International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

# Changes in the Pulmonary Functions in Different Phases of Ovarian Cycle in Premenstrual Syndrome

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**Abstract:** ***Ovarian cycle refers to rhythmic changes occurring in ovaries during the female sexual cycle of both 28 days. Ovarian changes occurring during the female sexual life completely depend on the gonadotropic hormones (FSH and LH). Ovarian cycle consist of follicular phase and luteal phase along with ovulation.[1] The present study was undertaken to assess the changes in pulmonary functions in different phases of ovarian cycle in PMS and Non-PMS group. Periodical changes in the levels of various hormones during different phases of ovarian cycle were known to affect functioning of different systems of the body including the respiratory system[2]. The study group comprise 10 samples per each group of age between 20-24 years and the samples were examined for five consecutive months. The respiratory parameters were assessed and the data collected during the follicular and luteal phases of ovarian cycle. The data analysis was done by using SPSS version 20.00. Our study results show that MMV, FEV1/FVC, 40MMHG, MEP, BHT inspiration and BHT expiration are statistically significant comparing PMS and Non PMS group except FEC.***

**Keywords**: Ovarian cycle, Gonadotropic Hormones, Luteal phase, Follicular phase, PMS (Pre menstrual syndrome)

## 1. Introduction

The normal reproductive years of the females are characterized by monthly rhythmic changes in the rate of secretion of the female hormones and corresponding physical changes in the ovaries and sexual organs. Although 28 days in the average cycle length, it is normal to have a cycle that is shorter or longer.[3]The normal human menstrual cycle can be divided in to two segments. Ovarian cycle and uterine cycle. The ovarian cycle further classified in to follicular phase and luteal phase. Average length of human follicular phase ranges 1-14 days including menstruation. Second is luteal phase. Average length of luteal phase is 14 days. Begins on 15th day from the time of ovulation to the onset of menstruation.[4] According to National Institute of Mental Health, pre menstrual syndrome is defined as "the cyclic occurrence of symptoms that are of sufficient severity to interfere with some aspect of life and which appear with consistent and predictable relationship to menses".[5] Woman with premenstrual syndrome experience physiological and psychological symptoms such as bloating, weight gain, breast tenderness, swelling, aches and pains, headache, nausea, dizziness, constipation, diarrhea, lack of concentration, sleep disturbances and change in eating pattern. When premenstrual symptoms make the daily life difficult, it is said as premenstrual syndrome. Most of these symptoms are present in luteal phase of cycle and cease around menstruation.[6] Premenstrual syndrome is very common and 10 million cases reporting per year in India. The prevalence of premenstrual syndrome has been reported in 20-32% of premenopausal and 30-40% of reproductive female population.[7] The variations in pulmonary functions during different phases of menstrual cycle follows a cyclical pattern which occurs due to the actions of various hormones. The influence of high levels of estrogen and progesterone in luteal phase bring out physiological changes in brain, in musculoskeletal system, in cardiovascular system and pulmonary function.[8] Human lungs have capability to adapt metabolic needs of body. The pulmonary functions may vary under different circumstances. Female gonadal hormones during the different phases of ovarian cycle has great role in changes in the pulmonary functions. The respiratory musculature strengthen by progesterone and estrogen levels and it also increase the relaxation of bronchial smooth muscles.[9] Ovulation is followed by the formation of a corpus luteum, which secrets progesterone. It may have some beneficial effect on the physical performance as well as on VO2 max.[10] The present study was aimed to observe effect of different phases of ovarian cycle on pulmonary functions in premenstrual syndrome.

## 2. Materials and Methods

The present study was conducted in department of Physiotherapy, Little Flower Hospital and department of Physiology, Little flower Institute of medical science and research centre, Angamaly, Kerala in between February 2018 – June2018 .The present study was approved by institutional ethical committee of Little Flower Hospital and Research Centre, Angamaly**.**

### Participants

A total of 10 females with premenstrual syndrome (cases) and 10 age matched, Non-PMS females (controls) were recruited in this study after obtaining written informed consent.

