ASSESSMENT OF PULMONARY FUNCTION BY SPIROMETRY IN ANTENATAL CASES

Dissertation Submitted to

THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY

CHENNAI – 600 032

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

DOCTOR OF MEDICINE

IN

PHYSIOLOGY

BRANCH –V

Reg. No. 201415601

DEPARTMENT OF PHYSIOLOGY

KARPAGA VINAYAGA INSTITUTE OF MEDICAL SCIENCES

AND RESEARCH CENTRE

CHINNAKOLAMBAKKAM

MADHURANTHAGAM – 603408

APRIL 2017

CERTIFICATE

This is to certify that this dissertation titled **"ASSESSMENT OF PULMONARY FUNCTION BY SPIROMETRY IN ANTENATAL CASES"** is a bonafide work of **DR. M.C. ARUMUGAM**, during the period of his post graduate study from 2014 to 2017 under guidance and supervision of the Department of Physiology, Karpaga Vinayaga Institute of Medical Sciences and Research Centre, Madhuranthagam - 603408 in partial fulfillment of the requirements for **MD PHYSIOLOGY** (Branch V) degree examination of The Tamil Nadu Dr. MGR Medical University to be held in April 2017.

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DECLARATION

I Dr. M.C. Arumugam hereby declare that this dissertation entitled "**ASSESSMENT OF PULMONARY FUNCTION BY SPIROMETRY IN ANTENATAL CASES**" submitted by me for the degree of M.D. is the record work carried by me during the period APRIL 2015 to January 2016 under the guidance of Dr. S. Vadivel, MD , Prof & Head of the Department of Physiology, Karpaga Vinayaga Institute of Medical Sciences and Research Centre, Madhuranthagam. This dissertation is submitted to the Tamilnadu Dr.M.G.R. Medical University, Chennai, in partial fullfillment of the University regulations for the award of degree of M.D. Physiology (Branch V) examinations to be held in April 2017.

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In the capacity as the guide for the candidate's dissertation work, I certify that the above statements are true to the best of my knowledge.

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ACKNOWLEDGEMENT

I render my heartfelt thanks to Almighty for the blessings showered upon me and my family. I express my sincere thanks to our respected Managing Director Professor **Dr. R. Annamalai M.S,** for permitting and extending his valuable support in conducting this study.

I humbly respect and thank our principal **Dr. Sufala Sunil Vishwasrao MD** for permitting and supporting me to conduct this study.

I express my deep, heartfelt and sincere thanks to my guide Professor, **Dr. S. Vadivel M.D**, for his guidance in every process of this study.

I extend my sincere gratitude to **Prof. Dr.Navin Rajaratnam, Dr.Vijaya Malathi and Dr.Jaya**, Department of Physiology for their constant support and valuable suggestions.

I express my wholehearted gratitude to **Dr.S.Sumithra,** department of Physiology for valuable suggestions and erudite guidance in my study.

I express my heartfelt thanks to **Dr.A.Anitha, M.D., Dch.,** Professor and HOD, Department of Physiology, Chengalpattu Medical College, Chengalpattu for her valuable suggestions.

I express my sincere thanks to **Ms. H.Gladius Jennifer**, Assistant Professor (Biostatistics), Department of Community Medicine for helping me in every process of this study.

I am very thankful to my co- Post Graduate **Dr.P.Sudhakar** for his cooperation.

I express my sincere thanks to other faculty members and supporting staffs in department of Physiology.

I would like to thank the Institutional Ethical Committee for approving my study.

I am grateful to my beloved wife **Dr.A.M. Indira** and my daughter **A.Kiruthika** and other family members who supported me throughout this postgraduate period.

Last but not the least I am very grateful to all the patients without whom this study would not have been completed.

INSTITUTIONAL ETHICAL COMMITTEE

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CERTIFICATE FOR APPROVAL

The Institutional Ethical Committee of Karpaga Vinayaga Institute of Medical Sciences & Research Centre, Maduranthagam reviewed and discussed the application for approval **"ASSESSMENT OF PULMONARY FUNCTION BY SPIROMETRY IN ANTENATAL CASES"** by **Dr. M. C. ARUMUGAM,** Post Graduate Student, Department of Physiology, Karpaga Vinayaga Institute of Medical Sciences & Research Centre, Maduranthagam.

The proposal is **APPROVED**

The Institutional Ethics Committee expects to be informed about the progress of the study, and Adverse Drug Reaction occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

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Pregnancy is the distinctive nature of a particular order in which related things follow each other of effective physiological changes that a marked effect on various organs function and is associated with multiple changes in respiratory system anatomy and physiology1-3. Three important changes in the organization of the thorax that occur during the period of pregnancy were an expansion in the width of the lower-level of chest wall (anteroposterior and the transverse diameters are increased); raise of the diaphragm (a cephalad displacement of approximately 4 cm to 5 cm) and a 50% broadening of the costal angle1-3. These alterations attain the maximum around the 37th week of pregnancy and become normal within 6 months after delivery6. Pulmonary function is disturbed by changes in the airway, thoracic cage, and respiratory drive. And also capillary engorgement in the entire respiratory tract leads to mucosal edema and hyperemia4,5. Multiple biochemical changes like increase in progesterone, estrogen, prostaglandins, corticosteroid and cyclic nucleotide levels occur simultaneously during the period of pregnancy6. The chest wall circumference raised about 6cm but not satisfactorily to present a marked dimnision in the Residual Volume of air in the lungs controlled by the raised diaphragm. The Diaphragmatic elevation is literally greater during pregnancy than during nonpregnant state6. During any level of normal pregnancy, the amount of oxygen entered into the lungs, by the rise in Tidal Volume in a clear manner go beyond the oxygen need to be forced by pregnancy. Furthur more the quantity of hemoglobin in circulation raises as a result of an effect of the maternal arteriovenous oxygen difference. Pregnancy is related with physiological adaptation in the control of breathing, in lung volumes, in the mechanisms of respiration and in acid-base balance. Maternal pulmonary changes in succession alter the metabolism and health of the fetus through their influence on placental gas exchange6. The most important changes in lung function is a rise in Minute Ventilation which enhances by 36% by the eighth week of antenatal period finally attaining the levels ,50% above the nonpregnant demand. These changes are needed to fulfill the increase in oxygen consumption of 30-35% by the growing fetus6. The respiratory alterations have far-reaching clinical implications as previous knowledge will aid significantly in the process of dealing with an antenatal women with respiratory disorders. Pulmonary alterations in antenatal period are of clinical significance to the anesthetist during management of anesthesia to antenatal women, especially during caesarean section6. Thus this study objective is specifically evaluating some ventilatory function changes as they affect normal antenatal women in different trimesters.

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INTRODUCTION

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Thus this study objective is specifically evaluating some ventilatory function changes as they affect normal antenatal women in different trimesters.

AIM AND OBJECTIVES

AIM AND OBJECTIVES OF THE STUDY

AIM:

To determine the effect of pregnancy on pulmonary function parameters in antenatal cases attending Karpaga Vinayaga Institute Medical Sciences and Research Centre, Kancheepuram District.

OBJECTIVES:

- To establish the values of Forced Vital Capacity (FVC) in Pregnancy
- To establish the values of Forced Expiratory Volume (FEV1) in Pregnancy
- To verify the difference in FEV1/FVC during Pregnancy
- To evaluate the values Peak Expiratory Flow Rate (PEFR) during Pregnancy
- To assess the effect of gestational age (1^{st} , 2^{nd} and 3^{rd} trimester) on these parameters

REVIEW OF LITERATURE

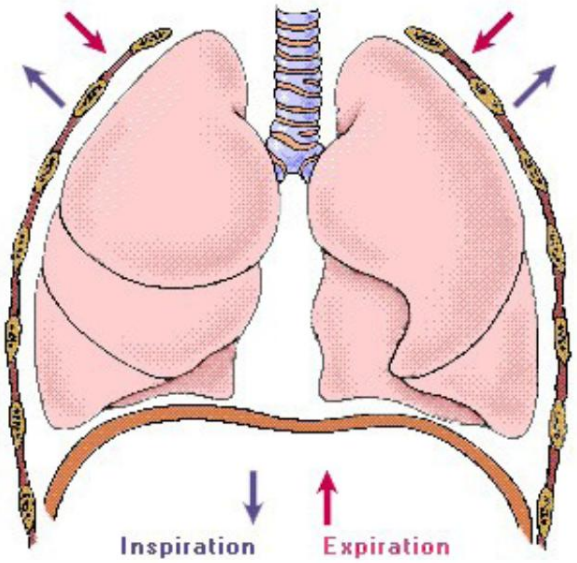
REVIEW OF LITERATURE

The pulmonary system includes the lungs, the conducting airways that direct air to the gas exchange sites (alveoli), respiratory centers in the central nervous system, the muscles of the chest wall and the diaphragm that are responsible for inflation and deflation of the lungs[7]. The lungs occupy most of the thoracic cavity except for the space filled by the heart and major blood vessels[7].

The process of respiration is divided into four categories: 1- Pulmonary ventilation. 2- Diffusion of oxygen and CO2 between alveoli and tissues. 3- Transport of oxygen and CO2 in body fluids to and from cells. 4- Regulation of respiration.[7]

Air is distributed to alveoli as a result of contraction of the respiratory muscle. These muscles comprise the diaphragm and the external intercostal muscles of the ribcage and accessory inspiratory muscles (scalenes and sternocleidomastoids which are not active in eupnea). Contraction of these muscles expands the thoracic cavity, creating a subatmospheric pressure in the alveoli. Contraction of the diaphragm results in downwards displacement of the thoracic cavity and contraction of external intercostals muscles resulting in a lifting of the thoracic cage leading to increasing in the anteroposterior diameter. As alveolar pressure decreases, atmospheric air enters into the alveoli by bulk flow till the pressure becomes equal. The process of filling up the lung is called inspiration. Expiration is generally passive, results from relaxation of the inspiratory muscles and powered by elastic recoil of lung tissue that is stretched during inspiration. With the relaxation of the inspiratory muscles and lung deflation, alveolar pressure overreaches atmospheric pressure, so gasses flow from the alveoli to the

atmosphere by bulk flow. Active expiration is because of internal intercostals muscles and the abdominal recti muscles[7].



Pulmonary ventilation includes the inflow and outflow of air in the lungs,which is altered by various independent factors. Spirometry is a method of assessing lung function by measuring the volume of air that the patient can expire from the lungs after a maximal inspiration.

Lung Volumes and Capacities

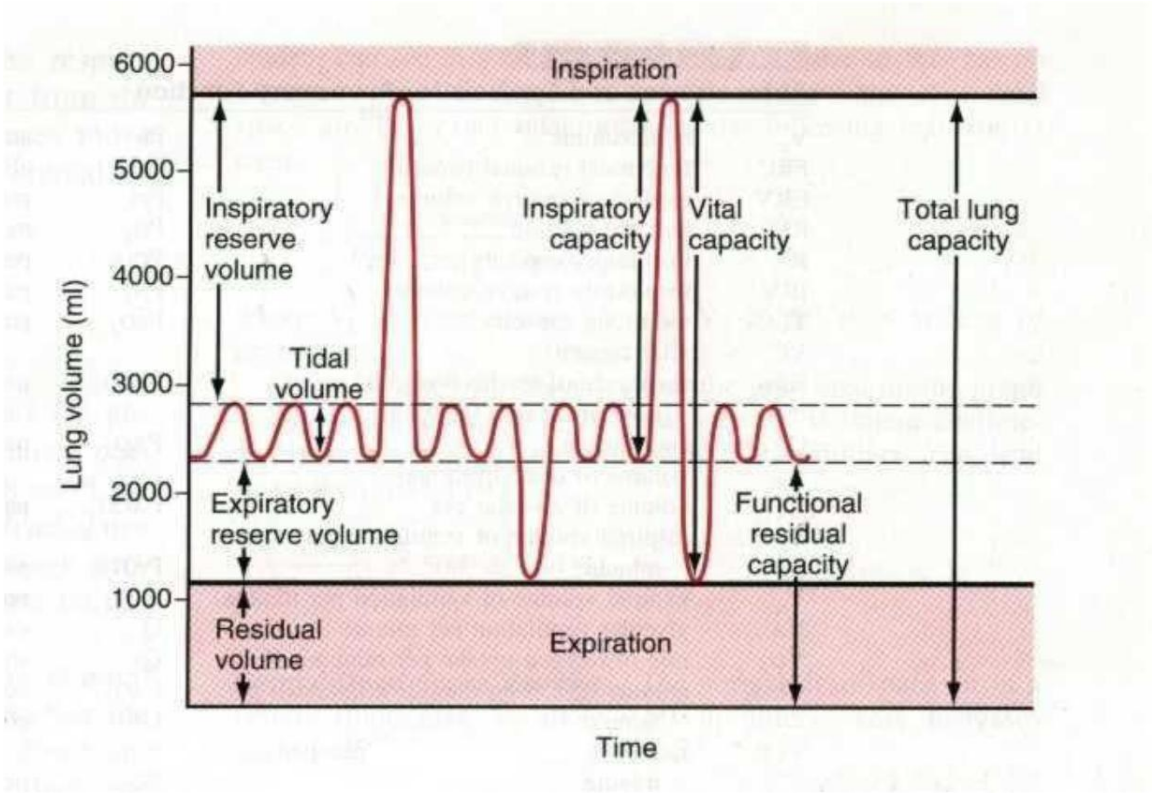
spirometry measurement of Lung volumes is fundamentally anatomical measurements of lung gas volumes. A lung volume refers to a principle volume of the lung, whereas lung capacities, also a volume measurement, are the sum of two or more principle lung volumes. The following lung volumes can be measured directly or indirectly with a spirometer[7]:

Tidal Volume (VT): volume of air inhaled or exhaled during a normal spontaneous breath.

