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Peak Expiratory Flow Rate of Pregnant Women in Port Harcourt

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Abstract

Peak expiratory flow rate represents a simple, non-invasive and cheap method of assessment of lung function especially in Africa where medical facilities are meager. There is paucity of data regarding the peak expiratory flow rate of pregnant women in Africa. The present study is aimed at studying the effects of pregnancy and gestational age on Peak expiratory flow rate. The study was carried out at the department of Obstetrics and Gynaecology of the University of Port Harcourt Teaching Hospital, Rivers State and Comprehensive Health Centre Rumuigbo, Port Harcourt, Rivers State from January through July, 2013. A total of 1000 female subjects, without any recent history of respiratory disease were recruited for the study. This comprised of 500 pregnant females (study group) and 500 non pregnant females as control. The Peak expiratory flow rate was determined using the Wright's peak flow meter. Peak expiratory flow rate was found to be significantly lower among the pregnant females compared to the control (p<0.05). PEFR was also significantly decreased with increased gestational age (p<0.05, r=-0.78). This study draws attention to the possible effect of the gravid uterus on the pulmonary function of a pregnant woman.

Keywords: Peak expiratory flow rate, pregnancy, gestational age.

Introduction

Peak exploratory flow rate (PEFR) is the maximum rate of airflow achieved during a forced expiration after maximal inspiration[1,2]. From a position of maximal inspiration, PEFR represents the largest expiratory flow rate expressed in liters per minute and has remained a simple effective tool for the assessment of ventilatory function[1-3]. The inexpensive nature of the peak expiratory flow rate (PEFR) makes it a suitable test of ventilatory function for use in many parts of Africa where medical facilities are still poor and hence represents a a simple, easy, reliable, portable and inexpensive test of lung function[4]. In the last 20 years, factors such as ethnic and postural differences has been found to affect PEFR in addition to age, sex, weight and height[5-10]. Hence the need for a population based determination of PEFR values[2].

The rib cage and abdominal cavity undergoes structural changes in the course of pregnancy and advancing gestation due an increase in progesterone and estrogen levels with attendant changes in respiratory function[11]. In the course of pregnancy, there is an elevation of the diaphragm which leads to an increased area of apposition of the diaphragm to the chest wall, improving the coupling of the diaphragm and chest wall [12]. Also, with advancing gestation, the enlarging uterus causes an increase in abdominal pressure which decreases chest wall compliance causing a reduction in functional residual capacity (FRC) and expiratory reserved volume (ERV)[13]. Due to constant breathing rate and pattern associated with pregnancy, resting minute ventilation is increased leading to occasional dyspneas[11,14-16,17]. This increase in minute ventilation and the load caused by the enlarging uterus has been known to increase the work of breathing[11]. Forced vital capacity (FVC) has been reported to be either minimally increased, decreased, or unchanged during pregnancy compared with the non-pregnant state[17]. Also Peak expiratory flow and force expiratory flow rate have been shown to be unchanged and in some cases found to decline linearly throughout gestation[18-22].

The adjustments of pulmonary function associated with pregnancy has been fairly documented in Western climes, however only few data exist in Africa and Nigeria in particular[18,20,23]. The aim of the present study is to assess simple ventilatory function of apparently healthy pregnant women in Port Harcourt, Nigeria using peak expiratory flow meter with a view to determining the effects of the gravid uterus and advancing gestation on peak expiratory flow rate. This will help to fully understand the extent of physiological adaptation in pregnancy to avoid adjusted physiological changes being misinterpreted as pathological changes during antenatal care[22,24].

Methodology

The study was carried out at the department of Obstetrics and Gynaecology of the University of Port Harcourt Teaching Hospital, Rivers State and Comprehensive Health Centre Rumuigbo, Port Harcourt, Rivers State from January through July, 2013. This is a prospective cross sectional study involving 1000 female subjects aged 18 – 35 without any recent history of respiratory, cardio pulmonary disease or any other disease which may affect lung function. Informed consent was obtained from the subjects that met the eligibility criteria. This comprised of 500 pregnant females (study group) and 500 non pregnant females as control. The Peak expiratory flow rate was determined using the Wright's peak flow meter with the subject in a standing position as described[8-10,20,21]. The subjects were asked to breathe out maximally into the peak flow meter after taking a maximum inspiration. Three readings were taken in three minute intervals with the highest reading recorded as the peak flow rate. Data obtained was analyzed using SPSS version 20. PEFR values were analyzed based on age and gestational age. The Z test was used to compare the mean PEFR for pregnant (study group) and non-pregnant females (control) at $p< 0.05$. The ANOVA was used to compare the mean PEFR obtained for the various trimesters at $p < 0.05$. Pearson correlation was used to establish the relationship between PEFR and gestational ages of the pregnant subjects at $p<0.05$.

