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Research Article

Physiological Alterations in Pulmonary functions during Pregnancy: Its application in clinical Scenario

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Abstract

Background: Pregnancy leads to profound alterations in the respiratory system of the mother, leading to alteration in the normal course of common pulmonary diseases. However there is insufficient information regarding the changes in respiratory parameters of smaller airways in different trimesters of pregnancy.

Objective: This study was designed to evaluate the pulmonary function tests in 1st, 2nd and 3rd trimesters of pregnancy & compare them with non-pregnant control group.

Methods: A cross-sectional study was carried in 200 healthy women in the age range of 19-35 years. The subjects were distributed in four groups, i.e control (non-pregnant) group and 1st, 2nd & 3rdtrimester pregnant groups. Number of subjects in each group was 50. We recorded respiratory parameters in control and study groups. Statistical analysis was done by 'Z' test.

Results: There is significant decrease in FEV1, FEV1%, FEF25-75%, FEF25%, FEF50%, FEF75% in all trimesters of pregnancy with maximum decrease in 1st trimester.

Conclusion: The changes in pulmonary functions are attributed to the marked changes in the respiratory parameters during pregnancy. This knowledge of pulmonary function changes during pregnancy may be helpful in the prevention of gestational complications associated with an inadequate maternal respiratory adaptation.

Keywords: Pregnancy, FEV1, FEV1%, FEF 25-75%

1. Introduction

Pregnancy is considered to be the normal physiological process in the life of a woman. It is characterized by profound changes in the homeostasis of every system in the human body involving the respiratory system as well. This knowledge of changes in the respiratory system helps the physician to prevent treatment of physiological changes misinterpreted as pathological[1].

In a study on maternal deaths from year 1994-96, 53.7% [2] of direct deaths were reported due to respiratory problems. Common respiratory problems encountered & complicating pregnancy are asthma, tuberculosis, cystic fibrosis, pneumonia, pneumothorax & some serious conditions are pulmonary embolism & adult respiratory distress syndrome[2].

In order to evaluate any respiratory ailment during pregnancy, an accurate knowledge of the physiological changes in pulmonary functions during normal pregnancy is necessary [3]. This work is intended to study the effects of pregnancy on

Computerized Spirometric Pulmonary function tests measuring the following static & dynamic lung volumes and capacities.

Studies have revealed that there is a sizeable proportion of evidence indicating relationship between pregnancy & respiratory functions from various parts of the world. Although some workers have already studied pulmonary function tests in women during pregnancy in some parts of our country[4], there are very few reports involving these parameters in subjects of South Indian origin. These parameters are difficult to calculate from simple spirometry & act as more sensitive detectors of small airway diseases thereby helping for better management. Hence the aim of this study was to evaluate the influence of pregnancy, on pulmonary function tests like FEV1, FEV 1%, FEF 25-75%, FEF 25%, FEF 50% and FEF 75% using computerized spirometry, involving subjects of South Indian pregnant women in the age group of 19-35 years in 1st, 2nd and 3rd trimesters and compare them with that of healthy non-pregnant age matched controls.

2. Material and Methods

A study was conducted in the Department of Physiology of a tertiary care hospital. The study was undertaken to determine the pulmonary function changes in 1st, 2nd & 3rd trimesters of pregnancy. The observations were compared with age matched healthy non pregnant women.

2.1 Method of Collection of data:

2.1.1 Study Group: 150 pregnant women in the age group of 19-35 years who were attending the outpatient department of Obstetrics & Gynecology of a tertiary care hospital, were included in the study group. The study group was in turn divided into 3 subgroups. Each sub group comprised of 50 women in first, second and third trimesters of pregnancy.

2.1.2 Control Group: Comprising of apparently healthy age matched (19-35) 50 non pregnant women.

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

2.1.3 Inclusion Criteria: Apparently healthy pregnant subjects of South Indian origin were included in the study. The apparent health status of the subjects was determined through thorough clinical examination and history taking.

2.1.4 Exclusion Criteria: Subjects with acute respiratory infection in the previous three months, chronic respiratory infection including asthma, history or clinical signs of cardiovascular diseases, diabetes mellitus, hypertension , tobacco consumption in any form , alcohol intake, endocrine disorders, obesity & moderate to severe anemia were excluded from the studies.

2.2 Following parameters were recorded in each subject:

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

The following pulmonary parameters are recorded by Computerized Spiropac (Medicad) [3].

1. FEV1 (Forced Expiratory Volume at the end of first second in L)
2. FEV1% (Percentage of Forced Expiratory Volume in one second in %)
3. FEF 25-75(Forced Expiratory Flow during 25-75% of Expiration in L/sec)
4. FEF 25% (L/sec)
5. FEF 50% (L/sec)
6. FEF 75% (L/sec)

2.2.1 Forced vital capacity (FVC): is the volume of air that can forcibly be blown out after maximum inspiration, measured in liters[5].

