

The Prescription Problem: The Impact of Prescription Drugs for Anxiety and Depression on Adolescent Brain Maturation

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INTRODUCTION

Adolescents often engage in behaviors that make people wonder why they do the things they do. An important question related to this is: are adolescents merely adults in a smaller body, or are there neurological differences between adults and that explain their feelings and behaviors? Research has shown that the human brain is still developing during adolescence, and these changes in neurological development may explain their impulsive actions, many of which could be related to the rise in diagnoses of mental health disorders amongst the nation's young adults. Such diagnoses including clinical depression, anxiety, ADD/ADHD, and various eating disorders are typically viewed as chronic; however, due to the continued development in multiple areas of the brain, it is difficult to determine whether these conditions might subside after full maturation. This paper will first examine the maturation process of adolescent brains, and then analyze the impact of pharmacological treatment on this continued maturation.

Advances in medical technology, such as the development of the fMRI, CT, and EEG, have allowed researchers to take a closer look at the brains of adolescents. The brain develops from deeper regions to the outer regions and then synaptic pruning occurs from the anterior regions of the brain to the posterior regions. The deeper region of the brain includes areas such as the midbrain, pons, and medulla. These are collectively referred to as the midbrain, responsible for autonomic functions such as respirations, body temperature, and cardiac function. The more outer region of the brain, referred to as the cerebrum, is responsible for judgment, reasoning, and impulse control. In addition to brain development expanding outwards, synaptic pruning from the anterior of the brain to the posterior of the brain is also a reason why the other key areas of the brain are late to develop (Edmonds, 2008). Synaptic pruning refers to the trimming of excess or unused synapses in an area of the brain, which then undergo an insulation process called myelination. Myelinated axons, referred to as white matter, allow for faster signal processing amongst the pathways leading to the various areas of the brain. This process allows for plasticity of the brain to occur, which shapes future behavior in adulthood. The prefrontal cortex, responsible for decision-making and impulse control, is the last to develop in the human brain—fully maturing at about the age of 20.

The reason why the period of adolescence is notorious for risky behavior is because this underdeveloped prefrontal cortex is paired with a fully developed nucleus accumbens, responsible for seeking out pleasure and reward. A brain image study on adolescents was conducted to assess the relationship between reward and brain stimulation indicated that when given a small, medium, or large reward, teenagers exhibited “exaggerated responses” to medium and large rewards compared to children and adults. When presented with a small reward, neurological response of adolescents was similar to that of children and adults (Edmonds, 2008). Coupled with hormonal changes, this relationship between the underdeveloped prefrontal cortex and the fully developed nucleus accumbens causes adolescents to become the thrill seekers they are. In addition to thrill-seeking and reckless behaviors, however, there has also been a rise in mental health issues amongst these youth.

Clinical depression amongst students in high school is currently at 6%, up 5% from 1938. In addition, Hypomania amongst these adolescents, a syndrome that involves increased energy, increased anxiety, and unrealistic optimism, is up to 31%, compared to 5% in 1938 (Hatch, 2010). ADHD diagnoses are highly common in the classroom setting today, increasing to 11% amongst children—up 3.2% just from 2003. These increases in depression, anxiety, and attention-deficits could be attributed to the interaction between increasing stress and the still-developing adolescent brain. Increases in stress are noteworthy. For example, according to the National Center for Education, 24.9% of Americans between the ages of 25 and 29 had bachelor's degrees; in 2012, this number surged to 33.5% (Rampell, 2013). Because college has now become the perceived standard for a competitive job, adolescents feel obligated to adhere to these high standards. Simultaneously, over the years, gaining admission to the nation's top schools has become more difficult. In 2005, Duke University admitted 23% of applicants, while last year, they only accepted 11.6% of applicants (IvyWise, 2013). This increase in stress does not dissipate when admitted to an esteemed institution, but rises once admitted. Cornell University, an Ivy League institution, was notorious for its six suicides in as many months in 2010.

Currently, most adolescents diagnosed with these disorders will be treated through

pharmacological means. For example, many adolescents diagnosed with depression are prescribed selective serotonin reuptake inhibitors (SSRI's). These drugs, often categorized as antidepressants, block the reuptake of serotonin back into the synapse, and leave it present in the synaptic cleft in order to be transferred to the adjacent neuron for creation of a chemical signal. This helps the brain send and receive chemical messages, which in turn, increases the mood of the individual to a more pleasurable state (Mayo Clinic, 2013). Various SSRIs are available in today's market such as Zoloft[®], Celexa[®], Lexapro[®], Prozac[®], and Paxil[®]. Doctors often primarily prescribe these medications in low dosages, but these dosages are then increased or changed based on response to the patient following a few weeks of trial. In addition to serotonin, norepinephrine has also been found to contribute to emotional well-being. SNRIs, selective norepinephrine reuptake inhibitors, also increase the amount of the neurotransmitter in the synapse and are therefore effective in treating disorders such as manic depression (McGill, 2013).

