

**PULMONARY FUNCTION TESTS IN THE SECOND AND  
THIRD TRIMESTER OF PREGNANCY****SUCHITRA DEOLALIKAR\****Department of Physiology, Christian Medical College & Hospital,  
Brown Road, Ludhiana- 141008 Punjab, India***ABSTRACT**

Health for all has been a goal for all health care delivery systems. Antenatal care is crucial aspect of it. Pregnancy brings in host of biochemical, physiological and anatomical changes. To better understand the respiratory changes, the study of Pulmonary function Test (PFT) in second and third trimester of pregnancy was undertaken. Total 140 women were studied. 35 were control group, and 35 each for second trimester cross sectional, third trimester cross sectional and second trimester longitudinal. For longitudinal study the second trimester patients were successively studied during the third trimester. PFT was done using (a) Vitalograph dry bellows spirometer; and (b) Wright's mini peak flow meter. Forced Vital Capacity (FVC) showed a significant decrease in second and third trimester of pregnancy compared with control. The other parameters Forced Expiratory volume in first second (FEV<sub>1</sub>), FEV<sub>1</sub> (Observed)/FVC (Predicted), Maximum mid expiratory flow rate (MMEFR), Mid expiratory flow rate (MEFR) and Peak flow did not show significant alteration. This study shows that pulmonary functions are largely within normal range.

**KEY WORDS:** Pulmonary Function Tests, Pregnancy, Second Trimester, Third Trimester.**SUCHITRA DEOLALIKAR***Department of Physiology, Christian Medical College & Hospital,  
Brown Road, Ludhiana- 141008 Punjab, India*

## INTRODUCTION

Health for all has been a goal for all the health care delivery organizations including the WHO. Maternal and child health care is an important link in the chain. Antenatal care forms a crucial aspect of it and is based on the premise that every wanted pregnancy culminates in the delivery of a healthy baby without impairing the health of the mother. Pregnancy constitutes a very stressful physiological situation for both the mother and the foetus. For the foetus, the first 38 weeks of life spent inside the amniotic environment are extremely dynamic with changes occurring in the foetus by each day. For the mother, the short span of pregnancy brings in a host of biochemical, physiologic and anatomic changes in order to accommodate the growing need of the foetus. The respiratory system is influenced by the biochemical and anatomical changes occurring during pregnancy. The diaphragm rises about 4 cm in pregnancy leading to reduction in residual volume and functional residual capacity. Increase in the transverse diameter of thoracic cage leads to widening of subcostal angle. There is an increase in thoracic circumference by about 6cm. Diaphragmatic excursion are greater in pregnant than non-pregnant women. Tidal volume and minute ventilation increase as pregnancy progresses<sup>1</sup>. Alterations in serum progesterone concentration during pregnancy along with low expiratory reserve volume and compensated respiratory alkalosis is responsible for increase in minute ventilation<sup>2</sup>. A precise understanding of pulmonary functions during pregnancy helps to better the antenatal care and is of immense help in the

administration of anaesthesia in cases of Caesarean sections. The present study was undertaken to evaluate the pulmonary functions in second and third trimester of pregnancy, both, in longitudinal as well as cross-sectional groups.

### AIMS & OBJECTIVES

This study was conducted, by the author, at a municipal medical college hospital in an Indian metropolis. The prime aim of this study was:

- a) To estimate and compare the pulmonary functions in second and third trimester of pregnancy in longitudinal and cross-sectional groups
- b) To compare these with pulmonary functions of non-pregnant states as control group.

### MATERIALS AND METHODS

This study was conducted, by the author, at a municipal medical college hospital in an Indian metropolis after taking the requisite permission. The subjects were chosen from antenatal clinic of the said hospital and healthy age matched controls were chosen from the Obstetrics & Gynaecology OPD of the same hospital. Total 140 women were studied. Of these, 35 were control group, and 35 each for second trimester cross sectional, third trimester cross sectional and second trimester longitudinal. For longitudinal study the second trimester patients were successively studied during the third trimester also.

The subjects were grouped broadly into following categories –

Category A: Cross Sectional Study – patients belonging to second and third trimester were different, but had common criteria of selection.

Category B: Longitudinal Study – same group of 35 women were followed from second to third trimester pregnancy.

Category C: Control group- healthy age matched control.

