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ORIGINAL ARTICLE

# PULMONARY FUNCTION IN THE THIRD TRIMESTER – A CROSS-SECTIONAL STUDY.

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## ABSTRACT:

**Background:** The present cross-sectional study was conducted on 43 women who were in their third trimester. Analysis of the Pulmonary function of the individual was done by using the Pulmonary Function Test. **Methods:** It was an observational study with four months duration. A total of 43 Pregnant women in the Third trimester were recruited with a purposive sampling method. The Outcome measure was FEV1, FVC, FEV1/FVC & PEFR, which was seen using the Pulmonary Function Test. **Result:** The predicted and performed value of FEV1, FVC, PEFR were compared using Paired t-test where the p-value was <0.0001, which was Extremely Significant. The reduction seen between Predicted and Performed values was 46%, 53% and 40%. The predicted and performed value of FEV1/FVC were compared using the Paired t-test where the p-value was 0.6232, which showed Not Significant. **Conclusion:** The study concludes that changes seen in Pulmonary Function during the Third trimester, i.e. FEV1, FVC and PEFR, decreases during the Third trimester, whereas there is no change seen in FEV1/FVC ratio.

**Keywords:** Third trimester, Pulmonary function test.

## INTRODUCTION:

Pregnancy is a dynamic, anabolic state. After several weeks of conception, a new endocrine organ, i.e., the placenta, is formed and secretes the hormones that affect the metabolism of all nutrients. These adjustments in nutrient metabolism, in addition to changes in the anatomy and physiology of the mother, support foetal growth and development while
maintaining maternal homeostasis and preparing for lactation. [1,2]

Functionally, pregnant women at rest tend to increase their ventilation by breathing more deeply. Alveolar ventilation is increased by up to 50%, despite dilated bronchioles, rising physiologically dead space. As pregnancy proceeds, the subcostal angle widens from 68° to 103°, leading to an increased transverse diameter of the chest. Due to this, there is an increase in lower chest circumference of 5–7cm. The enlarging uterus causes a 4-cm elevation of the diaphragm. As a result, total lung capacity decreases 5% due to a 20% reduction in the residual volume. Lung compliance itself does not change during pregnancy, but compliance of the chest wall reduces by 30%, causing a parallel decrease in total respiratory compliance.

Minute ventilation increases by 40% in the first trimester and remains elevated throughout pregnancy. This increase is mainly achieved by the rise in tidal volume with an increase in respiratory rate. Because minute ventilation increases more than the metabolic requirements of pregnant women, arterial PCO2 falls substantially, and the average gravid individual develops a compensated respiratory alkalosis. (3,4) There is a progressive reduction in the functional residual capacity (FRC) and expiratory reserve volume (ERV).

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The decrease in the resting lung volume might be associated with increased airway resistance, known to be volume-dependent. Metabolic changes occurring in pregnant women might modify pulmonary mechanics. Hypocapnia happens during pregnancy, and this is known to increase airway resistance. However, hormone-determined changes in smooth muscle tone and possibly connective tissue elastance might occur during pregnancy and could potentially alter the mechanical properties of the respiratory system. [5] In addition, the upward movement of the diaphragm causes FRC to decrease. The diaphragmatic work may increase to contract against higher load represented by higher end-expiratory pressure and enlarged gravid uterus. [6]

The pulmonary function can be measured with the help of spirometry. Spirometry is one of the most commonly ordered tests of lung function. Spirometry assesses the integrated mechanical function of the lung, chest wall, and respiratory muscles by measuring the total volume of air exhaled from an entire lung (full lung capacity [TLC]) to maximal expiration (residual volume [RV]). This volume, the forced vital capacity (FVC) and the forced expiratory volume in the first second of the forceful exhalation (FEV1), should be repeatable to within 0.15 L upon repeat efforts unless the most significant value for either parameter is less than 1L. [7]

**METHODS:**

This is an Observational, Cross-sectional study with a study duration of 04 months. A total of 43 Pregnant women were recruited using a purposive sampling method from the Department of Obstetrics and Gynaecology, Dr Vikhe Patil Memorial Hospital, Ahmednagar. The study material used was Pulmonary Function Testing. The inclusion criteria included Pregnant women in the third trimester from 21-30years of age and Willing to participate. While the Exclusion criteria were pregnant women with medical complications or a history of addiction. The subject associated with daily yoga/ exercise training of endurance. Pregnant Women

contraindicated for Pulmonary Function Test.

