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## Balance score assessment in menstrual phase vs late follicular phase of reproductive cycle.

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### Abstract:

**Background:** The Menstrual Cycle, a vital biological rhythm, after circadian rhythm can affect various functions of body systems and activity, secondary to the differential effects of sex steroid hormones. It has been suggested that musculoskeletal and neurological functions may get affected due to it during this biological rhythm. Thus, the overall aim of this study was to assess if balance score gets affected in Menstrual Phase Vs Late Follicular Phase of the reproductive cycle.

**Objectives:** To Compare the effect of Menstrual phase vs late follicular phase of reproductive cycle on balance.

**Methods:** 30 Normal females from a reputed institution were recruited for the study according to the inclusion criteria. The subjects' parameters for balance (GBS) were collected at two instances i.e., Menstrual Phase and Late Follicular Phase. Global Balance Score of subjects was noted using Phyaaction Balance Master, after having obtained informed consent and giving a trial session. Statistical analysis was performed using the statistical package SPSS.

**Results:** The effects of menstrual phases on balance, as measured via Global Balance Score, was assessed using paired t-test and level of significance was set at  $p < 0.05$ . P-value was found to be 0.59 which is non-significant i.e., there is no change in Global Balance Score in Menstrual Phase vs Late Follicular Phase of reproductive cycle.

**Conclusions:** The study had shown non-significant results of Global Balance score in Menstrual Phase vs Late Follicular Phase.

**Keywords:** Menstrual Cycle, Balance, Global Balance Score

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### Introduction:

The Menstrual Cycle is the second most important biological rhythm, next to the circadian one. [1] It is a series of physiological changes that occur in the ovaries and lining of the uterus beginning with the onset of menstrual flow on Day1. It consists of three phases: Menstrual Phase, Follicular Phase and Secretory/Luteal Phase. Menstrual Phase, lasting for a variable of 4 to 6 days in individuals, is defined as “shedding of the thickened endometrium, a process known as menstrual bleeding. The Follicular or Proliferative phase continues until ovulation, lasting for about 7 to 14 days and is the period when follicles are grown under the influence of hormones. The Luteal Phase begins at ovulation and continues until the onset of menstrual flow, typically day 15 through 28”. [2, 3]

Balance, as an “essential neuromuscular function in human daily life and sports activities, can be defined as central nervous system input from proprioceptive, vestibular, and visual afferent nerve signals, with analysis of signal integration” [4]. “It involves a combination of stability and postural orientation, being necessary for keeping a position in space, moving in a controlled and coordinated fashion, and conducting functional activities of daily living”.[5]

Henkin RI in 1974 reported changes in somatic sensory processes during the menstrual cycle suggesting that hormones which regulate the menstrual cycle, may influence sensory acuity during the phases of the menstrual cycle. Their study showed changes in taste, smell, hearing, light touch, and 2-point discrimination in the follicular

phase of the cycle and suggested that estrogen may enhance sensory acuity during the follicular phase while progesterone release in luteal phase may lessen acuity. [6]

It is therefore imperative to gain a better understanding of the effect of the menstrual cycle on balance. The aim of this study was to assess if balance score gets affected in Menstrual Phase Vs Late Follicular Phase of the reproductive cycle.

### Methods

2.1: Participants: Thirty normal and healthy females from a reputed institution/setup were recruited for the study according to the inclusion criteria. Females with a regular menstrual cycle from the last three months, of age between 18-25 years and a normal BMI of 19-25 kg/m<sup>2</sup>, with no smoking history as it can affect the outcome of the study were included with informed consent. [7-11]. Females with any history of gynecological/reproductive disease (e.g., PCOD), treatment or surgical procedures, or irregular menstrual cycle, taking any medications/drugs/painkiller intake or hormonal treatment during menstrual phase or otherwise, at least 3 months before study initiation were excluded from the study. [10,11]. Pregnant women and females with history of visual or vestibular system disorder, having any type of neurological /cognitive impairment/musculoskeletal disorders/injury that can affect the outcome of the study were also excluded. [11,12]

2.2: Procedure and design: After explaining the procedure of this study and taking informed consent, they were asked to complete a data collection form. Subjects were asked history (date) of their last

menstrual cycle and date of next expected menstrual cycle/reproductive cycle. The subjects' parameters for balance (GBS) were collected two times, in two different phases of menstrual cycle i.e., they were assessed at two instances i.e., Menstrual Phase: When the data was collected on Day1 or Day 2 of menstrual phase/cycle and Follicular Phase: When the data was collected between Day10 to Day 12 of Reproductive cycle. (i.e., 10th -12th day after day one of Menstrual cycle).

