

Study shows elevated brain blood flow linked to anxiety and mood symptoms in females

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Adolescence is a critical period for emotional maturation and is a time when significant symptoms of anxiety and depression can increase, particularly in females. Prior work by a team of Penn Medicine researchers found that sex-specific changes in cerebral blood flow (CBF) begin at puberty. The team's newest research shows that higher blood flow in emotional brain regions such as the amygdala is associated with higher levels of anxiety and mood symptoms in females. These findings, which are published online in *Biological Psychiatry*, provide further insight into the developmental biology of sex differences in mood and anxiety disorders.

"Women have approximately two times the risk of [anxiety](#) and [mood symptoms](#) as men, but we still don't know why," said the study's senior author Theodore D. Satterthwaite, MD, MA, an assistant professor of Psychiatry in the Perelman School of Medicine at the University of Pennsylvania. "This study gets us one step closer to understanding this phenomenon and it may ultimately aid in early identification of youth at risk for mood and [anxiety symptoms](#) as well as help with the development of new treatments."

The study evaluated the hypothesis that [sex differences](#) in [blood flow](#) to brain regions involved in emotion processing during adolescence could be linked to sex differences in anxiety and mood symptoms. "We predicted that greater levels of anxiety would be associated with greater blood flow in emotional brain regions such as the amygdala. Following our prior work, we also predicted that females would have higher perfusion (blood flow) as adolescence progresses. And, finally we examined whether higher blood flow in emotional brain regions explained higher levels of anxiety and mood symptoms in females," said the lead author, Antonia Kaczkurkin, PhD, a

postdoctoral fellow at Penn's Center for the Treatment and Study of Anxiety (CTSA).

The Penn team imaged the brains of 875 children, adolescents and young adults (ages 12 – 23), using arterial spin labeled (ASL) MRI. Participants were all members of the Philadelphia Neurodevelopmental Cohort, a National Institute of Health-funded collaboration between the University of Pennsylvania Brain Behavior Laboratory and the Center for Applied Genomics at the Children's Hospital of Pennsylvania. Prior to imaging, each participant self-reported their level of anxiety and mood symptoms.

Results showed how the development of brain perfusion may relate to sex differences in anxiety during adolescence. Data revealed that anxiety and mood symptoms were associated with greater blood flow in a network of brain regions including the amygdala, anterior insula and fusiform cortex in both males and females. These regions also showed substantial developmental sex differences, with females demonstrating higher blood flow than males in post-pubertal period. It was also noted that the relationship between anxiety symptoms and blood flow in these regions increased in strength with age and puberty, and [higher levels](#) of symptoms present in post-pubertal females was in part explained by elevated blood flow to the left amygdala - a region known to be important for emotional processing. Taken together, these results suggest a new mechanism for understanding sex differences in anxiety and mood symptoms, which the authors say may be used to direct future research regarding targeted treatments.

More information: Antonia N. Kaczkurkin et al. Elevated Amygdala Perfusion Mediates Developmental Sex Differences in Trait Anxiety,

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