**PROCEDURE:**

Institutional Ethical Committee approval was obtained before the commencement of the study. After explaining the importance of research, when a pregnant woman agreed to participate in the study, a verbal and written informed consent form in Marathi/English was obtained from all the participants. All the basic demographic information, Week of Pregnancy, Height and Weight were documented. A sample of 43 pregnant women in the third trimester was recruited. The outcome measure for this study was FEV1, FVC, FEV1/FVC & PEFR. This Pulmonary compliance was evaluated by using the Pulmonary Function Test. The subject was seated on a chair in a relaxed manner. The subject has then demonstrated the procedure that has to be done. Regular breathing pattern was encouraged, then a nose clip was applied to close the nostrils, and an attached mouthpiece was given. The subject was asked to take a deep breath and hold it for a few seconds. The subject was then requested to exhale it as hard as she can. The value of the best of three trials was considered.

**RESULT:**

The data was analysed in an excel sheet. An instant version3 was used to calculate the mean, standard deviation and p values. Paired "t" test was used to compare predicted and performed values.

**TABLE 1:** Forced Expiratory Volume in One Second (FEV1) Predicted and Performed value:

| FEV1 | Mean ± SD | t value | p-value | Result |
|---|---|---|---|---|
| Predicted | 3.11± 0.49 | 16.512 | <0.0001 | Extremely significant |
| Performed | 1.44 ± 0.34 | | | |

The above table shows the value of FEV1. The predicted and performed values were compared using a Paired t-test where the p-value is <0.0001, which indicates Extremely

Significant. The reduction seen between Predicted and Performed values is 46%.

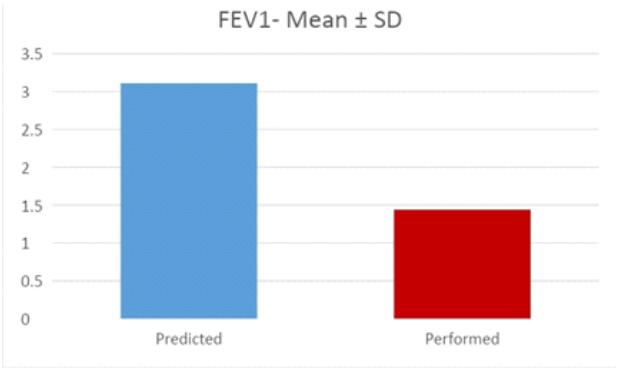



**TABLE 2:** Forced Vital Capacity (FVC) Predicted and Performed value:

| FVC | Mean ± SD | t value |
|---|---|---|
| Predicted | 3.78± 0.59 | 7.312 |
| Performed | 2.01± 1.53 | |

The above table shows the value of FVC. The predicted and performed values were compared using a Paired t-test where the p-value is <0.0001, which indicates Extremely Significant. The reduction seen between Predicted and Performed values is 53%.

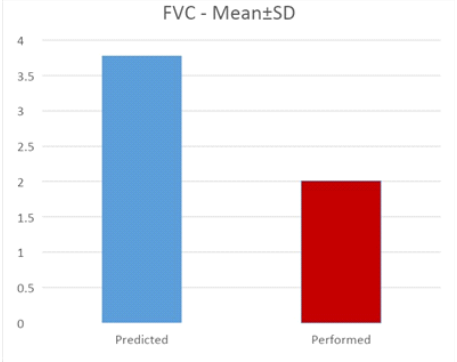



**TABLE 3:** Peak Expiratory Flow Rate (PEFR) Predicted and Performed value:

| PEFR | Mean ± SD | t value | p value | Result |
|---|---|---|---|---|
| Predicted | 6.89± 0.45 | 22.511 | <0.0001 | Extremely significant |
| Performed | 2.68± 1.05 | | | |

The above table shows the value of PEFR. The predicted and performed values were compared using a Paired t-test where the p-value is <0.0001, which indicates Extremely Significant. The reduction seen between Predicted and Performed values is 40%.

