

RESEARCH ARTICLE

Study of forced expiratory volume in one second and forced vital capacity in normal pregnancy from Western Maharashtra

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ABSTRACT

Background: Pregnancy is a phenomenon of maternal adaptation to the increasing demands of the growing fetus. Pregnancy causes many visible and invisible changes in human body and it represents one of the best examples of selective adaptation in respiratory physiology. Many previous studies observed significant changes in pulmonary function tests in pregnant women as compare to non-pregnant women. **Aims and Objectives:** This study aims to study and compare pulmonary function tests, especially forced expiratory volume in 1 s (FEV_1) and forced vital capacity (FVC) in healthy pregnant women and healthy non-pregnant women. **Materials and Methods:** This case-control study was carried in the Department of Physiology, Rural Medical College, Loni, in collaboration with Pravara Rural Hospital, Loni, in Maharashtra. The study was carried out after the approval of the institutional ethics committee registration No. PMT/PIMS/RC/2012/25. Four hundred subjects were selected and divided into four groups, non-pregnant women, and normal pregnant women of the 1st, 2nd, and 3rd trimesters. Pulmonary function tests were done using "Spirovit SP-1." **Results:** Highly significant decrease in the FEV_1 and FVC ($P < 0.001$) was seen in the 1st, 2nd, and 3rd trimesters of healthy pregnant women as compared to healthy non-pregnant women. **Conclusion:** FEV_1 and FVC were significantly decreased in all the three trimesters of pregnancy. The mechanical effect of growing uterus and the interplay of estrogen and progesterone are attributed to the changes observed in pulmonary function test among pregnant women.


KEY WORDS: Forced Expiratory Volume in 1 s; Forced Vital Capacity; Pregnancy

INTRODUCTION

During pregnancy, various physiological changes take place in the body. It involves various systems such as circulatory and respiratory. Knowledge of these physiological changes is important while treating the pregnant women to avoid unnecessary medical and surgical interventions for normal physiological changes during pregnancy.^[1] Physiological

changes in various systems in mother start as early as from conception itself and continue through all pregnancies. Respiratory functions are mainly affected due to changes in airway and changes in diameter of thoracic cage. Lung compliance remains unchanged. However, there is decrease in total respiratory compliance. During pregnancy, changes in hormonal level and changes in abdominal volume cause adverse mechanical impact on pulmonary function. These changes in chest oppose the effect of enlarged uterus and maintain altered functions of respiratory system during pregnancy.^[2]

Strength of respiratory muscles does not change significantly during the pregnancy. There is a displacement of the diaphragm up to 2 cm due to increasing size of uterus.^[3,4] Improvement of mechanics of diaphragm is due to simultaneous changes in rib cage during pregnancy.^[5] However, spirometric values

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such as forced expiratory volume in 1 s (FEV₁) and forced vital capacity (FVC) ratio are not changed. Hormonal changes during pregnancy cause a change in tone of smooth muscles and some changes are connective tissue which finally alters the pulmonary functions in pregnant women. The changes in levels of progesterone and estrogen affect the balance of bronchoconstrictor and bronchodilator. Increase in peptide during pregnancy alters characteristics of connective tissue. The FVC and FEV₁ remain unchanged in pregnancy.^[6,7] The diameter of lower thoracic cage increases by 2 cm and increase in circumference may up to 6 cm. Abdominal muscles tone is decreased in pregnant women and respiration is more diaphragmatic during the pregnancy. It is also found that lung volumes and lung capacities are altered in pregnant women.^[8] The lung volumes and lung capacities go on decreasing with advancement in pregnancy due to mechanical effects of enlarging uterus. There may be 20% in overall pulmonary function tests in pregnant women.^[9] FEV₁ goes on decreasing with advancing pregnancy and at the 28th week, it is significantly lower than non-pregnant women.^[10] Different studies from India also found significant changes in FVC and FEV₁.^[11,12]

The study of pulmonary functions during pregnancy in normal women will helpful in improving antenatal care and preventing unnecessary medication for normal physiological changes in pulmonary functions in pregnancy.

Hence, the present study was done to evaluate term-by-term changes in pulmonary function tests during different trimesters of pregnancy and compare these changes with age-matched non-pregnant women from Western Maharashtra.

MATERIALS AND METHODS

This case-control study was carried in the Department of Physiology, Rural Medical College, Loni, in collaboration with Pravara Rural Hospital, Loni, in Maharashtra. The present study is the part of PHD work titled "Study of cardiovascular activity and pulmonary function during different trimester of pregnancy in rural area" and the study was carried out after the approval of the institutional ethics committee registration No. PMT/PIMS/RC/2012/25. A total of 400 women of the age group of 20–30 years were selected. Cases group included 300 pregnant women: 100 healthy pregnant women in each trimester 1st (up to 12 weeks), 2nd trimester (13–28 weeks), and 3rd trimester (29–40 weeks). Control group included 100 healthy non-pregnant women.

Inclusion Criteria

The following criteria were included in the study:

1. Age group between 20 and 30 years
2. Free from any systemic illness which can affect pulmonary function (Example: asthma and chronic

bronchitis)

3. Able to complete the tests for pulmonary functions
4. Those given written informed consent.

Exclusion Criteria

The following criteria were excluded from the study:

1. H/O respiratory disorders
2. Healthy females with a history of addiction to tobacco, mishri, and alcohol
3. Females with a history of any lung disorder.

