ORIGINAL ARTICLE

# EXPIRATORY FLOW RATE CHANGES DURING MENSTRUAL CYCLE

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**Background:** The dynamic changes in the level of various hormones during different phases of menstrual cycle are known to affect various functions of the body, apart from the reproductive system. This study was intended to confirm the probable effects of follicular, secretory and menstrual phases on pulmonary functions. **Methods:** The study was conducted in the Department of Physiology, Indira Gandhi Medical College Shimla. Study involved 40 women in the reproductive age group. Spirometry was done in various phases of menstrual cycle and compared. **Results:** The mean value of lung function tests, i.e., forced vital capacity (FVC), forced expiratory volume in 1st second ($FEV_1$), $FEV_1$/FVC ratio, and the forced expiratory flow 25% to 75% ($FEF_{25–75}$) in secretory phase were significantly higher than in menstrual phase ($p<0.05$). The PFTs in menstrual phase were even lower than in follicular phase ($p<0.04$). **Conclusion:** Respiratory parameters of women in reproductive age group show significant variation during different phases of menstrual cycle.

**Keywords:** Menstrual cycle, Pulmonary function tests, Spirometry, Progesterone, Oestrogen

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## INTRODUCTION

The association between menstrual cycle and lung functions has long been recognised.[1] The pathophysiology of this process is still not proved. During various phases of menstrual cycle, the blood level of female hormones, i.e., progesterone and or oestrogen vary.[2-5] Studies suggest that progesterone and oestrogen levels strengthen the respiratory musculature and increase the relaxation of bronchial smooth muscles.[6–8] This variation has been cited as the cause of changes in lung functions during various phases of menstrual cycle.[9] Some other studies have also reported significant variation in pulmonary functions during different phases of menstrual cycle.[10,11]

The objective of this study was to confirm the probable effects of the three phases of menstrual cycle on pulmonary functions.

## MATERIAL AND METHODS

The study was conducted in the Department of Physiology, Indira Gandhi Medical College, Shimla from Dec 2005 to Jun 2006. The study was approved by the ethical committee of the institute.

Forty women in the reproductive age group were included in the study. Informed consent was obtained from all subjects. A detailed menstrual history was taken from them so that their PFTs could be carried out in various phases of menstrual cycle. General clinical examination of their respiratory system was carried out to exclude any obvious respiratory disease.

Only 15–45 years age group women were included; women on hormonal therapy were excluded from the study. Women with any respiratory illness were not included.

The subjects were divided into 2 groups. Group I included 20 women aged <30 years, and Group II included 20 women in age group >30 years.

The pulmonary functions of these were done in various phases of menstrual cycle. The variations in pulmonary functions were then studied. The Pulmonary Function Tests were done using Vitalograph COMPACT II™. Three readings were taken at a sitting and the highest reading at any testing session was used in trend analysis. The spirometry done was standardised as per American Thoracic Society criteria. Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second ($FEV_1$), and Maximal Midexpiratory Flow Rate (MMFR or $FEF_{25–75}$) of each subjects were calculated at BTPS.

Three pairs were made for analysis of the data collected. Pair I between follicular and menstrual phase, Pair II between secretory and menstrual phase, and Pair III between follicular and secretory phases. Data were analysed using SPSS-16. Paired Student's *t*-test was employed and $p\leq0.05$ was taken as significant.

## RESULTS

The mean values of all parameters of lung function tests in all the phases were higher in Group I than in Group II. The mean values of FVC in both Group I and Group II were the highest in secretory phase followed by follicular phase and the lowest in menstrual phase. The mean values of $FEV_1$, $FEF_{25–75}$ in both groups were higher in secretory phase followed by follicular phase and the lowest in menstrual phase. No significant differences were found in $FEV_1$/FVC in pairs 1 and 3 in both groups. (Tables 1–3).

**Table-1: Pulmonary function tests in women in age group <30 years (Mean±SD)**

| Pulmonary function test | Follicular phase | Secretory phase | Menstrual Phase |
|---|---|---|---|
| FVC (L) | 2.85±0.39 | 3.00±0.41 | 2.67±0.36 |
| $FEV_1$ (L) | 2.67±0.32 | 2.82±0.33 | 2.46±0.38 |
| $FEV_1$/FVC (%) | 94.0±5.05 | 94.4±6.11 | 92.2±8.1 |
| $FEF_{25–75}$ (L/Sec) | 3.77±0.67 | 4.04±0.68 | 3.48±0.75 |