On Day 1-2 of the menstrual cycle, the Global Balance Score was taken. On the Phyaction software, the Exercise program was set up for standing position with bilateral feet, at 40 cm diameter, straight board heading with Line profile done at Level 5. After Trial of 30 seconds, balance was again evaluated for one minute, which was used for results. During the test, they were asked to try maintaining the natural standing center of gravity without moving while keeping eyes open and instructed to keep themselves balanced using the indicator in the center of the target on the screen [3] Global Balance Score was noted and its significance was explained to the subject i.e. the lower the Global Balance Score, the better the ability of the subjects to maintain the center of gravity. The same procedure was followed on Day 11-12 of the Follicular Phase of the same subject.

VARIABLE	Mean	Standard Deviation
Age (yrs.)	21.043	0.9760
BMI	21.352	2.6108

Table 1 Mean Age and BMI of subjects



Figure 1 – Subject performing Balance Score Assessment Test

### Statistical Analysis

The Statistical analysis was performed using the statistical package SPSS. Paired t-test and Shapiro-Wilk test were used for comparing the values of GBS between Menstrual phase and Late Follicular phase. Data were assessed by a Shapiro-Wilk test for normal distribution. The effects of menstrual phases on balance, as measured via Global Balance Score, was assessed using paired t-tests. Level of significance was set at  $p < 0.05$ .

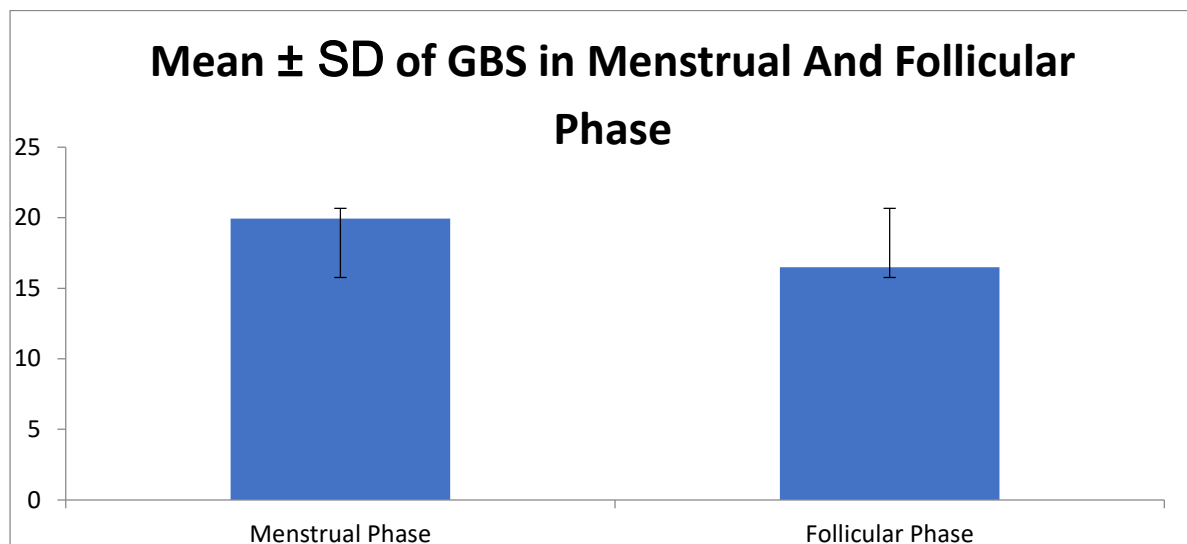
### Results

3.1: Demographic characteristics of the subjects are provided in table 1. Mean and standard deviation of the subjects were calculated for age and BMI parameter and the Mean age was found to be in the range 18-25 years.

