



## Study of Pulmonary Function Tests during Pregnancy in women attending OPD in tertiary care hospital of Bettiah, Bihar

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### Abstract

**Introduction:** In pregnancy profound alterations in the functioning of all the systems metabolic, digestive, renal, endocrine, behavioral and cardiopulmonary system of the mother occur to help provide need as demanded by growing fetus. Respiratory system do undergoes both anatomical and physiological changes. Present study aimed to verify such changes when compared to control group as well as see the effect of different gestational age on the pulmonary function parameter.

**Material & Methods:** A case control study of the pulmonary function tests were carried out in different trimester of pregnancy, on 75 normal pregnant women from 16 to 30 years attending antenatal clinic at Department of Obstetrics and Gynaecology; Government Medical College, Bettiah, Bihar. Four respiratory parameters FVC, FEV1, FEV3, MVV & PEFR were determined in both, 75 pregnant women as cases & control group of 25 non-pregnant women of same age groups, Using spirometer instrument.

**Results:** The study showed significant decrease of pulmonary function test parameters (VC, FEV1, ERV) in pregnant women than normal women. TV, RF is increased in 3<sup>rd</sup> trimester when compared to 1<sup>st</sup> trimester women.

**Keywords:** pulmonary function test, spirometer, pregnancy, lung volume.

### Introduction

Pulmonary function tests are aimed to measure the efficiency of the respiratory system in carrying out its functions. Although Pulmonary function tests do not provide an etiological diagnosis of the disease process, they can however determine the characteristic pattern of altered function and are of great help in arriving at a diagnosis in a case of cardio-respiratory or respiratory disorders.

Information regarding pulmonary functions in normal women during pregnancy is necessary for better antenatal care, in assessment of fitness for anesthesia and to evaluate the progress of pre existing lung disease. Anatomical, Physiological and Biochemical changes occur during pregnancy are profound. Changes in ventilator functions are a part of same physiological process.

Many studies on lung functions in pregnancy has measured various dynamic functions such as – Forced vital capacity (FVC), Forced vital capacity in 1 second (FEV<sub>1</sub>) etc. The PEFr decreases with advancing pregnancy which could be due to lesser force of contraction of main expiratory muscles like anterior abdominal muscles and internal intercostals muscles. Mokkapatti *et al.* in his cross sectional study of pregnant women have observed this decline, right from first trimester.<sup>[1]</sup>

The vital capacity is decreased during third trimester along with the decrease in IRV and ERV. The PEFr decreases with advancing pregnancy which could be due to lesser force of contraction of main expiratory muscles like anterior abdominal muscles and internal intercostals muscles.

Many study have found that the maintained FVC, FEV<sub>1</sub>% and MEFr in spite of increasing blood volume could be due to the state of relative broncho dilatation which might be brought about by the smooth muscle relaxing action of certain hormones such as Progesterone, Relaxin and Corticosteroids.

Mrunal *et al.*, 2003, in his study found no significant change is observed in FEV<sub>1</sub>%<sup>[2]</sup>. During pregnancy; Progesterone, Corticosteroids and Relaxin cause certain degree of bronchodilatation due to relaxation of smooth muscle. Thus the mechanical disadvantage to the respiratory apparatus induced by advancing pregnancy is compensated by decrease in air way resistance and an improved air way conductance.

Pulmonary function tests are an important tool in differentiating obstructive and Restrictive pulmonary diseases and if a pregnant woman suffers from either restrictive or obstructive diseases, a regular pulmonary function test is necessary to assess the progress of the diseases condition. So the present work is undertaken to study the changes in various respiratory function tests during pregnancy in South Bihar

## Material and Methods

The present study is undertaken with a view to study the Respiratory function tests of women during pregnancy and compare it with normal non-pregnant women.

**Selection of subject:** Normal pregnant women of different age groups were selected from antenatal clinic of Department of Obstetrics and Gynaecology; Government Medical College, Bettiah, Bihar .Respiratory function tests were performed in 25 women each between 12 to 16, 24 to 28 weeks and 34 to 34 weeks of gestation. 25 non-pregnant women were formed control group for comparison.

**Inclusion Criteria** Selection of subjects:

1. Uncomplicated pregnant women.
2. Age group (16-30) years
3. Physically and mentally capable of adequate cooperation during the performance of the tests.