### Inclusion Criteria

- Healthy females with premenstrual syndrome having regular menstrual cycle within the age group of 20 to 24.
- Healthy females without premenstrual syndrome having regular menstrual cycle.
- Not suffering with any major complication or respiratory disease.
- Willing participants.

**Exclusion Criteria**

- Females having irregular menstrual cycle.
- Participants who are taking oral contraceptive or bronchodilators.
- Non willing participants.

## 3. Methods of Data Collection

1. Questionnaire: Premenstrual syndrome questionnaire was used to identify participants with premenstrual syndrome.[11,12,13]
2. Respiratory parameters: All the following parameters were observed at the two phases of ovarian cycle.

- **Spirometry**: It is most frequently used measure of lung function and is a measure of volume against time. It was performed using Pneumotrac (serial no: 07220). Parameters recorded includes MVV (L/M), FEV1/FVC (L), FEC.[14]
- **40mmHg test:** It was conducted by asking the subjects to take in a full breath and blow against the mercury column to the pressure of 40 mm, maintaining it as long as possible. The time for which the subject should maintain the mercury level at 40 mmHg will be noted. The lips should be secured tightly around the mouthpiece with the help of fingers to ensure that there is no leak.[14]
- **Maximum expiratory pressure (MEP):** The participants were asked to blow against a mercury column after taking in a full breath and to maintain the column at the maximum level for - 2 s.[15]
- **Breath holding time expiration (BHTexp):** It was determined by noting the maximum time (in seconds) for which the subject could hold his breath after breathing out fully.[14] The participants were instructed not to make any abdominal or chest movements during breathe holding.
- **Breathe holding time inspiration (BHT insp):** It was determined after the participant takes in a full breath. It was ensured that there was no hyperventilation prior to breathe holding. Participants were instructed not to make any abdominal or chest movements during breathe holding.[15]

**Statistical Analysis**

Descriptive statistics used to assess the baseline characteristics of the data. All quantitative variables were presented as mean and standard deviation. All qualitative variables were presented as percentages. Graphical presentations were used accordingly. Paired t test was used for within comparison of the PMS and Non-PMS group, also independent sample t test used for between comparisons of data. All data were entered in Microsoft excel and analysed using SPSS version 20.00.

## 4. Results

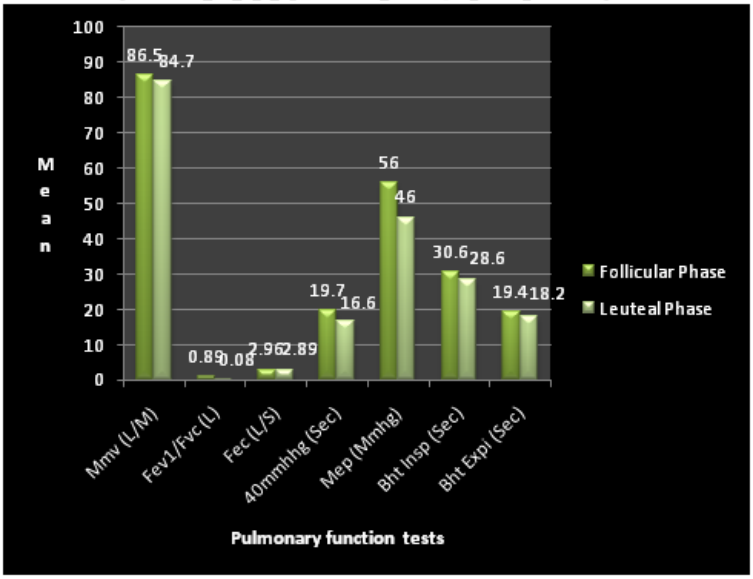
This comparative study was conducted on 20 females aged between 20-24 years. The population was equally divided in two, i.e. PMS and NON-PMS group. Anthropometric measurements (Height, Weight and BMI) were assessed as baseline characteristics of the data.