Results and Discussion

Pregnancy and advancing gestation has been associated with physiologic changes in ventilatory function[15-17]. Although these changes are well tolerated, prompt recognition and treatment of altered respiratory function is needed to protect the health of the mother and fetus[11]. Peak expiratory flow rate can provide this simple routine assessment of ventilatory function in pregnancy[5-10]. In the present study, peak expiratory flow rates of pregnant females in various gestational stages was studied and mean values were compared with non-pregnant females as controls.

Table 1 shows the mean values of age and the PEFR for pregnant and non-pregnant females. Pregnant females (27yrs) were found to be slightly older than the non-pregnant females (26yrs) though not statistically significant. However mean values for PEFR was found to be significantly lower in pregnant females (324.85 L/min) compared to the non-pregnant females (475.72 L/min) ($p<0.05$).

The mean PEFR observed for pregnant non pregnant females in this study fell within the range of PEFR values obtained elsewhere in Nigeriaand Indiabut lower than Caucasian values[18,20-22,25-27]. Though the pregnant and non-pregnant females did not have any statistical age difference (table 1), mean PEFR was found to be significantly lower in pregnant females (324.85 L/min) compared to the non-pregnant females (475.72 L/min)($p<0.05$). This agrees with the work by Puranik at eland Harirahet al[18,19]. Also, mean PEFR was significantly lower in the pregnant females when compared with the non-pregnant females of the same age group (figure 1). PEFR has been known to be affected to by age [4-10]. This suggests that the observed lower mean PEFR obtained for pregnant females is due the effect of pregnancy and advancing gestation. This can be 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[5-8]. Also inadequate nutrition due to morning sickness and altered eating habits can further cause muscle weakness leading to decreased PEFR in pregnant females[4,8,19].

In this study, PEFR was found to decrease with advancing gestational age. Figure 2 shows the mean PEFR of pregnant females for the various trimesters. PEFR was found to be lowest in the third trimester (271.85L/min) and highest in the first trimester (418.04 L/min) which were both found to be significantly different from the second trimester (348.19 L/min) ($p<0.05$). There was a decrease in PEFR of the pregnant females with increased gestational age as shown in figure 3 which shows a significant negative correlation between PEFR and gestational age of pregnant females ($r=0.78$, $p<0.05$) with a decline rate of 0.01, 0.08 and 0.17L/min per week observed for first, second and third trimesters respectively. This agrees with the work by Harirah *et al*, Puranik *et al*, Neeraj *et al* and Sunyal*et al*[19,21,22,24]. This observed progressive reduced PEFR in the three trimesters of pregnancy can be attributed to the mechanical effects of the enlarging gravid uterus which by pushing the diaphragm upwards limits its movement. The airway obstruction caused by the gravid uterus causes reduced PEFR especially in late pregnancy as our study shows that the third trimester had the highest decline rate in PEFR (0.17L/min per week).

Table-1
Age and Peak expiratory flow rate in pregnant and non-pregnant subjects

Parameters	Non Pregnant Females (Control) (n=500)	Pregnant Females (Study Group) (n=500)	Z Test Significance (p<0.05)
Age (yrs)	25.72±4.28 (18-35)	26.7±4.18 (18-35)	p=0.08 Not Significant
PEFR (L/min)	475.72±93.84 (220-680)	324.85±74.25 (200-600)	p=0.01 significant

Values are given as mean ± Standard deviation with range in parenthesis.

