SHORT RESEARCH ARTICLE

# A Comparative Study on Dynamic Balance During Menstrual and Non-Menstrual Period Among Female University Students

**Yughdtheswari Muniandy[1*], Chin S Xuan[2], Sumedha Singh[3], Rajkumar Krishnan Vasanthi[4], Vignesh Srinivasan[5], Priyadharshini Kumar[6], Prathap Suganthirababu[7]**

[1]INTI International University, Malaysia; University Putra Malaysia, Malaysia
[2,4]INTI International University, Malaysia
[3]SB College of Physiotherapy, Bangalore, India
[5,6,7]College of Physiotherapy, Saveetha University, India

**DOI:** 10.55489/njcm.140720232963

## ABSTRACT

**Background:** The ability to maintain dynamic balance is crucial for carrying out daily tasks. The female body's balance may be impacted by a number of important factors, including the menstrual cycle. Due to changes in sex hormone levels during menstruation, postural control and muscular coordination may be affected. The aim of this study was to compare the dynamic balance among female university students during menstrual and non-menstrual period's students.

**Methodology:** A comparative study was conducted among female university students to compare the differences in dynamic balance between menstrual and non-menstrual periods. Using the purposive sampling method, a total of 45 university students were recruited. Data were gathered using a validated self-administered questionnaire, and the subjects' dynamic balance was assessed using the Y-balance test.

**Results:** The results indicate that the reach distance (anterior, posteromedial, posterolateral) for right and left stance shows an improvement during non-menstrual period when compared during menstruation ($p< 0.001$).

**Conclusions:** Regardless of the dominant or non-dominant leg, the dynamic balance of females is better during non-menstruation than it is during menstruation. While recommending exercises to females or while they engage in sports activities, these balance fluctuations in females must be taken into account to mitigate health risks.

**Keywords**: Health risk, Sex Hormones, Menstruation, Balance, Y- Balance Test

## ARTICLE INFO

**Financial Support:** None declared
**Conflict of Interest:** None declared
**Received**: 05-04-2023, **Accepted**: 07-06-2023, **Published**: 01-07-2023
***Correspondence:** Yughdtheswari Muniandy (Email: eshwari_physiorehab@yahoo.com)

**How to cite this article:** Muniandy Y, Xuan CS, Singh S, Vasanthi RK, Srinivasan V, Kumar P, Suganthirababu P. A Comparative Study on Dynamic Balance During Menstrual and Non-Menstrual Period Among Female University Students. Natl J Community Med 2023;14(7):452-456. DOI: 10.55489/njcm.140720232963


*www.njcmindia.com | pISSN09763325 | eISSN22296816 | Published by Medsci Publications*

## INTRODUCTION

Balance is maintained via sensory inputs (visual, vestibular, and somatosensory), central nervous system and an active motor response.[1,2] Dynamic balance (DB), or a person's capacity to regulate the displacement of their centre of mass, is necessary for carrying out functional tasks successfully.[1, 3, 4] One of the intrinsic factors that may affect the DB in females is the fluctuation in the levels of gonadal hormones pertaining to different phases of the menstrual cycle (MC).[5-7]

The average MC length is approximately 28 days and is divided into follicular and luteal phase. There is absence of both estrogen and progesterone at the beginning of the MC. During days 7–14, the estrogen levels rise to a peak and then falls within 1-2 days before the ovulation. During the luteal phase, levels of estrogen remain higher than that at the start of the MC but relatively stable. Progesterone levels rise to a peak following ovulation and throughout the luteal phase.[4] Previous studies have shown that sex hormone receptors are present in tendons, ligaments and skeletal muscles which may alter the myofascial force transmission and neuromuscular control during various phases of the MC.[8,9] With the increase in female participation in sports and exercise, the understanding of the relationship between DB ability and sex hormones fluctuation is necessitated for its potential role in formulating injury prevention protocols.[3]

A previous study showed that both static and dynamic balance improved in ovulation phase as compared to the follicular phase ($p$ <0.001). However, this study did not assess the effects of hormonal fluctuations in dominant and non- dominant leg. To the best of our knowledge, current study is the first to assess the effects of hormonal fluctuations during MC on DB for dominant and non- dominant leg. The currents study uses a simple clinical test, which is easily available in clinical setups, to determine the DB.[4] The objective of this study was to determine whether the dynamic balance would differ during menstrual period (MP) compared to non- menstrual period (NMP) among female university students.