2.2.2 Forced expiratory volume in 1 second (FEV1): FEV1 is the volume of air that can forcibly be blown out in one second, after maximum inspiration. Average values for FEV1 in healthy adults depends mainly on sex and age. Values between 80% and 120% of the average value are considered normal.[5]

2.2.3 FEV1/FVC ratio (FEV1%) is the ratio of FEV_1 to FVC. Normal value in healthy adults is approximately 75–80%. In obstructive diseases both FEV_1 and FVC are reduced, but the former is more affected because of the increased airway resistance, which causes a reduced value of <80% (often ~45%). In restrictive diseases there is proportional reduction in both FEV_1 and FVC and the value would be normal or even increased as a result of decreased lung compliance[5].

2.2.4 Forced Expiratory Flow (FEF) is the flow (in terms of speed) of air coming out of the lung during the middle portion of a forced expiration. It can be given at discrete times, generally defined by what fraction of the functional vital capacity (FVC). The usual intervals are 25%, 50% and 75% (FEF25, FEF50 and FEF75). It can also be given as a mean of the flow during an interval, generally delimited when specific fractions remain of FVC, usually 25–75% (FEF25–75%). Values ranging from 50-60% and up to 130% of the average are considered normal and depend on age and sex of an individual[5].

FEF 25–75% or 25–50% is a sensitive indicator of small airway disease where most of chronic obstructive pulmonary diseases start. It is affected before FEV, so acts as an early detector of small airway disease [6,7]. In small airway diseases such as asthma this value is reduced & appears to be more than 65% less than expected value[5].

2.3 Statistical analysis: The results were expressed as Mean ± SD. Z test was used for comparison between control and study groups in consultation with statistician. The analysis of data was performed using SPSS 16 and a 'p' value of 0.05 or less was considered as statistically significant.

3. Results

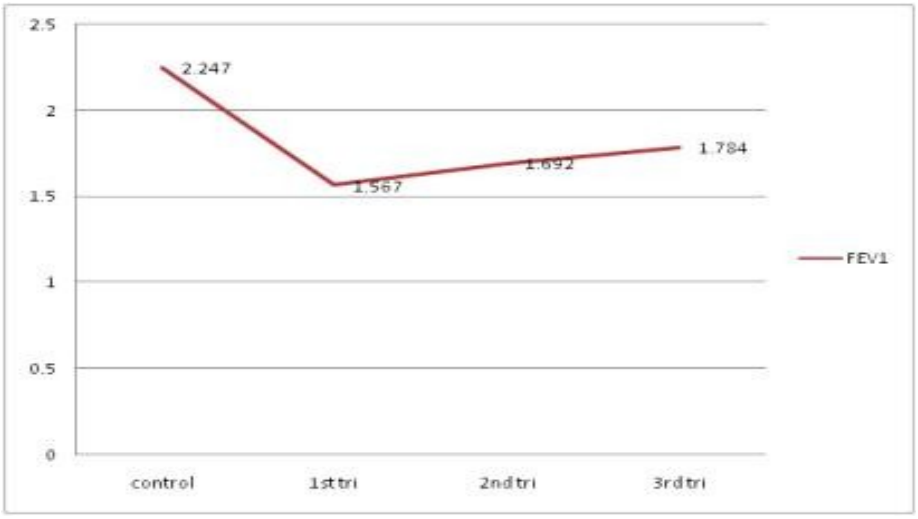
3.1 Forced Expiratory volume at the end of 1st second (FEV1) in Litres: There is a statistically very highly significant decrease in FEV1 in 1st (p=0.001), 2nd (p=0.002) & 3rd (p=0.001) trimesters of pregnancy when compared to non pregnant women (Table 1). Similarly, there is a statistically highly significant decrease in FEV1 in 1st trimester (p=0.005) when compared to 3rd trimesters of pregnancy (fig 1).

Table 1: Test of Significance for Respiratory Parameters Using Z Statistics between Control and Study groups

Parameters	Control & 1st Trimester		Control & 2nd Trimester		Control & 3rd Trimester	
	Z-Value	P-Value	Z-Value	P-Value	Z-Value	P-Value
FEV1	-7.852	0.001***	-7.307	0.001***	-6.717	0.001***
FEV1%	-2.124	0.017**	0.051	0.48	-1.045	0.15