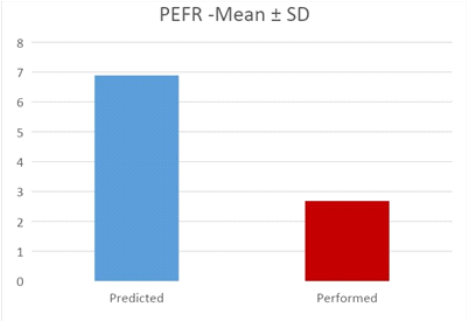
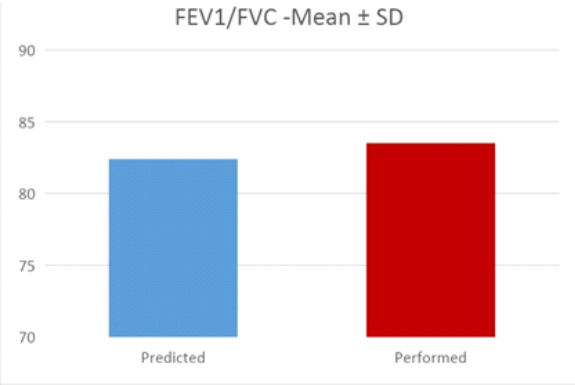



**TABLE 4:** FEV1/ FVC ratio Predicted and Performed value:

| p value | Result |
|---|---|
| <0.0001 | Extremely significant |

The above table shows the value of FEV1/FVC. The predicted and performed values were compared using Paired t-test where the p-value is 0.6232, indicating Not Significant.

| FEV1/FVC | Mean ± SD | t value | p value | Result |
|---|---|---|---|---|
| Predicted | 82.40± 0.93 | 0.4949 | 0.6232 | Not Significant |
| Performed | 83.51± 14.50 | | | |



**DISCUSSION:**

In pregnancy, hormonal changes and the progressive increase in abdominal volume have a mechanical and functional impact on respiratory function. An increased transverse diameter of the chest, resulting from a widened subcostal angle, opposes the effect of the enlarging pregnant uterus and elevated diaphragm, causing pulmonary function altered during pregnancy. Effects of pregnancy on pulmonary function have shown that both minute ventilation (VE) and tidal volume (VT) increase. In contrast, the functional residual capacity (FRC) and expiratory reserve volume (ERV) are decreased. Studies have reported a direct relationship between maternal FEV1 during pregnancy and infant birth weight and an inverse relationship with intrauterine growth retardation, gestational hypertension, and preterm birth in asthmatic women. In pregnant women with cystic fibrosis, low FEV1 is associated with preterm delivery and a more significant lung function loss during pregnancy. Consequently, pregnant women with pulmonary disease need regular monitoring of symptoms and measures of lung function by spirometry to optimise their lung function throughout pregnancy. Hence, evaluating pulmonary changes in pregnancy through spirometry in normal pregnancy is of major clinical importance. [8] Hence this study was conducted to assess the Changes in Pulmonary function during the Third trimester.

This was an Observational study performed on 43 pregnant women in the Third Trimester.

After considering informed consent in both verbal and written forms; the

The Pulmonary Function Test evaluated pulmonary function and the values of FEV1,

FVC, PEFR and FEV1/FVC were recorded. **Harirah et al.** conducted a study that suggests

PEFR to decline with advancing gestational age. They explain their findings on a mechanical basis, pointing out the effect of uterine enlargement and maternal weight gain. They found a significant difference in FEV1, FVC and PEFR, but no significant difference was seen in FEV1/ FVC compared with the predicted values. **Forced Expiratory Volume in One Second (FEV1):** Wee found a substantial difference between the Predicted and Performed values as the p-value <0.0001. The reduction seen was

46%. During pregnancy, the diaphragm level is raised up to 4 cm, which causes a decrease in FEV1. An increase in the transverse diameter of the chest due to widened subcostal angle causes lower costal girth to increase by 10-15cm. **Forced Vital Capacity (FVC):** We found a significant difference between the Predicted and Performed values in our study as the p-value <0.0001. The reduction seen was 53%. It was due to the restrictive effect of enlarging the uterus. In pregnancy, abdominal compliance is progressively decreased.

