

The Difference Between Children's Learning Abilities With and Without ADHD



Written by Leah Rupp

Introduction

Attention-deficit hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders found in children (Cleveland Clinic, 2023). It is a developmental disorder that can interfere with social and school-related activities and can be diagnosed as young as 2 years of age. Low amounts of gray matter and neurotransmitter γ -aminobutyric acid (GABA) have all been connected to ADHD symptoms. Gray matter, primarily composed of neuronal cell bodies, dendrites, and unmyelinated axons, is commonly found in lower amounts in patients with ADHD. Another cause of ADHD is lower concentrations of GABA.

Physicians most commonly screen for ADHD by using the Diagnostic and Statistical Manual, Fifth edition (DSM-5), a test consisting of a series of yes or no questions. Individuals aged 16 or younger who answer 'yes' to six or more of the questions meet the diagnostic criteria for ADHD. These questions are designed to assess common behaviors associated with ADHD, such as, "often does not seem to listen when spoken to directly," "often has trouble holding attention to tasks or play activities," and "often fidgets with or taps hands or feet" (Cleveland Clinic, 2023). It can be difficult to diagnose ADHD because many symptoms are very similar to various anxiety and mood disorders. Moreover, ADHD affects young children mostly in school (Cleveland Clinic, 2023), where challenges sitting still for extended periods can impact their learning experience.

For children six years and younger it is recommended to try behavior therapy rather than start ADHD drugs (Cleveland Clinic, 2023). Parents can try to better manage children's behavior by creating a routine, utilizing prizes when goals are achieved, and limiting choices. However, for children older than six, medical treatments are recommended (Cleveland Clinic, 2023). ADHD medications consist of stimulants and non-stimulants, with non-stimulants being less effective. Common stimulants are methylphenidate and amphetamine, which create a calming effect on children with ADHD. Individuals may only see results after weeks of taking the drug (Cleveland Clinic, 2023).

Gray's Matters Effect on ADHD

Dr. Luke Norman, a scientist at the National Institute of Mental Health (NIMH), discovered that ADHD is linked to irregular connections between the brain's frontal cortex and information processing centers. The cerebral cortex, the outermost layer of the brain, plays a critical role in processing information, supported by the dendrites that play a key role in receiving chemical messages from other nerve cells. According to the Cleveland Clinic, this region of the brain is also responsible for "memory, learning, and decision-making" (Cleveland Clinic, 2024). Individuals with ADHD have a smaller amount of gray matter in addition to a decreased volume of specific cortical regions, as shown in Figure 1. This may help explain why individuals diagnosed with ADHD

often exhibit a shorter attention span and may struggle to maintain focus for extended periods because of the lower amounts of dendrites that receive chemical messages.

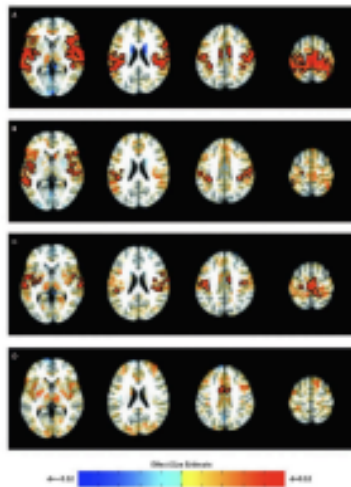


Figure 1. Smaller amounts of gray matter seen in individuals with ADHD, images C and D vs those without ADHD, images A and B

The frontal cortex of individuals with ADHD tends to develop at a much slower rate than individuals with a neurotypical brain. Children with neurotypical brains may have higher rates of neuroplasticity, which can increase their ability to retain information efficiently (Puderbaugh, 2023). According to the National Institute of Health, Neuroplasticity is "a process that involves adaptive structural and functional changes to the brain" (Puderbaugh, 2023). Children are often able to learn more quickly than adults due to greater neuroplasticity; however, this ability diminishes with age. During the early years of life, a child's brain is rapidly absorbing and processing new information like a sponge, leading to learning a language more readily than an individual in their 80s for example.

Studies on γ-aminobutyric acid

Dr. Sebastian M. Frank, a researcher at Brown University, discovered that the increased amount of neurotransmitter γ-aminobutyric acid (GABA) in children helps them retain new information that is learned. According to the Cleveland Clinic, GABA is an inhibiting neurotransmitter that "creates a calming effect" as it stops chemical messages from being sent from one nerve cell to another.

Dr. Richard A. Edden, a neuroradiologist at The John Hopkins University School of Medicine, conducted a study connecting GABA amounts and those diagnosed with ADHD. The goal of the study was to connect GABA concentration in an individual and whether or not they have ADHD. Patient's brains were scanned with a 3-Tesla MRI scanner. Children from ages 8-12 with ADHD were compared with children with neurotypical brains. The findings, shown in Figure 2,

reveal a notable difference in GABA concentrations between children with and without ADHD. Children without ADHD have higher levels of GABA, which may contribute to their ability to learn efficiently and maintain focus. In contrast, children with ADHD tend to have lower GABA concentrations, potentially reducing the 'calming effect' that GABA provides, as described by the Cleveland Clinic. This difference can negatively impact their ability to stay focused in school, making it challenging to engage in prolonged learning activities. With the correlation between GABA and ADHD noticed, potential GABAergic therapies could decrease symptoms of ADHD seen in kids (Edden, 2012).

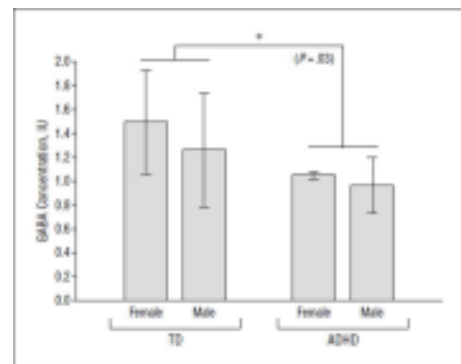


Figure 2. The bar graph displays a statistically significant difference in GABA concentration between the Female and Male TD group (neurotypical) as compared to the Female and Male ADHD group.

Conclusion

By studying gray matter and GABA, ADHD medication can better target what is exactly causing ADHD. Qelbree and Kapvay are newer drugs that target grey matter to help lower hyperactivity as seen in those diagnosed with ADHD. However, so much still needs to be discovered on what is the most efficient way to reduce ADHD symptoms, as many of these common drugs have drastic side effects such as nausea, headaches, and tiredness. According to the CDC, six million children between the ages of 2-17 in America have been diagnosed with ADHD. The implications of this diagnosis and its treatment negatively affect them academically and socially. From the connections found between grey matter and GABA in ADHD, more drugs could better target these areas to treat ADHD.

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About the Author

Leah Rupp is a freshman at the University of Illinois in Urbana-Champaign studying Molecular and Cellular Biology within the honors concentration. Leah joined Brain Matters to get the opportunity to learn and write about new neuroscience research. Leah is also a Stress Management Peer with McKinley Health Center and a volunteer with the Food Assistance and Well-being Program. In her free time, Leah enjoys running and playing the piano. Her career aspiration is to become a physician.