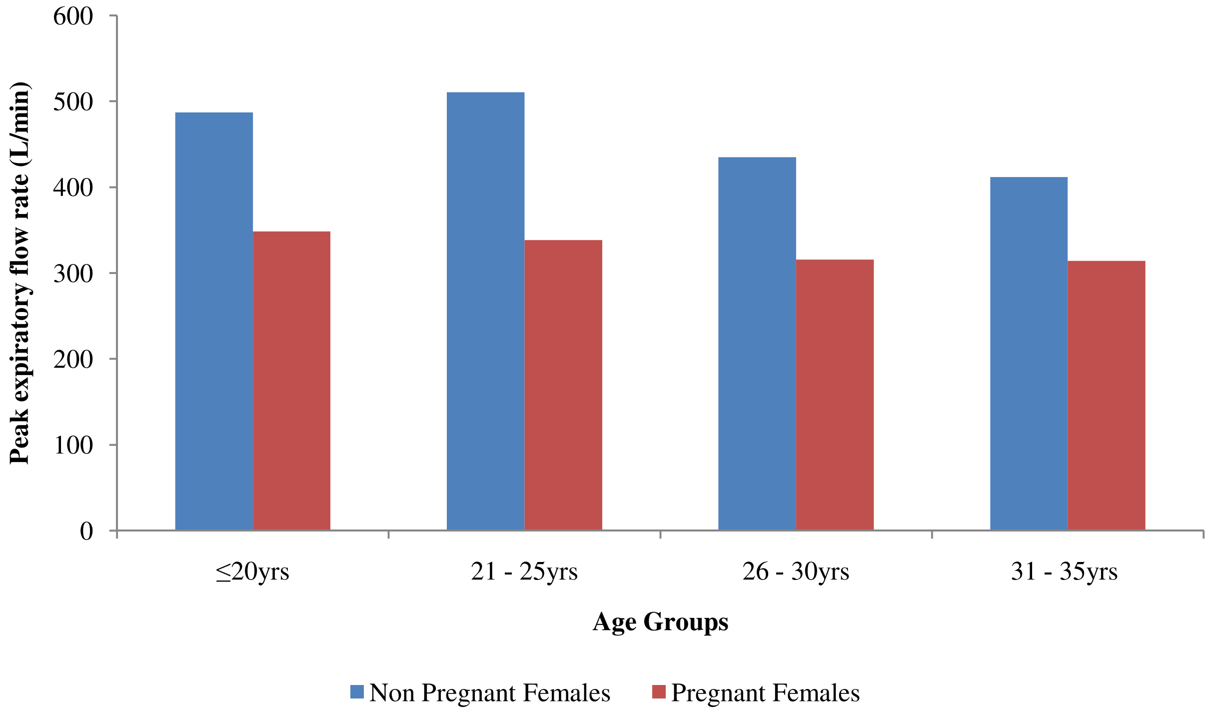

Figure-1
A pictorial representation of mean PEFR values of pregnant and non-pregnant females