Inspiratory Reserve Volume (IRV): volume of air that can be inhaled at the end of a spontaneous inspiration.

Expiratory Reserve Volume (ERV): volume of air that can be exhaled at the end of a spontaneous VT.

Residual Volume (RV): volume of air in lungs that cannot be forcefully exhaled or the volume of air in the lung at end of a vital capacity.



Vital Capacity (VC): maximum volume of air that can be exhaled after a maximal inspiration or IRV + VT + ERV.

Inspiratory Capacity (IC): the maximal volume of air that can be inhaled from normal end-expiration or VT + IRV

Functional Residual Capacity (FRC): total volume of air in the lung at end of normal end-expiration or ERV + RV.

Total Lung Capacity (TLC): total volume of air in lung at maximal endinspiration or VC + RV or IRV + VT + ERV + RV.

The minute respiratory volume: Total amount of new air moved into the respiratory passages per minute and is equal to tidal volume (500 ml) multiplied by the respiratory rate (12/min) = 6000ml/minute.

SPIROMETRY:-

Spirometry is a physiological test that estimates how an individual inspires or expires volumes of air as a function of time. The basic signal estimated in spirometry may be volume or flow. Spirometry is extremely useful as a screening test of general respiratory health in the same way that blood pressure gives crucial information about general cardiovascular health. However, on its own, spirometry does not lead clinicians directly to an aetiological diagnosis[8,9].

Spirometry has many other applications in evaluating and governing respiratory disease. These include estimating the presence and severity of restrictive lung diseases, screening of the employees in hazardous occupational environments, pre-employment screening for definite occupations, and evaluating fitness to work. Some believe it may be helpful as an encouraging tool to help smokers to quit, but solid scientific evidence on this point is lacking at present, and research findings have been equivocal[8,9].

Spirometry can be done with many different types of equipment and involves cooperation between the subject and the examiner, and the results got will depend on technical as well as personal factors.[8,9]

If the quality of uneven results can be decreased and the estimation accuracy can be improved, the range of normal values for populations can be narrowed and alterations more easily observed. The first American Thoracic Society (ATS) statement on the standardization of spirometry as the consequence of The Snowbird workshop held in the year 1979[10] . This was upgraded in 1987 and again in 1994[11, 12]. The European Community have taken a similar initiative for Steel and Coal, resulting in the first European standardization document in 1983[13]. This was then updated in

1993 as the official statement of the European Respiratory Society (ERS)[14]. There are usually only minor differences between the two most recent ATS and ERS statements, except that the ERS statement includes absolute lung volumes and the ATS does not. The ATS and ERS together in an attempt to publish standards that can be applied more widely. The statement is designed to cover definitions, equipment, and patient-related procedures. All recording devices covered by this statement must meet the appropriate requirements, despite whether they are for monitoring or diagnostic purposes. There is no separate category for ‘‘monitoring’’ devices[9].

TYPES OF SPIROMETERS: -

Bellows or rolling seal spirometers are big and not easily transportable, and are used mainly in lung function laboratories. They require regular calibration with a 3-liter syringe and are very accurate[9].

Electronic desktop spirometers are small, easily transportable, and generally fast and easy to use. They have a real-time visual display and paper or computer printout. Some need calibration with the 3-liter syringe; others can be examined for accuracy with the syringe but necessitates any alterations to be executed by the manufacturer. Usually, they require small observation other than cleaning. They sustain validity over years and are perfect for primary care[9].

Small, inexpensive **hand-held spirometers** give a numerical record of blows but no printout. It may be important to look up predicted values in tables, but some include these in their built-in software. Recent new models allow pre-programming of details about the

patient so that the spirometer also gives percent predicted values. These are useful for simple screening and are precise for diagnosis if the more costly desktop form is unsuitable or too expensive[9].

Many spirometers give two forms of traces. One is the standard plot of volume expired against time. The other is a plot of flow (L/sec) on the vertical axis versus volume expelled (L) on the horizontal axis. This is a flow–volume trace and is most helpful in diagnosing airway obstruction[9].

In some countries, a printed record of spirometry is necessary for claiming insurance/practitioner reimbursement. The type of spirometer to be used may need to

think careful in the light of this, as some automatically produce a printout, others can store data to be printed later from a PC, and others do not have printing capacity at all[8,9].

SPIROMETRY INDICES:-

Forced Vital Capacity (FVC): -

This is the volume change between maximal inhalation and maximal exhalation. It can be measured during normal inhalation and exhalation or during forced ventilatory effort (FVC). FVC measures about 4.8 liters in males and 3.7 liters in females[8,9].

Forced Expiratory Volume in one second (FEV1): -

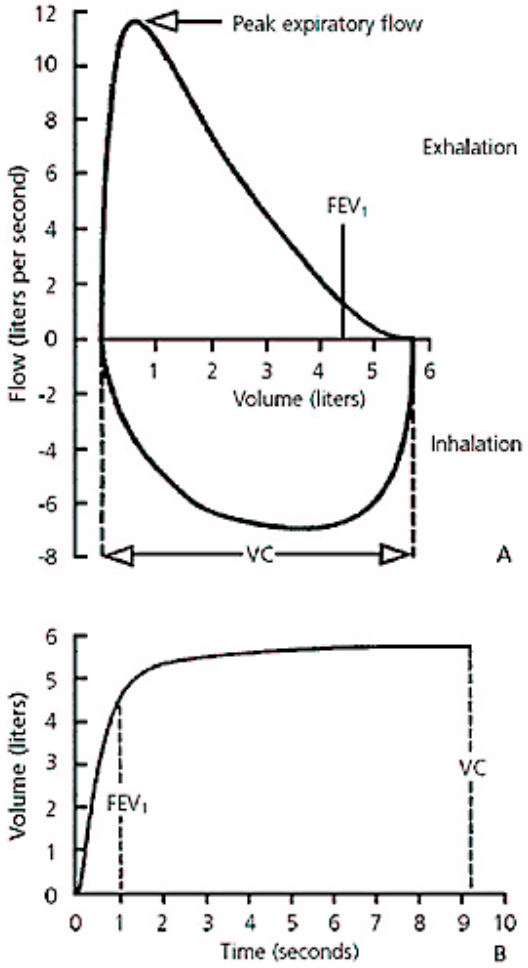
FEV1 is the volume of air expired during the first one second of exhalation maneuver starting from total lung capacity (TLC).It is the very often used index to assess airway obstruction, bronchodilation, and constriction of airways. The FEV1 should be more than 80% of the predicted value for age, race, and height is normal[8,9].

FEV1/FVC% : -

When expressed as the percentage of VC (FEV1 percentage FVC), it is an index of evaluating and quantifying airflow limitation. In patients with obstructive lung disease, the IVC is more than the EVC, which is more than FVC. Thus when using the FEV1/FVC ratio as an index, the actual VC should be specified; hence FEV1percentageFVC or FEV1percentageIVC. The normal ratio of FEV1/ FVC is 0.8 to 1[8,9].

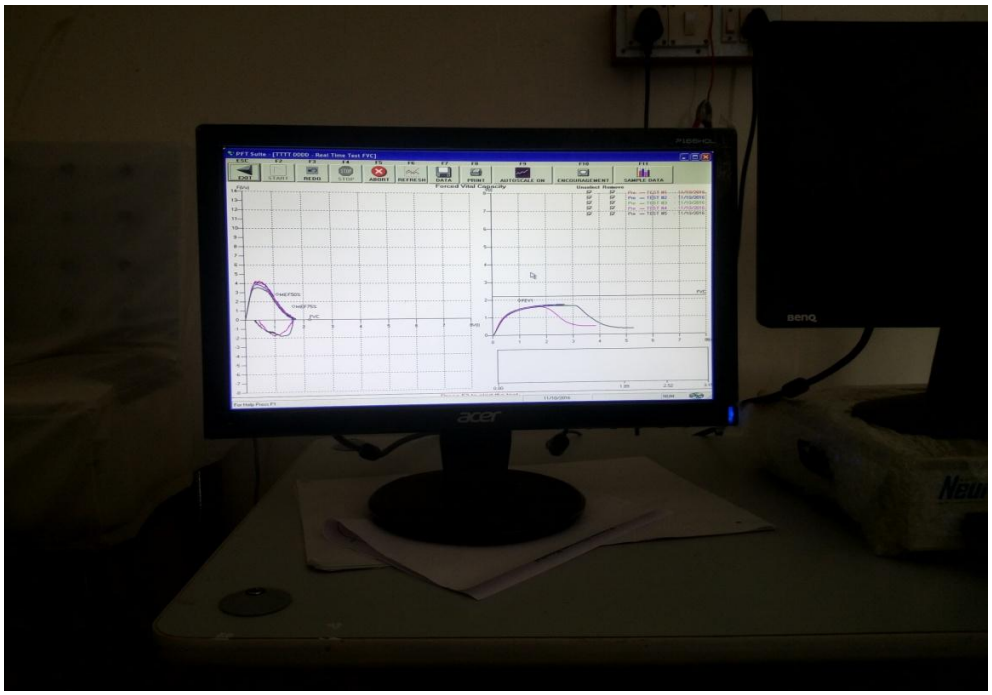
Expiratory Peak Flow Rate (PEFR): -

This is the maximum flow generated during expiration performed with maximal force and started after a full inspiration. PEFR is appreciably larger if the maneuver is performed without pause, immediately after the inspiration than if it is performed after a pause. The normal value is between 250 and 450litres /minute[8,9].



Several factors decide the value of respiratory parameters. These variations occur from one geographical location to the other, and even within the same population. Furthermore, other socio-demographic and anthropometric factors influence results. The

relationship between some respiratory parameters with age, weight, height race etc has been established.



Pregnancy leading to some physiological and biochemical alterations that influence generally all the organ of the body. Indeed, the alterations in the pulmonary system have far-reaching implications for the antenatal woman, her baby, and health care providers[6].

The nasal obstruction is related with clear rhinorrhea and physical examination of nose shows edematous nasal mucosa. It is known to be caused by a number of related factors. The nasal mucosa is affected by a generalized rise in interstitial fluid volume seen during the antenatal period and is also made worse by the direct effect of estrogen on the nasal mucosa, which causes increased vascularity and mucosal oedema[16].

Pregnancy-induced hypertension (PIH) or preeclampsia can increase the symptoms of nasal obstruction by fluid overload or edema. In PIH or Pre-eclampsia,

manipulation of the airway can lead to massive bleeding from the nose or oropharynx; endotracheal intubation can be a difficult one, and only a smaller than usual endotracheal tube may fit through the larynx[17-19].