*Selection Criteria:* Selection criteria for inclusion in the present study were-

- Age between 20-30 years
- Height between 152 and 167 cm – average height range of Indian women
- Haemoglobin level more or equal to 10 gm. %
- Absence of medical illness of any nature and involving any system. This was determined by detailed medical history and clinical examination.

After taking written consent from each subject, a detailed history was recorded and a thorough clinical examination was done to ascertain that the subject full fills the selection criteria.

Height, weight, BP, Pulse rate and Haemoglobin were recorded on every visit. Height and weight were recorded on the standard measuring scale. Lung functions were studied using – (a) Vitalograph dry bellows spirometer; and (b) Wright's mini peak flow meter. Before performing the PFT, the procedure was explained to the subject in detail.

The following parameters were recorded in Test and control subjects:

FVC (Forced Vital Capacity-predicted [P] and observed [O]), FVC (O/P), FEV1 (Forced Expiratory volume in first second- predicted and observed), FEV1 (O)/FVC (O), MMEFR (Maximum midexpiratory flow rate), MEFR (Mid expiratory flow rate) and Peak flow rate (Predicted and observed)

The observed readings were subjected to statistical calculations. The mean, the standard deviation and standard error of mean (SEM) were derived. Critical ratio z value was determined.

Z value more than 1.96 is considered significant as per statistically accepted values. The observations as tabulated are given under results

## RESULTS

The mean age and height in various groups of the study had no significant variation and hence the predicted values for various parameters (obtained from normograms) showed no significant variation from each other. It was observed that practically all the parameters did not change significantly during second and third trimester of pregnancy except for FVC observed. It showed a significant decrease in second and third trimester of pregnancy as compared to control. However the FVC in third trimester of each category (cross-sectional and longitudinal), when compared to second trimester of its own category showed a decrease but this decrease was not significant. FEV1 in all groups compared to control showed a decrease, but the decrease was not statistically significant. FEV1 of third

trimester of both, cross sectional and longitudinal groups, when compared with its corresponding second trimester value showed a decrease. This decrease also was not statistically significant. The ratio of FEV1 (O) to FVC (O) was found not to vary significantly, in any group when compared to control. So also the ratio was within normal limits when compared between third trimesters with respective second trimesters. The MMEFR recorded in this study showed no statistical change on comparing with the control group and also while comparing between second and third trimester of corresponding study groups. Same is the findings with MEFR. PEFR studied shows a marginal decrease in each group when compared to control. This was not statistically significant.

**Table I**  
**Comparison of Parameters of Second Trimester Cross Sectional (S.T.C.S.) with Control group. Z > 1.96 = Significant.**

Parameter	Control Group Mean $\pm$ SD	S.T.C.S. Mean $\pm$ SD	SEM	Z Value	LEVEL OF SIGNIFICANCE
Age in years	25 $\pm$ 2.927	24.85 $\pm$ 2.996	0.707	0.212	Not Significant
Height in cm	156 $\pm$ 3.107	155.77 $\pm$ 2.957	0.725	0.317	Not Significant
FVC(P) in Litres	2.79 $\pm$ 0.149	2.7 $\pm$ 0.482	0.084	1.07	Not Significant
FVC(O) in Litres	2.64 $\pm$ 0.208	2.484 $\pm$ 0.13	0.04	3.9	Significant
FVC (O/P)	89 $\pm$ 1.317	89.628 $\pm$ 1.332	0.316	-1.98	Not Significant
FEV1 (P) in Litres	2.338 $\pm$ 0.097	2.333 $\pm$ 0.093	0.022	0.227	Not Significant
FEV1 (O) in Litres	2.031 $\pm$ 0.125	2.016 $\pm$ 0.114	0.0264	0.568	Not Significant

FEV1(O)/FVC(O)	81.428±1.049	81.31±1.063	0.2522	0.4678	Not Significant
MMEFR (L/Min)	151.5142±0.095	151.4574±1.0666	0.2515	0.2258	Not Significant
MEFR (L/Min)	321.5142±0.781	321.4571±0.78	0.1862	0.3066	Not Significant
Peak Flow (P) in Litres/Min	391.114±6.705	390.714±6.474	1.2572	0.3182	Not Significant
Peak Flow (O) in Litres/Min	383.942±6.224	383.657±6.018	1.4633	0.1947	Not Significant