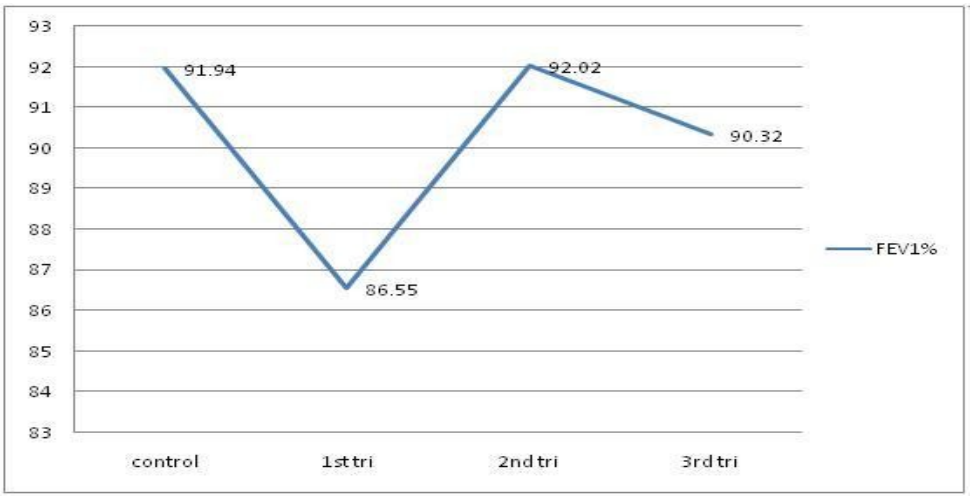
p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Figure 1: Comparison of FEV1 (L) in all trimesters of pregnancy & control group.



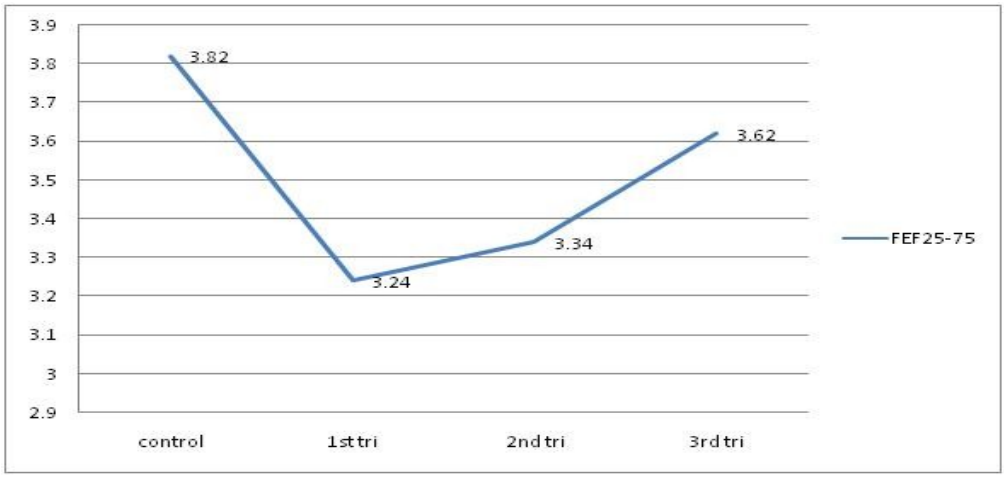
3.2 FEV1% (Forced Expiratory Volume expressed as percentage of vital capacity in the 1st second): There is decrease in FEV1% in 1st & 3rd trimesters of pregnancy compared to non- pregnant women (Table 1) & the decrease is statistically significant in 1st (p=0.001)(fig 2).

Figure 2: Comparison of FEV1% (percent) in all trimesters of pregnancy & control group.



3.3 Forced Expiratory Flow during 25-75% 0f Expiration (FEF25-75%) in Liters/sec: There is a statistically significant decrease in FEF25-75% in 1st, 2nd & 3rd trimesters of pregnancy when compared to non pregnant women. Maximum decrease is seen in 1st trimester only (table 3) (fig 3).

Figure 3: Comparison of FEF25% - 75% (L) in all trimesters of pregnancy & control group



3.4 (FEF25%) in Liters/sec: There is a statistically very high significant decrease in FEF25% in 1st (p=0.001), 2nd (p=0.001) & 3rd (p=0.001) trimesters of pregnancy when compared to non pregnant women. Maximum decrease is seen in 1st trimester (table 3) (fig 4).

3.5 (FEF50%) in Liters/sec: There is a statistically very high significant decrease in FEF50% in 1st (p=0.001) and 2nd (p=0.001) & insignificant decrease in 3rd trimesters of pregnancy when compared to non pregnant women. Maximum decrease is seen in 1st trimester only (table 3) (fig 4).

3.6 (FEF75%) in Liters/sec: There is insignificant variation in FEF75% in all the groups (table 3) (fig 4).

Figure 4: Comparison of FEF25% (L), FEF50% (L) & FEF75% (L) in all trimesters of pregnancy & control group.