There have been a lot of alterations and important advances in pulmonary function testing, but little has been applied to antenatal women particularly in our environment and it is hoped that our work in this area will help to refine the situation. Hyperventilation occurs during the antenatal period. The attendant hypocapnia and alkalosis of results from a complex interaction of pregnancy, induced changes in wakefulness and central chemoreflex drive to breathe, acid-base balance, metabolic rate, and cerebral blood flow[19] **.** There had been a lot of controversy surrounding the effects of pregnancy on vital capacity with many conflicting results.

Puranik et al, working in India, evaluated pulmonary function status in fifty normal pregnant women tested monthly. The parameters studied were Vital Capacity (VC), Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1st second (FEV1) using Vitalograph Spirometer; tidal volume (VT), inspiratory capacity (IC) and expiratory reserve volume (ERV) using spirograph and resting minute ventilation (VE) using Tissot's spirometer. Control values were obtained in the same subject 8-10 weeks after delivery. The increment seen in VT, VE and IC was very highly remarkable[20]. The small increase in the frequency of respiration was important and the decreasing trend noticed in ERV was very highly noteworthy. VC and FVC were conserved by the increase in IC and an associated decline in ERV. An increase in VC is caused mainly to increase in VT than the increase in frequency[20].

Another study in India using a dry bellows spirometer and a Wright's peak flow meter showed a marked decline in peak expiratory flow rate, forced vital capacity and forced expiratory volume in one second during the third trimester compared to controls[21].

Chhbra et al. study, 70 selected women, 50 pregnant and 20 nonpregnant controls found that out of seven parameters studied five showed alterations. There were alterations in the frequency of respiration, tidal volume, vital capacity, inspiratory capacity and expiratory reserve volume[22]. Maximum voluntary ventilation and timed vital capacity did not change. RF, VT, VC and IC increased significantly while a significant decline of ERV. These alterations may affect the antenatal behavior of pregnant women and their pregnancy outcomes[22].

Kolarzyk, working in Poland on 51 antenatal women aged 26.6±4.9 years and 40 healthy women (control group), showed a statistically significant increase during the antenatal period in cases of tidal volume (VT) and minute ventilation (MV) (whereas breath frequency was nearly on the same level)[23].There were also differences in inspiratory drive (VT/TI), occlusion pressure (P0.1), RRS. In addition, there was a correlation between BMI at the baseline with P0.1, MV, and VT/TI[23].

Sroczynski examined the function of the respiratory system in antenatal women in the last month of non-complicated pregnancy. Spirometry with Lung test 1000 was performed in 31 antenatal women at a mean gestational age of 37.72 weeks. In 24 of them, the test was repeated after delivery[24] .The results were compared with a control group of 31 healthy non-pregnant women. The vital capacity in the last month of pregnancy did not differ from values after delivery and in the control group. Component volumes changed: tidal volume was increased, expiratory reserve volume decreased, and

inspiratory reserve volume remained unchanged[24]. Minute ventilation recorded at rest in antenatal period is raised despite lowered breathing rate, whereas maximum voluntary ventilation was lower than after delivery and in the control group, evidencing decreased breathing reserve. The main forced expiratory parameters continue to exist unchanged in pregnancy. Parameters characterizing bronchioles showed an increase in airflow (bronchodilation). Furthermore, dyspnoeic symptoms found in antenatal women correlated with alterations in vital capacity components. Symptoms depended on the mechanics of ventilation and not on the status of bronchi[24].

Rees measured some respiratory parameters longitudinally during pregnancy and post partum in 20 normal subjects with a computer-assisted mass spectrometer[25]. It showed that resting tidal volume, minute ventilation, oxygen consumption, and carbon dioxide production raised during pregnancy. End-tidal carbon dioxide tension fell continuously during the antenatal period. Respiratory exchange ratio was 0.9 at 36 to 39 weeks' gestation and 0.8 at 5-13 weeks postpartum. Ventilatory frequency did not alter during the antenatal period[25]. Wise and colleagues (1992) in the USA observed that the important physiologic changes that occur during antenatal period are the increased minute ventilation, which is caused by enhanced respiratory center sensitivity and drive; a compensated respiratory alkalosis; and a low expiratory reserve volume. The vital capacity and measures of forced expiration are well preserved. Patients who have many lung diseases tolerate pregnancy well, with the exception of those who have pulmonary hypertension or chronic respiratory insufficiency from a parenchymal or neuromuscular disease.

Lui measured the lung functions in different pregnant stages in 41 women with pregnancy and 12 normal women without pregnancy. Forced Vital Capacity (FVC) significantly, but gradually decreased as pregnancy advanced[26]. After 28 weeks of gestation, the Vital Capacity (VC), Forced Expired Volume in 1 second (FEV1) significantly declined as compared with the normal values. These results suggested that the lung function altered gradually during pregnancy, especially after the 28th week, but more significantly in VC, FVC, and FEV1. Maybe there are slight obstructions in the bronchial tubes, after the 28th week of gestation and it may be the reason for the occurrence of shortness of breath and the lung infection[26].

Peak expiratory flow rate has exhibited variations during the antenatal period. Peak expiratory flow rates (PEFR) were measured longitudinally in 60 pregnant women aged 20-28 years (average 24 yrs), with the height between 130-160 cm (average 154.5 cm), each month beginning from 3rd month of gestation and also 8-10 weeks postpartum using Wright's Peak Flow Meter. The PEFR decreased from 329.12 +/- 4.40 lpm in the 3rd month to 286.22 +/- 3.81 lpm in the 9th month of gestation and risen to 347.86 +/- 2.93 lpm in postpartum period[20]. However *Brancazio, study* longitudinally in the USA on 57 women during each trimester of pregnancy and postpartum demonstrated that peak expiratory flow rate does not change with pregnancy and advancing gestation[27]. This finding is in agreement with a recent study in Northern Nigeria using 250 female (123 pregnant and 127 non-pregnant).Although values obtained were lower than that of Caucasians, there were no significant changes between pregnant and non-pregnant subjects [28]. The Pulmonary function does not seem to be affected by fundal height or number of fetuses.

A cross-sectional study of pulmonary function was performed in 68 women with twin pregnancies (17 examined in the first trimester, 35 second trimester, 16 third trimester) and 140 women with singleton pregnancies (28, 80, 40, respectively) and 22 non-pregnant women in a London teaching hospital. In both the twin and singleton pregnancies, the mean FRC and expiratory reserve ventilation of women studied in the third trimester and minute ventilation of women studied in each trimester differed significantly from that of the non-pregnant women. There were, however, no significant differences demonstrated in respiratory function between healthy women with a twin as compared with singleton pregnancies[29]. Moreover , Strauss studied, retrospectively, carried out 69 spirometric pulmonary function tests on 19 singletons, seven twins, 38 triplets, and five quadruplet pregnancies; maternal age 19–37 years; pregnancy weeks 22–41[30].The vital capacity forced expired volume in 1 second, Tiffeneau's index, blood gasses as well as blood pH levels were not significantly different in singleton, twin, triplet or quadruplet pregnancies before or after 30 weeks of gestation. Finally, no significant difference in respiratory function measurements could be found between higher order pregnancies with or without subjective dyspnea. Thus, no clinically relevant correlation between any spirometrically measurable pulmonary function values and pregnancy data referring to uterine size, fundal height or breathlessness were found[30]. Various physiological and pathological conditions may affect lung function during pregnancy. A study performed by Schultz *et al.* in Denmark showed a significant decrease in FRC, PEFR and FEV1 because of the postural changes, however, arterial oxygenation, MVV, and DLCO remained largely the same.

In Switzerland, it has been shown that epidural analgesia improves lung function[31]. Spirometry was performed in sixty consenting participants receiving epidural analgesia during the antepartum visit and in labour. After effective epidural analgesia was established; at both assessments and the women were pain-free the results were as follows: Values were within normal ranges but increased significantly after effective epidural analgesia; median inter quantan range (IQR)) increase for vital capacity 7.4 (3.0-13 [-12- 27])% , forced vital capacity 4.4 (1.7-9.8 [-13-26])% ; forced expiratory volume in 1 s 5.5 (1.7-8.6 [-14-28])% ; and peak expiratory flow rate 2.3 (-1.6-5.8 [-18-16])%[31].

Unsal measured FVC, FEV1 and PEFR in 13 pre-eclamptic and 15 control subjects undergoing cesarean section[31]; and 11 pre-eclamptic and 15 control subjects undergoing vaginal delivery (VD) on the postpartum third day. It was demonstrated that certain pulmonary functions might be impaired in the early postpartum period in pre-eclamptic women undergoing a caesarean section. Preeclamptic women had significantly lower FVC, FEV1 and PEFR measurements than the control. When the subjects were grouped according to the mode of delivery, FVC, and FEV1 values were observed to be significantly different between the preeclamptic and control groups undergoing a caesarean section.None of these parameters was significantly different between the pre-eclamptic and control groups who had delivered vaginally[31]. Lung function is affected by multifactorial variables including normal pregnancy. These changes are further modified by some obstetrics complications. Thus, baseline values are extremely invaluable in the management of pregnant women with obstetric and pulmonary complications.

MATERIALS AND METHODS

MATERIALS AND METHODS

STUDY DESIGN:

Observational Study

STUDY SETTING:

Antenatal women attending the obstetric and gynecology Department of Karpaga Vinayaga Institute of Medical Sciences and Research Centre, Chinnakaolambakkam, Kancheepuram district

STUDY PERIOD:

April 2015 to January 2016

POPULATION AND SAMPLING:

The antenatal mothers visiting OBG department were taken for the study after getting informed consent, the consent being explained in their own language. The subjects were grouped into three: Pregnant subjects of first trimester (up to12 weeks), second trimester (13 weeks to 28 weeks) and third trimester (29weeks to up to birth) gestational period. Totally 90 samples, (i.e) 30 subjects in each group were selected for this study by purposive sampling technique.

ETHICAL CLEARANCE:

Ethical clearance (Reg No: 201415601) was obtained from Institutional Ethical Committee, Karpaga Vinayaga Institute of Medical Sciences and Research Centre.

INCLUSION CRITERIA

- Confirmed pregnant women who were willing to participate
- Ability to demonstrate sufficient proficiency in carrying out the tests needed to assess ventilatory function.

EXCLUSION CRITERIA

Patients with the following were excluded:

- Pre-existing cardio-respiratory diseases like asthma, Chronic Obstructive Airway Disease (COPD), Congestive Cardiac Failure (CCF).
- Presence of spinal deformities (scoliosis, kyphoscoliosis)
- Upper and lower respiratory tract infections.
- Medications that alter lung function (e.g. bronchodilators and constrictors).
- Acute malaria in pregnancy.
- Pre-eclampsia.
- Diabetes in pregnancy
- Other pregnancy complications (threatened abortion, antepartum hemorrhage etc)

We have used computer-based spirometry, Medicaid spiro excel in performing pulmonary function test for the study participants in this study.

METHODOLOGY:

The subjects considered for this study are with Hemoglobin more than 10 gm%. All the subjects were called for spirometric tracings, 3 to 4 hrs after meal, in the post absorption stage in order to keep uniform conditions for recording the tests. All the subjects were given instructions and with regard to the performance of the tests. The tracings in the spirograph were taken after being fully satisfied. Two to three tracings were taken out of which the best is taken as the final reading.

PROCEDURE:

The standard spirometry maneuver is a maximal forced exhalation (greatest effort possible) after a maximum deep inspiration (completely full lungs). Several indices can be derived from this blow.

• **FVC –** Forced Vital Capacity – the total volume of air that the patient can forcibly exhale in one breath[8,9].

• **FEV1** – Forced Expiratory Volume in One Second – the volume of air that the patient is able to exhale in the first second of forced expiration[8,9].

• **FEV1 /FVC** – the ratio of FEV1 to FVC expressed as a fraction (previously this was expressed as a percentage). Values of FEV1 and FVC are measured in liters and are also expressed as a percentage of the predicted values for that individual[8,9].

MEASURING FEV1, FVC, AND FLOW–VOLUME CURVES[8,9]

- Attach a clean, disposable, one-way mouthpiece to the spirometer.
- Instruct the patient to breathe in fully until the lungs feel full.

