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Menstrual Cycle Phase Influences Static Postural Control Under Single-Leg and Visual Deprivation Conditions

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Abstract-

Anterior cruciate ligament (ACL) injuries are highly prevalent in sports and occur more frequently in female athletes, potentially due to hormonal influences across the menstrual cycle. This study aimed to analyze static postural control across menstrual cycle phases under varying postural and sensory demands. A longitudinal repeated-measures design was conducted in 22 healthy women (18–30 years) with regular menstrual cycles and moderate physical activity levels. Static balance was assessed using a Zebris pressure platform across three menstrual phases (follicular, ovulatory, luteal), three stance conditions (bipedal, dominant and non-dominant single-leg), and two visual conditions (eyes open and closed). Center of pressure variables included confidence area, velocity, and anteroposterior and mediolateral displacement. Differences between phases were analyzed using the Friedman test with Wilcoxon post hoc comparisons and Kendall’s W effect size. No significant differences were observed in bipedal stance or under eyes-open conditions. However, under eyes-closed single-leg conditions, significant phase-dependent differences emerged. In dominant-leg stance, greater instability during the ovulatory phase was found for mediolateral displacement (p < 0.001;W = 0.321), anteroposterior displacement (p = 0.007;W = 0.223), confidence area (p < 0.001;W= 0.378), and velocity (p = 0.048; W = 0.138). Similar results were observed in the non-dominant leg for mediolateral displacement (p = 0.03; W = 0.159) and confidence area (p = 0.002; W = 0.287). These findings indicate that menstrual cycle phase influences postural control primarily under increased sensory and postural demands. The ovulatory phase appears to be associated with reduced stability when visual input is removed, suggesting a transient decrease in sensorimotor efficiency and a potential increase in neuromuscular vulnerability related to ACL injury risk.

Index Terms- menstrual cycle; postural control; anterior cruciate ligament; injury risk

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