**Table II**  
**Comparison of Parameters of Third Trimester Cross Sectional (T.T.C.S.) with Control group. Z>1.96 = Significant.**

Parameter	Control Group Mean ± SD	T.T.C.S. Mean ± SD	SEM	Z Value	LEVEL OF SIGNIFICANCE
Age in years	25±2.927	24.43±2.904	0.6969	0.8179	Not Significant
Height in cm	156±3.107	155.31 ±3.42	0.7809	0.8836	Not Significant
FVC(P) in Litres	2.79±0.149	2.762±0.151	0.0346	0.8092	Not Significant
FVC(O) in Litres	2.64±0.208	2.469±0.133	0.04123	4.1474	Significant
FVC (O/P)	89±1.317	89.54±1.272	0.3093	-1.7458	Not Significant
FEV1 (P) in Litres	2.338±0.097	2.309±0.095	0.0226	1.283	Not Significant
FEV1 (O) in Litres L	2.031±0.125	1.999±0.116	0.0286	1.1188	Not Significant
FEV1(O)/FVC(O)	81.428±1.049	81.057±1.012	0.2462	1.506	Not Significant
MMEFR (L/Min)	151.5142±1.039	151.542±1.038	0.2479	-0.1121	Not Significant
MEFR (L/Min)	321.5142±0.781	321.48571±0.742	0.1819	0.1566	Not Significant
Peak Flow (P) in Litres/Min	391.114±6.705	389.6±7.464	1.6959	0.8927	Not Significant
Peak Flow (O) in Litres/Min	383.942±6.224	382.4±7.088	1.5944	1.0636	Not Significant

**Table III**  
**Comparison of Parameters of Second Trimester Longitudinal (S.T.L) with Control group. Z > 1.96 = Significant.**

Parameter	Control Group Mean ± SD	S.T.L. Mean ± SD	SEM	Z Value	LEVEL OF SIGNIFICANCE
Age in years	25±2.927	25.85±2.79	0.6835	-1.2436	Not Significant
Height in cm	156±3.107	155.82 ±3.26	0.7612	0.2365	Not Significant
FVC(P) in Litres	2.79±0.149	2.784±0.148	0.15	0.04	Not Significant
FVC(O) in Litres	2.64±0.208	2.49±0.136	0.412	5.8252	Significant
FVC (O/P)	89±1.317	89.57±1.293	0.3121	-1.8263	Not Significant
FEV1 (P) in Litres L	2.338±0.097	2.316±0.095	0.0245	0.8979	Not Significant
FEV1 (O) in Litres L	2.031±0.125	2.02±0.119	0.0283	0.3887	Not Significant
FEV1(O)/FVC(O)	81.428±1.049	81.257±0.995	0.2441	0.7005	Not Significant
MMEFR (L/Min)	151.5142±1.039	151.6285±1.0314	0.2473	-0.4622	Not Significant
MEFR (L/Min)	321.5142±0.781	321.5428±0.78	0.3779	-0.0757	Not Significant
Peak Flow (P) in Litres/Min	391.114±6.705	390.68±7.138	1.6554	0.2622	Not Significant
Peak Flow (O) in Litres/Min	383.942±6.224	383.428±6.737	1.5378	0.3342	Not Significant

**Table IV**  
**Comparison of Parameters of Third Trimester Longitudinal (T.T.L.) with Control group. Z> 1.96 = Significant.**

Parameter	Control Group Mean ± SD	T.T.L. Mean ± SD	SEM	Z Value	LEVEL OF SIGNIFICANCE
Age in years	25±2.927	25.12±2.87	0.6929	-0.1732	Not Significant
Height in cm	156±3.107	155.485 ±3.165	0.7497	0.6869	Not Significant
FVC(P) in Litres	2.79±0.149	2.77±0.143	0.0346	0.5882	Not Significant
FVC(O) in Litres	2.64±0.208	2.476±0.132	0.0412	3.9806	Significant
FVC (O/P)	89±1.317	89.542±1.273	0.3097	-1.7436	Not Significant
FEV1 (P) in Litres	2.338±0.097	2.319±0.094	0.0245	0.7755	Not Significant
FEV1 (O) in Litres	2.031±0.125	2.006±0.114	0.0283	0.8834	Not Significant

