Comparative Study of Dynamic Lung Function Tests between Third Trimester of Pregnancy and Non-Pregnant Women

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ABSTRACT
BACKGROUND: An O₂ supply from mother is prime importance in fetus during all stages of pregnancy, lung function tests are powerful tool in the assessment of respiratory functions. Purpose: To compare the pulmonary function tests in third trimester of pregnancy and normal non pregnant women. MATERIALS AND METHODS: The study was carried out in normal non pregnant women (total no. 25) and normal pregnant women of third trimester (total no. 50) at reputed medical college in western India. All patients were in the age group between 22 to 32 years. Selected subjects were asked to perform various dynamic lung function tests under proper guidance. RESULTS: There is statistically significant increase in heart rate and decrease in dynamic lung function tests is seen in pregnant women compared to normal non-pregnant women. CONCLUSION: In pregnancy dynamic pulmonary function tests (FVC, FEV₁, PEFR, MVV) are declining and respiratory rate is increases compared to normal non – pregnant women due to multiple reasons like progressive enlargement of uterus, increase in progesterone, increase in blood flow and blood volume.

Keywords: Dynamic Lung Function Tests, Forced Vital Capacity, Spirometer, Pregnancy

INTRODUCTION
The anatomical, physiological and biochemical adaption to pregnancy are profound³. The changes in female pregnant women are in response to maternal adaptation to an increasing demand of growing fetus⁴. Maternal pulmonary functions in pregnancy are changing because of multiple reasons like progressive enlargement of uterus, increase in progesterone, increase in blood flow and volume⁵,⁶,⁷. These changes are said to be mediated by progesterone mainly rather than estrogens that increases respiratory effort and in turn increases respiratory oxygen consumption⁸. Lung function tests are powerful tool for diagnosis of respiratory condition. Availability of advanced instruments like computerized spirometer, study to evaluate lung functions has become easy and accurate⁹. There are different forms of lung functions available⁸,⁹ e.g. (1) Static lung volumes and capacity includes TV(tidal volume), IRV & ERV (inspiratory & expiratory reserve volume), VC (vital capacity), FRC (functional residual capacity) (2) Dynamic lung volumes and capacity includes forced vital capacity(FVC), Forced expiratory volume in one second (FEV₁), Forced expiratory volume in three second(FEV₃), Maximum voluntary ventilation (MVV), Peak expiratory flow rate(PEFR). We have used dynamic lung function tests in our study. Pulmonary function test depends on parameter like age, body size(height and weight), pulmonary health and history of smoking.

MATERIALS AND METHODS
With this context present study was designed to find out difference in lung function tests between normal non pregnant women (total no. 25) and normal pregnant women in third trimester (total no. 50) at reputed government hospital, located in western India. All patients were in the age group of 22 to 32 years. Inclusion Criteria: In the phase of third trimester of pregnancy, Hb level > 9GM%, Non-smoker, Normal cardio - respiratory status Exclusion Criteria: Hb level <9 GM%, H/o smoking, H/o heart disease, H/o Respiratory disease. An Informed consent was taken from all the subjects and study was carried out in accordance with the world medical association declaration of Helsinki. Third trimester of pregnancy was confirmed with report of ultrasonography and last menstruation period. The entire tests were done during morning session to avoid diurnal variation, each person was allowed to take two minute rest before actual test and test was done in standing position. The details of the test were explained and demonstrated to each of them. Steps of performing tests:
- Four normal breaths.
- Inhale as deeply as possible.
Exhale to normal depth.
Three normal breaths.
Exhale as much as possible.
Three normal breaths.
Inhale as much as possible.
Exhale as fast and completely as possible.
Four normal breaths.

The specifications of instruments are:
Volume detection  Pneumotach sensor Flow resistive type
Flow detection  Volume differential Method
Over all accuracy  with in ± 1%

Table 1 shows there is no statistical significance between age and height of pregnant and non-pregnant women, while weight and respiratory rate are statistically significant Statistical analysis of various pulmonary function test parameter in case(third trimester pregnant women) and control(normal non pregnant women) group. Table 2 – different dynamic lung function parameters are highly significant between pregnant women of third trimester and normal non-pregnant women

**DISCUSSION**

Our study shows that age and height of case and control group shows statistically no significant difference that may influence result of pulmonary function tests.

**Graph 1: Comparison of RR**

Respiratory rate: There was statistically highly significant increase in third trimester of pregnancy compared to normal women. The hyperventilation in pregnancy is attributed to respiratory stimulant effect of progesterone, upward displacement of diaphragm, hypervolemia, increased cardiac output, and increased demand of growing fetus. Forced vital capacity: As compared to control group there is highly significant decrease in FVC is observed in third trimester. Decrease in FVC in our study may
be due to relative decrease in negativity of the intrapleural pressure brought about by an upward displacement of diaphragm by enlarging uterus.

FEV$_1$, FEF$_{25-75}$%, PEFR: There is a highly significant decrease in FEV$_1$, FEF$_{25-75}$%, and PEFR during third trimester of pregnancy. Decrease in FEV$_1$, FEF$_{25-75}$%, and PEFR is caused by decrease in alveolar Pco$_2$, which is caused by hyperventilation which act as a bronchoconstrictor. Also decrease in PEFR could be due to lesser force of contraction of main expiratory muscles and internal intercostals muscles$^{10,11}$. We found similarity in our findings with that of Mokkapati$^{12}$ et al 1995 and Phatak$^{13}$ and Kurhade, Harirrah$^{14}$ et al.

Graph 2: Comparisons of different LUNG FUNCTION TESTS

Pefr: It is more sensitive to muscular effort in respiration and as anemia produces muscle weakness, it reflects in lowering the PEFR. It is possible that relative decrease in the level of haemoglobin in test versus control groups might have caused decrease in PEFR in our study. The mechanical factors are not only causative. Other factors such as hormonal influences also play a role in altering and compromising the pulmonary function parameter like FEV$_1$, PEFR and FEF$_{25-75}$%.

MVV: It shows statistically significant decrease in all trimester including first trimester. We have compared our result with latest study published in Indian Journal Physiol and Pharmacol 2010, 54(1) by Neeraj$^{15}$, Cancysodhi, John Pramod, which also shows statistically significant decrease in FVC, FEV$_1$, PEFR, FEF$_{25-75}$% and increase in FEV$_1$/FVC ratio.

CONCLUSION

During last few decades pulmonary function tests evolved from tools for physiologic study to clinical investigation in assessing respiratory status. The present study highlights observation that the respiratory parameter like FVC, FEV$_1$, FEV$_3$, PEFR and FEF$_{25-75}$%, MVV are significantly compromised due to gravid state in third trimester of pregnancy as compared to non pregnant women. This study highlights need for expected and accepted alterations in predicted values of PFT in comparison with non pregnant state for safer outcome of the pregnancy. With this study we also concluded that there is early intervention needed to improve lung functions in pregnant women with the help of yoga and certain exercises for better outcome of fetus and maternal health.

REFERENCES