Indian J Physiol Pharmacol 1995; 39(2) : 135-139

PEFR IN PREGNANCY: A LONGITUDINAL STUDY

B. M. PURANIK*, G. A. KURHADE, S. B. KAORE,
S. A. PATWARDHAN AND J. R. KHER**

Department of Physiology,
Government Medical College,
Nagpur - 440 003

(Received on April 11, 1994)

Abstract: Peak expiratory flow rates (PEFR) were measured in 60 pregnant women aged 20-28 years (average 24 yrs) height between 130-160 cm (average 154.5 cm), each month beginning from 3rd month of gestation and also 8-10 weeks postpartum using, Wright's Peak Flow Meter. The PEFR declined from 329.12 ± 4.40 lpm in 3rd month to 286.22 ± 3.81 lpm in 9th month of gestation and increased to 347.86 ± 2.93 lpm in postpartal period. A similar, declining trend is also observed in other Indian studies. However, the values are lower than those observed in Europeans. Also no change in PEFR during pregnancy was observed in an European study. The PEFR in our study regressed at a rate of 6.68 lpm/month of gestation and 5.49 lpm/kg increase in weight throughout pregnancy. The correlation with forced vital capacity (FVC) and forced expiratory volume in first second (FEV_1) is non-significant throughout pregnancy. The anaemic pregnant women showed lower PEFR when compared with PEFR of non-anaemic pregnant women, but showed a similar declining trend throughout pregnancy.

Key words: pregnancy lung function PEFR

INTRODUCTION

The studies of lung functions during pregnancy are scarce. Also these usually concern with evaluation of the standard lung volumes and capacities (1, 2, 3, 4). Furthermore, very few studies have analysed these changes longitudinally during pregnancy in the same women (2). Very little information in available on PEFR (1pm) in pregnant woman (5, 6) even though this is simple and fairly repeatable test of lung function (7, 8). We thus endeavoured to study monthly changes in this simple parameter of lung function in pregnant women of Central India. We have also attempted to derive and analyse various regression relationships of PEFR to month of gestation and weight in the pregnant state and have also derived a multiple regression equation relating PEFR with age and height in non-pregnant subjects.

METHODS

We have measured PEFR in 60 pregnant women monthly from 3rd to 9th month of gestation and 8-10 weeks after delivery, 10 of the women were anaemic with haemoglobin between 6-8 gm/dl (Sahli Hellige's method). Non-reporting during Ist trimester formed the major obstacle in nonavailability of subjects during this early phase of pregnancy. All subjects were between 20-28 yrs of age with height ranging between 130-160 cm. Informed consent was obtained in all after ruling out cardiopulmonary and renal disorders through careful history taking and clinical examination (ECG and X-ray chest if indicated).

The PEFR test was done as per the standard method of Wright and Mckerrow (7) using Wright's Peak Flow Meter (Airmed Ltd, Harlow, England, W 26541) which was already calibrated by the Company.

*Corresponding Author
**Present address: Department of Physiology, Indira Gandhi Medical College, Nagpur

It was checked before use by measuring PEFR in 50 normal healthy medical students having reliably known lung functions tests. All our subjects were trained to perform the PEFR test after which 3 readings were recorded in each month of pregnancy and in postpartum period. An average of 3 readings were included in the analysis (9). Spirometery was performed using Vitalograph S model spirometer with function analyser (Vitalograph Ltd, Buckingham) after calibration at 6 liters and temperature calibration at room temperature, to record the FVC and FEV_1.

The statistical analysis was done on a Sterling Computer SIVA PCAT 296 using Minitab packages to obtain mean ± Standard error of mean for PEFR lpm for each month of gestation and in the postpartum period. The means were compared using ANOVAR to obtain the F ratio. A regression coefficient was obtained to determine the relationship of the PEFR to weight and month of gestation.

Different regression equations were derived. Multiple regression equation for height and age dependency of PEFR was calculated. The level of significance was determined using Student's 't' test.

PEFR was also measured in fifty non-pregnant women of matching age and height (Table I). However, this data was not included as our aim was to evaluate the effect of pregnancy on PEFR. Furthermore, we studied the correlation of PEFR with weight in 20 female medical students of matching age and height (Table IV).

RESULTS

The PEFR values of nonpregnant women, of pregnant women in each month of pregnancy and in the postpartum period are shown in Table I.