FEV1(O)/FVC(O)	81.428±1.049	81.142±0.989	0.2435	1.1745	Not Significant
MMEFR (L/Min)	151.5142±1.039	151.4±1.0346	0.2478	0.4609	Not Significant
MEFR (L/Min)	321.5142±0.781	321.4285±0.7778	0.1863	0.46	Not Significant
Peak Flow (P) in Litres/Min	391.114±6.705	390.085±6.859	1.6213	0.6347	Not Significant
Peak Flow (O) in Litres/Min	383.942±6.224	382.971±6.491	1.52	0.6388	Not Significant

**Table V**  
**Comparison of Parameters of Second Trimester Cross Sectional (S.T.C.S.) with Third Trimester Cross Sectional (T.T.C.S.). Z > 1.96 = Significant**

Parameter	S.T.C.S. Mean ± SD	T.T.C.S. Mean ± SD	SEM	Z Value	LEVEL OF SIGNIFICANCE
Age in years	24.85±2.996	24.43±2.904	0.7053	0.5598	Not Significant
Height in cm	155.77±2.957	155.31 ±3.42	0.7642	0.6019	Not Significant
FVC(P) in Litres L	2.7±0.482	2.762±0.151	0.0849	-0.7303	Not Significant
FVC(O) in Litres L	2.484±0.13	2.469±0.133	0.0316	0.4747	Not Significant
FVC (O/P)	89.628±1.332	89.54±1.272	0.3113	0.2827	Not Significant
FEV1 (P) in Litres	2.333±0.093	2.309±0.095	0.0224	1.0714	Not Significant
FEV1 (O) in Litres	2.016±0.114	1.999±0.116	0.0283	0.6007	Not Significant
FEV1(O)/FVC(O)	81.31±1.063	81.057±1.012	0.2482	1.0193	Not Significant
MMEFR (L/Min)	151.4574±1.0666	151.542±1.038	0.2516	-0.3362	Not Significant
MEFR (L/Min)	321.4571±0.78	321.48571±0.742	0.1819	-0.1573	Not Significant
Peak Flow (P) in Litres/Min	390.714±6.474	389.6±7.464	1.6699	0.6671	Not Significant
Peak Flow (O) in Litres/Min	383.657±6.018	382.4±7.088	1.5717	0.7998	Not Significant

**Table VI**  
**Comparison of Parameters of Second Trimester Longitudinal (S.T.L) with Third Trimester Longitudinal (T.T.L.). Z > 1.96 = Significant.**

Parameter	S.T.L. Mean ± SD	T.T.L. Mean ± SD	SEM	Z Value	LEVEL OF SIGNIFICANCE
Age in years	25.85±2.79	25.12±2.87	0.6777	1.1067	Not Significant
Height in cm	155.82 ±3.26	155.485 ±3.165	0.7679	0.4363	Not Significant
FVC(P) in Litres L	2.784±0.148	2.77±0.143	0.0346	0.4046	Not Significant
FVC(O) in Litres L	2.49±0.136	2.476±0.132	0.0332	0.4217	Not Significant
FVC (O/P)	89.57±1.293	89.542±1.273	0.3068	0.0913	Not Significant
FEV1 (P) in Litres L	2.316±0.095	2.319±0.094	0.0245	-0.1224	Not Significant
FEV1 (O) in Litres L	2.02±0.119	2.006±0.114	0.0283	0.4947	Not Significant
FEV1(O)/FVC(O)	81.257±0.995	81.142±0.989	0.2371	0.485	Not Significant
MMEFR (L/Min)	151.6285±1.0314	151.4±1.0346	0.2469	0.9255	Not Significant
MEFR (L/Min)	321.5428±0.78	321.4285±0.7778	0.1863	0.6135	Not Significant
Peak Flow (P) in Litres/Min	390.68±7.138	390.085±6.859	1.6733	0.3556	Not Significant
Peak Flow (O) in Litres/Min	383.428±6.737	382.971±6.491	1.5813	0.289	Not Significant

## DISCUSSION

FVC shows statistically significant reduction in study groups when compared to control. But there was no statistical significant difference in FVC values between second and third trimester. However this reduction in FVC is not due to any obstruction but rather due to poor excursion of inter-costal and anterior abdominal wall muscles. These findings were in agreement with the study done by Sushma Jadhav, V.B. Dudhamal<sup>3</sup> FEV<sub>1</sub> is a reliable

indicator of airway obstruction. FEV<sub>1</sub> in all groups when compared with the control showed a decrease which was not significant. FEV<sub>1</sub> of third trimester in both groups – cross-sectional and longitudinal showed a decrease compared to the values in corresponding second trimester. This decrease too was not statistically significant. The ratio of FEV1 (O) to FVC (O) was found not to vary significantly, in any groups when compared with control.