**Exclusion criteria**

1. Clinically unhealthy women.
2. Past or present history of respiratory or cardiac diseases.
3. Evidence or history of diseases which could be expected to affect pulmonary functions.
4. Evidence of physical disabilities affecting pulmonary functions.

**Instruments**

1. Spirometer
2. Weighing Machine
3. Height measuring scale.

**Methods**

Pulmonary function tests were done using a computerized spirometer. PFT include FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC ratio, FEF<sub>25-75%</sub> PEFr. The Pulmonary function test values were compared between first (12-16 week), second (24-28 week) & third (34-38 week) trimester & between study and control group. During morning session, after taking written consent from subject pulmonary function test done. Pulmonary function test were conducted with the help of computerized spirometer (RMS-Helios 401 Transducer no 400-

666) in sitting posture. The procedure was explained to subject. Subject were asked to take maximum deep inspiration then blow out with maximum effort in mouth piece of spirometer which already apposed between the lips firmly. Nose was closed by nose clips. As three reading of Pulmonary function tests were taken on instrument and the highest one selected for calculation. Instruction give to subject do not eat a heavy meal before the test. The instrument was fed with the ID, data, height in cm, age in years, weight in Kg, sex and room temperature prior to performance of test. The specifications of Instrument provides flow rate Liter/Sec versus volume (Liter) plot and volume verses time plot recordings on thermo sensitive paper. The actual values , predicted values for the specific patient, when compared to others of same age, height, sex and percentage predicted values, i.e. a ratio of actual value and predicted value expressed as percentage are displayed and if resources available printed records can be obtained. The

blood pressure were recorded with a mercury column Sphygmomanometer, height by height measuring scale and weight by weighing machine in pregnant woman during three different trimester.

The respiratory records were taken at the speed of 60 mm per minute. Women were instructed to take normal respiration. Thus the normal tidal volume was recorded. After taking tracing of tidal volume the women were instructed to inspire maximally and then expire with as much force as they can exert. A record was taken on moving paper. From this tracing the other parameter VC, FEV<sub>1</sub>, IRV & ERV were calculated.

Thus following parameters were studied:-

1. Respiratory frequency (RF).
2. Tidal Volume (TV)
3. Vital Capacity (VC)
4. Expiratory Reserve Volume (ERV)
5. Time vital Capacity (FEV<sub>1</sub>)
6. Peak Expiratory Flow Rate (PEF)