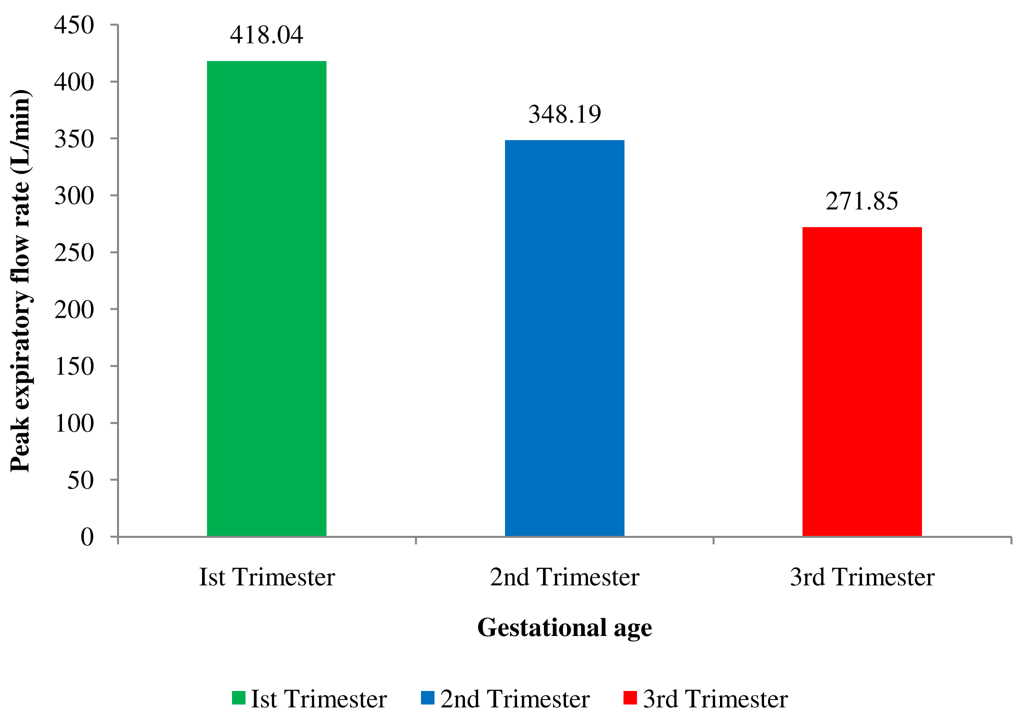

Figure-2
Mean peak expiratory flow rate values of pregnant subjects based on gestational age

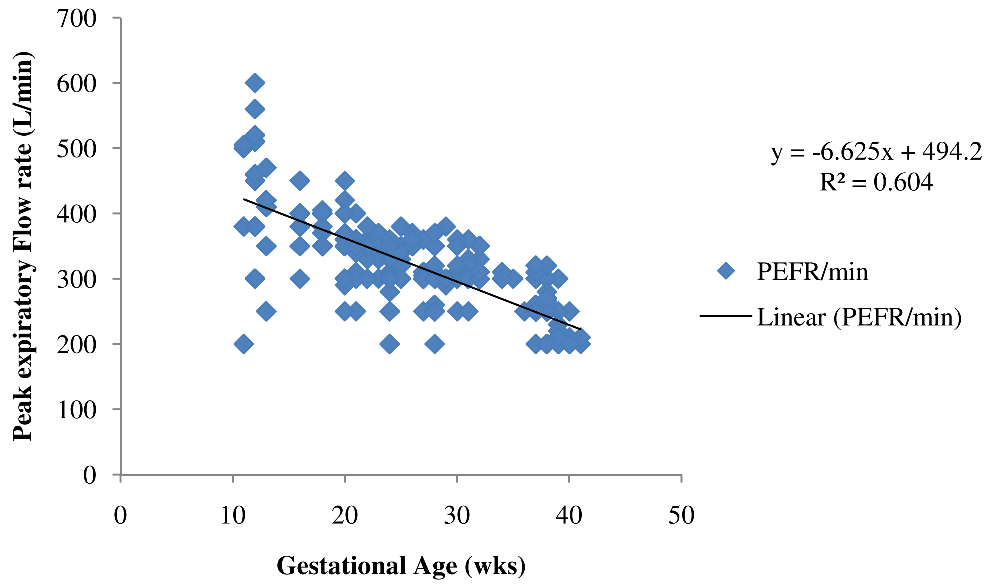

Figure-3
A correlation plot of peak expiratory flow rate against gestational age of pregnant females

Table-2
Peak expiratory flow rate of pregnant and non-pregnant females based on age groups

Age Groups	Control (non-pregnant females) (L/min)	n	n	Pregnant Females (L/min)	Z Test Significance (p<0.05)
<20yrs	487.08±98.18 (230-680)	84	54	348.61±80.07 (200-510)	p=0.01 significant
20 – 25yrs	510.42±85.21 (240-650)	231	129	338.41±84.79 (200-630)	p=0.01 significant
26 – 30yrs	435.08±83.24 (220-630)	123	232	315.75±69.64 (200-560)	p=0.01 significant
31 – 35yrs	411.63±73.75 (250-620)	62	85	314±58.79 (200 -450)	p=0.01 significant

Values are given as mean±Standard deviation with range in parenthesis

Table 2 shows an age group comparison of the mean PEFR for both pregnant and non-pregnant females. Peak expiratory flow rate was found to be significantly lower in all age groups (<20, 20-25, 26-30, 31-35yrs) for pregnant females compared to the non-pregnant females ($p<0.05$) (figure 1). This shows that though the pregnant females were found to be slightly older ($p>0.05$), it was pregnancy and not age that affected the PEFR.

Conclusion

This study draws attention to the possible effect of the gravid uterus on the pulmonary function of a pregnant woman. Peak expiratory flow rate is affected by pregnancy and advancing gestation especially in the second and third trimester due to airway obstruction caused by the gravid uterus.

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