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Evaluation of Balance During Different Menstrual Cycles in Non-Athletic Young Females

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Abstract

Background: Hormonal fluctuations during menstruation may affect muscles, ligaments, and joint functions. Therefore, this study aimed to determine how different menstrual cycle phases affected young females' balance.

Aim of Study: This study aimed to investigate and compare the balance between athletic and non-athletic young females during the ovulatory and mid-luteal phases.

Patients and Methods: This cross-sectional study was conducted on 25 non-athletic females with regular menstrual cycles. They were aged 18 to 25 years, with body mass index (BMI) ranging from 25 to 29.9kg/m^2, and free of any medical disorders.

Results: Non-athletic females showed a significant decrease (p<0.02) in the overall stability between the ovulation and mid-luteal phases.

Conclusions: Non-athletic females exhibit less balance during the ovulation phase than in the mid-luteal phase. The menstrual phases should be taken into consideration in designing the exercises.

Key Words: *Menstrual cycle – Balance – Non-athletics.*

Introduction

PERFORMING a task while keeping a stable position is a dynamic definition of postural control or balance. Maintaining the proper interaction between the environment, the task, and the body segment is the goal of postural orientation **[1].** Many factors can impact equilibrium. Menstruation is a significant factor that may impact one's ability to maintain proper posture **[2].**

Hormonal fluctuations during the menstrual cycle affect the levels of sex hormones, particularly estrogen, which influence the mechanical characteristics of soft tissues like muscles, tendons, and ligaments because human connective tissues contain the 17-β estradiol receptor **[3].** Because both progesterone and estrogen can cross the blood-brain barrier, their cyclical fluctuations can have an impact on central nervous system function **[4]**, which may have an impact on balance **[1].**

To prevent injuries, it is important to understand the relationship between a woman's ability to maintain balance and her hormonal changes **[5].** A fundamental component of the understanding of women's higher risk of musculoskeletal injuries appears to be disruption in postural control and neuromuscular function **[6].** Therefore, this study aimed to evaluate balance during the ovulation and mid-luteal phases in non-athletic females. This study hypothesized that there would be changes in the balance control between different menstrual cycle phases.

Patients and Methods

A cross-sectional repeated measures study was conducted at Ahram Candian University during 2022, on 25 healthy nulliparous females between the ages of 18 and 25 years old. They had regular menstrual cycles and a BMI between 25 and 29.9 kg/m^2. They did not participate in any physical activities. Exclusion criteria included menstrual irregularities, use of hormonal supplements or injections in the past 6 months, history of medical disorders, recent lower extremity fractures or sprains, previous knee/ankle injuries, neurological deficits, musculoskeletal or congenital disorders, polycystic ovary syndrome, vestibular dysfunction, otitis media, labyrinthitis, or other issues affecting balance. All females signed a written informed consent.

Procedures:

The menstrual phases detection:

To detect the ovulation phase, an strip was used. It is a valid and reliable test. Urine was collected in a sterile container, and each female dipped the strap

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in it. She performed this test again three to five days before the anticipated day of ovulation. A luteinizing hormone (LH) surge was indicated by a change in the color of the strip. Ovulation took place within 24 to 36 hours of the surge, according to an increased LH surge **[7].**

Balance assessment:

Each female had her balance measured during the ovulation and the mid-luteal phase using a Biodex balance system (Biomedical Balance System Inc., USA). It is a valid and reliable instrument for training and screening balance. It is interfaced with computer software and features a dynamic multiaxial platform that permits an inclination of about 20 degrees over a 360-degree range. One to eight was the range of stability levels. A microprocessor-based actuator in the system regulates the level of surface instability.

With stability level 8, the examiner put the platform in an unstable state and instructed each female to keep her eyes on the visual feedback screen and keep the cursor in the center of the circle without holding on to the support handle rails or her arms by her sides. She conducted the test three times with a three-minute break between each test trial. The three readings were then averaged and recorded.

Statistical analysis:

Statistical Package for Social Sciences (SPSS) computer program (version 19 Windows) was used for data analysis. The Kolmogorov-Smirnov test assessed the distribution of data measured. Accordingly, a paired *t*-test was used to compare the ovulation and mid-luteal phases. *p*-value ≤0.05 was considered significant.

Results

The females' mean age, weight, height, and BMI were 22±1.09 years, 75.3±6.8 kg, 163.3±4.2 cm, and 28.1±1.4 kg/m2, respectively. The mean value of the overall stability index was 0.486±0.16 in the ovulation phase, and it was 0.400±0.09 in the mid-luteal phase. The paired *t*-test showed a significant decrease ($p<0.02$) in the overall stability index (Fig. 1).