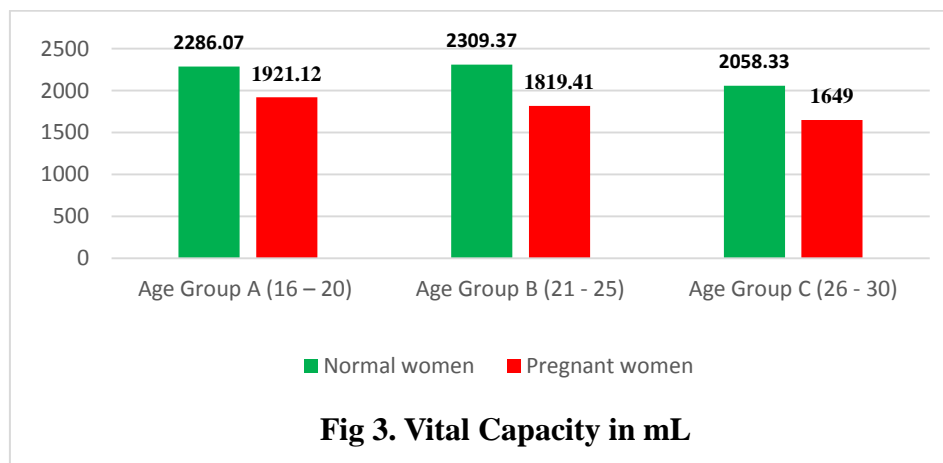
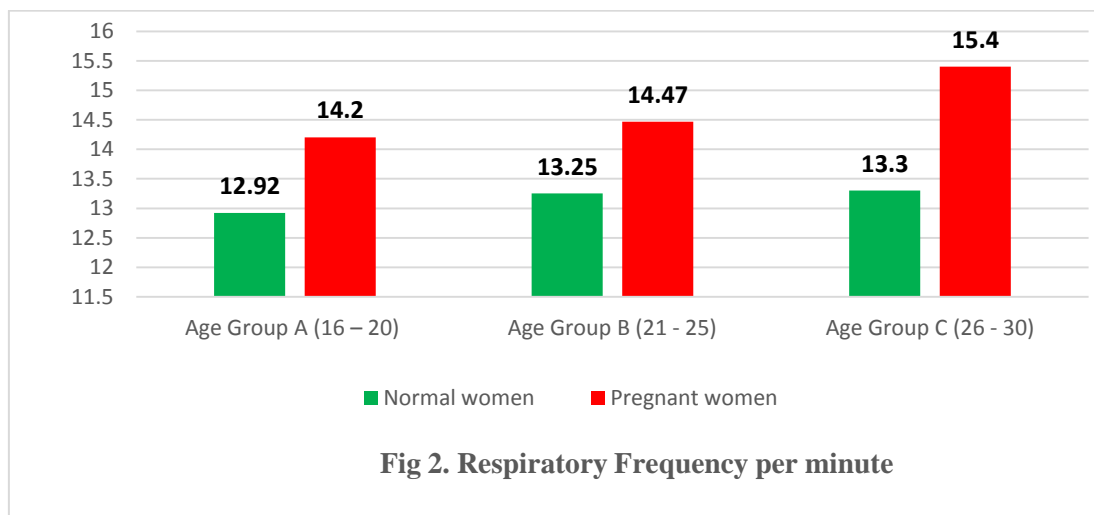
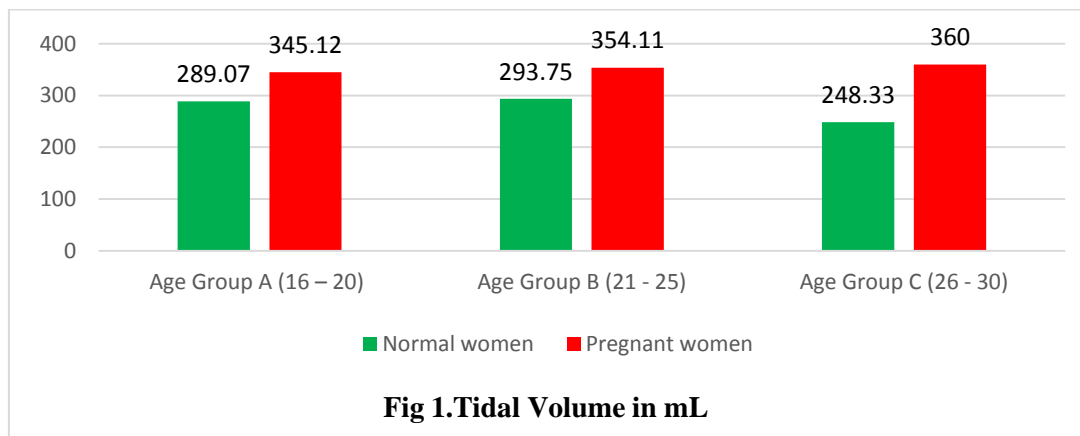
## Results