- The patient should hold their breath long enough to seal their lips tightly around the mouthpiece.
- Blast the air out as forcibly and fast as possible until there is no more air left to expel. The operator should verbally encourage the patient to keep blowing and keep blowing during this phase. Watch the patient make sure a good mouth seal around the mouthpiece is achieved.
- Check that an adequate trace has been achieved. Sometimes with electronic spirometers, the patient may leak a small volume of air into the mouthpiece while sealing the lips which will register as the blow.
- Repeat the procedure at least twice until three acceptable and repeatable blows are obtained. Maximum of 8 efforts
- There should be three readings, of which the best two are within 150 ml or 5% of each other and best.

The numbers appear as a table of actual and predicted figures together with volume–time and flow–volume traces. The best readings of FEV1 and FVC are usually recorded. Spirometer with real-time traces and printouts are taken as they provide helpful information about the quality and acceptability of the blows[8,9].

INTERPRETATION OF SPIROMETRY:

It involves looking at the absolute values of FEV1, FVC, and FEV1/FVC, comparing them with predicted values, and examining the shape of the spirograms. Patients should complete three blows that are consistent and within 5% of each other.

In a patient with normal lung function, the volume–time curve should rise rapidly and smoothly and plateau within 3-4 seconds. With increasing degrees of airway

obstruction, it takes longer to blow out the air—up to 15 seconds—and the upward slope of the spirogram is much less steep[8,9].

VARIABLES UNDER THE STUDY

In this study, a structured Proforma was used to collect clinical and laboratory values. The variables such as Age of the antenatal woman, gestational age in weeks, parity, whether they received Inj.TT and Iron Folic acid tablets, Weight (kgs), Height (cm), Blood Pressure and spirometric values were collected. BMI was calculated with the formula weight / $(Height)^2$, Pulmonary Parameters FVC, FEV1, FEVI/FVC and PEFR were measured.

STATISTICAL ANALYSIS:

The data were entered in MS Excel and analyzed in SPSS software 20v. Mean and Standard deviations were calculated for quantitative variables and percentages for categorical values.

The comparisons were assessed by one-way Analysis of Variance at 5% level of significance among the trimester for pulmonary parameters. Chi-square test was used to find the association between parity and trimester at 5% level of significance.

The results were represented in simple tables and graphs

RESULTS

RESULTS

Table 1: Age Distribution of Antenatal Mothers

Trimester					Chi Sq	p value
Age	**First**	**Second**	**Third**	**Total**		
≤20 years	4	2	3	9	1.43	0.8
21 – 30 Years	20	24	22	66		
≥31 Years	6	4	5	15		
Total	30	30	30	90		

In this study, 90 subjects were selected considering 30 equal samples in each group. Their age ranged from 18 years to 34 years overall. Table 1 describes the distribution of age among the three trimesters 66 subjects were in the age group of 21 years to 30 years. There is no significant difference between the groups by chi-square test ($p = 0.8$).

Their mean age was described in table 2. Mean age in the first trimester was 26.1 ± 4.7, Second trimester 24.8 ± 4.4 and in the third trimester 25.13 ± 4.61. There is no significant difference between the groups by Analysis of variance. ($p = 0.5$).

Graph 1: Age Distribution of Antenatal Mothers

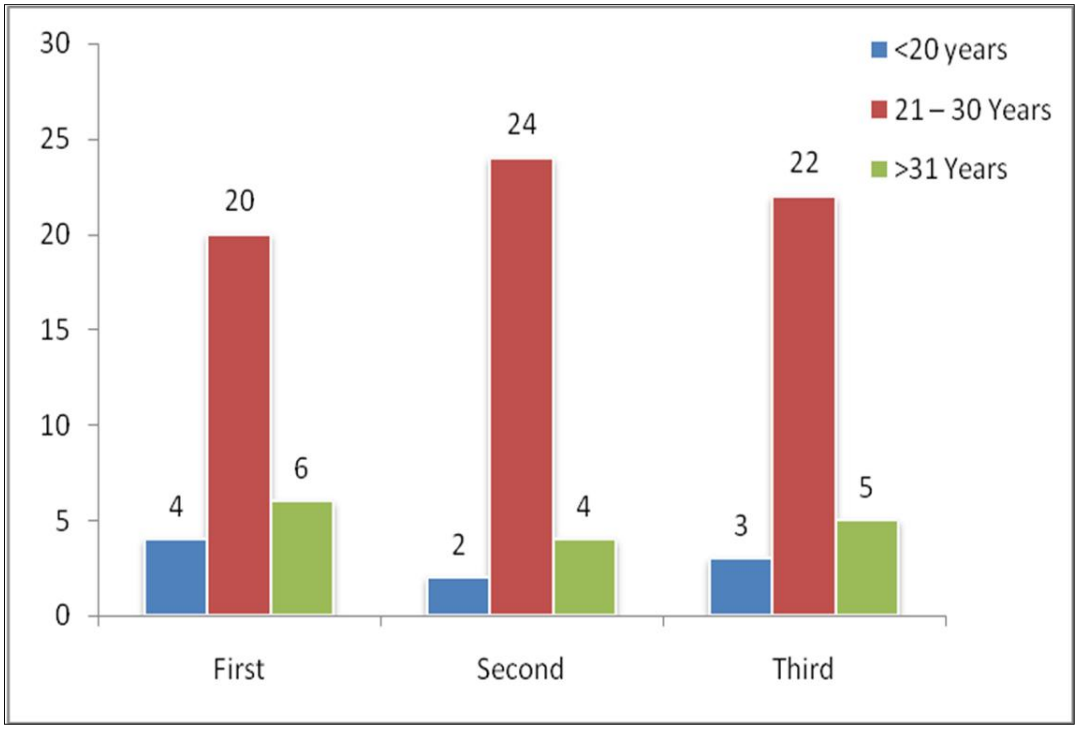


Table 2: Comparison of Mean age between the three trimesters among pregnant women

Trimester	Mean	SD	F	P Value
First	26.10	4.70	0.654	0.5
Second	24.80	4.40		
Third	25.13	4.61		

Graph 2: Comparison of Mean age between the three trimesters among pregnant women

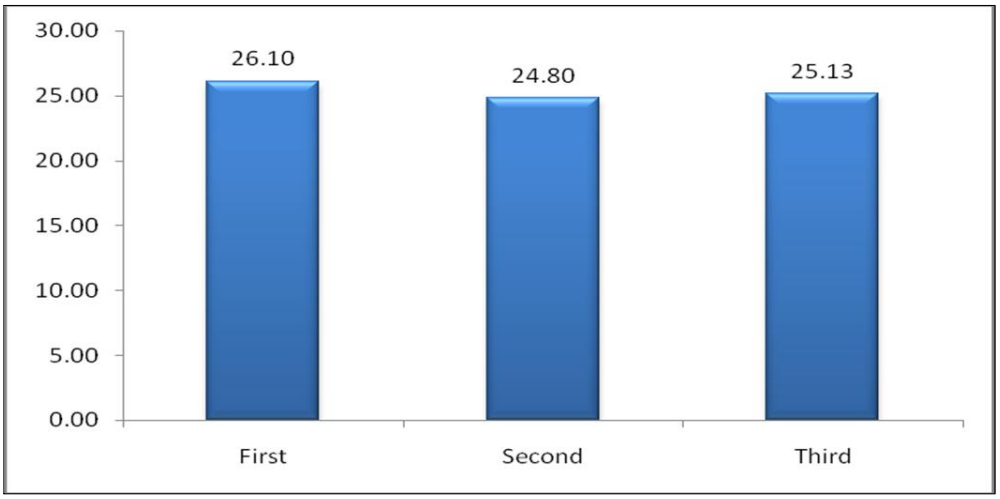


Table 3: Comparison of Mean Weight (kgs) between the three trimesters among pregnant women

Variables	Trimester	Mean	SD	F	Sig.
WEIGHT (Kg)	First	54.50	7.93	17.024	**0.0001**
	Second	62.53	9.46		
	Third	66.50	6.73		

Table 3 shows the anthropometric measurements such as weight Height and BMI were calculated. Table 3 shows the mean Weight (kgs) across the three groups. Mean weight 54.5 ± 7.93, 62.53 ± 9.46 and 66.5 ± 6.73 for first second and third trimesters respectively which showed a significant difference by One-way ANOVA (F = 17.024, p = 0.0001). Graph 3 explains the difference in the bar diagram.

Graph 3: Comparison of Mean Weight (kgs) between the three trimesters among pregnant women

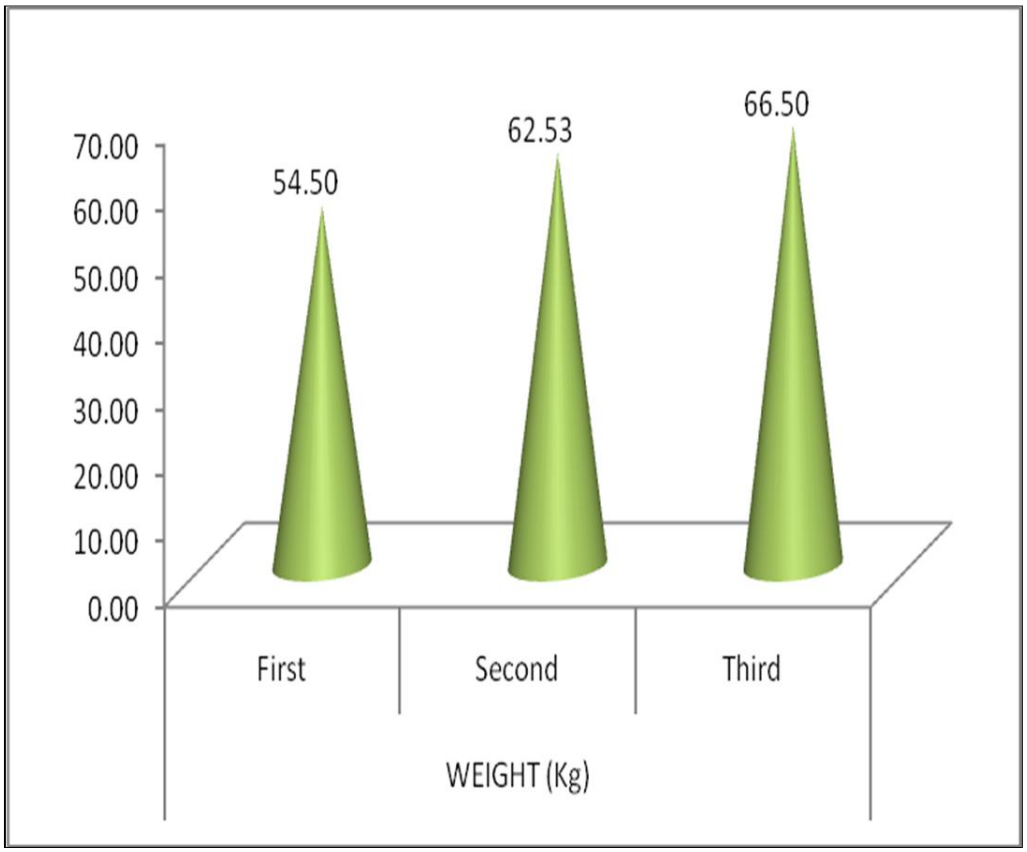


Table 4: Comparison of Mean Height (cm) between the three trimesters among pregnant women

Variables	Trimester	Mean	SD	F	Sig.
HEIGHT (Cm)	First	155.87	7.48	1.471	0.235
	Second	158.77	11.04		
	Third	160.03	10.07		

Table 4 shows the mean Height (cm) across the three groups. Mean Height 155.87 ± 7.48, 185.77 ± 11.04 and 160.03 ± 10.04 for first second and third trimesters respectively which showed no significant difference by One-way ANOVA (F = 1.471, p = 0.2). Graph 4 explains the difference in the bar diagram.

