

# Variation in the Pulmonary Functions with the Phases of the Menstrual Cycle in Adolescent Females

NANDHINI R., SUBHASHINI A.S.

## ABSTRACT

**Background:** The dynamic changes in the level of various hormones during different phases of the menstrual cycle are known to affect various functions of the body, apart from the reproductive system. This study was intended to demonstrate the variation in the pulmonary functions during different (menstrual, luteal and follicular) phases of the menstrual cycle in adolescent girls.

**Methods:** This was a prospective, observational study which was performed at a referral centre in India. Regularly menstruating adolescent girls who presented to the outpatients department for minor, non-respiratory ailments were included in the study. Their lung volumes were measured serially during various phases of the menstrual cycle. During the menstrual phases, various parameters were compared.

**Results:** Over the study period, 200 girls were enrolled in the study; the complete details for the final assessment were available from 43 girls (age range- 12 -18 years, mean height- 154.1 cm and mean weight -54.5 kg). The forced vital capacity, the forced expiratory volume, the FEV1/FVC ratio and the forced expiratory flow 25% to 50% were noticed to be significantly higher during the luteal phase and the lowest during the menstrual phase.

**Conclusions:** The pulmonary functions which were quantified as lung volumes and peak flow rates were better during the luteal phase of the menstrual cycle, thus suggesting a possible beneficial role of progesterone in the management of respiratory illnesses.

**Key Words:** Menstrual phase, Lung functions, Progesterone

## INTRODUCTION

The hormones which are released by the ovary bring out physiological changes in the brain, in the musculoskeletal system and in the cardiovascular and pulmonary functions, in addition to changes in the reproductive system. The variation in the pulmonary functions during different phases of the menstrual cycle follows a cyclical pattern, which possibly could be due to the action of various hormones [1,2]. Ovulation is followed by the formation of a corpus luteum, which secretes progesterone. It may have some beneficial effect on the physical performance as well as on  $VO_2$  max [3]. The information on the variability of the pulmonary functions which are relative to the menstrual phases is insufficient. This study intended to demonstrate the variation in the pulmonary functions during different (menstrual, luteal and follicular) phases of the menstrual cycle in adolescent girls.

## MATERIALS AND METHODS

This prospective cohort study was performed between March 2002 and December 2003 at a referral centre in India. Regularly menstruating adolescent girls who presented to the out patients department for minor non- respiratory ailments were included in the study after taking their written informed consent. Those with a history of chronic pulmonary illnesses or long term relevant medication use (bronchodilators, antitubercular drugs, etc) were excluded from the study. A detailed questionnaire was used to assess the pattern of the menstrual cycle, the premenstrual disturbances and the last menstrual period and to rule out allergic respiratory diseases and obesity. The anthropometric measurements and the vital

parameters were recorded. The preliminary clinical examination of the respiratory system was carried out. Pulmonary function tests (PFTs), viz. forced vital capacity (FVC), forced expiratory volume (FEV1), the FEV1/FVC ratio and the forced expiratory flow (FEF) 25% were studied by using RMS Medspiror (Nagpur, India) and standard laboratory methods, during different phases of the menstrual cycle with the girls in a sitting posture. The PFTs were performed after 30 minutes of non-ambulation and before having lunch, between 1 PM and 1.30 PM everyday, for 30 days continuously, starting from the first day of their menstrual phase. For each subject, the procedure was repeated thrice and the maximum value was considered for the study. The respective phases of menstruation were calculated from the day of the last menstrual period and during the usual duration of the menstrual cycle.

The data was entered in Microsoft Excel sheets and analyzed by using SPSS version 8.0. The continuous variables were compared by using ANOVA among the groups and a 'p' value of < 0.05 was considered as significant. The study protocol was approved by the ethics committee of our institute.