TABLE I : Showing PEFR in each month of pregnancy and in postpartum period.

Month	*Weight in kg ± S.D.*	*PEFR in LPM ± SEM*
3	48.63 ± 7.17	329.12 ± 4.40
4	49.77 ± 7.28	328.20 ± 4.51
5	51.00 ± 7.03	314.68 ± 3.43
6	52.29 ± 6.98	306.78 ± 4.60
7	53.85 ± 6.87	300.26 ± 6.07
8	54.78 ± 6.98	302.40 ± 6.06
9	56.19 ± 7.08	286.22 ± 3.81
PP	49.02 ± 6.64	347.86 ± 2.93
Non-pregnant women	47.80 ± 6.00	382.0 ± 4.45

A significant inter-group difference ($P < 0.05$) was seen after ANOVAR. The PEFR decreased with advancing pregnancy (Fig. 1) at a rate of 6.68 lpm/month increase of gestation as seen ($P < 0.001$) from Table II which shows regression equations

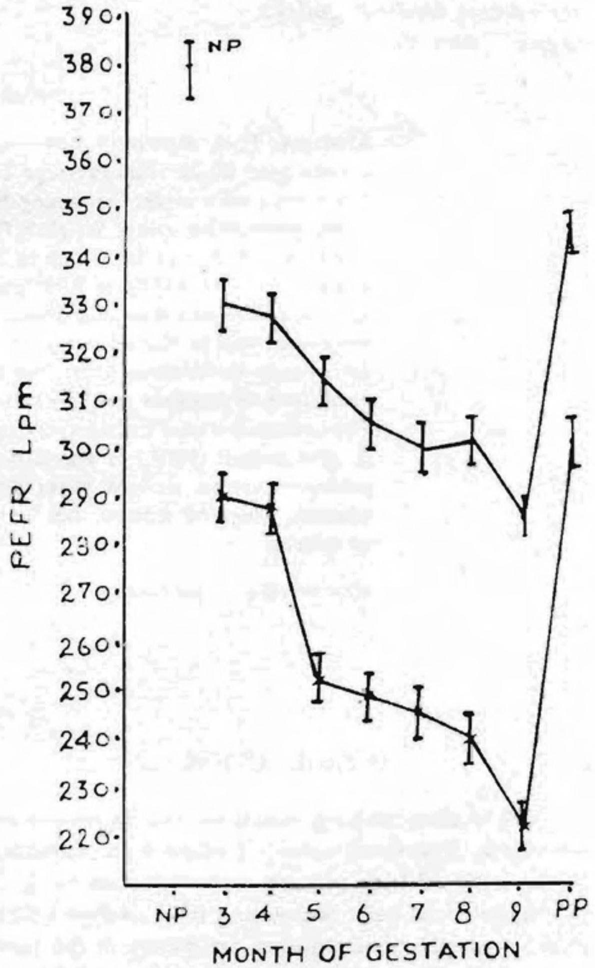

Fig. 1 : Showing the PEFR (± SEM) in non-pregnant women and in each month of gestation in pregnant (●) and anaemic pregnant (x) women.

TABLE II : Showing regression relationships of PEFR with month of gestation.

Weight and age (A) and height (H)		
PEFR = 597 - 5.49 x weight	r = —0.972	P < 0.001
PEFR = 348.281 - 6.6789 x month	r = —0.912	P < 0.001
PEFR = 4H-2.8A-170	r = 0.5	

relating PEFR to weight and month of gestation. The PEFR declines at a rate of 5.49 lpm/kg increase in weight during pregnancy ($P < 0.001$) (Fig.2). FVC and FEV_1 do not change significantly with advancement of pregnancy (10). PEFR declines with rise of FVC and FEV_1 but this was non-significant ($P < 0.05$). When studied in each month of pregnancy the correlation of PEFR with FVC and FEV_1 was inverse and statistically very high significant ($P < 0.001$).

The ten anaemic pregnant women showed lower PEFR in each month of gestation when compared with PEFR of non-anaemic pregnant women. It ranged between 290.3 ± 4.2 lpm in 3rd month to 221.5 ± 5.9 lpm in 9th month of gestation, thus showing similar declining trend.

In 20 medical students' decline, PEFR with rise of weight was observed (Table IV).