Graph 4: Comparison of Mean Height (cm) between the three trimesters among pregnant women

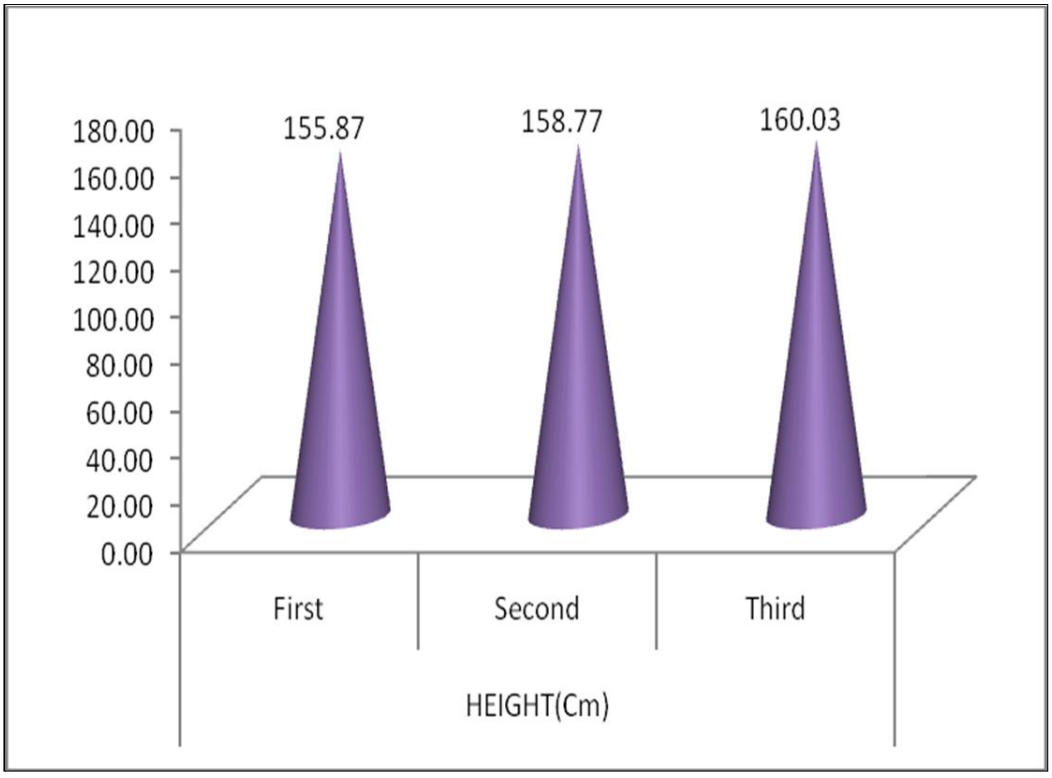


Table 5: Comparison of Mean Body Mass Index (BMI) between the three trimesters among pregnant women

Variables	Trimester	Mean	SD	F	Sig.
BMI	First	22.51	3.52	6.033	**0.004**
	Second	25.06	4.56		
	Third	26.34	4.84		

Table 5 shows the mean Body Mass Index (BMI) across the three groups. Mean BMI were 22.51 ± 3.52, 25.06 ±4.56 and 26.34 ± 4.84 for first second and third trimesters respectively which showed statistically significant difference by One-way ANOVA (F = 6.033, p = 0.004). Graph 5 explains the differences in the bar diagram.

Graph 5: Comparison of Mean Body Mass Index (BMI) between the three trimesters among pregnant women

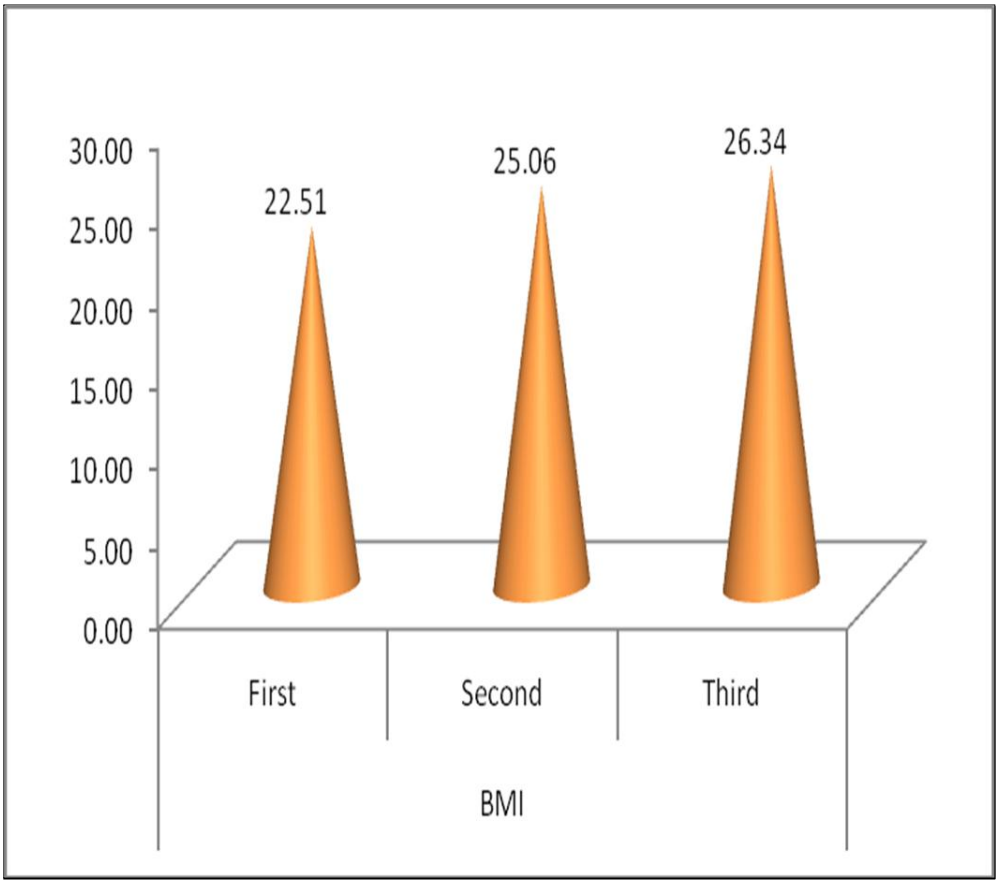


Table 6: Comparison of Mean Blood Pressure between the three trimesters among pregnant women

BP	Trimester	Mean	SD	F	Sig.
SBP	First	123.30	11.26	8.196	**0.001**
	Second	131.07	6.22		
	Third	121.07	11.71		
DBP	First	78.70	6.82	14.962	**0.0001**
	Second	84.97	3.76		
	Third	75.87	8.35		

Table 6 shows the mean Blood Pressures among the three group study subjects. Mean Systolic Blood Pressure 123.3 ± 11.26, 131.07 ± 6.22 and 121.07 ± 11.71 for first second and third trimesters respectively which showed statistically significant difference by One-way ANOVA (F = 8.196, p = 0.001).

Mean Diastolic Blood Pressure were 78.7 ± 6.82, 84.97 ± 3.76 and 75.87 ± 8.35 for first second and third trimesters respectively which showed statistically significant difference by One-way ANOVA (F = 14.962, p = 0.0001). Graph 6 and 7 explains the differences in Blood Pressures as bar diagrams

Graph 6: Comparison of Mean Blood Pressure between the three trimesters among pregnant women

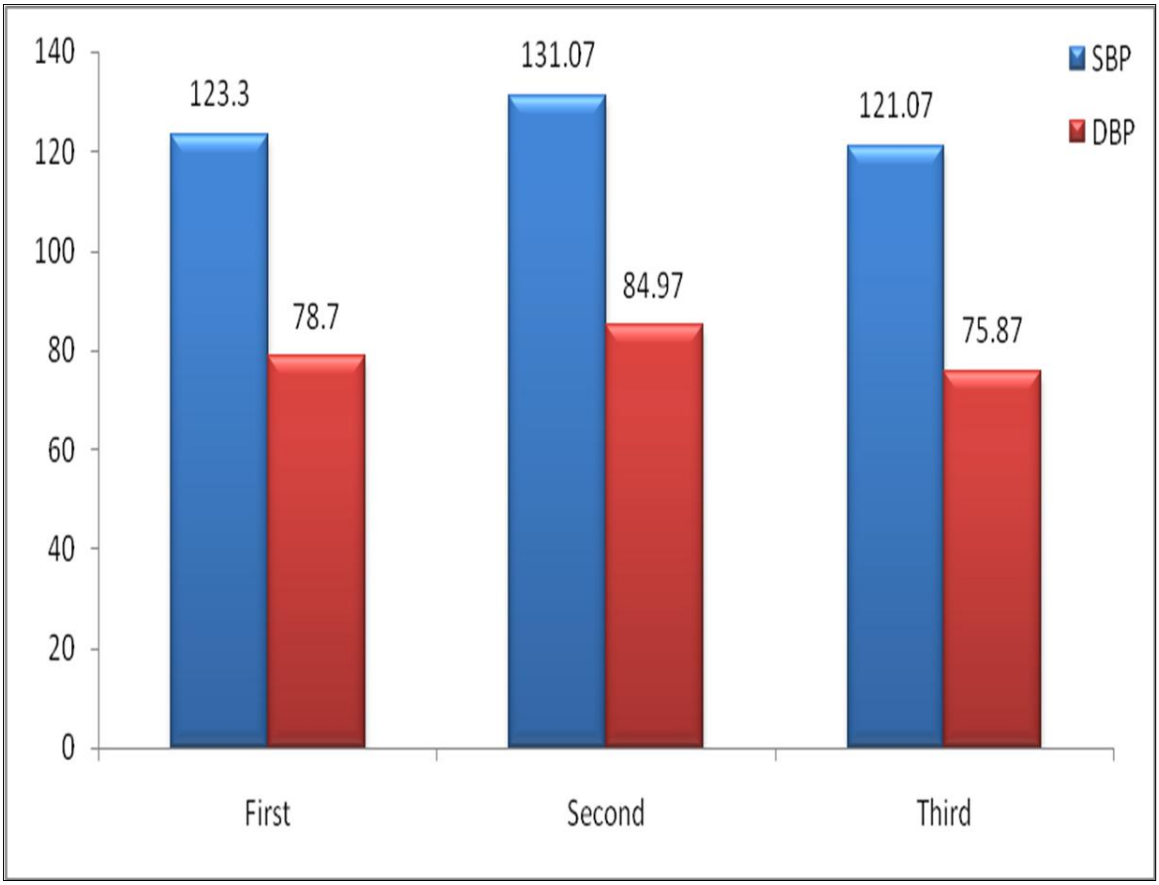


Table 7: Comparison of Parity between the three trimesters among pregnant women

Trimester					Chi Sq	p value
Parity	**First**	**Second**	**Third**	**Total**		
One	14	18	13	45	2.73	0.6
Two	14	10	16	40		
Three	2	2	1	5		
Total	30	30	30	90		

Table 7 describes the difference in study groups by parity which was not statistically significant with chi-square test (p = 0.6). Table 8 shows subjects received Injection TT and Iron-folic acid tablets during their follow ups. All the subjects were getting according to their gestational age. Graph 8 explains with pie / doughnut diagram.