**Peak Expiratory Flow Rate (PEFR):** In our study we found, a significant difference between the Predicted and Performed values as the p-value were <0.0001. The reduction seen between Predicted and Performed values is 40%. FEV1/ FVC ratio: In our study, we found no significant difference between the Predicted and Performed values as the p-value was 0.6232.. This is due to the mechanical disadvantage to the respiratory system due to advancing pregnancy is compensated by decreased airway resistance and improved airway conductance due to smooth muscle relaxation produced by progesterone, corticosteroids and relaxin. Pregnancy is associated with physiological changes such as control of breathing, lung volumes, mechanics of respiration: Anteroposterior and transverse diameter increase the chest wall circumference. The level of the diaphragm is raised to 4 cm; this causes a decrease in FRC. The respiratory excursion is limited at the lung base, and more significant movement is observed in the mid coastal and apical region; therefore, women exhibit breathlessness on modest exertion. [9]

G Grindheim et al. conducted a study that suggests Forced vital capacity (FVC) increases significantly after 14–16 weeks of gestation. They found that FVC% is significantly higher in parous than primigravida women, suggesting that the changes in FVC occurring during pregnancy persist postpartum. PEFR increases significantly during healthy pregnancies. Puranik et al. measured PEFR with a portable flow meter in an Indian population, and they found that PEFR declines throughout the pregnancy. They attribute their findings to inadequate nutritional status and developing muscular weakness because of the poor socio-economic situation in the studied population. The study's observations would not apply to all people because of variations in ethnic, social, and economic conditions. Hence, further studies would be warranted in different people. Yosef Eshetie Amare et al. conducted a study that suggests except for FEV1%, the mean values of FVC, FEV1, PEFR, and FEF 25–75% in the pregnant group (all the three trimesters) were significantly decreased from the controls ($P<0.05$). As the pregnancy progressed from the first to the third trimester, dynamic pulmonary function tests (FVC, FEV1, FEF25-75%, and PEFR) were dropped and increased respiratory rate. Anwar Hassan Siddiqui et al. conducted a study that concluded that all respiratory parameters FVC, FEV1, FEF25-75% except the FEV1/FVC ratio were found to be lower in pregnant women than in non-pregnant women. In our study, we found that there is a significant difference seen in Pulmonary compliance by using the Pulmonary Function Test. The difference was noted according to the predicted and performed values of an individual during the test. The difference was seen in following compliance FVC, FEV1 and PEFR except the FEV1/FVC ratio. As the numerator and denominator of the ratio are equal to 1, the value becomes the same. Therefore there was no change seen in FEV1/FVC ratio.

**CONCLUSION:**

The study concludes that Changes are seen in Pulmonary Function during the Third trimester, i.e. FEV1, FVC, and PEFR decrease during the Third trimester, whereas there is no change seen in FEV1/FVC ratio.

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**CONFLICT OF INTEREST**- None

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**REFERENCES:**

1. King JC. Physiology of pregnancy and nutrient metabolism. The American journal of clinical nutrition 2000 May 1;71(5) :1218S-25S.
2. Hytten FC. Clinical physiology in obstetrics - Oxford: Blackwell, 1980.
3. Campbell LA, Klocke RA. Implications for the pregnant patient. American journal of respiratory and critical care medicine. 2001 Apr 1;163(5):1051-4.
4. MARX GF, MURTHY PK, ORKIN LR. Static compliance before and after vaginal delivery. British Journal of anaesthesia. 1970 Dec 1;42(12):1100-4.
5. Gee JB, Packer BS, Millen JE, Robin ED. Pulmonary mechanics during pregnancy. The Journal of clinical investigation. 1967 Jun 1;46(6):945-52.

6. LoMauro A, Aliverti A. Respiratory physiology of pregnancy: physiologymaster class. Breathe. 2015 Dec 1;11(4):297-301.
7. Pulmonary Function Testing- Kevin Mc Carthy- 2 Feb 2018. (Google Scholar)
8. Grindheim G, Toska K, Estensen M, Rosseland L. Changes in pulmonary function during pregnancy: a longitudinal cohort study. BJOG 2012;119:94–101.
9. Rasika R Takke, D. A. Effects of different trimesters of pregnancy on pulmonary function test. International Journal of Multidisciplinary Research and Development. 2017:168-171.