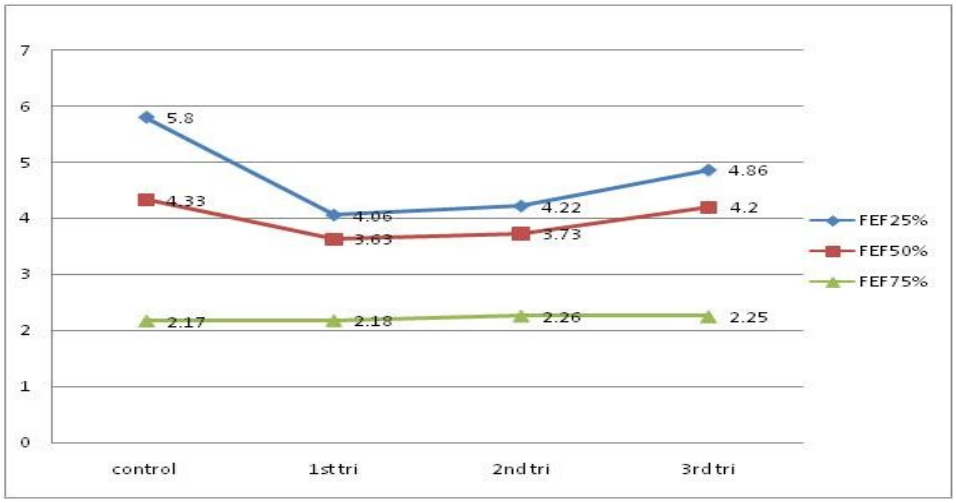


Table 3. Mean ± SD of FEF25-75, FEF25%, FEF50% & FEF75% of subjects in Control and Study groups.

Parameters	Control	1st Trimester	2nd Trimester	3rd Trimester
	Mean+ SD	Mean + SD	Mean + SD	Mean + SD
FEF25-75(L/s)	3.82+ 0.7	3.24+0.86 (p=0.001***)	3.34+0.92 (p=0.002**)	3.62+0.98 (p=0.120)
FEF25%(L/s)	5.81+ 1.16	4.06+1.25 (p=0.001***)	4.22+1.38 (p=0.001***)	4.86+ 1.18 (p=0.001***)
FEF50%(L/s)	4.33+ 0.83	3.63+1.15 (p=0.001***)	3.73+1.06 (p=0.001***)	4.20+ 1.12 (p=0.259)
FEF75%(L/s)	2.17+ 0.58	2.18+0.75 (p=0.490)	2.26+0.68 (p=0.250)	2.25+ 0.75 (p=0.283)

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

4. Discussion

FEV1 & FEV1%: Present study showed significant decrease in both FEV1& FEV1% from 1st trimester to 3rd trimester as compared to control which is in agreement with other workers[8]. The decrease in FEV1& FEV1% was maximum in first trimester which may be attributable to hormonal changes[8], which requires further studies.

A study by Neeraj & workers showed decrease in both FEV1& FEV1% in third trimester as compared to control group. The decrease may be due to decline in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor. Hormonal influences also play a role in altering & compromising the FEV1& FEV1%[8].

In a study by Mrunal Phatak & others, there was no significant change in both FEV1& FEV1%. They claimed that the change was due to progesterone, corticosteroids & relaxin during pregnancy which causes a certain degree of bronchodilatation due to relaxation of muscles[4].

FEF25-75%: Present study showed significant decrease in FEF25-75% from 1st trimester to 3rd trimester as compared to control with maximum decrease in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels[8], which requires further studies.

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

In a study by Neeraj & workers there was decrease in the FEF25-75% in the third trimester of pregnancy. The decrease was due to decrease in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor. Hormonal influences also play a role in altering & compromising the FEF25-75%[8].

FEF25%, FEF50%, FEF75%: Present study showed significant decrease in FEF 25%, FEF 50% & FEF 75% from 1st trimester to 3rd trimester as compared to control with maximum decrease in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels[8].

A study by Savita singh & others have reported that there was decrease in FEF25%, FEF 50% & FEF 75% in second trimester on comparison with third trimester. The cause was assumed to be that, the fetal bulk imposes a greater restriction on breathing pregnant women of Indian population who are generally anthropometrically diminutive compared to their western counterparts[10]. Yet, contradicting these findings, a study by Emilia Kolarzyk & workers showed that there is no statistical significant change in FEF25%, FEF 50% & FEF 75% [11].

5 Conclusion

There was significant decrease in FEV1, FEV 1%, FEF 25-75%, FEF 25%, FEF 50% & FEF 75% and maximum decrease of respiratory parameters was in 1st trimester. The decrease in the above parameters in different trimesters of pregnancy gave the knowledge about the normal physiological changes occurring which should not be interpreted as pathological and should not be treated unnecessarily.

6. Recommendations

To establish the cause of decrease in respiratory parameters more in first trimester of pregnancy than in 2nd & 3rd, further longitudinal studies are to be done on acid-base balance, hormonal assay in different trimesters to know the possible compensatory mechanism.

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