



Original Article

The effects of the menstrual cycle on the static balance in healthy young women

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Abstract. [Purpose] The purpose of this study was to investigate the effects of the menstrual cycle on the static balance of healthy young women. [Subjects and Methods] Eighteen healthy young subjects (mean age 19.1 years; weight 57.5 kg; height 159.9 cm) participated in this study. The Good Balance system was used to measure the postural sway speed and velocity moment of subjects in the static standing posture. Subjects were measured for static balance between 1 and 3 days after menstruation and 13 days after menstruation. [Results] The velocity moment of postural sway was significantly higher at 13 days after menstruation. [Conclusion] Our results indicate that the menstrual cycle affects the static balance of healthy subjects. During the menstrual cycle, intensity for balance exercises in females should be carefully controlled for injury prevention.

Key words: Menstrual cycle, Static balance, Postural sway

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INTRODUCTION

The percentage of people participating in exercises for the prevention and treatment of various adult diseases is increasing. In Korea, the proportion of persons participating in sports activities more than once a week increased from 45.5% in 2013 to 59.9% in 2016. However, the rate of injury increases as physical activity increases. Sports injuries are more common in women than in men¹⁾. Women have more body fat, greater flexibility, wider pelvis, lighter bone, and less muscle strength, and are more prone to the miserable malalignment syndrome than men²⁾. In particular, female athletes are known to be exposed to more sports injury due to insufficient energy utilization, bone loss, and menstrual disturbances³⁾.

The menstrual cycle is governed by hormonal changes. Each cycle can be divided into three phases based on events in the ovary (ovarian cycle) or in the uterus (uterine cycle). The ovarian cycle consists of the follicular phase, ovulation, and luteal phase. Estradiol reaches its lowest in the follicular phase and reaches its peak in the ovulation phase⁴⁾

Balance ability has been reported to be one of the factors associated with sports injuries⁵⁾. Balance is affected by various systems such as the sensory, motor, and central nervous systems. Sex hormone receptors are found in bone, skeletal muscle, ligaments, and the nervous system⁶⁾. Relationship between balance ability and hormonal changes in female is important in terms of injury prevention. However, no prior study investigated the relationship up to today. Therefore, this study investigated the effect of the menstrual cycle on the static balance ability of female young adults.

SUBJECTS AND METHODS

Eighteen healthy women participated in the study. The subjects did not have musculoskeletal or neurological diseases that

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Table 1. Comparison of the changes between the beginning of the menstruation and ovulation phases (n=18)

	Beginning of menstruation	Ovulation
Medio-lateral speed (mm/s)	3.18 ± 0.87	4.18 ± 1.84*
Anteroposterior speed (mm/s)	5.16 ± 1.00	5.77 ± 1.50*
Velocity moment (mm ² /s)	9.89 ± 6.79	14.01 ± 10.93**

Values are presented as mean ± standard deviation.

* p<0.05, **p<0.01

could affect balance, and did not take medications that could affect the sex hormones.

The mean age, height, and weight of the subjects were 19.11 ± 0.9 years, 159.93 ± 5.20 cm, and 57.50 ± 6.62 kg, respectively. Information regarding the study was provided to all of the subjects prior to their participation and written informed consent was obtained. The study was conducted according to the ethical standards of the Declaration of Helsinki.

The Good Balance System (Metitur Ltd., Jyväskylä, Finland) was used for measurement of postural sway in the standing posture. For measurement of postural sway under stable surface conditions, subjects stood on the force plate with their legs spread at shoulder width. The subjects' head movements were minimized by guiding them to gaze at a fixed forward point. The measurement was performed for 30 seconds and analyzed by calculating the average value of three measurements.

Measurements were taken at the time of ovulation (12–13 days after menstruation) and at the beginning of menstruation (1–3 days after menstruation).

The paired t-test was used to analyze static balance ability at the beginning of the menstrual period and ovulation. The significance level was set at 0.05.

RESULTS

All subjects completed the experiment. Experimental results showed that there was a significant increase in the postural sway velocity moment and speed at ovulation compared to the beginning of menstruation (p<0.05) (Table 1).

DISCUSSION

Balance is maintained by the co-action of the sensory (proprioceptive receptor, visual, vestibular organ), nervous (information processing), and motor systems (motion control). Therefore, changes in these systems affect balance.

Estrogen and progesterone receptors are found in bone, skeletal muscle, ligament, and the nervous system, and changes in the sex hormones affect the structure and function of these tissues.

Balance can be divided into static balance and dynamic balancing ability. Postural sway indicate static balance in standing. Postural sway can be expressed as the velocity moment of the center of gravity⁷. The increase of the velocity moment in each direction indicates a lower balance ability⁸.

The results of this study showed that the velocity moment increased significantly when female sex hormone levels were high. This means that higher levels of female sex hormones lead to less balance. Our finding is consistent with the results of previous studies in which there was a significant change in the balance ability and kinesthesia of subjects complaining of premenstrual syndrome according to the menstrual cycle^{9, 10}.

However, it reported that the female sex hormones do not affect the anterior cruciate ligament and mechanical properties of the medial gastrocnemius tendon¹¹. In another study, a low level of male sex hormones affected mobility and muscle strength; however, female sex hormones did not¹². Therefore, female sex hormones do not directly affect the muscles and ligaments regarding the maintenance of balance, but may affect the sensation or nervous systems.

In future studies, it will be necessary to study the effect of the female sex hormones on the sensation and nervous systems. Moreover, when planning exercise programs for women, the menstrual cycle should be considered. During the menstrual cycle with the levels of female hormones being high, a balance training can be a part of exercise programs for females but the intensity should be controlled to reduce risk of injuries.

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