



The Influence of Menstrual and Ovulatory Phase on Static Balance: Unraveling the Effect on Stability

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ABSTRACT

Balance is the ability to maintain the body in equilibrium or during motion, and it plays a crucial role in daily activities from standing to walking while talking or changing directions. Women have lower stationary balance than men, which is affected by hormones, particularly during different phases of the menstrual cycle, as sex hormones have a considerable effect on muscles and the musculoskeletal system that controls balance. This study was conducted to identify the influence of the menstrual and ovulatory phases of the menstrual cycle on static balance. An observational study was conducted consisting of 63 females, age group of 18-25 years, having regular menstrual periods and normal BMI residing in Delhi, India, who were recruited based on inclusion and exclusion criteria. Data was obtained by performing a Single Leg Stance Test (SLS Test) for 30 seconds to determine static balance with eyes open and eyes closed, 3 trials each, in the menstrual and ovulatory phases. The average of the 3 trials of the SLS Test with eyes open and eyes closed for both phases were compared separately. The comparison was done through a paired t-test (p-value = 0.001). When the mean of all the average values were compared, we found that the majority of women had higher values of the SLS Test in the Ovulatory phase. The results show that there is a significant effect of the menstrual and ovulatory phases on static balance. Therefore, women are advised to keep an eye on the balance status during different phases of the menstrual cycle while performing ADLs to prevent falls and fall-related injuries.

Keywords: Balance, Ovulatory phase, Estrogen, Progesterone, Falls, Menstrual cycle

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INTRODUCTION

Maintaining balance stands as a pivotal aspect of daily life, encompassing a spectrum from static positions to intricate movements like walking and directional changes. It constitutes a complex interplay involving sensory systems, motor skills, and central nervous system processes, while postural alignment and weight distribution assume critical roles [1]. This equilibrium manifests through two distinct types: static balance, characterized by stability during stationary positions, and dynamic balance, necessitating steadiness amidst weight shifts or alterations in the base of support [2,3]. Women, owing to factors such as higher body fat, wider pelvic structure, and comparatively lower muscle strength, encounter challenges in sustaining balance, rendering them more vulnerable to malalignment syndromes and falls [4]. Notably, common activities at the time of falls for women were walking (44%) and sports (33%), while for men, sports (49%) and walking (37%) dominated [5]. The prevalence of falls escalates with age, escalating from 18% in adolescents to 35% in aged individuals, with higher rates among women than men [3]. Falls present a significant public health concern across age groups, with women exhibiting poor static balance compared to men, consequently increasing their susceptibility to falls and fall-related injuries [6]. Notably, instances of muscle and tendon injuries surge by 88% during the late follicular phase in comparison to the early phase, with occurrences of muscle ruptures, strains, cramps, and tendon injuries more than doubling during this phase. Moreover, 20% of injuries among athletes occur when they are in the late phase of their menstrual cycle [7]. The presence of estrogen and progesterone receptors in bone, skeletal muscle, ligaments, and the nervous system underscores the influence of sex hormones on the structure and function of these tissues [8]. Consequently, fluctuations in hormone levels impact the musculoskeletal system, thereby affecting balance control, especially during different menstrual cycle phases. Given the substantial impact of sex hormones on muscular physiology, their fluctuations bear significance in understanding the dynamics of the musculoskeletal system and, subsequently, balance control. Estradiol, reaching its nadir in

the follicular phase and peaking during ovulation, assumes relevance in our focus on the menstrual and ovulatory phases.

The correlation between menstrual cycle phases and static balance aims to raise awareness among women regarding their balance fluctuations during different menstrual phases, emphasizing the importance of balance training to mitigate falls during daily activities. This study aims to identify the influence of menstrual and ovulatory phases on static balance, aiming to offer a more comprehensive understanding beyond the nuances explored in previous studies. Ultimately, comprehending the impact of menstrual cycle phases on static balance advocates for heightened awareness among women, promoting tailored balance training as a preventive measure against falls during routine activities.

MATERIAL AND METHODS

This study adopted an observational research design employing purposive sampling techniques. Sixty-three females aged between 18-25 years (mean age 21.5), with regular menstrual cycles and normal BMI, were recruited from Delhi, India, based on specified inclusion and exclusion criteria. Before participation, written informed consent was obtained from all participants. Assessment of static balance involved the execution of the Single Leg Stance Test (SLS Test), conducted for 30 seconds under two conditions: with eyes open and eyes closed, with each condition undergoing three trial repetitions. Testing occurred within the 1st-3rd day of the menstrual cycle for the menstrual phase and between the 12th-14th day for the ovulatory phase. Ethical approval was secured from the Institutional Ethics Committee (IEC). During the Single Leg Stance test, subjects stood barefoot on their preferred limb, raising the alternate limb close to but not touching the ankle of the stance limb. Each subject fixed their gaze on a designated spot at eye level on the wall during the eyes open test, with arms crossed over the chest. Time measurement commenced as the subject raised the foot off the floor and concluded if the subject: (1) uncrossed her arms, (2) moved the raised foot, (3) adjusted weight distribution on the stance limb, (4) reached the maximum duration of 30 seconds, or (5) opened their eyes during eyes closed trials. Three trials were conducted for each condition, and data from each trial, as well as the best and average performances, were recorded. Subjects alternated between eyes open and eyes closed conditions across the three trials. Statistical analysis employed paired T-tests using SPSS Version 21.0 Software to interpret the results.

