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 (FEV₁) 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
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). Spirometry 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 FEV₁.

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

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.
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 FEV₁ do not change significantly with advancement of pregnancy (10). PEFR declines with rise of FVC and FEV₁ but this was non-significant (P < 0.05). When studied in each month of pregnancy the correlation of PEFR with FVC and FEV₁ 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).

**DISCUSSION**

We have studied PEFR the much ignored parameter of lung function during pregnancy (1, 2, 3, 4). The PEFR alongwith FEV₁ 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.
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 postpartum period i.e. up to 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 1st week of postpartum period. The PEFR declined from 289 lpm to 283.7 lpm.

Singhal and Saxena (13) studied 4 normal and 10 anaemic pregnant women 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 force 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, 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 dependent 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


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