**Table 1:** Baseline characteristics of PMS and Non-PMS Group

| Variables | Mean±SD | |
|---|---|---|
| | *PMS | Non-PMS |
| Age (years) | 23.3±.82 | 22.5±.97 |
| Weight (kg) | 58.3±7.08 | 54.2±6.16 |
| Height (cm) | 160.6±4.24 | 157.1±4.09 |
| **BMI (kg/m$^2$) | 22.60±2.78 | 21.93±2.07 |

*Pre-Menstrual syndrome, **Body Mass Index

Table 1 shows the distribution of demographic variables of the PMS and Non-PMS group. Age varies from 20 to 24 years and the mean age was 23.3 with a standard deviation of .82. The mean weight was 58.03 with a standard deviation 7.08 and mean height was 160.6±4.24. BMI seems normal in our study population 22.60±2.78.




**Graph 1:** Distribution of pulmonary function tests in follicular phase and luteal phase in PMS group

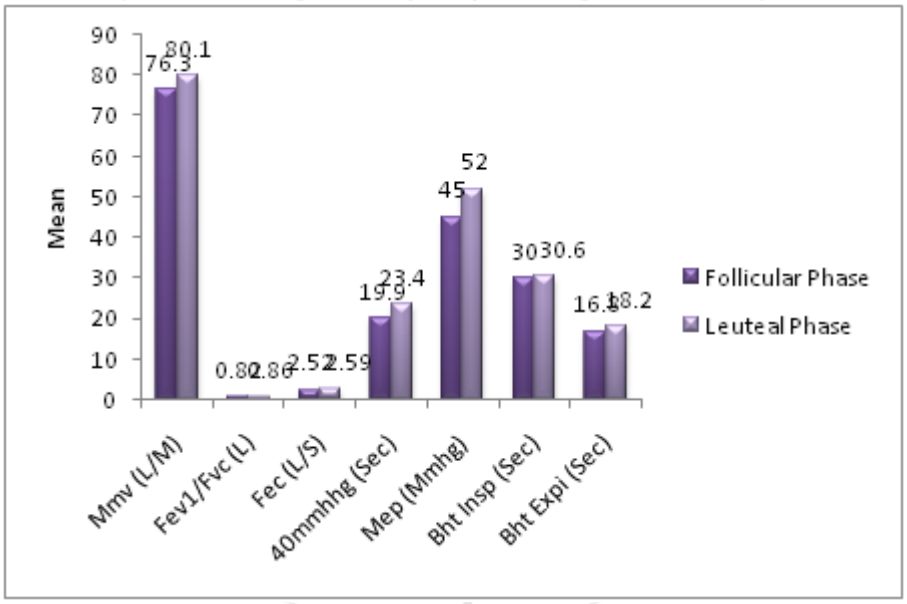
Multiple bar diagram (Graph 1) shows the distribution of pulmonary function tests in follicular and luteal phases of PMS group. The mean MMV score in follicular phase is 86.5 and luteal phase is 84.7. The mean scores of FEV1/FVC (c) where .89 and 0.08 respectively and the mean FEC (L/S) are 2.96 and 2.89. The mean 40mmhhg scores are 19.7 and 16.6 also the mean scores of MEP (mmhg) were 56 and 46, which shows more variation compared with other tests. Also the mean scores of BHT Insp (Sec) and BHT Expi (Sec) were 30.6& 28.6 and 19.4&18.2 respectively.

