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# Effect of menstrual cycle phase on glucose kinetics in healthy women & women with premenstrual symptoms

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## Abstract

**Objective:** To compare the blood glucose levels during the two phases of the menstrual cycle between healthy women and patients with premenstrual syndrome (PMS).
**Methods:** From January of 2012 to the August of 2013, a descriptive cross-sectional study was performed among staff of tertiary care hospital.
**Inclusion Criteria:** 1)100 women aged 18 to 45 years, 2) Regular Menstrual cycle.
**Exclusion Criteria:** 1) Menopause 2) Patient on Oral Contraceptive pills.
After approval from IEC and informed consent from the 100 enrolled subjects with either the most severe symptoms of PMS or healthy controls. 2ml of venous blood was collected on fasting condition during the follicular phase (5-11 days of menstrual cycle)and the luteal phase of the cycle (19-28 days menstrual cycle) and analyzed the serum concentrations of glucose by using the glucose oxidase method.
**Results:** The statistical analysis was done using student's paired T test. P value less than 0.0001was taken as significant. No significant differences between the demographic data of the control and PMS groups were observed. The mean concentrations of glucose were significantly different during the follicular and luteal phases.
**Keywords**: Premenstrual cycle, Blood glucose, Follicular phase.

## 1. Introduction

Information on the factors that affect glycemia is pivotal in the treatment of diabetes, including insulin sensitivity in different physiological processes [1-4].

Premenstrual syndrome (PMS) is a set of psychological and physiological symptoms that can occur during the ten days prior to menses and vanish either shortly before or after the start of menstrual flow [1]. According to these previous findings and since evidence regarding this issue is inadequate; levels of glucose would be different in the follicular and luteal phases of the menstrual cycle in women with PMS compared to controls.

Glucose control seems to differ in the follicular and luteal phases, probably due to a hormonal effect or additionally to the presence of premenstrual symptoms or premenstrual syndrome [5].

Menstrual cycle is a physiological phenomenon during reproductive life of women. Its phases are influenced by alteration in the concentration of hormones such as estrogen and progesterone.[5] Therefore, certain physiological parameters, such as blood glucose is affected during menstrual cycle. In healthy non diabetic women, some investigators have reported a worsening in glucose tolerance, as assessed by the oral glucose tolerance test (OGTT), during the luteal phase (secretory phase).[6,7]

However, other studies that used the OGTT [5,8,9] or the intravenous glucose tolerance test[10] did not find significant changes in glucose tolerance or insulin concentration as a function of the menstrual cycle phase. Evaluation of insulin sensitivity by means of the euglycemic-hyperinsulinemic clamp technique has failed to detect alterations during the luteal phase (secretory phases) in nondiabetic women.[11,12]

### 1.2 Objective

To evaluate the blood glucose levels during the two phases of the menstrual cycle between healthy women and patients with premenstrual syndrome (PMS).

## 2. Materials & Methods

The present study is a descriptive cross-sectional survey that was carried out among staff in the medical college.

**2.1 Inclusion Criteria:** 1) Women aged 18 to 45 years, 2) Regular Menstrual cycle, 3) With or without PMS

**2.2 Exclusion Criteria:** Menopause, Those on Oral Contraceptive pills.

The Study protocol was approved by the Institutional Review Board (IRB) and written informed consent was obtained from the enrolled subjects.

All of the participants were investigated with a screening history and physical examinations. Screening included a face-to-face interview and standardized questionnaires including personal data and clinical measurements such as age, drug consumption during the past two months and medical or family history of PMS. The onset of menses was considered to be day 1, and the presence of menstrual bleeding was used to determine the follicular phase, so days 5to 11 after the onset of menses were considered to be the follicular phase and 19 to 28days as luteal phase.

Subjects were asked to remain fasted for at least 12 hours. Glucose measurements were performed using the glucose oxidase peroxidase method.

**2.3 Statistical analysis**

Results were reported as mean ± SD. The Student's *t*-test was used to compare between parametric data sets. A 2-sided *p*-value of 0.05 or less was considered statistically significant.

## 3. Results

All the subjects completed the study were aged 18 to 45 years. The mean age at menarche of the participants was 13.41±1.7 years (range: 11 to 16 years).37 patients had symptoms of PMS in the form of Affective Symptoms like Depression, angry outbursts, irritability, anxiety, confusion, social withdrawal or Somatic Symptoms like Breast tenderness, abdominal bloating, headache, swelling of extremities. About 22 of them had irritability, breast tenderness and headache.