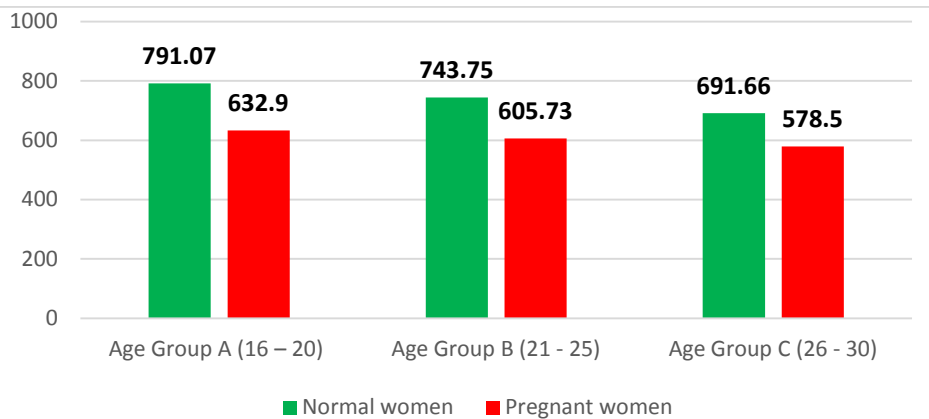
**Table No. 1**

SL. NO	Pulmonary Function Test	A				B				C			
		16-20		Pregnant		21-25		Pregnant		26-30		Pregnant	
		Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
1	Respiratory Frequency	12.92	± 0.13	14.2	± 1.21	13.25	± 2.12	14.47	± 0.45	13.3	± 0.85	15.4	± 1.28
2	Tidal Volume	289.64	± 12.63	345.80	± 44.31	293.75	± 33.45	354.11	± 28.31	248.33	± 14.64	360.0	± 64.35
3	Vital Capacity	2286.07	± 487.31	1921.12	± 192.32	2309.37	± 246.78	1819.41	± 202.84	2058.33	± 390.86	1649.0	± 288.47
4	Expiratory Reserve Volume	791.07	± 89.92	632.90	± 44.61	743.75	± 89.45	605.73	± 66.42	691.66	± 98.54	578.5	± 91.99
5	Inspiratory Capacity	1495.0	± 146.35	1269.67	± 88.91	1565.62	± 142.30	1219.55	± 142.8	1366.66	± 125.38	1062.5	± 156.54
6	Timed Vital Capacity (FEV <sub>1</sub> )	1848.64	± 188.19	1540.38	± 128.31	1905.87	± 138.26	1453.02	± 112.63	1652.33	± 233.84	1316.9	± 168.35
7	Peak Expiratory Flow	269.57	± 8.55	201.61	± 42.15	271.5	± 7.85	161.38	± 24.2	268.66	± 10.24	127.6	± 19.29

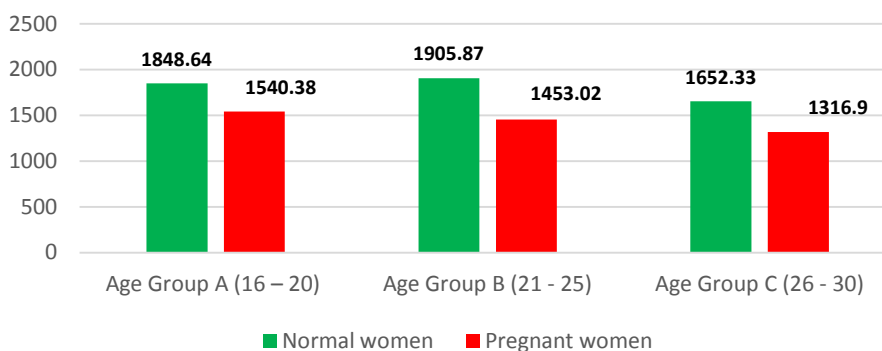
Table No. 2

		A	B	C			
	Gestational Age	12-16 wks	24-28 wks	34-36 wks			
SL.NO	Pulmonary Function Test	Mean	S.D	Mean	S.D	Mean	S.D
1	Respiratory Frequency	13.04	± 2.1	14.12	± 1.11	16.2	± 1.45
2	Tidal Volume	307.4	± 44.62	337.6	± 44.39	409.4	± 56.35
3	Vital Capacity	1974.8	± 210.45	1816.4	± 288.36	1725.0	± 264.39
4	Expiratory Reserve Volume	722.2	± 106.91	589.2	± 101.3	528.6	± 88.59
5	Inspiratory Capacity	1252.6	± 318.29	1204.2	± 164.42	1201.2	± 162.35
6	Timed Vital Capacity (FEV <sub>1</sub> )	1586.88	± 144.29	1450.44	± 201.49	1375.64	± 158.49
7	Peak Expiratory Flow	220.08	± 19.59	170.56	± 21.29	129.88	± 19.45

