	37.2	68.3
21	26	154	60	25.32	1.58	74	124	72	52	28	III	2.25	2.16	96.28	6.75	4.79	6.44	5.51	2.72	0.53	1.45	0.14	1.98	50	14.8	48.3	66.1
22	22	150	51	22.67	1.44	80	124	68	56	20	III	1.96	1.71	87.24	4.54	2.74	4.54	3.29	1.23	0.53	0.11	0.25	0.64	30	10.6	59.15	80.4
23	22	151	43	18.86	1.35	72	100	64	36	24	III	1.33	1.27	99.17	3.11	2.56	2.95	2.79	1.72	0.46	0.95	0.43	0.95	24	11.0	48.4	77.1
24	30	156	59	24.28	1.58	70	118	70	48	24	III	1.96	1.9	97.19	6.24	4.57	6.24	5.24	2.78	0.41	1.37	0.08	1.67	40	9.84	34.2	71.2
25	27	151	60	26.32	1.56	84	124	74	50	22	III	1.82	1.66	93.37	4.55	3.23	4.39	3.61	1.84	0.63	1.25	0.24	1.59	30	13.8	47.4	70.7

Sl.NO	Age	Ht	Wt	BMI	BSA	PR	SBP	DBP	PP	RR	Tri	FVC(L)	FEV1(L)	FEV1(%)	PEFR(L/s)	FEF25-75(L/s)	FEF25%(L/s)	FEF50%(L/s)	FEF75%(L/s)	TV(L)	IRV(L)	ERV(L)	IC(L)	MEP(mmHg)	M V	M V V	DI
26	29	164	68	25.28	1.74	82	126	76	50	28	III	2	1.93	96.5	6.22	4.83	5.81	5.83	2.82	0.63	1.17	0.13	1.8	30	14.84	43.05	59.02
27	29	149	48	21.62	1.4	74	120	84	44	24	III	1.82	1.82	100	4.16	3.19	3.98	3.35	2.17	0.35	0.21	0.06	0.51	22	17.64	21	60
28	29	150	61	27.11	1.56	72	124	74	50	32	III	2.39	2.37	99.16	7.96	5.29	7.6	6.04	2.97	0.49	1.4	0.27	1.88	40	8.4	51.5	69.55
29	23	152	62	26.84	1.58	80	118	72	46	28	III	2.02	1.97	97.52	6.3	5.19	5.72	5.19	3.51	0.5	0.14	0.17	0.64	44	15.68	50.4	72.22
30	29	154	59	24.89	1.57	88	110	70	40	26	III	2.35	1.99	84.68	3.62	2.75	3.62	3.22	1.58	0.61	0.38	0.08	0.99	70	14	53.1	70.47
31	23	142	47	23.27	1.37	70	110	60	50	22	III	1.94	1.66	87.58	3.69	2.59	3.59	3.09	1.23	0.35	0.39	0.14	0.71	26	15.86	18	57.22
32	26	154	73	30.8	1.71	100	100	70	30	28	III	2.13	1.99	93.62	4.93	3.59	4.93	4.28	1.94	0.37	0.43	1.86	0.8	20	7.7	63.25	83.62
33	34	160	64	25	1.67	80	134	70	64	24	III	2.23	1.89	84.75	6.9	5.43	6.56	6.16	3.37	0.43	1.25	0.03	1.68	40	10.36	70.4	85.34
34	28	152	59	25.54	1.55	70	116	76	40	24	III	2.21	2	93.43	6.11	3.78	6.11	5.29	3.53	0.82	1.66	0.51	1.96	50	10.32	50	60.64
35	26	166	78	28.26	1.86	76	124	64	60	24	III	2.11	1.63	77.25	2.94	2.41	2.6	2.76	1.53	0.74	0.09	0.13	0.83	22	19.68	14.2	-25.0
36	26	156	54	22.22	1.52	76	122	82	40	20	III	1.78	1.39	78.09	5.75	4.39	5.52	4.88	2.76	0.41	0.87	0.22	1.28	50	17.76	69.3	88.16
37	26	156	57	23.46	1.56	80	124	88	36	24	III	1.92	1.08	56.25	6.61	5.4	6.15	6.03	3.65	0.53	1.45	0.03	1.98	50	8.2	28.4	55.21
38	20	156	56	23.05	1.55	76	110	64	46	24	III	1.98	1.83	93.37	3.63	2.91	3.93	3.24	1.98	0.42	0.13	0.24	0.55	46	12.72	27.25	63
39	19	157	69	28.05	1.7	74	120	84	36	24	III	2.6	2.28	93.78	4.33	3.79	4.47	4.72	2.81	0.52	2.3	0.14	2.76	40	10.08	8.2	-52.1
40	27	160	65	25.39	1.68	96	120	76	44	26	III	1.82	1.32	72.23	5.74	5.02	5.23	5.59	3.75	0.54	0.98	0.06	1.52	50	12.48	61.6	77.2
41	26	147	47	21.76	1.38	84	120	74	46	24	III	1.78	0.79	44.38	6.07	5.33	5.45	5.93	3.93	0.67	1.39	0.87	2.06	50	14.04	50.8	68.34
42	23	147	52	24.07	1.44	80	124	76	48	24	III	1.7	1.61	94.71	3.71	2.7	3.71	2.99	1.56	0.53	0.21	0.24	0.74	22	16.08	39	67.38
43	25	160	65	25.39	1.68	80	110	80	30	24	III	2.27	2.19	96.48	6.79	4.42	6.79	5.4	2.28	0.35	1.33	0.05	1.68	50	12.72	12.6	33.33
44	30	152	61	26.41	1.57	76	120	76	46	24	III	2.21	2.06	93.21	5.95	4.04	5.93	4.91	1.87	0.38	1.23	0.14	1.61	50	8.4	67.95	86.57
45	25	157	66	26.83	1.67	74	120	82	38	24	III	2.31	2.16	93.51	5.66	3.17	5.66	4.18	2.06	0.71	0.58	0.58	1.06	40	9.12	30.8	44.67
46	21	151	50	21.93	1.44	72	116	80	36	26	III	1.98	1.72	86.87	3.8	2.65	3.8	2.94	1.44	0.38	1.66	0.14	2.04	20	17.04	42.3	76.64
47	26	160	65	25.39	1.68	70	120	84	36	24	III	2.41	2.24	92.95	7.15	4.54	7.15	5.43	2.1	0.51	1.14	0.05	1.46	40	9.88	54.3	77.45
48	27	165	68	25	1.75	68	116	82	34	20	III	2.19	2	96.39	6.21	3.77	6.07	4.73	1.88	0.45	1.5	0.11	1.95	44	12.24	40.95	78.02
49	25	154	57	24.05	1.54	78	130	86	44	26	III	2.25	2.03	96.43	6.28	3.72	6.14	4.68	2.26	0.51	1.52	0.58	2.03	40	9	41.7	68.2
50	27	152	62	26.84	1.58	80	118	74	44	24	III	2.19	2.04	94.27	5.33	3.95	5.03	4.5	2.26	0.45	1.17	0.13	1.62	42	13.26	20.3	40.77