Graph 7: Comparison of Parity between the three trimesters among pregnant women

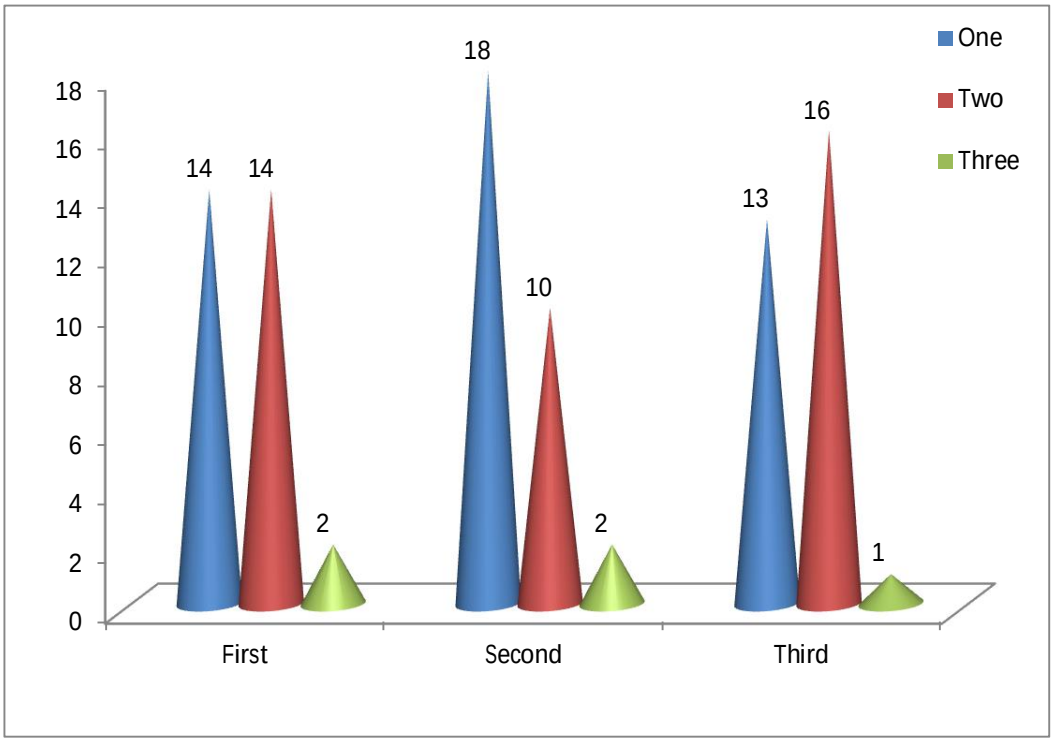


Table 8: Comparison of TT / IFT between the three trimesters among pregnant women

Trimester	First	Second	Third
Injection TT		30	30
Iron Folic Acid Tablets	30	30	30

Graph 8: Comparison of TT / IFT between the three trimesters among pregnant women

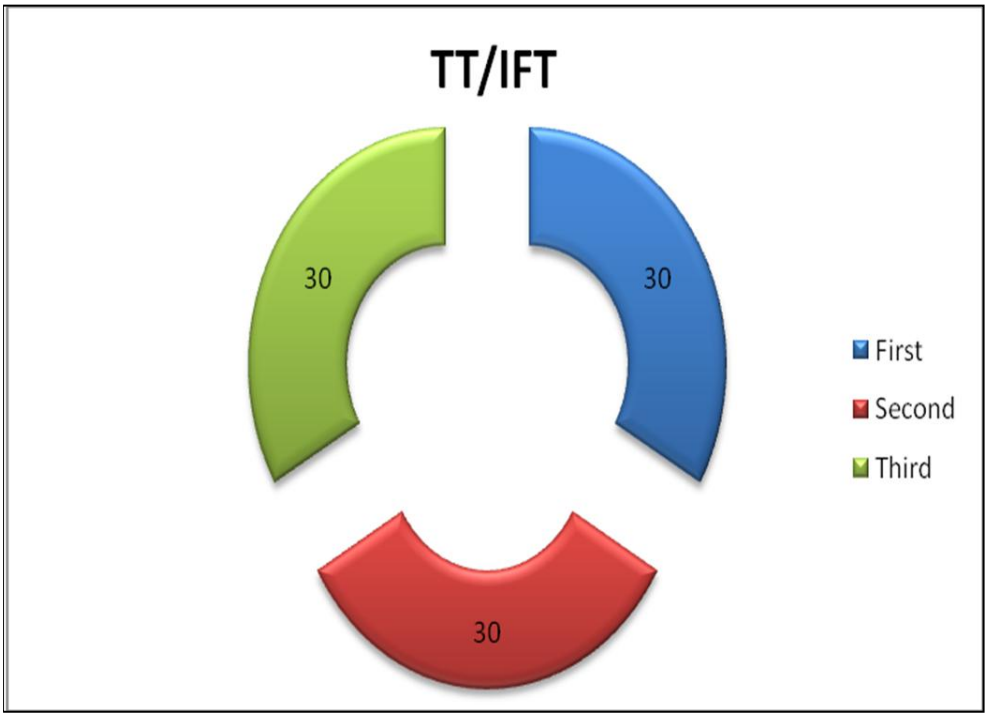


Table 9: Comparison of FVC (%) between the three trimesters among pregnant women

Variables	Trimester	Mean	SD	F	Sig.
FVC %	First	93.37	6.14	3.501	**0.034**
	Second	94.23	6.70		
	Third	97.53	6.45		

Table 9 shows the mean FVC% values among the three group study subjects. Mean FVC values were 93.37 ± 6.14, 94.23 ± 6.7 and 97.53 ± 6.45 for first second and third trimesters respectively which showed statistically significant difference by One-way ANOVA (F = 3.501, p = 0.034). Graph 9 explains the differences in the bar diagram.

Graph 9: Comparison of FVC (%) between the three trimesters among pregnant women

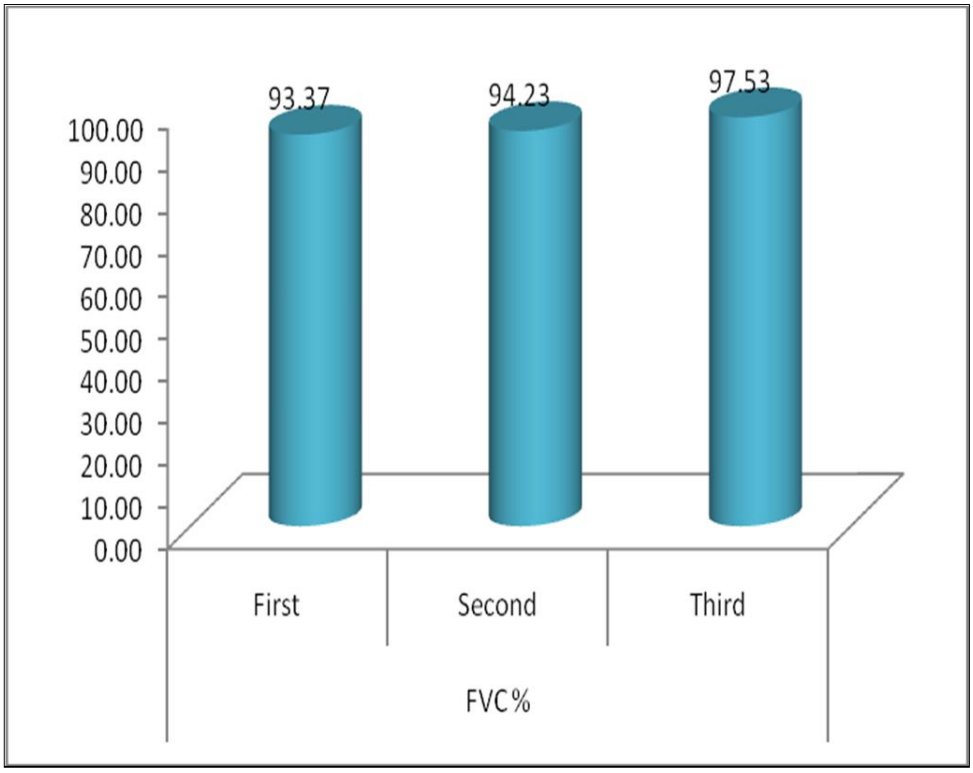


Table 10: Comparison of FEV1(%) between the three trimesters among pregnant women

Variables	Trimester	Mean	SD	F	Sig.
FEV1 %	First	91.13	8.14	3.367	**0.039**
	Second	91.63	9.00		
	Third	96.00	6.66		

Table 10 shows the mean FEV1% values among the three group study subjects. Mean FEV1 values were 91.13 ± 8.14, 91.63 ± 9 and 96 ± 6.66 for first second and third trimesters respectively which showed statistically significant difference by One-way ANOVA (F =3.367, p = 0.039). Graph 10 explains the differences in the bar diagram.

Graph 10: Comparison of FEV1(%) between the three trimesters among pregnant women

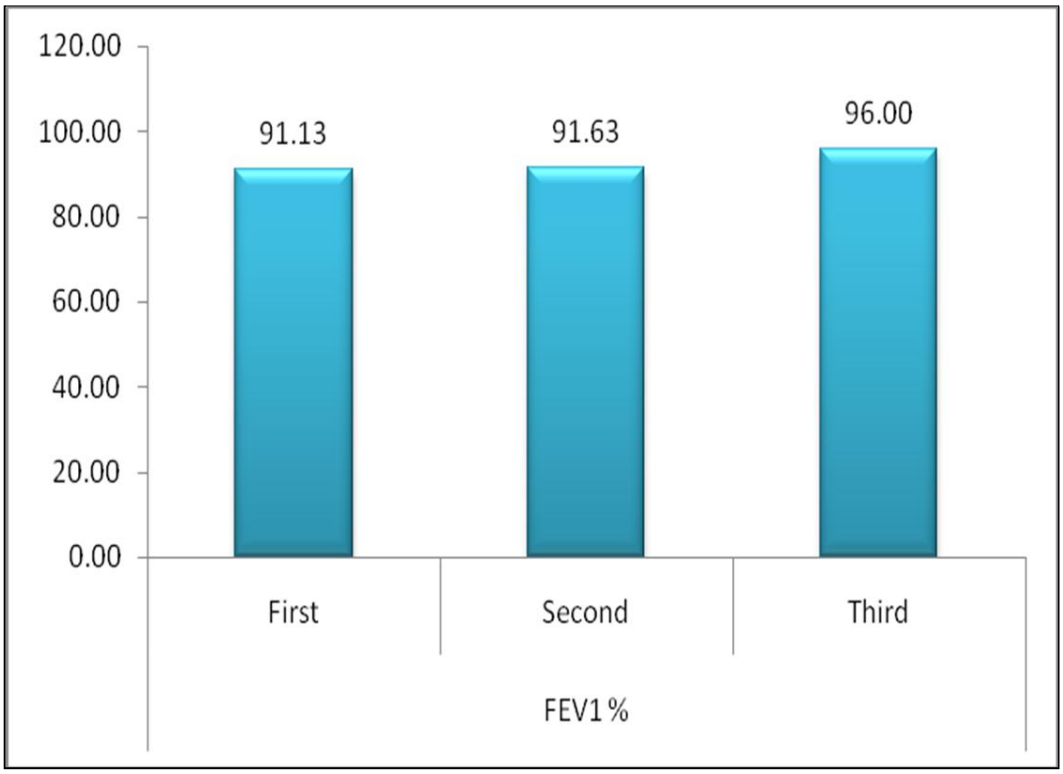


Table 11: Comparison of FEV1/ FVC(%) between the three trimesters among pregnant women

Variables	Trimester	Mean	SD	F	Sig.
FEV1/FVC (%)	First	91.84	6.32	4.904	**0.01**
	Second	93.19	6.47		
	Third	96.66	5.64		

Table 11 shows the mean FEV1/ FVC% values among the three group study subjects. Mean FEV1/FVC% values were 91.84 ± 6.32, 93.19 ± 6.47 and 96.66 ± 5.64 for first second and third trimesters respectively which showed statistically significant difference by One-way ANOVA (F = 4.904, p =0.01). Graph 11 explains the differences in the bar diagram.

