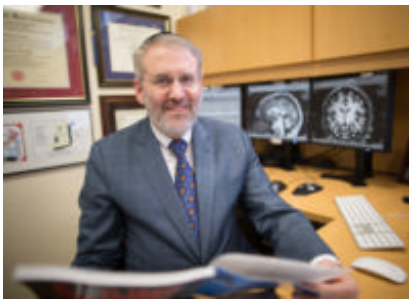

RSNA Press Release

Soccer Heading May Be Riskier for Female Players

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OAK BROOK, Ill. — Researchers have found that women who play soccer may be more at risk than their male counterparts. According to a new study published in the journal *Radiology*, female soccer players exhibit more extensive changes to brain tissue after repetitive 'heading' of the soccer ball.



Michael L. Lipton, M.D., Ph.D.

Soccer is the most popular competitive sport in the world, and female participation in the sport is on the rise. The Fédération Internationale de Football Association (FIFA) 2014 Women's Football Survey reported more than 30 million female soccer players worldwide.

Heading, in which players field the soccer ball with their heads, is a key component of the game. Heading-related impacts have been associated with abnormalities in the brain's white matter that are similar to those seen in patients with traumatic brain injury. Cumulative heading over a one-year period has been associated with cognitive dysfunction and microstructural changes to the brain's white matter.

Long-term consequences of repeated exposure to heading is an area of concern because repetitive head injury in athletes has been associated with cognitive decline and behavioral changes.

"In general, men do a lot more heading than women, but we wanted to specifically examine if men and women fare similarly or differently with a similar amount of exposure to repeated impacts to the head," said the study's lead author, Michael L. Lipton, M.D., Ph.D., professor of radiology at the Gruss Magnetic Resonance Research Center at the Albert

At A Glance

- Researchers used diffusion tensor imaging to assess microscopic changes in the brain's white matter on 98 amateur soccer players, including 49 men and 49 women.
- Compared to men, women showed more extensive changes to brain tissue after repetitive soccer heading.
- There are more than 30 million female soccer players worldwide.

Einstein College of Medicine and medical director of MRI at Montefiore Medical Center in New York City.

Dr. Lipton and colleagues used diffusion tensor imaging (DTI), an advanced MRI technique, to assess microscopic changes in the brain's white matter in 98 amateur soccer players—49 men and 49 women—with an average age of 25.8 years. All participants had many years of soccer and heading exposure, including 12 months of frequent heading exposure leading up to the study (median headers: 487 per year for the men and 469 per year for the women). Participants had no significant differences in demographic factors.

DTI produces a measurement, called fractional anisotropy (FA), which characterizes the movement of water molecules in the brain. In healthy white matter, the direction of water movement is fairly uniform and measures high in FA. When water movement is more random, FA values decrease.

"A decline in FA is an indicator of changes in the white matter microstructure that may be indicative of inflammation or loss of neurons, for example," Dr. Lipton said.

For the study, the researchers compared white matter FA values among the male and female soccer players. The analysis revealed that while both men and women experienced lower FA values related to more repetitive heading, women exhibited lower FA levels across a much larger volume of brain tissue.

"In both groups, this effect we see in the brain's white matter increased with greater amounts of heading," Dr. Lipton said. "But women exhibit about five times as much microstructural abnormality as men when they have similar amounts of heading exposure."

Researchers were also able to identify specific regions of the brain where frequent heading was associated with lower FA: three brain regions in men and eight brain regions in women.

"The important message from these findings is that there are individuals who are going to be more sensitive to heading than others," Dr. Lipton said. "Our study provides preliminary support that women are more sensitive to these types of head impacts at the level of brain tissue microstructure."

Dr. Lipton cautions that more investigation is warranted to confirm and further characterize gender differences in vulnerability to brain injury due to heading.

"We don't have enough information yet to establish guidelines to protect the players," Dr. Lipton said. "But by understanding these relationships—how different people have different levels of sensitivity to heading—we can get to the point of determining the need for gender-specific recommendations for safer soccer play."

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"MRI-defined White Matter Microstructural Alteration Associated with Soccer Heading is More Extensive in Women than Men." Collaborating with Dr. Lipton were Todd G. Rubin, M.S., Eva Catenaccio, M.D., Roman Fleysher, Ph.D., Liane E. Hunter, M.S., Naomi Lubin, B.A., Walter F. Stewart, Ph.D., Mimi Kim, Sc.D., and Richard B. Lipton, M.D.

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