**Table 2:** Comparison of pulmonary function tests in follicular and luteal phases of PMS group

| Pulmonary function tests | Follicular Phase | | Luteal Phase | | *t-value | **P-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| **MMV(L/M)** | 86.5 | 9.50 | 84.7 | 9.8 | 2.71 | .024 |
| **FEC (L/S)** | 2.96 | .79 | 2.89 | .87 | 1.50 | .168 |
| **40mmhhg (Sec)** | 19.7 | 6.83 | 16.6 | 4.45 | 2.84 | .015 |
| **MEP (mmhg)** | 56 | 17.12 | 46 | 16.46 | 2.53 | .032 |
| **BHT Insp (Sec)** | 30.6 | 6.73 | 28.6 | 7.12 | 3.35 | .008 |
| **BHT Expi (Sec)** | 19.4 | 2.53 | 18.2 | 1.98 | 1.96 | .081 |

*Paired t test, **P<0.05 will considered as statistically significant

Table 2 shows the comparison of follicular and luteal phase in PMS group. The pulmonary function tests MMV (L/M), 40mmhhg (Sec), MEP (mmhg), BHT Insp (Sec) shows statistically significant difference in follicular and luteal phases (i.e. P=.024, P=.015, P=.032, P=.008) respectively. But the difference seen in FEC (L/S) and BHT Expi (Sec) tests were not statistically significant (i.e. P=.168 and P=.081). Thus we can say out of the 6 pulmonary function tests which conducted in follicular and luteal phases of PMS group, 4 tests shows significant difference from phase 1 to phase 2, whereas 2 tests were not differ significantly in both phases.




**Graph 2:** Distribution of pulmonary function tests in follicular phase and luteal phase in Non-PMS Group

Multiple bar diagram shows the distribution of pulmonary function tests in follicular and luteal phases of Non-PMS group. The mean MMV score in follicular phase is 76.3 and luteal phase is 80.1 which is less compared with PMS group. The mean scores of FEV1/FVC (L) where .82 and 0.86 respectively and the mean FEC(L/S) are 2.52 and 2.59, these tests are not much differ in both phases. The mean 40mmhhg scores are 19.9 and 23.4, also the mean scores of MEP (mmhg) were 45 and 52, which shows more variation compared with other tests. Also the mean scores of BHT Insp (Sec) and BHT Expi (Sec) were 30& 30.6 and 16.8 & 18.2 respectively.

**Table 3:** Comparison of pulmonary function tests in follicular and luteal phases of Non-PMS group

| Pulmonary function tests | Follicular Phase | | Luteal Phase | | t-value | P-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| **MMV (L/M)** | 76.3 | 11.16 | 80.1 | 10.42 | -5.33 | .000 |
| **FEC (L/S)** | 2.52 | .70 | 2.59 | 0.63 | 1 | .343 |
| **40mmhhg (Sec)** | 19.9 | 7.95 | 23.4 | 6.60 | -1.72 | .119 |
| **MEP (mmhg)** | 45 | 14.33 | 52 | 16.86 | -1.3 | .226 |
| **BHT Insp (Sec)** | 30 | 3.39 | 30.6 | 3.40 | -.53 | .604 |
| **BHT Expi (Sec)** | 16.8 | 2.85 | 18.2 | 3.04 | -2.68 | .025 |

*Paired t test, **P<0.05 will considered as statistically significant

Table 3 shows the comparison of follicular and luteal phase in Non-PMS group. The pulmonary function tests MMV (L/M), BHT Expi(Sec) shows statistically significant difference in follicular and luteal phases (i.e. P=.000 and P=.025). But the difference seen in FEC(L/S), 40mmhhg (Sec), MEP (Mmhg), and BHT Insp (Sec) tests were not statistically significant (i.e. P=.343, P=.119, P= .226 and P= .604) respectively. Thus we can say out of the 6 pulmonary function tests which conducted in follicular and luteal phases of Non-PMS group, 4 tests does not shows any significant difference from phase 1 to phase 2, whereas 2 tests were statistically significant differ in both phases.