Graph 11: Comparison of FEV1/FVC (%) between the three trimesters among pregnant women

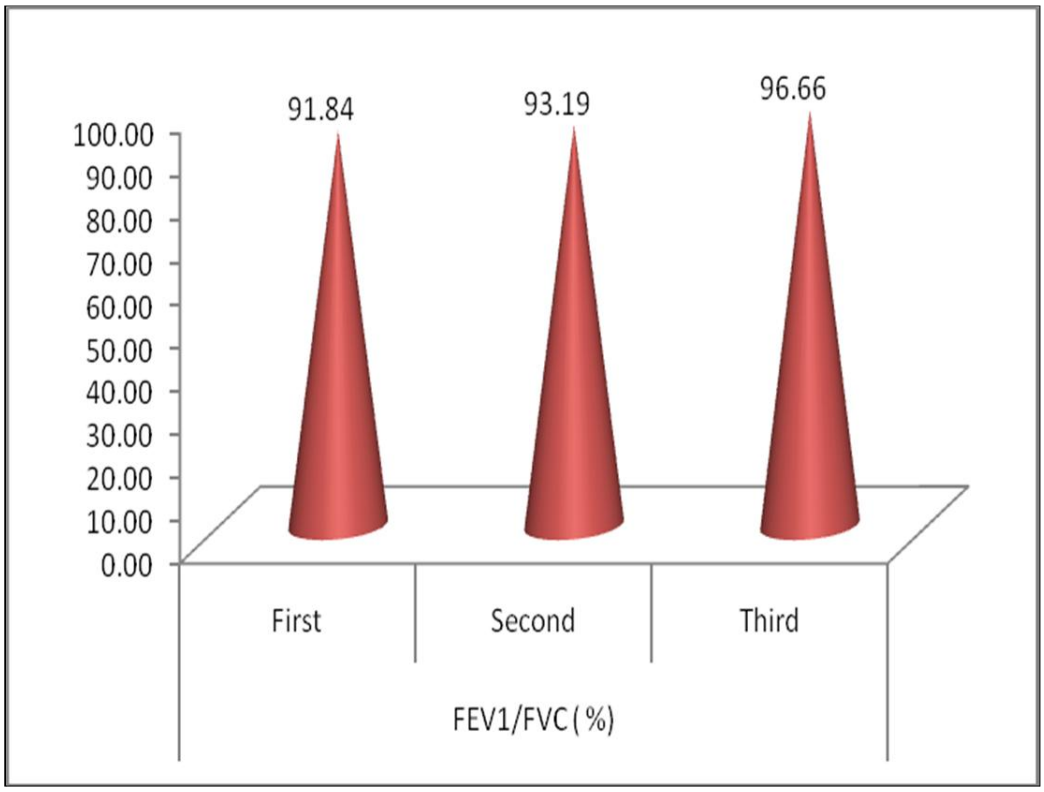
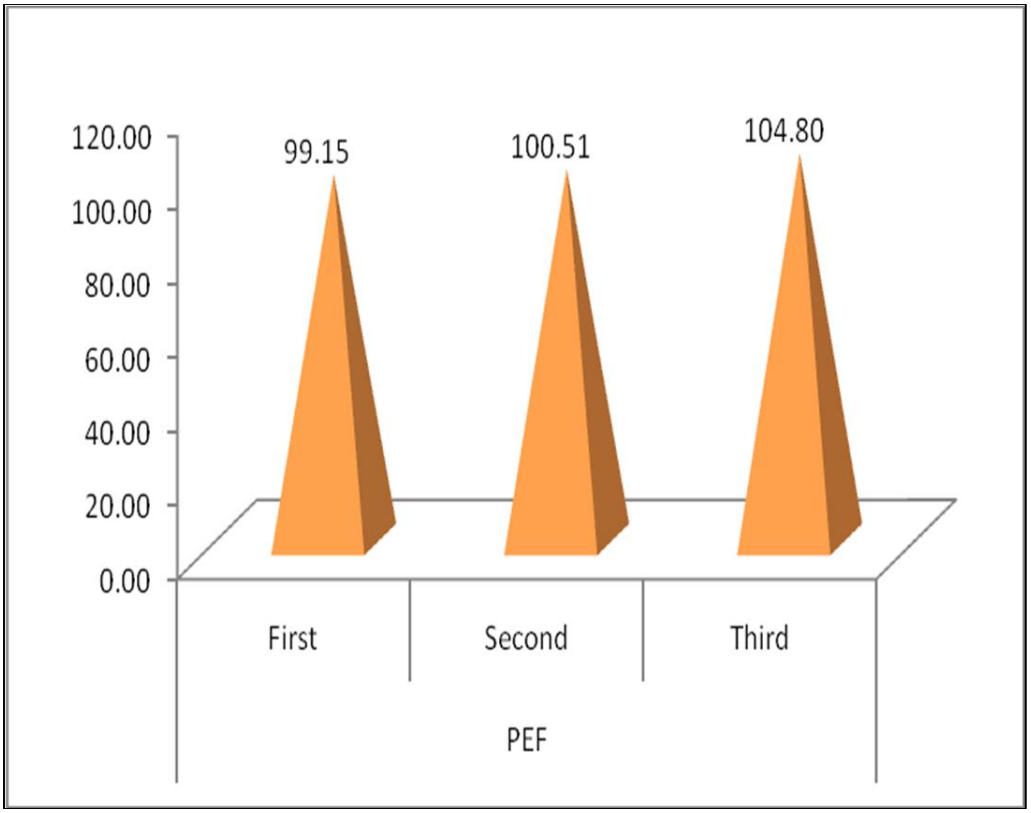


Table 12: Comparison of PEFR between the three trimesters among pregnant women

Variables	Trimester	Mean	SD	F	Sig.
PEF	First	99.15	4.62	9.965	**0.0001**
	Second	100.51	5.49		
	Third	104.80	5.21		

Table 13 shows the mean PEFR values among the three group study subjects. Mean PEFR values were 99.15 ± 4.62, 100.51 ± 5.49 and 104.8 ± 5.21 for first second and third trimesters respectively which showed statistically significant difference by One-way ANOVA (F = 9.965, p =0.0001). Graph 13 explains the differences in bar diagram

Graph 12: Comparison of PEFR between the three trimesters among pregnant women



DISCUSSION

DISCUSSION

The present cross-sectional study had an equal number of samples in three-trimester groups group 1:up to 12 weeks, group 2 :13weeks to 28 weeks and group 3: 29 weeks to term. Most of the subject participants were in the mean age of 20 to 30 years. The anthropometric measures weight, Height, and BMI were calculated. Height not having any significant difference where in weight and BMI were statistically differing in each trimester. As gestational age increases, there is a rise in weight and BMI which correlating with previous studies as well.

During pregnancy, caloric intake increases to make the sure proper development of the fetus. The amount of weight gained during a single pregnancy varies among women. The overall pregnancy weight gain for women starting pregnancy at a normal weight, with a BMI of 18.5 - 24.9 range from 11.4 to15.9 kg[32]

Gestational weight is a unique and complex biological phenomenon that supports the functions of growth and development of the foetus. Gestational weight gain is influenced not only by alterations in maternal physiology and metabolism but also by placental metabolism. The placenta functions as an endocrine organ, a barrier, and a transporter of substances between maternal and fetal circulation. Practitioners may formulate different recommendations based on specific and individualized patient`s needs, based on factors including low maternal age, nutritional status, foetal development, and morbid obesity. During the antenatal period, insufficient or excessive weight gain can compromise the health of the mother and fetus and also affect respiratory function.

The blood pressures both systolic and diastolic were also showed significant difference due to the trimesters. There were increases in the second trimester, third-trimester values more or less equal to first by Tukey's multiple comparison tests.

In respiratory parameters, there was rising trend across the three trimesters of FVC%, FEV1%, EFR and PEF values. Similar studies showed raise in these values. These were due to the downward movement of the uterus, as the head of the fetus gets engaged. It is generally observed that the breathlessness seen in the 3rd trimester of antenatal period disappears near full term. This finding is consistent with other authors[8, 9]

PEFR was significantly increased in group 3 antenatal women. As PEFR is muscular element it could be because of downward displacement of the diaphragm at full term pregnancy. This finding is in agreement with other researchers[10] At the same time some authors have found that PEFR decreases throughout pregnancy[6,7,11]

Some studies showed a significant increase in Forced Vital Capacity (FVC) while other studies showed a decline in FVC. They noticed a small but definite increase in the vital capacity curve during the antenatal period from the third to the eighth month. They observed, rise in the Vital Capacity during the last month of antenatal period[20, 21].

Landt CK, Widlund G and Benjamin PR found a rise in Vital Capacity during the antenatal period. Root , Cohen , Landt and others concluded that the Vital Capacity of the lung is raised during pregnancy and the rise in VC noticed[6]. Rubin et al observed that there is a decrease in Vital Capacity while Cugell felt that Vital Capacity remained unchanged during pregnancy[6]. Howard G Knuttgen and Kendall E studied the physiological changes during normal pregnancy. Pulmonary hyperventilation developed early in pregnancy and persisted at rest which was due to increase in Tidal Volume[6].

Bernard J, Gee L , Bernard S Packer et al, studied about the Pulmonary Mechanics during Pregnancy. They noticed that during late pregnancy, there is a 25% decrease in FRC and about 40% decrease in ERV. The slight and statistically insignificant decrease in total lung capacity and VC were also found in their study[6]. FVC is maintained by the rise in inspiratory capacity.

The work was done by the study of Skandan KP, Mehta YB, Shah V, Parikh SR et al showed an increase in Tidal Volume (TV) together with a decline in Expiratory Reserve Volume (ERV) and Vital Capacity during antinatal period. Gazioglu K, Kaltreider NL, Lehmann V and Fabel H found that during the antenatal period the Inspiratory Capacity rises and the expiratory capacity is declines[6].

Knox AJ, Petkova S et al, noticed a number of physiological alterations which occurred during the antenatal period. At the end of the first trimester, Ventilation rose by 20-25% and was sustained throughout antenatal period[6]. A decline in the Residual Volume (RV) and Functional Residual Capacity (FRC) was noticed. Also, Diaphragmatic excursion, Vital Capacity, and Total Lung Capacity remained unchanged[6].

It would have been more suitable if patients were recruited in the 1st trimester and longitudinally followed up to delivery and six weeks postpartum to make sure of the actual time it will take for these alterations to come back to normal. Moreover, percentage oxygen saturation should have been obtained during the time of the study.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The present study proved that the respiratory parameters are significantly altered during pregnancy.

The increased FVC, PEFR, FEV1, and FEV1/FVC ratio is a strong indication that pregnancy causes physiological adaptation in the lungs. Hormones determine changes in smooth muscle tone and possibly connective tissue - elastance might occur during pregnancy which probably alters the mechanical properties of the respiratory system.

FVC increases significantly during the second trimester of gestation and throughout pregnancy. FEV1/FVC% is significantly higher in Second and the third trimester multiparous than primigravida women, suggesting that changes in FVC occurring during pregnancy persist postpartum. PEFR increases significantly during healthy pregnancies and should be interpreted cautiously in pregnant women with impaired lung function

With the combination of increased oxygen consumption and the decreased expiratory reserve volume due to the reduced functional residual capacity, rapid fall in arterial oxygen tension despite careful maternal positioning and pre-oxygenation may occur during labour and spinal anesthesia. Even with short periods of apnea, either from obstruction of the airway or inhalation of a hypoxic mixture of gasses, the gravida has little defense against the development of hypoxia.

Pregnant women with respiratory disorders should undergo lung function test during labour to ascertain the degree of severity and to institute appropriate intervention. These will go a long way in reducing maternal mortality and morbidity and hasten the

attainment of Millennium Developmental goal 5 (Reduction in maternal mortality by 75 % by the year 2015).

Limitations of this study were the sample size which is small for cross-sectional studies. Future studies need to do with large sample size and if funds and time feasible then longitudinal studies would be better. PFT should be a part of the routine antenatal checkup to prevent any possible respiratory complication.

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ANNEXURES

PATIENT CONSENT FORM

Title of the study **: ASSESSMENT OF PULMONARY FUNCTION BY SPIROMETRY IN ANTENATAL CASES**

Name : Date :

Age : OP No :

Sex : Individual ID No: :

The details of the study have been provided to me in writing and explained to me in my own language.

I confirm that I have understood the above study and had the opportunity to ask questions.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected.

I agree not to restrict the use of any data or results that arise from this study provided such a use is only for the scientific purpose(s).

I have been given an information sheet giving details of the study.

I fully consent to participate in the above study.

SIGNATURE OF PARTICIPANT SIGNATURE OF INVESTIGATOR

Ra xgGjy; gbtk;

MaT nraaggLk jiygG : கர்பிணி பெண்களுக்கான நுரைஈரல் செயல்திறன் பரிசோதனை

MaT nraaggLk ,lk : கற்பக விநாயகா மருத்துவ கல்லூரி

gqF ngWNthh;d ngah :

gqF ngWNthh;d taJ : gqF ngWNthh;d vz :

NkNy Fw;gg;lLss kUjJt Mat;d t;guqfs vdfF t;sffgglLssJ. ehd ,tthat;y jdd;rirahf gqNfwf;dNwd. vej fhuzjj;dhNyh vej rllrr;ffYfFk clglhky ehd ,tthat;y ,UeJ t;yf;f nfhssyhk vdWk mw;eJ nfhzNld.