Even it was within normal range when the ratio in third trimester was compared with corresponding second trimester. This is comparable to study done by Puranik and Kaore et al<sup>4</sup> done in past. In a recent study conducted by Neeraj, John Pramod et al<sup>5</sup> found that the FVC decreased more than the FEV1 in the third trimester, consequently the FEV1/FVC ratio increased. The MMEFR recorded in this study shows no statistically significant change in any group when compared with control, and neither on comparing third trimester with corresponding second trimester. This observation is similar to observations of De S, Bhargava RP et al<sup>6</sup> MEFR recorded in this study showed no significant changes in any group when compared with control, and neither in third trimester when compared with corresponding second trimester. PEFR showed marginal statistically insignificant decrease in study groups when compared to control. This observation confirms with the study of Savita Singh and others<sup>7</sup> stating that there is no significant change in PEFR in pregnancy.

## REFERENCES

1. Williams Obstetrics, Ed. F .Gary Cunnigham---- [et al].23<sup>rd</sup> Edn. McGraw Hill Medical publisher: 121-122,(2010).
2. Wise RA, PolitoAJ, Krishnan V: Respiratory physiologic changes in pregnancy. Immunol Allergy Clin North Am 26:1(2006)
3. Sushma Jadhav, V.B. Dudhamal, S.S. Karadkhedkar, Sayeeda Afroz. .A.Razvi. Comparative study of Pulmonary function tests on Different Trimesters of Pregnancy. Int J Cur Res Rev, 05(02) 118-122 (2013)
4. B. M. Puranik, S. B. Kaore, G. A. Kurhade, S. D. Agrawal,S. A. Patwardhan and J. R. Kher, A Longitudinal study of Pulmonary Function Tests during pregnancy.Indian J Physiol Pharmacol; 38(2) : 129-132(1994)
5. Neeraj, John Pramod and Joydeep Singh, Effect of advanced gestation on cellular activity in Respiratory system in females: A study of alveolar ventilation parameters in pregnant women of North India. International Journal of Pharma and Bio Sciences Vol 3/Issue 1/ B-31 –B37 (2012)
6. De S, Bhargava RP, etal 1982 Longitudinal Ventilatory Function (static & dynamic) studies during different trimesters in pregnant women. Journal of Obstetrics and Gynaecology of India 812-816(1982)
7. B. M. Puranik, G. A. Kurhade, S. B. Kaore, S. A. Patwardhan and J. R. Kher, PEFR InPregnancy: A Longitudinal study. Indian J Physiol Pharmacol,39(2):135-139(1995)
8. Savita Singh, K. C. Singh, Sabyasachi S. Sircar and Kamal N.Sharma, Airway Functions in Pregnant Indian Women, Indian J PhysioJ Pharmacol, 39(2): 160-162 (1995)
9. Mrunal S.Phatak, and G. A. Kurhade, A Longitudinal Study Of Antenatal changes in Lung Function Tests and importance of postpartum exercises in their recovery, Indian J Physiol Pharmacol ,47 (3) : 352–356(2003)
10. Brancazio L.R, Laifer SA, Schwartz T, Peak expiratory flow rate in normal pregnancy, Obstet.Gynecol,89(3):383-6(1997)

However a study done by Mrunal S.Phatak<sup>8</sup> and another study done by B.M.Puranik<sup>9</sup> showed a decline in PEFR values during pregnancy. A study done by BrancazioLR, Laifer SA, Schwartz T<sup>10</sup> demonstrates that peak expiratory flow rate does not change with pregnancy and advancing gestation

## CONCLUSION

The cross sectional and longitudinal studies of various pulmonary functions done are largely within normal limits, there is no danger either to the mother or the foetus, and hence does not warrant any additional precautions for airway management during pregnancy in absence of any overt respiratory illnesses. It would be worthwhile to establish norms on predicated PFT values in various phases of pregnancy and for this extensive study in larger population need to be done.

**CONFLICT OF INTEREST: Declared None**