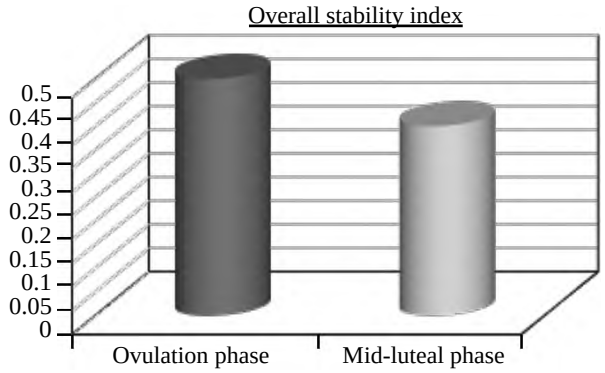

Fig. (1): Mean values of the overall stability index in the ovulation and mid-luteal phases in the non-athletic females.

Discussion

One of the variables linked to injuries during exercise was balance ability. Many systems, including the sensory, motor, and central nervous systems, influence balance. Bone, skeletal muscle, ligaments, and the nervous system contain sex hormone receptors. Thus, this study investigated how female young adults' static balancing ability was affected by their menstrual cycle. Females showed a significant decrease in the overall stability between the ovulation and mid-luteal phases.

The findings agreed with Lee **[5]**, who investigated the effects of the menstrual cycle on the static balance of 18 young women using the Good balance system. They reported no significant difference in the overall stability index between the ovulation and mid-luteal phases. Also, the results were supported by Sung and Kim **[1]**, who examined the dynamic balance during the menstrual, ovulation, and luteal phases using the Biodex balance system in young females. They found that the total, forward-left, forward-right, backward-left, and backward-right stability balance indexes were significantly higher in the ovulation phase than in the mid-luteal phase. In addition, Emami **[2]** investigated the static and dynamic balance using a single-leg stance test and Y-balance test, respectively, in non-athletic healthy women. They found that the mediolateral sway and overall sway indexes were significantly higher during the ovulation phase than in the mid-luteal phase.

The findings of a previous study demonstrated that high levels of female sex hormones led to a significant increase in the velocity moment. This implies that less balance results from increased levels of female sex hormones **[8],** which agrees with this study. Also, it has been reported that the menstrual cycles impact a variety of exercise performance-related parameters **[9].**

Also, McNulty **[10]** reported that exercise performance may be negligibly decreased during the early follicular phase of the menstrual cycle. The hormonal fluctuations may affect strength, metabolism, inflammation, body temperature, fluid balance, and injury risk, which may impact a female's performance **[11].**

During the menstrual cycle, changes in body composition, substrate metabolism, muscle activation, and thermoregulation have all been suggested as reasons why physical performance may change. The altered force production that could impact muscle strength and power could be attributed to concentrations of female sex hormones. Because of its neuroexcitatory action on the brain and its inhibitory effect on cortical excitability, progesterone and estrogen have opposing effects on force production, exhibiting a positive and negative correlation, respectively **[12].**

In addition, Tornberg **[13]** have demonstrated that these hormones affect different physiological and psychological aspects. So, there is no doubt that these effects can affect women's performance. To further support the findings, more investigation is required to investigate other factors that affect balance, such as hip and ankle strategy. Also, there is a need for more studies conducted on large sample sizes in all phases of the menstrual cycle.

Conclusions:

Non-athletic females showed less balance during the ovulation phase than in the mid-luteal phase. This finding should be taken into consideration duringthe design of the exercises for sedentary females.

References

1- SUNG E.S. and KIM J.H.: The difference effect of estrogen on muscle tone of medial and lateral thigh muscle during ovulation. J. Exerc Rehabil, 14: 419-23, 2018.

2- EMAMI F., KORDI YOOSEFINEJAD A. and MOTEALLEH A.: Comparison of static and dynamic balance during early follicular and ovulation phases in healthy women, using simple, clinical tests: A cross sectional study. Gynecol. Endocrinol., 35: 257-60, 2019.

3- HAM S., KIM S., CHOI H., LEE Y. and LEE H.: Greater Muscle Stiffness during Contraction at Menstruation as Measured by Shear-Wave Elastography. Tohoku J. Exp. Med, 250: 207-13, 2020.

4- ANSDELL P., BROWNSTEIN C.G., ŠKARABOT J., HICKS K.M., SIMOES D.C., THOMAS K., et al.: Menstrual cycle-associated modulations in neuromuscular function and fatigability of the knee extensors in eumenorrheic women. Journal of Applied Physiology, 126: 1701-12, 2019.

