PEAK EXPIRATORY FLOW RATE WITH SPIROMETRY DURING PREGNANCY: RURAL INDIAN PERSPECTIVE

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Abstract: Introduction: Peak expiratory flow rate (PEFR) represents effort dependent large airways function. It is a simple and non-invasive method of assessment of lung function. Present study was aimed to study the PEFR components of ventilation in normal pregnancy during three different trimesters and their comparison with matched nonpregnant control. **Methods**: Total 279 normal apparently healthy rural pregnant women were studied during pregnancy in different trimesters with a computer assisted spirometer SpiroWin+. Apparently healthy 97 nonpregnant women, matched with age and socioeconomic status, were studied as control. **Results**: Data was analyzed by unpaired t-test and Pearson correlation test (α error was set at 5% level). Study shows that PEFR remain unaltered during pregnancy. Comparison of pregnant with nonpregnent shows insignificant change ($p<0.05$). Pearson correlation showed positive correlation between gestational age and PEFR but statistically not significant. **Conclusion**: Although gravid uterus affects the respiratory functions, our results evident that pregnancy is a state of adaptation. Unaltered changes suggest the role of progesterone on respiratory muscle functions.

Key Words: PEFR, Pregnancy, Pulmonary function, spirometry.

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Introduction:

Number of anatomical, biochemical and hormonal changes take place in normal woman during the course of pregnancy; including changes in both pulmonary function and ventilation.[1] Peak expiratory flow rate (PEFR) as a measurement of ventilatory functions was introduced by Hadorn in 1942 and accepted in 1949 as an index of spirometry.[2] PEFR represents the largest expiratory flow rate expressed in litres/minute from a position of maximal inspiration and has remained a simple effective tool for the assessment of ventilatory functions.[3-5] The inexpensive nature of the PEFR make it a suitable test for ventilatory functions in many parts of world where medical facilities are still poor and hence represents a simple, easy, reliable, portable and inexpensive test of lung function.[6]

There have been a large number of studies on the maternal ventilatory functions in pregnancy. The results of most of the studies conducted on western population indicate that vital capacity and timed vital capacity, which were earlier thought to be altered during pregnancy, are more or less unchanged throughout the course of pregnancy.[1,7] Although so many studies reported change in PEFR during pregnancy, there is paucity of data regarding the rural pregnant women in India. Similarly discrepancies in the data available for PEFR and final conclusion are not reported yet. The present study is aimed to study the effect of pregnancy and gestational age on PEFR, based on the hypothesis that pregnancy is a state of adaptation in terms of airway functions.

Material and Methods:

Study population: Pregnant women attending antenatal clinic of Dhiraj General hospital, Piparia village, Gujarat, India. Nonpregnant women matched with age and socioeconomic status studied as control mainly the relatives of pregnant woem. Socioeconomic status were analysed on the basis of their annual income and profession. Sample size: Random sampling was used. Total 376 rural women of lower socioeconomic class were studied. Experimental group included 279 pregnant women, 87 during I trimester (8-12 wk), 90 during II trimester (13-24 wk), 102 during III trimester

(25-40 wk) serially and vertically both. Determination of gestational age was based on last menstrual period (LMP) reported by clinician. Control group included 97 apparently healthy nonpregnant women matched with age and socioeconomic status.

Ethics: This study was complied with the ethical committee guidelines of SVIEC (EC No. SVIEC/ON/MEDI/PhD/1202) and the procedures followed were in accord with the ethical standards of Sumandeep Vidyapeeth.

Inclusion criteria's: Age group: 20-40 years, Gestational age: 8^{th} to 40^{th} weeks, primipara or multipara, Singleton pregnancy.

Exclusion criteria's: Respiratory tract infection, acute/active asthma, cardiac renal or hemolytic disorders, Neuromuscular/musculoskeletal disorders that may affect the test. After informed consent and information about the study, participants were invited to the respiratory laboratory and given 15 min rest. During rest anthropometric parameters were measured. PEFR was measured by Forced spirometry with the help of digital spirometer SpiroWin+, made in Hyderabad, India. The pregnant women were investigated for at least thrice, as per the American Thoracic Society (ATS) guidelines, for each trimester of pregnancy. The control group was studied with same procedure only once.