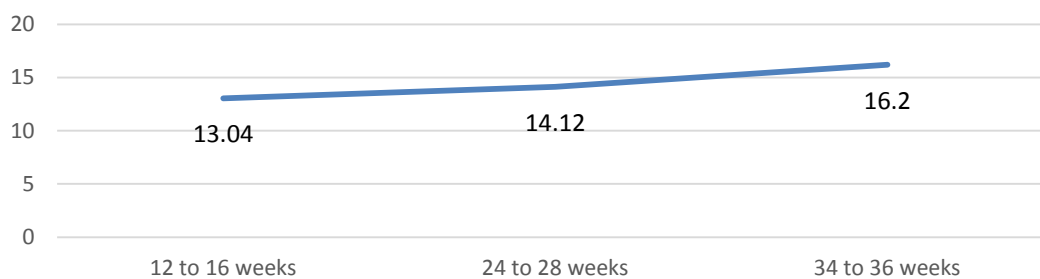




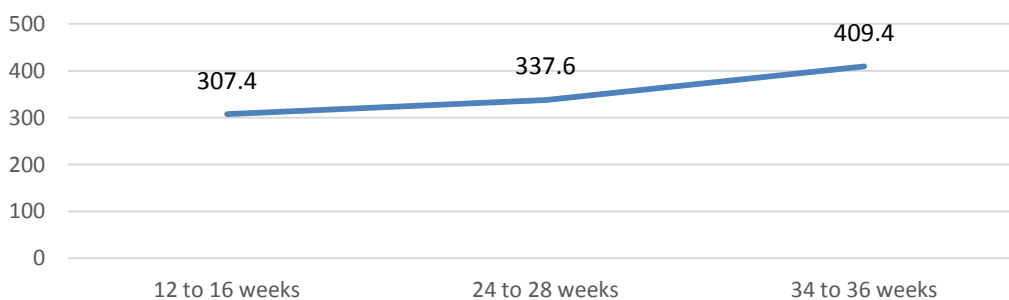
**Fig 4.Expiratory Reserve Volume in mL**



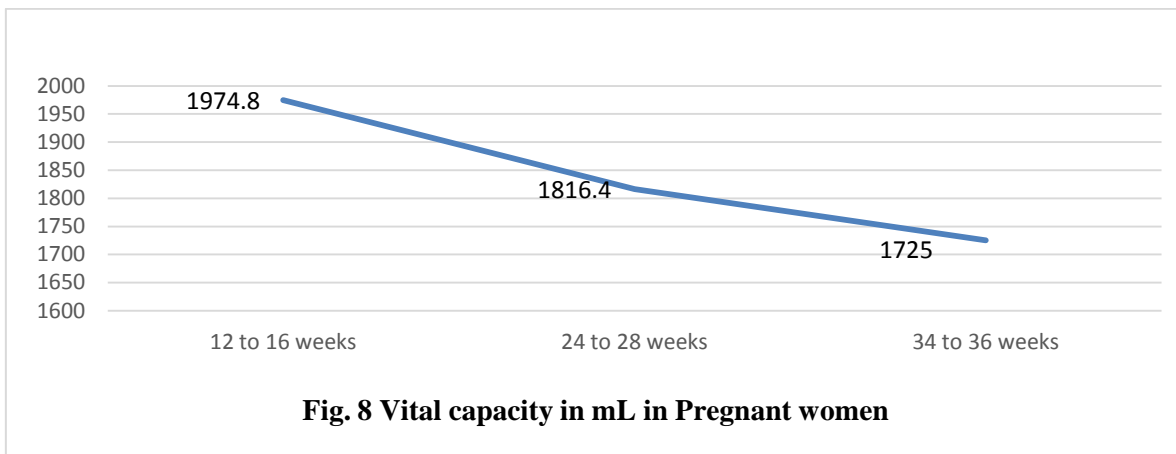
**Fig 5.Timed Vital Capacity (FEV<sub>1</sub>)**



**Fig .6 Respiratory Frequency per min in Pregnant Women**



**Fig. 7. Tidal Volume in mL in Pregnant women**



## Discussion

**Respiratory frequency:** The respiratory frequency is increased in all three age groups when normal compared to pregnant women as shown in table 1. Frequency of breathing from 12 to 16 weeks to 34 to 36 weeks of gestation shows increment in numerical value (ie. 13.04 to 16.2 per minute) as shown in fig 6 and table 2.

