# Longitudinal Study Of Peak Expiratory Flow Rate In Pregnant Women

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**Abstracts**: Background: Several changes have been reported in the maternal pulmonary function tests during pregnancy. A longitudinal study was undertaken to document these changes throughout pregnancy using Peak Expiratory Flow Rate (PEFR). Effect of age and height on PEFR was also documented. Method :The study included 100 pregnant females and 100 non-pregnant female controls. PEFR was measured in each trimester of pregnancy at postpartum with Mini Wright peak flow meter and the highest value of PEFR from three correctly performed blows was considered. Results: There was a decrease in mean PEFR as the pregnancy advanced from 1st to 3rd trimester and increase in PEFR in post-partum, both being statistically significant. PEFR had significant negative correlation with age. Mean PEFR increased with an increase in age of the study subjects in all the 3 trimesters of pregnancy, with maximum value at 24 -29 years of age and there after started declining. PEFR had highly significant positive correlation with height in all the 3 trimesters of pregnancy. Conclusion : The study documented the changes in PEFR during pregnancy, the effect of age and height on PEFR along with their prediction equations. [ Bansal M et al NJIRM 2012; 3(1) : 34-38]

**Key Words:** Peak Expiratory Flow Rate, Pregnancy, Active breathing exercises

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**Introduction:** Pregnancy is such a remarkable state of physiological adaptation, in which profound alterations in the functioning of all the systems of the mother occur to accommodate the needs of the developing fetus[1]. Several changes reported in the maternal pulmonary function tests during pregnancy are also a part of this adaptation[2].

Increasing size of the fetus impedes the normal process of ventilation in the mother[3]. So, it would be logical to expect an increase in the respiratory function because the fetus depends on the mother's lungs for oxygenation and any impairment in the mother may result in fetal distress[4].

Pulmonary Function Tests (PFTs), provide an accurate knowledge of the physiological changes in the pulmonary functions occurring during pregnancy, so proper evaluation of any respiratory ailment during pregnancy can be done[2]. Moreover, their precise knowledge allows the clinician to verify the extent of the adaptation in pregnant women and helps to avoid unnecessary treatment of physiological changes misinterpreted as pathological changes in reference to pre-pregnancy standards[5]. Assessment of pulmonary functions in normal women during pregnancy is also necessary for better antenatal care, in the assessment of fitness for anesthesia and to know the progress of pre-existing lung disease[6].

Peak Expiratory Flow Rate (PEFR) is an important PFT, which has been used effectively and economically by many researchers. The measurement of peak expiratory flow rate is a simple procedure in which an individual takes a full inspiration and blows out as forcibly as possible into an instrument called a peak flow meter, which measures the maximal gas flow during exhalation in litres per minute (LPM). It is also recommended by the British Thoracic Society as a useful tool in the diagnosis and management of asthma[7].

Studies have been done on PEFR in pregnant women, but, with conflicting results[6,8,9,10,11]. So a longitudinal study was undertaken to document the changes in PEFR in each trimester of pregnancy and in postpartum and comparing them with each other and with the non- pregnant females in the same age group taken as controls. Additionally the effect of age and height on PEFR in pregnancy was also studied. Various prediction equations were also formulated.

**Material and Methods:** This longitudinal study was conducted in the department of Physiology in association with the Deptt. of Obstetrics and Gynecology at Government Medical College and Rajindra hospital, Patiala, Punjab after approval from the institutional ethics committee. The study included 100 healthy pregnant women in the age group of 18-35 years as study subjects taken from the out patient department. 100 healthy non-pregnant women in the same age group served as control taken from hospital staff and students.

The subjects were judged to be healthy on the following criteria:

-No history, current or past of any cardiovascular or respiratory disorder.

-No history of smoking.

-No history of exertional dyspnoea or general debility.

-No history of recurrent or persistent expectoration.

-No history of asthma or recurrent bronchitis during their childhood.

-No history of occupational exposure to lung toxins.

-No sign of any bony deformity of the thoracic cage.

A detailed history was taken to rule out any significant illness. A detailed general physical and obstetrical examination was done to rule out any abnormality. Written informed consent was obtained from all subjects.

PEFR was measured with Mini Wright peak flow meter (Clement Clarke) and the highest value of PEFR from three correctly performed blows was considered. Adequate rest was given in between the readings. Before performing the procedure, it was thoroughly explained to each subject.

