Women's mental agility is better during menstruation, shows study

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Participants reacted quicker and made fewer errors during menstruation, despite believing their performance would be worse, according to new research from UCL and the Institute of Sport, Exercise & Health (ISEH).

The study, published in *Neuropsychologia*, is the first to assess sports-related cognition during the menstrual cycle and is part of a larger research project.

The findings act as a proof-of-principle that specific types of cognition fluctuate throughout the menstrual cycle, which could have implications for injury and other aspects of women's health.

Previous sports medicine research has shown that women seem to be at greater risk of sports-related injury during the luteal phase, which is the time between ovulation and menstruation. This is possibly related to the significant hormonal changes that occur throughout the menstrual cycle. But precisely how these changes are linked to an increased likelihood of injury is unknown at present.

In this study, researchers at UCL and ISEH collected reaction time and error data from 241 participants who completed a battery of cognitive tests 14 days apart. Participants also completed a mood scale and a symptom questionnaire twice. Period-tracking apps were used to estimate which phase of their cycle the participants were in when they took the tests.

The tests were designed to mimic mental processes that are typical in team sports. In one test, participants were shown smiling or winking faces and asked to press the space bar only when they saw a smiley face, to test inhibition, attention, reaction time and accuracy. In another, they were asked to identify mirror images in a 3D rotation task, which assesses spatial cognition. A task that asked them to click when two moving balls collided on screen measured spatial timing.

Though participants reported feeling worse during menstruation and perceived that this negatively impacted their performance, their reaction times were faster and they made fewer errors. For example, their timing

was on average 10 milliseconds (12%) more accurate in the moving ball task, and they pressed the space bar at the wrong time 25% less in the inhibition task.

Participants' reaction times were slower during the luteal phase, which begins after ovulation and lasts between 12-14 days up to the beginning of menstruation. They were on average 10–20 milliseconds slower compared to being in any other phase. They didn't make more errors in this phase, however.

Dr. Flaminia Ronca, first author of the study from UCL Division of Surgery and Interventional Science and ISEH, said, "Research suggests that female athletes are more likely to sustain certain types of sports injuries during the luteal phase and the assumption has been that this is due to biomechanical changes as a result of hormonal variation. But I wasn't convinced that physical changes alone could explain this association.

"Given that progesterone has an inhibitory effect on the cerebral cortex and estrogen stimulates it, making us react slower or faster, we wondered if injuries could be a result of a change in athletes' timing of movements throughout the cycle. What is surprising is that the participant's performance was better when they were on their period, which challenges what women, and perhaps society more generally, assume about their abilities at this particular time of the month.

"I hope that this will provide the basis for positive conversations between coaches and athletes about perceptions and performance: How we feel doesn't always reflect how we perform."

To put the findings in context, the authors say the fluctuation in timing could be the difference between an injury or not. Previous research has shown that a variation of just 10 milliseconds can mean the difference

between a concussion and a lesser injury, for example. In the colliding balls task, participants' timing was on average 12 milliseconds slower during the luteal phase compared to every other phase, a difference of 16%.

Dr. Megan Lowery, an author of the study from UCL Surgery & Interventional Science and ISEH, said, "There's lots of anecdotal evidence from women that they might feel clumsy just before ovulation, for example, which is supported by our findings here. My hope is that if women understand how their brains and bodies change during the month, it will help them to adapt.

"Though there's a lot more research needed in this area, these findings are an important first step towards understanding how women's cognition affects their athletic performance at different points during their cycle, which will hopefully facilitate positive conversations between coaches and athletes around performance and well-being."

Professor Paul Burgess, senior author of the study from UCL's Institute of Cognitive Neuroscience, said, "This study emerged from listening carefully to female soccer players and their coaches. We created bespoke cognitive tests to try to mimic the demands made upon the brain at the points in the game where they were telling us that injuries and problems of timing occur at certain times of the menstrual cycle.

"As suggested by what the soccer players had told us, the data suggested that women who menstruate—whether they are athletes or not—do tend to vary in their performance at certain stages of the cycle. As a neuroscientist, I am amazed that we don't already know more about this, and hope that our study will help motivate increasing interest in this vital aspect of sports medicine."

More information: F. Ronca et al, Attentional, anticipatory and spatial

cognition fluctuate throughout the menstrual cycle: potential implications for female sport, *Neuropsychologia* (2024). DOI: 10.1016/j.neuropsychologia.2024.108909