RESULTS

This study consisted of sixty-three young women aged between 18 to 25 years residing in Delhi. Table 1 presents the descriptive statistics indicating a mean age of 21.5 years, mean height of 1.6 meters, mean weight of 53.95 kilograms, and mean BMI of 21 kg/m² for the participants.

Table 1: Demographic Data

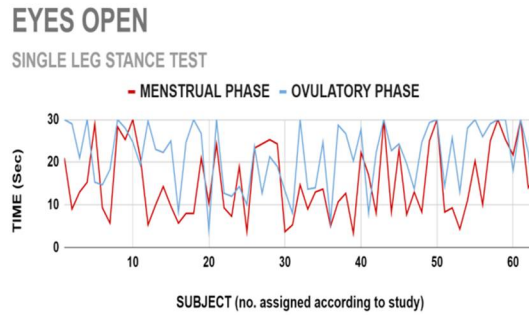
Variables	Mean	SD
AGE	21.5	2.13
Height (in m)	1.6	0.08
Weight (in Kg)	53.95	6.35
BMI (Kg/m ²)	21	2.01

Analysis of the average time duration for both eyes open trials revealed a mean of 15.4 seconds during the menstrual phase and 21.47 seconds during the ovulatory phase. Similarly, the average time for eyes closed trials exhibited a mean of 5.18 seconds during the menstrual phase and 7.79 seconds during the ovulatory phase. These recorded values fall below the standard Single Leg Stance (SLS) norms for women and notably varied across different phases of the menstrual cycle, as detailed in Table 2.

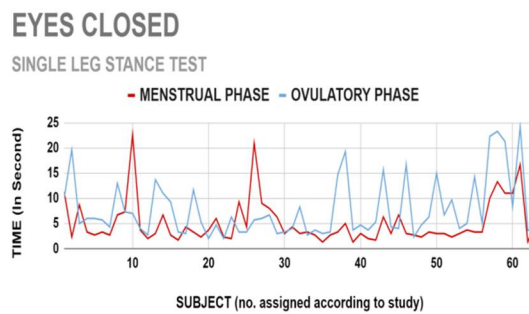
Table 2: Comparison of SLS Test Readings in Both the Phases with Normative Data

SLS	MP		OP		Normal Data	
	EO	EC	EO	EC	EO	EC
Mean	15.4	5.1	21.4	7.7	43.5	8.5
SD	8.3	4.4	7.6	5.8	3.8	9.1

The comparison was done through a paired t-test p-value = 0.001 i.e., <0.05, which indicates that there is a significant effect of menstrual and ovulatory phases on static balance in the phases of eye open and eye closed time as shown in graphs 1 & 2.



Graph 1: Comparison of Mean of 3 Trials in Single Leg Stance Test (Eyes Open).



Graph 2: Comparison of Mean of 3 Trials in Single Leg Stance Test (Eyes Closed).

DISCUSSION

The results of our study demonstrated that there is a significant effect of menstrual and ovulatory phases on static balance. The majority of participants had poor static balance and had a great difference in both phases. The majority of women were found to have higher static balance in the ovulatory phase. Therefore, women are advised to keep an eye on the balance status during different phases of the menstrual cycle while performing ADLs to prevent falls and fall-related injuries. In our investigation, a prevalent concern among participants regarding the comprehension of equilibrium principles within communal settings. However, pastoral women exhibited a pronounced dearth in understanding, attributable to limited education and mindfulness. Within the urban populace, a minority comprehended the broad applicability of balance, extending beyond mere locomotion to encompass all physical activities. Notably, the concept of static balance remained elusive to many. Our findings revealed a prevalent deficiency in static balance among most participants, markedly distinct across menstrual phases. Predominantly, women exhibited enhanced static balance during the ovulatory phase. While dynamic balance remained relatively stable throughout the menstrual cycle, notable fluctuations in static balance were evident, consistent with Hayashi *et al.*'s observations in 2004 [11]. Conversely, BJ Lee *et al.*'s 2017 study on 18 athletic females in Korea suggested an increment in velocity moment during elevated female hormone levels, implying an increased predisposition to balance impairment [12]. Correspondingly, Emami *et al.*'s 2019 study supported heightened static and dynamic balance scores during ovulation [13]. Females face a heightened risk of falls and associated injuries, constituting a significant public health concern across various age groups. Fall-related incidents occur more frequently among adult females compared to males [5]. Even among women engaging in regular general exercises, fluctuations in balance persisted, indicating the insufficient impact of general exercise on enhancing balance. Therefore, targeted balance training should supplement general exercise routines to ameliorate balance issues. Furthermore, recognizing the fluctuating balance dynamics during different menstrual phases is imperative for optimizing exercise performance. Mitigating daily risk factors is essential to curbing falls and injuries. Encouraging the integration of exercise into daily routines among women could substantially enhance balance and promote menstrual health awareness.

CONCLUSION

In conclusion, our study substantiates the profound influence of menstrual and ovulatory phases on static balance. Widespread deficiencies in static balance were evident across participants, particularly distinct

between menstrual phases, with notably heightened static balance during the ovulatory phase. Hence, advocating vigilant attention to balance status during various menstrual phases during Activities of Daily Living (ADLs) becomes pivotal to preventing falls and associated injuries among women.

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Ethical Permissions: This study was ethically approved by the Institutional Ethical Committee.

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