Data gathered was analyzed using analysis of variance (ANOVA) and 't' test. Correlation coefficient was performed by Pearson correlation analysis (r). Values of $p<0.05$, $<0.01$ and $>0.05$ were taken as statistically significant, highly significant and not significant respectively.

**Result & Discussion:** The following observations and results were drawn out:-

Table I shows the baseline characteristics of the study subjects at different trimesters and postpartum and in the controls. There was no statistically significant difference ($p>0.05$) in mean age, weight, height, body surface area (BSA) between the study subjects at postpartum and in controls. The difference in mean Hb was statistically significant in two groups.

**Table I: Baseline Characteristics Of The Study Subjects**

| Variable | I$^{st}$ Trimester | 2$^{nd}$ Trimester | 3$^{rd}$ Trimester | Postpartum (6-8 wks) | Control Subjects |
|---|---|---|---|---|---|
| Age (years) | 25.24± 4.07 | 25.24± 4.07 | 25.24±4.07 | 25.24±4.07 | 24.92±4.62 |
| Weight (kg) | 55.26±6.12 | 57.75±5.62 | 62.13±5.74 | 54.81±5.22 | 54.31±4.06 |
| Height (cm) | 153.03± 2.93 | 153.03±2.93 | 153.03±2.93 | 153.03±2.93 | 153.28±2.96 |
| BSA ($m^2$) | 1.514± 0.060 | 1.543±0.063 | 1.592±0.062 | 1.509±0.063 | 1.506±0.062 |
| Hb(gm%) | 10.79± 0.58 | 10.34±0.70 | 10.31±0.51 | 13.34±0.49 | 11.03±0.67 |

The mean PEFR of the study subjects showed statistically highly significant decline as the pregnancy advanced from 1$^{st}$ to 3$^{rd}$ trimester (Table IIb). This observation was similar to the observations by the authors in the earlier studies[2,6,9,11,12,13,14,15,16,17]. However, statistically highly significant increase in mean PEFR was observed at 6-8 weeks of postpartum, when compared to each trimester. This observation was consistent with the observations of the authors in the earlier studies[2,13,17]. However, Brancazio et al[8] observed not significant change during the 3 trimesters and postpartum. On the other side the difference in mean PEFR in study subjects at postpartum and in controls was not significant statistically (Table IIb).

The variation in Mean PEFR was also found to be highly significant statistically (ANOVA) when comparison was made in between the trimesters and postpartum. (Table IIa)

The decrease in mean PEFR may be attributed to lesser force of contraction of main expiratory muscles viz. anterior abdominal muscles and internal intercostal muscles or could be due to mechanical effect of enlarging gravid uterus affecting vertical dimension by restricting the diaphragmatic movement.

**Table IIa : Variation of PEFR in different trimesters and post-partum**

| No. | Time of Observation | No. of subjects | Range of PEFR | Mean ± SD Of PEFR | P value |
|---|---|---|---|---|---|
| I | Ist trimester | 100 | 240-374 | 297.52±32.81 | <0.01 |
| II | 2nd trimester | 100 | 176-312 | 234.77±34.44 | |
| III | 3rd trimester | 100 | 106-260 | 183.81±33.90 | |
| IV | postpartum | 100 | 270-415 | 334.29±33.15 | |
| V | Control subjects | 50 | 246-410 | 331.46±40.84 | |

**Table IIb : Comparison of mean PEFR between different trimesters, between trimesters and postpartum, postpartum and controls**

| Comparison between groups | 't' | 'p' | significance |
|---|---|---|---|
| I &II | 13.19 | <0.001 | HS |
| I & III | 24.09 | <0.001 | HS |
| I & IV | 7.88 | <0.001 | HS |
| II & III | 10.54 | <0.001 | HS |
| II & IV | 20.81 | <0.001 | HS |
| III & IV | 31.73 | <0.001 | HS |
| IV & V | 0.45 | >0.05 | NS |

The increase in PEFR at postpartum could be possibly due to regain in strength of the muscles of anterior abdominal wall leading to return of lung functions towards normal in the postpartum period. The variation in Mean PEFR according to the age was also highly significant statistically in 3 trimesters. (Table IIIa) The correlation coefficient between PEFR and age was (r -0.147) found to be significant statistically.(Table V) This observation was consistent with other studies conducted by several workers[18,19,20,21,22,23,24,25,26,27,28]. However, Bhargava et al[29] found this correlation to be not significant.