## METHODOLOGY

**Participants:** The present single group comparative study was undertaken among the female university students to compare the DB during MP and NMP. The study was conducted at a private university in Malaysia. The subjects were recruited through purposive sampling method. Healthy female university students between the age group of 18-40 years and having regular MC were included for this study. Meanwhile, those who had any musculoskeletal injuries of lower limb, vestibular disorder, irregular MC or using oral contraceptive were excluded from this study. G power 3.0.1. (Heinrich Heine University Dusseldorf, Dusseldorf, Germany) was used to estimate the sample size for this study. A sample size of 41 participants was estimated using an effect size of 0.58, level of significance of 0.05, and power of 0.95.[10] An additional 4 participants were recruited to provide for an unanticipated attrition. The subjects were explained regarding the purpose of the study and an informed written consent were obtained. This study was approved by the Research and Ethics Committee of the University (INTI-IU/FHLS-RC/BPHTI/7NY12020/014).

**Procedure:** A self-administered questionnaire in English was given to each subject to collect information regarding the demographic data and MC history. The menstrual period was determined as days 1–3 (early follicular phase) since the start of menstruation, whereas the non-menstrual period was determined as days 12–13 (ovulation stage) since start of menstruation. The Y-balance test (YBT) procedure was then demonstrated to the participants, who then completed 6 practice trials to reduce the impact of a learning effect. During their MP, the same subject was given instructions to repeat the test. *Y-balance test (YBT)* the YBT is a modification of the Star Excursion Balance Test which is used to test the DB of an individual.[4, 11] The intra-tester and intertester reliability of YBT is shown to be excellent.[1] A Y shape was placed on the floor with subjects standing at the midpoint of the Y shape. Subjects begin the test by maintaining a single leg stance with their dominant leg at the mid-point of the "Y" shape with hands on the waist. Subjects then reached as far as they could in 3 directions (anterior, posterior medial, and posterior-lateral) with the other leg.[11]

**Table 1: Demographic characteristics of female university students (n=45)**

| Variables | Students (%) |
|---|---|
| **Age (years)** | |
| 18 to 20 | 4 (8.9) |
| 21 to 23 | 35 (77.8) |
| 24 to 26 | 6 (13.3) |
| Above 27 | 0 (0) |
| Mean age ± SD | 22.18 ± 1.37 |
| **Body Mass Index (BMI)** | |
| <18.5kg/m$^2$ (Underweight) | 6 (13.3) |
| 18.5 to 24.9 kg/m$^2$ (Normal) | 32 (71.1) |
| 25.0 to 29.9 kg/m$^2$ (Over-weight) | 6 (13.4) |
| 30.0 to 39.9 kg/m$^2$ (Obese) | 1 (2.2) |
| Mean BMI ± SD | 21.76 ±3.59 |
| **Dominant leg** | |
| Right | 42 (93.3) |
| Left | 3 (6.7) |
| **Ethnicity** | |
| Chinese | 34 (75.5) |
| Indian | 4 (8.9) |
| Malay | 3 (6.7) |
| Others | 4 (8.8) |
| **Activity level** | |
| Active | 17 (37.8) |
| Sedentary | 28 (62.2) |

The test was deemed unsuccessful, and the subjects had to retake it if they couldn't maintain their hands at their waists, moved their stance leg, or didn't bring their free leg to the starting position[4]. The same procedure was repeated on non- dominant leg.

**Statistical Analysis:** The paired sample t-test was used to analyse the comparison of the reach distance during MP and NMP. The data were analysed using Statistical Package for the Social Sciences (SPSS; version 26). The level of significance was set as $p < 0.05$.

## RESULTS

A total of 45 subjects were recruited for this study. The demographic characteristics (age, BMI, ethnicity, dominant leg and activity level) of these participants are shown in Table 1. Meanwhile table 2, compute the difference between MP and NMP, indicates there is statistically significant difference in Y-Balance test in all the direction for both dominant and non-dominant leg.