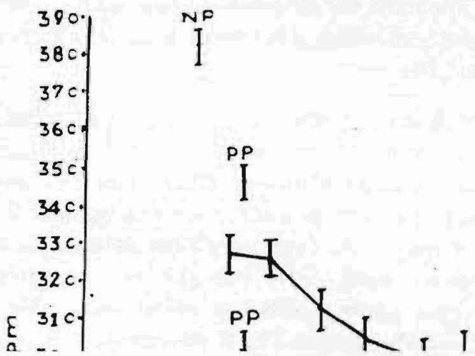

Fig. 2 : Showing correlation of PEFR (± SEM) lpm in non-pregnant, pregnant (●) and anaemic pregnant (x) women plotted against weight.

TABLE III: Showing PEFR in non-anaemic and anaemic pregnant women.

Month	Non-anaemic (n=50)	Anaemic (n=10)
3	329.12 ± 4.40	290.3 ± 4.20
4	328.20 ± 4.51	288.8 ± 5.02
5	314.68 ± 3.43	252.2 ± 5.30
6	306.78 ± 4.60	247.5 ± 5.08
7	300.26 ± 6.07	245.1 ± 4.80
8	302.40 ± 6.06	240.9 ± 5.00
9	286.22 ± 3.81	221.5 ± 5.90
PP	347.86 ± 2.93	302.0 ± 5.03

TABLE IV: Showing the decline of PEFR with rise in weight in 20 Medical students.

Age	*Height(cm)*	*Weight in kg*	*PEFR lpm*	*Rate of decline*
18	142	33.0	320	
18	142	37.7	310	
19	142	41.5	290	4.8 lpm/kg
18	145	43.0	270	
18	147	45.0	260	
18	147	45.5	250	
19	145	46.5	240	
18	152.5	38.5	370	
18	156	40.0	330	
18	155	49.0	300	
19	155	52.0	280	
18	155	51.0	280	8.6 lpm/kg
18	155	53.0	260	
18	155	53.5	250	
19	153	53.5	240	
19	157	56.0	400	
18	157	58.5	380	
19	158	59.5	370	8.3 lpm/kg
18	160	60.0	370	
18	160	62.0	350	

DISCUSSION

We have studied PEFR the much ignored parameter of lung function during pregnancy (1, 2, 3, 4). The PEFR alongwith FEV_1 is a relatively good indicator for early detection of deteriorating ventilatory capacity (9). Also PEFR test is easily done and fairly repeatable so it can be used for beside assessment of ventilatory capacity and in antenatal checkup camps.

The PEFR in non-pregnant women of our study was 382 ± 4.45 lpm. The decline in PEFR was observed right from 1st trimester i.e. 3rd month of gestation

(Table I). This can be attributed to inadequate nutrition due to morning sickness and altered eating habits which result in muscular weakness. There is a significant reduction in PEFR during pregnancy which is due to lesser force of contraction of main expiratory muscles like anterior abdominal muscles and internal intercostal muscles (5). PEFR increases 8-10 weeks after delivery but is still less than the non-pregnant women (Table I) as the muscles take longer time to come to normal and force of contraction of these muscles is very weak. Early return of lung function to normalcy can be speeded by graded active exercises in postpartal period i.e. upto 6 weeks after delivery (11) for increasing the strength of the muscles of anterior abdominal wall (12). Complementary results as ours have been obtained by other Indian studies (5, 6, 13).

Ganeriwal et al (5) studied PEFR in 185 female subjects aged 16-30 yrs. They were grouped into 65 non-pregnant and 120 pregnant subjects in IIIrd trimester out of which 50 were followed up in the Ist week of postpartal period. The PEFR declined from 289 lpm to 283.7 lpm.

Singhal and Saxena (13) studied 4 normal and 10 anaemic pregnant woman in their IIIrd trimester. The mean PEFR in normal pregnant women was 352.5 lpm and of anaemic pregnant women was 251 lpm. Mokkapatti et al (6) in their cross-sectional study analysed the PEFR in 119 South Indian pregnant women of which 25 were in Ist, 49 in IInd and 45 in IIIrd trimester of pregnancy. They found that PEFR declined from 335 lpm in 1st trimester to 312 lpm in IIIrd trimester.