The increase in mean PEFR with age is probably due to an increase in muscular power and rapid growth of the airway passages. The subsequent decline in mean PEFR is due to gradual decrease in muscular power because this variable is dependent upon expiratory muscle effort, lung elastic recoil and airway size, factors which are known to reduce with advancing age.

**Table IIIa: Variation of PEFR in different age groups and in different trimesters**

| age group No. | Age wise | PEFR | | | 'p' value |
|---|---|---|---|---|---|
| | | 1st trim. | 2nd trim. | 3rd trim. | |
| I | 18-23 | 299.72 ±25.22 | 242.59 ±31.31 | 190.91 ±29.39 | <0.01 |
| II | 24-29 | 307.62 ±30.89 | 240.82 ±31.10 | 190.25 ±30.63 | |
| III | ≥30 | 276.39 ±38.08 | 211.65 ±35.91 | 161.17 ±37.40 | |

**Table IIIb : Comparison of mean PEFR between different age groups in each trimester**

| Age group | 'p' value in different trimesters | | |
|---|---|---|---|
| | 1st | 2nd | 3rd |
| I & II | >0.05 | >0.05 | >0.05 |
| I & III | <0.05 | <0.01 | <0.01 |
| II & III | <0.01 | <0.01 | <0.01 |

The increase in mean PEFR with the increase in height was observed in each trimester, though the mean PEFR decreased in each height group as the pregnancy advanced from 1st trimester to 3rd trimester. The increase in mean PEFR was not significant statistically on comparing height intervals I & II, but it was significant on comparing height intervals II & III and I & III(Table IVb).

**Table IVa : Variation of PEFR in different height intervals and in different trimesters**

| Ht group | Ht. Int. | PEFR | | | 'p' value |
|---|---|---|---|---|---|
| | | 1st trim. | 2nd trim. | 3rd trim. | |
| I | 145-149 | 275.61±20.35 | 216.61±29.44 | 161.84 ±19.97 | <0.01 |
| II | 150-154 | 291.01±33.42 | 227.01±33.35 | 175.82 ±32.59 | |
| III | ≥155 | 316.27±28.81 | 254.60±29.34 | 205.69 ±29.10 | |

But, there was decrease in mean PEFR in all the height intervals as the pregnancy advanced from 1st to 3rd trimester. The decrease in mean PEFR was highly significant statistically on comparing 1st trimester with 2nd trimester and 3rd trimester, as well as on comparing 2nd trimester with the 3rd trimester.(Table IVb)

**Table IVb : Comparison of mean PEFR between different ht. intervals in each trimester**

| Ht. group | 'p' value in different trimesters | | |
|---|---|---|---|
| | 1st | 2nd | 3rd |
| I & II | >0.05 | >0.05 | >0.05 |
| I & III | <0.001 | <0.01 | <0.01 |
| II & III | <0.01 | <0.01 | <0.01 |

The variation in Mean PEFR according to the height was also highly significant statistically in 3 trimesters. (Table IVa)

The coefficient of correlation between PEFR and height was found to be (r +0.327) highly significant statistically.(Table V) This observation was consistent with the findings of earlier studies[23,30,31,32,33,34,35,36,37,38,39,40,41]. This observation could possibly be due to more chest volume in the taller subjects and an increase in expiratory muscle effort with an increase in height.

**Table V : Correlation coefficient between PEFR and age and PEFR and height**

| Variable | PEFR & Age | PFR &Height |
|---|---|---|
| Correlation coefficient (r) | -0.147 | +0.327 |
| 'p; value | <0.05 | <0.001 |

**Table VI :Possible regression of PEFR in relation to age and height**

| Variable | Regression equation |
|---|---|
| Age (years) | Y=291.175-2.07x |
| Height (cms) | Y=-746.46+6.43x |

**Conclusion:** The present study was done to draw conclusive evidence as to what influence the normal pregnancy has on pulmonary functions. Thus, our study documented the changes in PEFR values with advancing gestational age, age and height and concluded that PEFR had significant negative correlation with age. Mean PEFR increased with an increase in age of the study subjects in all the 3 trimesters of pregnancy, with maximum value at 24 -29 years of age and there after started declining.

PEFR had highly significant positive correlation with height in all the 3 trimesters of pregnancy. There was statistically highly significant decrease in mean PEFR as the pregnancy advanced from 1st to 3rd trimester and postpartum. The PEFR regressed on independent variables age and height.

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