Data Collection Method

The anthropometric data such as name, age (years), height (cm), and weight (Kg) were obtained. The FVC and FEV₁ were measured with automatic "Spirovit SP-1." Statistical analyses in the case group and control group done by one-way ANOVA (Kruskal-Wallis test). $P < 0.001$ was taken as highly statistically significant.

RESULTS

Table 1 shows anthropometric parameters of both pregnant and non-pregnant participants. There was no statistically significant difference in age and height found, but weight was significantly higher ($P < 0.05^*$) during the 2nd and 3rd trimester as compared to non-pregnant group. Table 2 shows FEV₁ and FVC of both cases and control. Significant decrease in both FEV₁ and FVC ($P < 0.001$) in the 1st, 2nd, and 3rd trimesters of pregnancy observed when compared with non-pregnant.

DISCUSSION

This case-control study was carried in the Department of Physiology, Rural Medical College, Loni, in collaboration with Pravara Rural Hospital, Loni, in Western Maharashtra in India. A total of 400 women were selected. Cases group included 300 pregnant women with 100 in each trimester. One hundred healthy non-pregnant women were taken as control. In the present study, anthropometric parameters such as age and height do not show any significant change, but weight shows significant change ($P < 0.001$) in during the 2nd and 3rd trimesters when compared with non-pregnant group. Significant decrease in both FEV₁ and FVC ($P < 0.001$) in the 1st, 2nd, and 3rd trimesters of pregnant women observed as compared to non-pregnant women.

In the present study, significant increase in weight found in the 2nd and 3rd trimesters when compared with non-pregnant group ($P < 0.001$). Similar results were found in an Algerian study by Taleb *et al.* in which significant weight gain was observed among pregnant women.^[13]

Table 1: Anthropometric parameters

Parameters	Non-pregnant	1 st trimester	2 nd trimester	3 rd trimester
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Age (years)	22.81±3.37	22.37±3.65	21.78±2.33	22.10±2.69
Height (cm)	154.99±4.81	154.99±4.82	155.41±5.05	155.26±4.95
Weight (Kg)	49.06±5.66	48.32±5.60	51.32±6.64*	57.06±5.62*

Statistically significant difference $P < 0.05^*$. SD: Standard deviation

Table 2: FEV₁ and FVC

Pulmonary function tests	Non-pregnant	1 st trimester	2 nd trimester	3 rd trimester
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
FEV ₁ (lit/1 st sec)	2.40±0.57	2.11±0.46**	1.72±0.28**	1.36±0.26**
FVC (lit/sec)	2.58±0.60	2.26±0.44**	1.95±0.36**	1.70±0.42**

Highly statistically significant difference at $P < 0.001^{**}$. FEV₁: Forced expiratory volume in 1 s. FVC: Forced vital capacity. SD: Standard deviation

Pulmonary functions response to FEV₁ was evaluated in pregnant and non-pregnant women. In the present study, decrease in FEV₁ was significant in the 1st, 2nd, and 3rd trimesters pregnancy compared to non-pregnant. However, there was a significant decrease of FEV₁ in the 1st trimester compared to the 2nd and 3rd trimesters pregnancy. Similar results were seen in the study conducted by Yerneni and Sajja. Significantly lower FEV₁ values obtained in all three trimesters. FEV₁ goes on decreasing from the 1st to 3rd trimester.^[14] Similar results obtained in the study by Monga and Kumar he found significantly lower FEV₁ and FEV₁/FVC% in the 3rd trimester. A gradual decrease of FEV₁/FVC% observed as pregnancy advances.^[15] Batool and Shakoor found significant decrease in FEV₁ during all trimesters in pregnant women.^[16] Neeraj suggested that the decreased pulmonary functions in pregnancy may be due to a decreased alveolar PCO₂.

Pulmonary functions response to FVC was evaluated in all the pregnant and non-pregnant women. The present study showed a significant decrease in FVC from the 1st trimester to 3rd trimester as compared to control which is in agreement with other workers. The decrease in FVC was maximum in the 1st trimester which may be attributable to hormonal changes which require confirmation by further studies. A study of FVC in pregnant women by Sunyal *et al.* showed reduced FVC in all trimesters as compared to control and maximum decrease in the 3rd trimester. The restricted movements of lungs caused due to elevation of diaphragm and pressure changes by enlarged uterus during pregnancy results in decreased FVC in pregnant women.^[17]

Decreased power of expiratory muscles, effect of enlarged uterus, and displacement of diaphragm during pregnancy all these factors result in decreased pulmonary function tests in pregnancy.^[18]

Hormonal alteration in pregnancy causes a reduction in the tracheobronchial smooth muscle tone and the increasing thoracic width may be due to enlarging uterus as a result

there is no impairment in large airway function throughout pregnancy.^[19]

Strength and Limitation

All the pregnant and non-pregnant were in the age group of 20–30, and hence, most of the fertile age group of the women was covered in the study. In our study, only healthy pregnant women without any pre-existing pulmonary disease were included. So this data can be used in further studies where comparison between normal pregnant woman and those with pulmonary disease can be assessed.

In the present time, infertility is very common in females and pregnancy after 30 years of age is increasing again in our country, early marriage and pregnancy before 20 years of age are also common so the result will not applied to this population of the age group of below 20 years and above 30 years.

CONCLUSION

The present study found a significant decrease in FEV₁ and FVC in pregnant women as compare to non-pregnant women. Mechanical effect of growing uterus and the interplay of estrogen and progesterone are the various reasons attributed to the changes observed in pulmonary function test among pregnant women. All these physiological changes during pregnancy must be considered during the assessment of pregnant women.

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