3.2: As shown in table 2, p-value was found to be 0.59 which is non-significant. i.e., there is no change in Global Balance Score in Menstrual Phase vs late Follicular Phase of reproductive cycle.

VARIABLE	Mean	Standard Deviation	t-value	P-value
Menstrual Phase	19.943	9.0472	1.992	0.59
Follicular Phase	16.483	8.3002		

Table 2 Comparison between Menstrual Phase and Follicular Phase

Figure 2 Comparison of Mean  $\pm$  SD of Global Balance Score in Menstrual Phase vs Late Follicular Phase of reproductive cycle.

### Discussion

Twenty-three subjects were included in this cross-sectional observational study to observe whether there is any significant difference in balance score in Menstrual Phase vs Late Follicular Phase of reproductive cycle. Computerized Balance Trainer (Phyaction Balance) assessed this via a software in computer that records Global Balance Score connected to Balance Board. The main finding of our study has shown non-significant results between Global Balance score in Menstrual Phase vs Late Follicular Phase. The effect of hormonal fluctuations during the menstrual cycle on postural control is less explored and there is dearth of literature depicting their relation. The results of present study show that Balance Score does not get affected in Menstrual Phase or Late Follicular Phase. These corroborate with Hayley Erickson et al., who also found that hormone fluctuations during the menstrual cycle did not affect ankle stability or

posture. Dynamic postural control was assessed with the posteromedial reaching distance of the Star Excursion Balance Test. [13]

Christina Friden from Karolinska University, Sweden in 2004 studied "Neuromuscular performance and balance during the menstrual cycle and the influence of premenstrual symptoms". Subjects were studied during each phase within the menstrual cycle at three different instances by assessing their balance by an ankle disc placed on a Statometer and an AMTI Force Platform where visual feedback showed no significant difference in the two – legged stance. As seen in our study they too found no significant association between the variations in the hormones and parameters of postural control with respect to the phases of Menstrual Cycle. [14] A study by Bruce D. Beynon et al. obtained the same results in which they demonstrated greater lower limb joint laxity in women as compared to

men, but there was no relation to alterations in the hormonal status i.e., there was no relationship between estradiol and progesterone fluctuation, ankle, and knee joint laxity.<sup>[15]</sup>

Jerrold Petrofsky et al. in 2015 studied balance control during the menstrual cycle. There was no difference in sway during menstrual phase, but impaired balance was seen at the day of ovulation due to increase in plantar fascia elasticity associated with increased levels of estrogen. However, there was no change in balance control during menstrual phase and late follicular phase and hence, results agree with our study.<sup>[16]</sup>

Evidence suggest that fluctuating levels of estrogen may result in changes in knee stability as it can affect the biochemical milieu of ACL that may affect its structure and function and increase the risk for an individual.<sup>[17]</sup>

Elisabeth Livingstone et al studied the effect of menstrual cycle on musculotendinous stiffness and knee joint laxity. The results of their study proved no statistically significant effect of the menstrual cycle on knee stability.<sup>[18]</sup> Similarly Karageanes and Blackburn reiterating the same also demonstrated no statistically significant effect of the phases of Menstrual cycle on knee stability even following exercise.<sup>[19]</sup>

However, there are few studies whose results do not corroborate with our results. Study by Darlington proved “the effects of menstrual cycle on postural stability but not on optokinetic function”. It concluded that menstrual cycle significantly affects “Lateral sway but there was no significant effect on gaze-holding, optokinetic nystagmus slow phase velocity, amplitude, or frequency”.<sup>[20]</sup>

## Conclusions

Thus, looking at our results, one can presume that hormonal changes during different phases of the menstrual cycle do not cause significant alteration in balance scores thus accepting the null hypothesis.

## Conflict of Interest

The authors declare there is no conflict of interest about publication of this article.

## Author Contributions

All the authors have equally contributed for the study.

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