Statistical analysis: This study had prepared a database of findings of both groups in the form of master chart. Values were expressed as Mean±SD. Student's unpaired t-test was used for between group variations of pregnant and non-pregnant control (α error was set at the 5% level). Pearson correlation test was used to find correlation between gestational age and PEFR.

Results:

Table-1 shows the anthropometric parameters (age, height and weight), mean gestational age and PEFR in all three trimesters of pregnancy and control. There is no significant change in age of pregnant and nonpregnant women (p value <0.05)). Table-2 shows Statistical analysis of PEFR values in all three trimesters and control. Graph-1 shows correlation between gestational age and PEFR value.

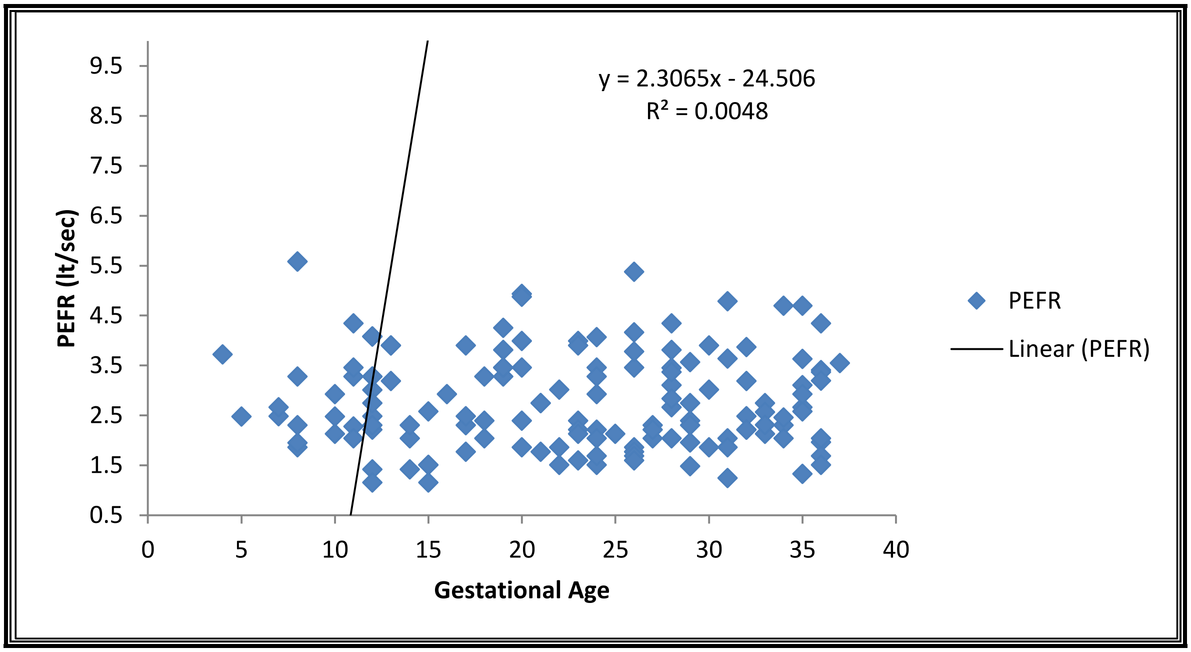
TABLE-1: Anthropometric parameters, Mean Gestational age and PEFR in all three trimesters of pregnancy and nonpregnant control

Parameter	I trimester (N=87)	II trimester (N=90)	III trimester (N=102)	Control (N=97)
Age (years)	23.03±2.45	22.3±2.5	22.73±2.6	26.4±4.41
Weight (kilograms)	47±7.3	48.3±6.52	50.7±6.5	47.9±7.13
Height (meters)	1.56±.05	1.56±.05	1.53±.06	1.54±.05
Mean Gestational age (weeks)	10.37±2.69	19.45±3.5	38.9±2.68	-
PEFR (litre/second)	2.932±1.09	2.79±0.98	2.77±0.96	2.93±0.69