**Table 1: Distribution of subjects enrolled**

| Total(A) | Healthy women | Women with PMS |
|---|---|---|
| 100 | 63 | 37 |

**Table 2: Pattern of Blood glucose levels**

| | (B)↑ BSL > 10mg/dl | (C)↑BSL < 10mg/dl | (D)↓BSL |
|---|---|---|---|
| Healthy women | 21 | 42 | |
| Women with PMS | 8 | 15 | 14 |

The mean concentrations of glucose are shown at days 6$^{th}$ to 10$^{th}$ day and 19$^{th}$ to 25thday of menses in the two study groups. The mean concentrations of glucose of the two study groups were significantly different during the follicular and luteal phases.

**Table 3: Mean blood glucose levels in different phases of menstrual cycle**

| | Follicular phase | | Luteal Phase | | p value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Total | 82.86 | 8.73 | 88.27 | 9.54 | 0.001 |
| Healthy controls | 85.06 | 7.69 | 88.14 | 9.55 | 0.04 |
| PMS | 89.86 | 9.56 | 81.78 | 9.48 | 0.0005 |
| Between groups level of significance | | | | | FP 0.01 LP 0.001 |

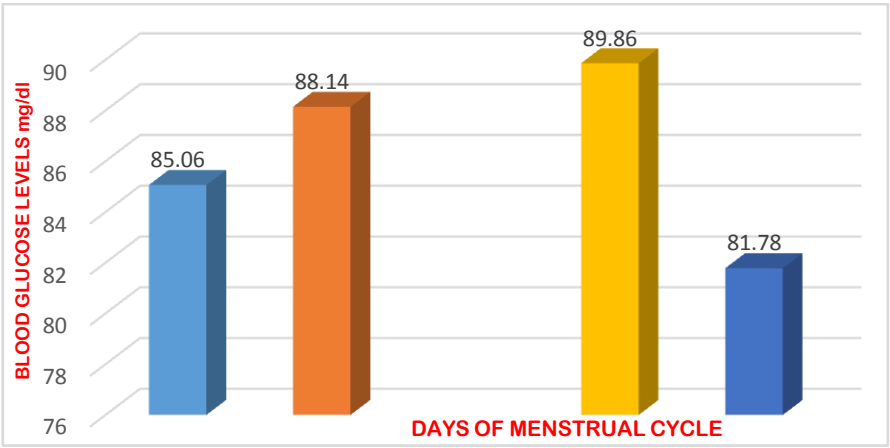


**Figure 1: Mean blood glucose levels in controls and PMS group in follicular and luteal phase**

## 4. Discussion

As fluctuations of steroidal hormones have been marked on certain days of the menstrual cycle, we have selected these times, specifically 6th to 13th and 19th to 26th days after the onset of menses. Based on the theory of which steroidal hormones affect glucose homeostasis, any derangement of steroidal hormone fluctuations would cause further stimulation of PMS symptoms on the specific days of the menstrual cycle mentioned above. According to the results obtained from the present study, the decreased level of blood glucose in the PMS group during the luteal compared to controls can exacerbate PMS symptoms. During the present study, we observed that glucose concentrations in the luteal phase were significantly higher than in the follicular phase in controls. Trout et al. [14] found significant differences in the blood glucose levels between the follicular and luteal phases in women with type 1 diabetes. In that study, they concluded that increased blood glucose levels during the luteal phase may be the result of elevated insulin-independent glucose disposal. The elevated glucose during the luteal phase in healthy women due to increased progesterone levels prevents the entry of glucose into the insulin-sensitive tissues, either in combination with estrogen or alone [15]. Some other studies performed in healthy women have documented that blood glucose did not change across different phases of the menstrual cycle [16,17]. On the other hand, others have theorized that the energy consumption during the luteal phase is due to fat instead of carbohydrate metabolism, resulting in the increased glucose levels in the luteal phase. This metabolism pattern is also attributed to the role of estradiol in relation to carbohydrate metabolism and loading in the luteal phase [18,19]. This suggests that the reduction in insulin sensitivity during the luteal phase depends on the increased level of progesterone
The blood glucose levels were significantly lower during the luteal phase in the PMS group compared to those of the controls. Liver function regulates the rate of glucose output. Therefore, because of liver dysfunction in women with PMS, the rate of glucose output is reduced.

Widom et al indicated that women who exhibited significantly higher estradiol levels in the luteal phase were observed to have significantly lower insulin resistance during this phase of the menstrual cycle. In contrast, women who did not show differences in estradiol levels between the follicular and luteal phases of the menstrual cycle exhibited no phase dependent-changes in insulin resistance.

The strength of the present study is that it is a comparative study, comparing the blood glucose level on the different days of the menstrual period between healthy women and those with PMS. The limitations: levels of insulin, estradiol and progesteron were not estimated.

## 5. Conclusion

The findings of the present study revealed the lower level of blood glucose in the PMS group during the luteal phase of the menstrual cycle compared to those of healthy women, hypoglycemia a stimulating factor of PMS symptoms.

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