,ej MaT rkgejkhfNth ,ij rhheJ NkYk MaT Nkwnfhs Sk NghJk ,ej Mat;y gqFngWk kUjJth vdDila kUjJth vdDila kUjJt mw;fiffis ghhggjwF vd mDkj; Njit ,yiy vd mw;eJ nfhsf;Nwd. ,ej Mat;d %yk f;ilfFk jftiyNah KbitNah gadgLjj;f nfhss kWff khlNld.

,ej Mat;y gqF nfhss xgGf nfhsf;Nwd. ,ej Mait Nkwnfhs Sk kUjJt mz;fF czikAld ,UgNgd vd cWj;as;ff;Nwd.

gqNfwgth;d ifnahggk

,lk:
Njj;:

rhlr;ahsh;d ifnahggk

,lk:
Njj;:

PROFORMA FOR PATIENT DETAILS

NAME:

AGE : **D.O.B:**

OP.NO.:

INDIVIDUAL ID. NO:

ADDRESS:

HISTORY:

LMP: **EDD**

GRAVIDA: **PARA:** **LIVE:** **ABORTION:**

PAST HISTORY :

FAMILY HISTORY:

DRUG HISTORY:

IMMUNISATION:

IRON & FOLIC ACID SUPPLEMENTATION:

GENERAL EXAMINATION:

HEIGHT:

WEIGHT:

BMI:

BLOOD PRESSURE:

SYSTEMIC EXAMINATION

MASTER CHART

S.NO	Trimester	NAME	AGE	Parity	SBP	DBP	TT/IFT	WT (Kg)	HT (Cm)	BMI	FVC (Lit)	FVC %	FEV1 (Lit)	FEV1 %	FEV1/FVC (%)
1	1	SRILAKSHMI GAYATHIRI	22	1	110	70	1	63	163	23.7	2.74	95	2.52	99	92
2	1	GAYATHRI	27	2	120	80	1	50	150	22.2	2.76	107	2.43	104	93
3	1	BRINDHA	18	1	120	70	1	38	158	15.2	2.7	90	2.25	86	99
4	1	VINODHINI	20	1	130	90	1	40	150	17.8	2.74	101	2.31	98	84.3
5	1	SANMATHI	21	1	130	80	1	50	155	20.8	3.07	106	2.59	103	84.4
6	1	SHABANA	22	1	120	80	1	72	152	31.2	2.28	82	2.04	84	106
7	1	VIJAYA	26	2	110	80	1	62	164	23.1	3.08	96	2.78	99	90.3
8	1	MAGESHWARI	26	2	126	80	1	63	155	26.2	2.53	88	2.26	90	106
9	1	RATHIKA	27	1	130	90	1	65	164	24.2	2.91	91	2.41	87	99
10	1	VIJAYALAKSHMI	28	2	130	80	1	75	150	33.3	2.02	77	1.81	79	107
11	1	DHAKSHAYINI	30	2	120	80	1	57	154	24	2.34	85	1.98	83	101
12	1	VANTHY	30	2	130	80	1	55	148	25.1	2.51	100	2.06	94	98
13	1	POONGKODI	31	2	120	70	1	57	156	23.4	2.58	92	1.99	82	93
14	1	SUDHA	32	2	120	80	1	73	165	26.8	2.6	83	2.25	83	86.5
15	1	JAYANTHI	22	2	130	90	1	71	158	28.4	2.22	78	1.95	79	87.8
16	1	RADHIKA	32	2	120	70	1	71	156	29.2	2.66	96	2.16	90	98
17	1	KAVITHA JAYARAMAN	34	2	130	81	1	80	154	33.7	2.03	77	1.61	70	80.1
18	1	KAVITHA	24	1	120	70	1	52	147	24.1	2.08	87	1.75	85	84.1
19	1	BAVITHRA	34	2	130	90	1	68	182	25.5	2.7	91	2.17	84	97
20	1	SENTHAMIL	25	1	130	80	1	79	151	34.6	1.88	75	1.71	79	91
21	1	PERIYAMMAL	30	1	120	80	1	52	145	24.7	2.5	110	2.13	109	103
22	1	RADHA	26	1	120	80	1	63	155	26.2	2.53	88	2.26	90	106

S.NO	Trimester	NAME	AGE	Parity	SBP	DBP	TT/IFT	WT (Kg)	HT (Cm)	BMI	FVC (Lit)	FVC %	FEV1 (Lit)	FEV1 %	FEV1/FVC (%)
23	1	RADHIKA	27	1	130	80	1	65	164	24.2	2.91	91	2.41	87	99
24	1	VANAJARANI	31	2	120	80	1	57	156	23.4	2.58	92	1.99	82	93
25	1	NIVETHA	21	1	120	80	1	50	155	20.8	3.07	106	2.59	103	84.4
26	1	SANGEETHA	30	2	150	80	1	55	148	25.1	2.51	100	2.06	94	98
27	1	DHAYA	22	1	133	80	1	63	163	23.7	2.74	95	2.52	99	92
28	1	DEVI	27	2	140	80	1	50	150	22.2	2.76	107	2.43	104	93
29	1	SHAKTHI	18	1	100	70	1	38	158	15.2	2.7	90	2.25	86	99
30	1	KEERTHANA	20	1	90	60	1	40	150	17.8	2.74	101	2.31	98	84.3
31	2	RATHIKA	34	2	130	90	1	80	154	33.7	2.03	77	1.61	70	80.1
32	2	RANI	22	1	130	80	1	72	152	31.2	2.28	82	2.04	84	106
33	2	POONGKODI	26	2	140	90	1	62	164	23.1	3.08	96	2.78	99	90.3
34	2	SHAMUGI	34	2	140	89	1	68	182	25.5	2.7	91	2.17	84	97
35	2	VENI	22	1	136	88	1	71	158	28.4	2.22	78	1.95	79	87.8
36	2	NAYAGI	28	2	126	81	1	75	150	33.3	2.02	77	1.81	79	107
37	2	RENUGA	30	2	130	85	1	57	154	24	2.34	85	1.98	83	101
38	2	MONISHA	25	1	126	84	1	79	151	34.6	1.88	75	1.71	79	91
39	2	SOWNDARI	30	2	131	85	1	52	145	24.7	2.5	110	2.13	109	103
40	2	ARCHANA	32	2	129	85	1	73	165	26.8	2.6	83	2.25	83	86.5
41	2	RAJEE	24	1	124	84	1	52	147	24.1	2.08	87	1.75	85	84.1
42	2	RAJALAKSHMI	32	2	132	86	1	71	156	29.2	2.66	96	2.16	90	98
43	2	VANI	21	1	140	90	1	70	155	29.14	2.08	87	1.75	85	84.1
44	2	NITHIYA	24	1	128	82	1	34	153	14.52	2.7	91	2.17	84	97
45	2	MAHESWARI	24	1	132	86	1	75	168	26.57	2.74	101	2.31	98	84.3
46	2	MOHANA	21	1	140	86	1	54	148	24.65	2.5	110	2.13	109	103

S.NO	Trimester	NAME	AGE	Parity	SBP	DBP	TT/IFT	WT (Kg)	HT (Cm)	BMI	FVC (Lit)	FVC %	FEV1 (Lit)	FEV1 %	FEV1/FVC (%)
47	2	VASUGI	23	1	138	88	1	70	166	25.40	2.53	88	2.26	90	106
48	2	PAVITHRA	22	1	130	85	1	50	174	16.51	2.5	110	2.13	109	103
49	2	SUGUMARI	19	1	126	82	1	78	170	26.99	2.58	92	1.99	82	93
50	2	LOGANAYAGI	21	1	125	85	1	50	165	18.37	2.66	96	2.16	90	98
51	2	RENUGA	21	1	130	85	1	51	155	21.23	2.51	100	2.06	94	98
52	2	PRIYA	24	2	130	85	1	52	148	23.74	2.74	95	2.52	99	92
53	2	MARGRET	24	1	138	88	1	38	134	21.16	2.5	110	2.13	109	103
54	2	TINU	21	1	135	85	1	64	176	20.66	2.7	90	2.25	86	99
55	2	DANYA	23	1	136	86	1	58	166	21.05	2.74	101	2.31	98	84.3
56	2	RASHMITHA	22	1	132	85	1	52	172	17.58	2.66	96	2.16	90	98
57	2	FLORA	19	1	130	84	1	56	175	18.29	2.28	82	2.04	84	106
58	2	AMBIKA	21	2	128	85	1	50	148	22.83	2.74	101	2.31	98	84.3
59	2	LAKSHMI	25	2	130	85	1	64	157	25.96	2.7	91	2.17	84	97
60	2	SANJANA	30	2	110	70	1	67	155	27.89	2.53	88	2.26	90	106
61	3	FATHIMA	32	2	130	82	1	52	150	23.11	2.74	95	2.52	99	92
62	3	ESWARI	24	2	128	78	1	47	146	22.05	2.03	77	1.61	70	80.1
63	3	SONA	32	2	128	86	1	50	150	22.22	2.76	107	2.43	104	93
64	3	GAYATHRI	21	1	114	76	1	57	163	21.45	2.91	91	2.41	87	99
65	3	LAKSHANA	24	2	108	74	1	53	154	22.35	2.74	101	2.31	98	84.3
66	3	RITHANI	24	1	134	84	1	54	153	23.07	2.76	107	2.43	104	93
67	3	ABIRAMI	25	2	148	96	1	52	151	22.81	3.07	106	2.59	103	84.4
68	3	RAJESHWARI	30	1	108	68	1	50	160	19.53	2.76	107	2.43	104	93
69	3	SUMITHRA	26	2	106	70	1	50	143	24.45	2.03	77	1.61	70	80.1

S.NO	Trimester	NAME	AGE	Parity	SBP	DBP	TT/IFT	WT (Kg)	HT (Cm)	BMI	FVC (Lit)	FVC %	FEV1 (Lit)	FEV1 %	FEV1/FVC (%)
70	3	KANIMOZHI	22	2	110	70	1	51	161	19.68	2.5	110	2.13	109	103
71	3	SNEHA	19	1	110	68	1	60	149	27.03	2.76	107	2.43	104	93
72	3	VIDYA	21	1	124	70	1	30	170	10.38	3.08	96	2.78	99	90.3
73	3	SINTHUJA	34	2	120	72	1	60	166	21.77	2.28	82	2.04	84	106
74	3	ROWENA	22	2	118	70	1	67	163	25.22	2.7	91	2.17	84	97
75	3	SAMUNDEESWARI	27	2	124	70	1	73	172	24.68	1.88	75	1.71	79	91
76	3	VANITHA	21	1	120	60	1	78	152	33.76	2.7	90	2.25	86	99
77	3	RAMYA	27	2	128	78	1	60	156	24.65	2.74	95	2.52	99	92
78	3	SUDHA	31	2	124	70	1	66	174	21.80	2.53	88	2.26	90	106
79	3	SUMATHY	21	1	126	80	1	58	149	26.12	2.7	90	2.25	86	99
80	3	DHARANI	30	2	110	70	1	64	182	19.32	2.74	101	2.31	98	84.3
81	3	KAVITHA	22	1	130	82	1	70	165	25.71	2.08	87	1.75	85	84.1
82	3	LATHA	27	2	128	78	1	66	167	23.67	2.53	88	2.26	90	106
83	3	VINODHINI	18	1	128	86	1	53	146	24.86	1.88	75	1.71	79	91
84	3	ASHWINI	20	1	114	76	1	70	178	22.09	2.76	107	2.43	104	93
85	3	UMA	34	2	108	74	1	60	166	21.77	2.28	82	2.04	84	106
86	3	MALAR	24	2	134	84	1	66	170	22.84	3.08	96	2.78	99	90.3
87	3	VINEETHAYA	21	1	148	96	1	64	163	24.09	2.28	82	2.04	84	106
88	3	KIRUTHIKA	23	1	108	68	1	61	160	23.83	2.91	91	2.41	87	99
89	3	KALAI	22	1	106	70	1	73	166	26.49	3.08	96	2.78	99	90.3
90	3	SHYNEE	30	2	110	70	1	64	156	26.30	2.74	101	2.31	98	84.3