TABLE-2: Statistical analysis of PEFR values in all three trimesters and control

Sample	Mean±SD	N	P value
Control vs I Trimester	2.93±0.69	97	0.498184
	2.932±1.09	87	
Control vs II Trimester	2.93±0.69	97	0.554098
	2.79±0.98	90	
Control vs III Trimester	2.93±0.69	97	0.155043
	2.77±0.96	102	
ANOVA	I=2.932±1.09	87	0.7686
(I, II, III Trimester)	II=2.79±0.98	97	
	III=2.77±0.96	102	
Pregnant vs Non pregnant	2.82±0.99	279	0.517
	2.93±0.69	97	

GRAPH-1: Correlation between the gestational age of pregnant woman and PEFR value



Discussion:

Pregnancy reported remarkable changes in respiratory system, which are essential to meet the increase metabolic demand of mother and fetus, lead to successful pregnancy. The occurrence of concomitant cardio-respiratory diseases or their prior presence to pregnancy requires an understanding of such physiological changes.[8] There is sparse data regarding airway and respiratory muscle functions in pregnant women especially in developing countries like India. The only fraction of lung functions received repeated attention is vital capacity, but discrepancies in the data available[9-11] and simultaneously determination of timed vital capacity and flow rates are scanty.

PEFR can provide the simple routine assessment of ventilatory function in pregnancy. In the present study rural pregnant women were studied for PEFR in various gestational stages and mean values of all three trimesters were compared with non-pregnant females as controls. Unlike reported earlier author found PEFR remains unaltered during pregnancy (ANOVA, p value <0.05) and decline nonsignificantly when compared to nonpregnant control (t-test, p value <0.05). Lack of changes suggest that shortening of thorax by upward displacement of diaphragm is compensated by an increase in the other dimensions as transverse diameters, costal angle and lower thoracic perimeters.[12-13] Despite the upward displacement of diaphragm by gravid uterus, diaphragm excursion actually increases by 2 cm compared with the non-pregnant state.[1,7] Increased diaphragmatic excursion and preserved respiratory muscle strength are important adaptations that accompany pregnancy. It is reported that large airway calibre, reflected by PEFR, and small airway calibre, reflected by forced expiratory flow at 50% of forced vital capacity (FEF50%) and forced expiratory flow at 25% of forced vital capacity (FEF25%), are also unchanged.[10,14] The low results of PEFR may be due to the poor nutritional status of the subjects as most of the subjects are from lower socioeconomic class.[15]

Most Indian studies reported that PEFR value decreased significantly with advance pregnancy due to the gravid uterus[16-18] attributed to the lesser force of contraction of main expiratory muscles (anterior abdominal and internal intercostals muscles) of the pregnant females, as PEFR is largely effort dependent.[19-20] Also inadequate nutrition due to morning sickness and altered eating habits can further cause muscle weakness leading to decreased PEFR in pregnant females.[21] Similarly some studies in Indian population found that vital capacity and PEFR tend to increase in the later stage of pregnancy.[22-23] Study conducted in Oslo University Hospital in 2012 has shown that PEFR increased significantly during healthy pregnancies and should be interpreted cautiously with impaired lung function test.

The compensated ventilation during pregnancy has been attributed to the effect of progesterone, hormone of pregnancy, on ventilatory smooth muscles of upper airways. Progesterone may have a local pulmonary effect, which results in bronchodilatation and improvement in gas exchange. Serum levels of progesterone increase progressively during human pregnancy and remain high until delivery of the placenta.[24] Previous studies have shown that progesterone increases the ventilatory performance in healthy individuals and in patients with chronic obstructive pulmonary disorders.[25-26] Progesterone also improves ventilatory performance in adult trauma patients during partial support mechanical ventilation.[27]

Conclusion: Large airways ventilatoy functions are not impaired by pregnancy, in spite of gravid uterus and other factors with advancing gestation. Our findings in healthy subjects demonstrated that large airways function may be compensated by smooth muscle relaxation due to progesterone, hormone of Pregnancy. Increased diaphragmatic excursion and preserved respiratory muscle strength are important adaptations that accompany pregnancy. Discrepancies are in data available for change in PEFR during pregnancy. Extensive studies on larger population and different ethnic groups need to be done and the correction factors be introduced while evaluating PFT readings.

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