In a study on 13 pregnant European women, the PEFR remained virtually unchanged (406 lpm in the 3rd month and 403 lpm in the 9th month) (14). This was thought to be due to effective force development at the same level of efferent nervous output brought about by altered diaphragmatic position with increase in length and decrease in radius of curvature. The PEFR reported by them is higher than any of our values suggesting that PEFR in European is higher (ethnical variation) which is due to greater thoracic volume (15). The anatomical changes during pregnancy are similar in all women. Inspite of these changes in Indian women, the muscular force development may be less effective due to factors like (i) lack of antenatal exercises, (ii) casual patient approach to nourishment, iron and calcium supplementation. The given reason is a hypothesis by Knuttgen et al (14). For further evaluation in Indian pregnant women, more extensive studies are required.

Various regression equations were derived but we should be careful while using these to predict PEFR outside the age and height range specified, as a regression line must not be extended beyond the range of observations on which it is based, without sufficient justification (16).

The PEFR in our study was significantly correlated to month of gestation and weight. The very highly significant inverse correlation of PEFR with FVC and FEV_1 in each month of pregnancy may be because the early part of maximum expiratory flow volume curve which includes peak flow (i.e. 10 ms) is effort depandent and latter portion is effort independent (17). Anaemia also affects PEFR adversely. It is seen that height, age, weight, muscle strength, airway resistance, lung recoil, body fat content etc. affect PEFR (18, 19). PEFR is more sensitive to muscular element in respiration and as anaemia produces muscle weakness it reflects in lowering the PEFR (13).

REFERENCES

1. Saxena SC, Rao VSC, Mudgal SA. Study of pulmonary function tests during pregnancy. *J Obs Gyn of India* 1979; 29:993-995.
2. De S, Bhargava RP, Benawari S. Longitudinal Ventilatory function (Static & dynamic) studies during different trimesters in pregnant women. *J Obs Gyn of India* 1984; 36: 812-816.
3. Chhabra S, Nangia V, Ingley KN. Changes in respiratory function tests during pregnancy. *Indian J Physiol Pharmacol* 1988; 32(1):56.
4. Das TK, Jana H. Maternal airways function during normal pregnancy. *Ind J Med Sci* 1991; 45(10):265.
5. Ganeriwal SK, Deshpande DR, Reddy BV, Shaikh RM. Effect of pregnancy on pulmonary ventilation. *J Obs Gyn of India* 1984; 36:639-641.
6. Mokkapatti R, Prasad EC, Venkatraman, Kaneez Fatima. Ventilatory functions in pregnancy. *Indian J Physiol Pharmacol* 1991:35(4): 237-240.

7. Wright BM, Mckerrow CB. Maximum forced expiratory flow as a measure of ventilatory capacity. *BMJ* 1959;2:1041-1047.

8. Tinker CM. Peak expiratory flow measure by Wright's peak flow meter. *BMJ* 1961; 1:1365-1366.

9. Cotes JE. Lung function: assessment and application in medicine. 3rd edition Blackwell Scientific Publications, Oxford 1975; P 107, 99.

10. Puranik BM, Kurhade GA et al. A longitudinal study of pulmonary function tests during pregnancy. *Indian J Physiol Pharmacol* 1994; 38: 129-132.

11. Percival : Holland & Brews Manual of Obstetrics 15th edition B. I. Churchill Livingstone Pvt. Ltd. New Delhi, 1991; Page 514.

12. Puranik BM, Kurhade GA. A longitudinal study of antenatal respiratory changes and importance of postpartal excercises (To be published).

13. Singhal U, Saxena K. Effect of anaemia on respiratory and metabolic parameters during IIIrd trimester of pregnancy. *Indian J Physiol Pharmacol* 1987; 31(2): 130-135.

14. Knuttgen HG, Emerson K. Physiological response to pregnancy at rest and during exercise. *J Appl Physiol* 1974; 36: 549.

15. Bradford Hill A. A short textbook of Medical statistics ELBS, London 1977, quoted by 15.

16. Dikshit MB, Prasad BAK, Jog NV. Peak expiratory flow rates in elderly Indians. *Indian J Physiol Pharmacol* 1991;35(1): 39-43.

17. Cecil. Textbook of Medicine 18th edition, edited by Wyngaarden and Smith. WB Saunders Co. Philadelphia 1988; P 397.

18. Gupta CK, Mathur N. Statistical model relating PEFR to age and height in men and women. *J Epidemiol Commun Hlth* 1982;36:64-67.

19. Primhak RA, Biggins JD, Tsanakas JN et al. Factors affecting the PEFR in children. *Br J Dis Chest* 1984;78:26-35.