**Table-2: Pulmonary function tests in women in age group >30 years (Mean±SD)**

| Pulmonary function test | Follicular phase | Secretory phase | Menstrual Phase |
|---|---|---|---|
| FVC (L) | 2.75±0.32 | 2.089±0.36 | 2.63±0.32 |
| $FEV_1$ (L) | 2.55±0.28 | 2.71±0.29 | 2.36±0.33 |
| $FEV_1$/FVC (%) | 93.25±9.04 | 94.4±5.71 | 89.90±7.33 |
| $FEF_{25–75}$ (L/Sec) | 3.84±0.73 | 4.06±0.75 | 3.56±0.76 |

**Table-3: Statistical analysis of pulmonary functions tests in three phases of menstrual cycle**

| PFTs | Comparison Group | *t*-value Group I | *t*-value Group II | *p*-value Group I | *p*-value Group II |
|---|---|---|---|---|---|
| FVC | Pair 1 | 5.891 | 4.023 | 0.000** | 0.000** |
| | Pair 2 | 8.283 | 7.119 | 0.002** | 0.000** |
| | Pair 3 | 6.007 | 4.731 | 0.000** | 0.000** |
| $FEV_1$ | Pair 1 | 6.205 | 5.497 | 0.000** | 0.000** |
| | Pair 2 | 8.922 | 10.68 | 0.000** | 0.000** |
| | Pair 3 | 5.041 | 6.782 | 0.000** | 0.000** |
| $FEV_1$/FVC | Pair 1 | 1.204 | 1.781 | 0.24 | 0.091 |
| | Pair 2 | 1.345 | 3.028 | 0.195 | 0.007** |
| | Pair 3 | 0.550 | 0.886 | 0.589* | 0.387 |
| $FEF_{25–75}$ | Pair 1 | 4.352 | 4.245 | 0.000** | 0.000** |
| | Pair 2 | 6.567 | 6.178 | 0.000** | 0.000** |
| | Pair 3 | 5.638 | 5.887 | 0.000** | 0.000** |

Group I=women in age group <30 years, Group II=women in age group >30 years, Pair 1=Follicular and menstrual, Pair 2=Secretory and menstrual, Pair 3=Follicular and secretory, *Significant, **Highly significant

## DISCUSSION

The present study shows that respiratory parameters of women in reproductive age group show significant variation during different phases of menstrual cycle. It demonstrated better pulmonary functions which were measured as the lung volumes and the peak flow during the luteal phase of the menstrual cycle as compared to those in the follicular and menstrual phases in the regularly menstruating adolescent girls. Though statistically significant differences were demonstrated in our study, our results need to be interpreted in the background of certain limitations. Our study is *at par* with Beynon *et al.*[1] He reported that the administration of high doses of progesterone throughout the menstrual cycle prevented the deterioration of the premenstrual exacerbation of asthma. The withdrawal of progesterone, therefore, is expected to cause lower flow rates during the premenstrual and the menstrual phases. Das *et al* showed that use of progesterone in hypoventilation syndrome, obesity and emphysema has been by its virtue of increasing the sensitivity of the respiratory neurons to $CO_2$, producing a stimulatory effect directly on the medullary receptors, thus indicating the role of progesterone on the pulmonary function.[12]

According to Beynon *et al*[1], both the pre-ovulatory and the premenstrual phases are the actual triggers of the exacerbation of asthma in some women, or maybe these two phases serve as 'co-factors' that worsen other recognised triggers of acute asthma, thus indicating the role of low levels of progesterone during these two phases. This has been emphasised by Rajesh[13], where the pulmonary functions reflect better values in the luteal phase as compared to those in the follicular phase, and also by Rao *et al*[14], where a change in the expiratory flow rates during various phases of the menstrual cycle has been demonstrated. The low peak expiratory flow and the $FEF_{25–75}$ that were observed during the premenstrual and the menstrual phases indicated a higher bronchial tone during these phases, even in normal women.[15] The possible reason for the changes in the bronchial tone could be the fluctuating levels of sex hormones in the blood or of the mediators which circulate in the blood.[16] In a study conducted by Chen *et al*[17] the pulmonary functions were measured and compared in the midfollicular phase and in the midluteal phase in 30 healthy women. They concluded that the inspiratory muscle endurance was higher in the midluteal phase and that it was lower in the midfollicular phase. This is *at par* with the findings of our study. According to Chong *et al*[18], the menstrual cycle appeared to have little effect on the peak expiratory flow rate in healthy, non-asthmatic, Asian women.

## CONCLUSION

Expiratory flow rates show significant fluctuations during menstrual cycle in normal women being better in secretory phase. These changes may be kept in mind in assessment of changes in lung functions by serial testing and planning of therapeutic regimen in women with predisposition to respiratory allergies.

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