**Table 4:** Group wise comparison of pulmonary function tests in follicular and luteal phases

| Pulmonary function tests | Mean Difference | Standard Error of Difference | T- Value | P Value |
|---|---|---|---|---|
| **MMV (L/M)** | 5.6 | .973 | 5.756 | .000 |
| **FEV1/FVC (L)** | .059 | .014 | 4.13 | .001 |
| **FEC (L/S)** | .146 | .098 | 1.48 | .155 |
| **40mmhhg (Sec)** | 6.6 | 2.3 | 2.86 | .013 |
| **MEP (Mmhg)** | 17 | 6.67 | 2.54 | .020 |
| **BHT Insp (Sec)** | 2.6 | 1.26 | 2.05 | .049 |
| **BHT Expi (Sec)** | 2.6 | .803 | 3.23 | .005 |

*Independent t test, **P<0.05 will considered as statistically significant

Table 4 shows the comparison of PMS and Non-PMS group. Here we have considered the difference in occurred in follicular phase to luteal phase on each pulmonary function tests. We have taken each tests and assessed the difference in follicular to luteal phase of each group and then compared this differences. Only FEC (L/S) shows that the difference occurred is not statistically significant (p=.15) All other tests shows that the difference seen in PMS and Non-PMS group were statistically significant i.e., MMV (L/M) (P=.000), FEV1/FVC (L) (P= .001),40mmhhg (Sec) (P= .013), MEP (Mmhg) (P= .020), BHT Insp (Sec) (P= .049), BHT Expi (Sec) (P= .005).

## 5. Discussion

The study was undertaken to assess the pulmonary functions in different phases of ovarian cycle in PMS and Non-PMS group and also the comparison of pulmonary functions among follicular and luteal phases in both groups. Majority of studies have evaluated the respiratory parameters in different phases of menstrual cycle in normal healthy girls.[16.17.18] A study done by Manish Goyal, effects of different phases of menstrual cycle on lung functions in young girls of 18-24 year age was reported that all lung volumes except FEV1/FVC% were low in menstrual phase and highest in secretory phase.[19]

In this study the respiratory parameters were evaluated during the follicular and luteal phases of ovarian cycle in PMS group and Non-PMS group with normal BMI. The study demonstrated better lung volumes during the luteal phase rather than in follicular phase in Non-PMS group. In PMS group the lung volumes were less in luteal phase compare to follicular phase.

Comparing follicular and luteal phase in PMS group lung volumes were less seen in luteal phase. The mean values were higher in follicular phase than luteal phase. The respiratory parameters such as MMV, 40mmhg, MEP, BHT inspiration shows statistically significant difference in follicular and luteal phase (P value<0.05). But in FEC, BHT expiration was not statistically significant.

In Non-PMS group the lung volumes were higher in luteal phase than in follicular phase. MMV, BHT Expiration shows statistically significant difference in follicular phase and luteal phase (P value<0.05). Here mean values were higher seen in luteal phase than follicular phase. But the difference seen in FEC, 40mmhg, MEP and BHT Inspiration were not statistically significant. A study conducted by Rajani Bala, Arvind and Jaman, effect of menstrual cycle on pulmonary function and respiratory efficiency had shown that FVC, FEV1, MMV, BHT expiration and inspiration were statistically significant during the luteal phase comparing with menstrual phase.[20]

While comparing both groups (PMS and Non-PMS) MMV, FEV1/FVC, 40mmhhg, MEP, BHT inspiration, BHT expiration were statistically significant except FEC.

The variations in pulmonary functions during the different phases of ovarian cycle are due to the action of various hormones. The reason behind is the influence of progesterone hormone. Progesterone induces hyperventilation during luteal phase. Periodical hyperventilation improves respiratory muscle strength and lung capacities. Progesterone also affects relaxation of bronchial smooth muscles. [21, 22]

## 6. Conclusion

It was seen that respiratory parameters show higher values during the luteal phase in women who do not have premenstrual syndromes. It may be due to the higher concentration and the bronchodilator effect of progesterone hormone during luteal phase. In PMS the respiratory parameters show significant difference during the follicular phase and luteal phase. The values of lung volumes were also decreased during the luteal phase. Our study concluded that there is possible changes present in pulmonary functions during different phases of ovarian cycle in women having severe premenstrual syndrome. Further studies are recommended to study the effect of ovarian hormones such as estrogen and progesterone in

respiratory parameters during ovarian cycle in PMS and Non-PMS with high sample size.

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