5- LEE B.J., CHO K.H. and LEE W.H.: The effects of the menstrual cycle on the static balance in healthy young women. J. Phys. Ther. Sci., 29: 1964-6, 2017.

6- EKENROS L.: The influence of sex hormones on neuromuscular function and premenstrual symptoms. Karolinska Institutet (Sweden), 2017.

7- DEMIR A., HERO M., ALFTHAN H., PASSIONI A., TAPANAINEN J.S. and STENMAN U.H.: Identification of the LH surge by measuring intact and total immunoreactivity in urine for prediction of ovulation time. Hormones (Athens), 21 (3): 413-20, 2022.

8- MICUSSI M.T., FREITAS R.P., ANGELO P.H., SOARES E.M., LEMOS T.M. and MARANHÃO T.M.: Is there a difference in the electromyographic activity of the pelvic floor muscles across the phases of the menstrual cycle? J. Phys. Ther. Sci., 27: 2233-7, 2015.

9- MEIGNIÉ A., DUCLOS M., CARLING C., ORHANT E., PROVOST P., TOUSSAINT J.-F., et al.: The effects of menstrual cycle phase on elite athlete performance: A critical and systematic review. Frontiers in Physiology, 12, 654585, 2021.

10- MCNULTY K.L., ELLIOTT-SALE K.J., DOLAN E., SWINTON P.A., ANSDELL P., GOODALL S., et al.: The Effects of Menstrual Cycle Phase on Exercise Performance in Eumenorrheic Women: A Systematic Review and Meta-Analysis. Sports Med., 50: 1813-27, 2020.

11- BRUINVELS G., BURDEN R., BROWN N., RICHARDS T. and PEDLAR C.: The prevalence and impact of heavy menstrual bleeding (menorrhagia) in elite and non-elite athletes. PLoS One, 11: e0149881, 2016.

12 -PALLAVI L.C., UJ D.S. and SHIVAPRAKASH G.: Assessment of Musculoskeletal Strength and Levels of Fatigue during Different Phases of Menstrual Cycle in Young Adults. J. Clin. Diagn. Res., 11: Cc11-cc3, 2017.

13- TORNBERG Å.B., MELIN A., KOIVULA F.M., JOHANSSON A., SKOUBY S., FABER J., et al.: Reduced Neuromuscular Performance in Amenorrheic Elite Endurance Athletes. Med. Sci. Sports Exerc, 49: 2478-85, 2017.

تقييم التوازن خلال مراحل الدورة الشهرية لدى الشابات غير الرياضيات

الخلفية: بحثت العديد من الدراسات فى كيفية تأثير الدورة الشهرية على الجهاز العضلى الهيكلى والجهاز العصبى العضلى. وقد تؤثر التقلبات الهرمونية أثناء فترة الحيض على العضلات والأربطة ووظائف المفاصل. ومع ذلك، لم تقدم أى دراسات معلومات حول الفرق فى تأثير مراحل الدورة الشهرية على التوازن فى الفتيات غير الرياضيات. ولذلك، هدفت هذه الدراسة إلى تحديد مدى تأثير مراحل الدورة الشهرية المختلفة على توازن الشابات ومقارنة التوازن أثناء التبويض ومرحلة منتصف الجسم الأصفر لتطوير استراتيجيات فعالة فى التدريب وفقًا لاحتياجات الإناث الغير رياضيات .

هدف الدراسة: هدفت هذه الدراسة إلى مقارنة التوازن بين الشابات غير الرياضيات خلال مرحلتى التبويض ومرحلة الجسم الاصفر.

الطرق: شاركت فى هذه الدراسة خمسة وعشرون فتاة ليست رياضية. تم تقييم التوازن باستخدام نظام التوازن (بايودكس) ، ومقارنة الاتزان بين مرحلة التبويض ومرحلة منتصف الجسم الأصفر من الدورة الشهرية.

النتائج: أظهرت الفتيات غير الرياضيات فرقًا كبيرًا فى مؤشر الاستقرار الكلى (p=٠,٠٢) بين مرحلة التبويض ومرحلة الجسم الاصفر.

الاستنتاج: تؤثر مراحل الدورة الشهرية على التحكم في التوازن عند الفتيات غير الرياضيات بشكل سلبى، مما يشير إلى أن الفتيات غير الرياضيات أكثر حساسية للتقلبات الهرمونية. لذلك، يجب أن يكون تدريب التوازن جزءًا من برامج التمارين الرياضية للإناث غير الرياضيات لتقليل خطر الإصابة أثناء الدورة الشهرية عندما تكون مستويات الهرمونات الأنثوية.