## RESULTS

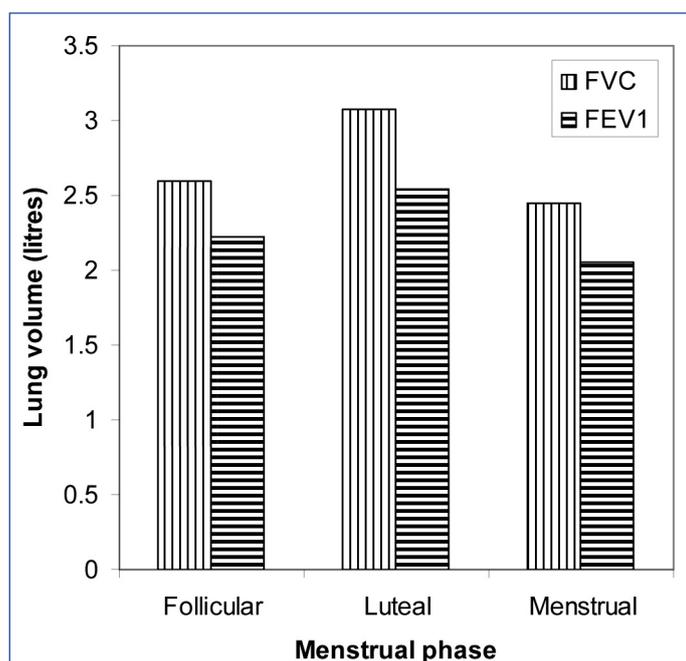
Over the study period, 200 girls were enrolled for the study. The complete details for the final assessment were available from 43 girls (age range- 12-18 years, mean height -154.1 cm and mean weight- 54.5 kg). The pulmonary function measures in the cohort over the phases of the menstrual cycle are shown in [Table/Fig-1]. The mean of the FVC was more during the luteal phase and it was statistically significant. The mean of the FEV1 was more during the

luteal phase as compared to that in the follicular and the menstrual phases and it was statistically significant. FEV<sub>1</sub>/FVC% and FEF<sub>25</sub>% were more in the luteal phase as compared to those in the follicular and the menstrual phases and this was statistically significant. The comparison between FVC and FEV<sub>1</sub> during various phases of the menstrual cycle is shown in [Table/Fig-2].

Parameters	Follicular	Luteal	Menstrual
FVC (Litres)	2.6 ± 0.43	3.07 ± 0.71*	2.45 ± 0.34
FEV <sub>1</sub> (Litres)	2.22 ± 0.28	2.54 ± 0.42*	2.05 ± 0.32
FEV <sub>1</sub> /FVC (%)	87.83 ± 0.88	89.84 ± 0.67*	86.13 ± 0.88
FEF 25 % (L/min)	5.3 ± 0.92	5.75 ± 1.0*	5.19 ± 1.1

[Table/Fig-1]: Pulmonary function measures over the phases of menstrual cycle (n=43).

Forced vital capacity (FVC), forced expiratory volume in one second (FEV<sub>1</sub>) and the ratio FEV<sub>1</sub>/FVC & forced expiratory flow (FEF) 25%.\*Significantly higher (p<0.05) as compared to other 2 groups.



[Table/Fig-2]: Comparison between FVC and FEV1 during various phases of menstrual cycle

## DISCUSSION

The present study 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. An adequately powered study design which uses the objective measurements of the hormonal levels and the detailed pulmonary functions including diffusion studies, are expected to provide a better insight to the suggested relationship.

Our study is on par with a study which was conducted by 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. A study

which was done by Das et al showed that the use of progesterone in the hypoventilation syndrome, obesity and emphysema has been by its virtue of increasing the sensitivity of the respiratory neurons to CO<sub>2</sub>, producing a stimulatory effect directly on the medullary receptors, thus indicating the role of progesterone on the pulmonary function [4].

According to Brenner et al, both the pre-ovulatory and the pre-menstrual 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 recognized triggers of acute asthma [5], thus indicating the role of low levels of progesterone during these two phases. This has been emphasized by Rajesh et al, where the pulmonary functions reflect better values in the luteal phase as compared to those in the follicular phase [2], and also by Sundar et al, 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 forced expiratory flow 25-75% that were observed during the premenstrual and the menstrual phases indicated a higher bronchial tone during these phases, even in normal women. The possible reason for the changes in the bronchial tone could be the fluctuating levels of the sex hormones in the blood (or) of the mediators which circulate in the blood [6]. In a study which was conducted by Chen et al, 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 [7]. This was in par with the findings of our study. According to Chong et al, the menstrual cycle appeared to have little effect on the peak expiratory flow rate in healthy, non-asthmatic, Asian women [8].

## CONCLUSION

The pulmonary functions were better, 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 the menstrual phases in regularly menstruating adolescent girls. This suggests a possible role of the increased levels of progesterone during the luteal phase on the respiratory system.

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