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Nerve and muscle activity vary across menstrual cycle: May help explain higher rates of knee injuries in female athletes

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Numerous studies have shown that female athletes are more likely to get knee injuries, especially anterior cruciate ligament (ACL) tears and chronic pain, than their male counterparts. While previous research has focused on biomechanical differences as the main source of these problems, a new study suggests another distinction that could play a role: changes across the menstrual cycle in nerves that control muscle activity. The finding may eventually lead to new ways to prevent knee problems in female athletes.

Matthew Tenan, Yi-Ling Peng, and Lisa Griffin, all of the University of Texas-Austin, and Anthony Hackney, of the University of North Carolina-Chapel Hill, measured the activity of motor units—nerve fibers and the muscles they control—around the knees of female volunteers at various points of their menstrual cycles. They found that these bundles had firing rates that were significantly higher in the late luteal phase, about a week before a woman's next period, compared to earlier in the menstrual cycle. This difference in firing rate could affect the stability of the joint, potentially affecting its susceptibility to injury.

Their poster presentation entitled, "Maximal Force and Motor Unit Recruitment Patterns are Altered Across the Human Menstrual Cycle," will be discussed at The Integrative Biology of Exercise VI meeting being held October 10-13 at the Westin Westminster Hotel in Westminster, CO.

More Than Biomechanics?

Differences in muscle structure around female athletes' knees have typically gotten the blame for disparities in knee injuries between the sexes, especially for athletes who play sports such as soccer or basketball that involve a substantial amount of knee twisting, turning, and jerking, says study leader Tenan. However, he adds, it's been unclear whether other factors, such as differences in motor unit firing patterns, might also play a part. Since female athletes' hormones fluctuate across the menstrual cycle, Tenan and his colleagues decided to investigate whether these changes affect motor unit activity.

Working with seven female volunteers, all between the ages of 19 and 35, the researchers asked these study participants to chart their menstrual cycles using basal body temperature. This method involves taking body temperature every morning upon waking over the course of the menstrual cycle. Because temperature increases slightly after ovulation (the luteal phase), then dips to pre-ovulation temperatures just before the start of a new cycle (the follicular phase), it's possible to track where each volunteer was in her menstrual cycle on any given day.

The researchers also asked each volunteer to visit their facility five different times at various points of the menstrual cycle. At each visit, they inserted a fine wire electrode, no thicker than a human hair, into two muscles around one of each of the volunteers' knees. The women then did knee extensions while the researchers used these electrodes to measure the activity of motor units in those muscles.

Avoiding Injury

Results showed that motor unit firing patterns varied significantly across the menstrual cycle. Most notably, Tenan and his colleagues found that

the rate of firing jumped in the late luteal phase compared to rates earlier in the cycle. Though they're not sure whether these results coincide with a difference in knee injury rates at different points in the menstrual cycle—a topic for future research. Tenan notes that changes in motor unit activity could make women more vulnerable to injury in general.

"Our results suggest that muscle activation patterns are altered by the menstrual cycle," he says. "These alterations could lead to changes in rates of injury."

The findings, he adds, could prompt a closer look at the neuroendocrine system in addition to biomechanics as a possible cause for knee injuries in female athletes—potentially leading to new ways to help female athletes avoid these problems.

More information: bit.ly/OrMFtN

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