**Tidal Volume (TV):** Mean TV is raised in pregnant women of higher gestational age groups i.e. B & C when compared to control group in same age difference. In between different gestational age group women TV increases from early pregnancy (12 to 16 weeks to 34 to 36 weeks) to term pregnancy i.e. 307.4 ml to 409.4 ml) as shown in Fig. 7 and table 2. An increase in tidal volume and minute ventilation which occurs in pregnancy was observed in many studies<sup>[3]</sup>. Most studies find that this hyperventilation (increase in tidal volume) is a progesterone effect that occurs early in pregnancy during the first trimester, and stays constant or increases slightly as pregnancy progresses<sup>(4)</sup>. Typically, resting minute ventilation is increased about 30% during pregnancy compared to the postpartum value. This primary increase in minute ventilation is enhanced secondarily, by an increase in metabolic rate and carbon dioxide production

**Expiratory Reserve Volume (ERV):** In group A, mean ERV decreased in pregnant women in comparison to normal women but it is not statistically significant as shown in Fig 4. In group B mean ERV decreased in pregnant women in

comparison to normal women, which is partially significant. In group C mean ERV decreased in pregnant women in comparison to normal women, which is partially significant statistically.

Decrease in mean ERV is higher between extreme gestational period i.e. From 12 to 16 weeks to 34 to 36 weeks of gestation is partially significant statistically (i.e. 722.2 ml to 528.6 ml). it is not that significant when compared between 12 to 16 weeks and from 24 to 28 weeks as shown in table 2. Our observation that there is an increase in Tidal Volume and a decrease in Expiratory Reserve Volume (ERV) is in agreement with the results of shailja et al<sup>[5]</sup>. An increase in tidal volume and minute ventilation which occurs in pregnancy was observed in studies<sup>[6]</sup>

**Vital Capacity (VC):** Decrease in vital capacity was not significant in age group A between normal women and pregnant women. Decrease in vital capacity was highly significant statistically in age group C between normal women and pregnant women as shown in fig 3 and table 1. Decrease in vital capacity from 12 to 16 weeks to 34 to 36 weeks of gestation is statistically highly significant. This may be due to mechanical load of gravid uterus on lung (i.e. 1974.8 ml to 1725 ml) as shown in table 2 and fig 8. Some studies showed significant rise in Forced Vital Capacity (FVC) while other studies showed decrease in FVC<sup>[7,8,9]</sup>

**Timed Vital Capacity (FEV<sub>1</sub>):** In group A, B and C mean FEV<sub>1</sub> is decreased in pregnant women when compared to normal women being more in

group Bas shown in fig 5 and table 1. The mean FEV<sub>1</sub> decreased in 12 to 16 weeks to 25 to 28 weeks of gestation, it is not statistically significant. Same as observation on ERV, extreme gestational period have higher FEV<sub>1</sub> difference (i.e. from 1586.88 ml to 1375.64 ml) due to mechanical load produced by gravid uterus on the lung function more in 34 to 36 weeks of gestation. FEV<sub>1</sub> is seen to be reduced in pregnancy but was insignificant which is also showed in the studies of Singh S et al 1995<sup>[10]</sup> and others.

**Peak Expiratory Flow (PEF):** Among different age group of pregnant women B,C showed higher difference than Group A. when PEF was estimated from 12 to 16 weeks and compared to 34 to 36 weeks it is found to be highly significant (i.e. 220.08 to 129.88 L/min.). Chinko et al in his found that Peak expiratory flow rate was found to be significantly lower among the pregnant females compared to the control.<sup>[11]</sup> PEFR was also significantly decreased with increased gestational age (p<0.05), similar study was also done by rasheed et al.<sup>[12]</sup> There was decline in all the values of FVC, FEV<sub>1</sub>, FEV<sub>3</sub>, PEFR and MVV when compared to control values, which was highly significant. Similar study was done by Santha kumari et al<sup>[13]</sup> and Jadhav et al<sup>[14]</sup>

### Conclusion

In the present work it has been found that in comparison to normal women, pregnant women have increased respiratory frequency and tidal volume whereas vital capacity, ERV, FEV, PEF are decreased.

When pregnant women were compared for difference in respiratory parameter it was found that RF, TV are increased whereas FEV, PEF, ERV are decreased in 3<sup>rd</sup> Trimester when compared to women in 1<sup>st</sup> Trimester.

Although these changes in respiratory physiology are remarkably well tolerated, there is diminished reserve capacity to deal with emergency respiratory insults. Thus, prompt recognition and treatment of altered respiratory function is needed to protect the health of the mother and fetus

It is concluded that from the present study Respiratory Function Tests are very useful to assess the fitness of pregnant women for anesthesia and the progress of pre-existing pulmonary disease. So the preventive and curative measures can be applied on time.

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