**Table 2: Comparison of Y- Balance test scores during menstrual and non-menstrual period among female university students**

| Test Components | Y- Balance test scores (Mean ± SD) | | *P value (t test)* |
|---|---|---|---|
| | Menstrual Period | Non – menstrual Period | |
| **Anterior reach** | | | |
| Right stance | 62.61 ± 8.98 | 67.10 ± 8.57 | < 0.001* |
| Left stance | 62.08 ± 8.85 | 66.82 ± 9.13 | |
| **Posteromedial reach** | | | |
| Right stance | 71.33 ± 9.70 | 75.66 ± 9.82 | < 0.001* |
| Left stance | 68.72 ± 9.17 | 73.01 ± 9.28 | |
| **Posterolateral reach** | | | |
| Right stance | 60.84 ± 9.83 | 64.65 ± 9.73 | < 0.001* |
| Left stance | 59.83 ± 8.69 | 64.02 ± 9.09 | |

Statistically significant *p-value*< 0.05*

## DISCUSSION

The findings of the present study revealed that the dynamic balance assessed via YBT for right and left stance showed an improvement during NMP in comparison to MP. Our study finding is in agreements with previous studies.[1,4,12] The improvement in dynamic balance scores can be attributed by changes in central nervous system function which occurs due to fluctuations in the level of sex hormones during menstrual cycle. [13, 14] Estrogen and progesterone can alter postural control by acting on central nervous system as they bind to their related neurotransmitters which results in altered interaction.[4,14] Previous study has reported that females with long term estrogen users have better postural control. This could be explained further by the preservative effect of estrogen on connective tissue function and muscle strength.[15] Skeletal muscle is more prone to atrophy, decreased strength, and function in estrogen-deficient conditions.[4,16] Additionally, a study conducted by Calleja-Aguis and Brincat, suggested that estrogen levels have a significant impact on the function and turnover of connective tissue.[17]

In the contrary, the results in the study Ericksen et al., showed that hormonal fluctuations do not influence the dynamic postural. The difference could be attributed to the various assessment periods. However, it should be noted that assessment in the study by Ericksen et al., was conducted five days prior to (pre-ovulatory) and five days following (post-ovulatory) the ovulation.[18] Meanwhile, the assessment in our present study performed on days 1-3 (early follicular phase) and days 12–13 (ovulation stage) following the onset of menstruation.

Previous studies on investigating the relationship between postural control and changes in oestrogen levels have produced conflicting findings. Individual with low oestrogen levels were reported to have high incidence of falls and balance issues,[3,15] similarly joint laxity brought on by estrogen-induced changes in collagen synthesis was also linked to more injury occurrences.[19] These seemingly opposing results can be explained by the fact that although estrogen has beneficial effects on bone and muscle by improving muscle proteostasis and enhancing sinew collagen content; it does come at a cost of increased connective tissue laxity.[4,20-22] The contradicting results in literature regarding role of estrogen in balance, joint laxity and injury formation can be further attributed to hormonal interrelationship rather than effect of estrogen in singularity.[3, 23]

Body mass index is another element that might have an impact on a person's ability to maintain balance (BMI). Individuals with obesity tend to have a poorer balance than those with normal BMI. According to earlier studies, when a person's BMI is high, an increase in centre of pressure will decrease the average peak stability time and increase the average distance between stable positions, both of which will lower the person's ability to balance.[24] According to research, women with a BMI of more than 27 $kg/m^2$ are more likely to experience irregular periods than women with a BMI of 18.5 $kg/m^2$ to 23.9 $kg/m^2$. This is because they have lower levels of the sex hormone-binding protein and higher levels of testosterone, the free androgen index, and insulin.[25]

Additionally, a person's age may also contribute to a decline in balance performance. In earlier studies,

the likelihood of falls in young adults and older adults was compared. Typically, the study's findings would indicate that older adults have a higher risk of falling than younger adults. With aging, people tend to lose the ability to control the centre of mass, which causes increase in postural sway and dynamic balance to become poorer.[26] Additionally, a person over the age of 40 may be more susceptible to a decline in visual-vestibular function, that could impair balance.[27]

The current study's findings inform women about the significance of maintaining good balance while they are menstruating and the need for safety measures like wearing appropriate footwear while exercising or participating in sports. The results are intended to educate healthcare professionals about the significance of including balance exercises in training females, especially during menstruation.

## Recommendations

Future research should, however, take into account incorporating serum tracking and profiling to determine the exact timing of ovulation and to measure each phase of the menstrual cycle in order to identify the exact phase in which the balance is impacted.

## Conclusion

In conclusion, the DB of the females during NMP is better than during MP regardless of dominant or non-dominant leg. These balance fluctuations in females must be considered while prescribing exercises to them or while they participate in sports activities. The results of this study may also lead clinicians and researchers to focus on specific interventions such as neuromuscular and balance training which could improve the balance of females and prevent injuries.

## Acknowledgement

We are grateful to our study participants for their wholehearted participation.

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