In addition to depression, SSRI's are also prescribed to combat anxiety. Anxiety disorders affect about 18% of the United States population age 18 or older. These disorders are different from the nervousness encountered from a specific stressful event, as these symptoms that cause anxiety disorders usually last for at least six months and can worsen if left untreated. Symptoms of general anxiety disorder include restlessness, tremors, nausea, sweating, and shortness of breath. When an individual with anxiety experiences a panic attack, symptoms escalate to ones such as heart palpitations, hyperventilation, and hallucinations can become harmful to long-term mental and physical health. SSRI's are effective in treating a wide range of anxiety disorders including Obsessive-Compulsive Disorder and Post-Traumatic Stress Disorder by increasing the level of serotonin in the brain, streamlining chemical signaling pathways (NIMH, 2013). For more immediate symptom relief, medical professionals often couple an SSRI with a benzodiazepine such as Xanax[®], Klonopin[®], or Ativan[®]. These prescription medications function by increasing the effectiveness of Gamma Amino Butyric Acid (GABA) in the brain, also referred to as the "tranquilizing neurotransmitter" (Modell, 2013). Beta-blockers can also be prescribed in order to alleviate physical symptoms that may accompany certain anxiety disorders (NIMH, 2013). More specifically, these drugs block the transmission of norepinephrine, a stress hormone, in situations during which flight-or-flight response is evoked (Help Guide, 2013).

Although these medications help alleviate the symptoms for which they were intended, long-term

dependency on these drugs can be detrimental to adolescents due to their still-maturing brains. This may be especially the case when we consider the fact that, due to decreased ability to make proper judgments, adolescents are at high risk for substance abuse. Research shows that in any given month, four out of ten high school students report drinking some amount of alcohol while three out of ten engaged in binge drinking (Office of Adolescent Health, 2013). Alcohol is of prime concern due to its addictive qualities and potential for abuse. A study conducted by Dr. Susan Tapert of the University of California, San Diego, assessed the brain tissue of high school students who binge drink and those who did not have a history of binge drinking. Tapert analyzed the nerve tissue, or white matter, of the brain and found that students who had a history of binge drinking "appeared to have a number of dings throughout their brain's white matter, indicating poor quality," according to Tapert. What was furthermore worrisome was that Tapert found "the binge drinking kids hadn't, in fact, engaged in a great deal of binge drinking. They were drinking on average once or twice a month, but when they did drink, it was to a relatively high quantity of at least four or five drinks on an occasion" (Trudeau, 2010).

Current studies are taking a look at the effect of SSRI's on the white matter of the brain. Thus far, this research has indicated that these selective serotonin reuptake inhibitors decrease platelet aggregation and may cause lesions on the white matter of the prefrontal cortex. MRI scans show that late life depression is associated with white matter lesions (Steffens, 2008). Because many adolescents often succumb to the impulsive decision to binge drink, this already deteriorating white matter is coupled with the same effect of SSRI's. White matter, otherwise regarded as the fully myelinated axons, is essential for regulating signals in the axon and amongst the multitude of neurons in the brain.

These findings are concerning due to the impact of antidepressants on the still-developing white matter of the prefrontal cortex in adolescents. In addition, many of these mental health disorders are characteristic of undeveloped areas of the brain, which when fully developed, could result in remission of the symptoms. The hastiness of doctors to prescribe adolescents these long-term medications potentially turns these students into life-long patients. These medications may cause abuse of the substance, physiological addiction to the substance for an extended period of time, or a tolerance of to the medication after repeatedly increased doses; however, it is still vital to address situations regarding mental health that may arise amongst adolescents. The more holistic approach of psychotherapy is ideal for adolescents because it allows an outlet for

adolescents to express their emotions in a controlled environment. Talk therapy may also involve inclusion of family or significant others in counseling sessions, allowing for environmental changes possibly contributing to the patient's mental health problems

Antidepressant medication should be a last resort after an attempt at psychotherapy due its long-term implications. However, if an adolescent is prescribed an antidepressant for anxiety or depression, he/she should still couple this with continued counseling or group therapy for maximum effectiveness. With advances in medicine, researchers have been able to learn more about the adolescent brain and no longer consider adolescents as merely "smaller adults." Due to the changes that adolescent brains undergo during this period, it is possible they should not be simply prescribed the same neurologically taxing medications as adults. Instead, these individuals may be better served by holistic approaches in dealing with their reactions to their changing neurological function, as well as their changing environments.

10. Office of Adolescent Health. "Office of Adolescent Health." *Substance Abuse*. N.p., 4 Sept. 2013. Web. 12 Dec. 2013.
11. Steffens, DC. "Result Filters." *National Center for Biotechnology Information*. U.S. National Library of Medicine, Mar. 2008. Web. 12 Dec. 2013.
12. Trudeau, Michelle. "Teen Drinking May Cause Irreversible Brain Damage." *NPR*. NPR, 25 Jan. 2010. Web. 10 Dec. 2013.

REFERENCES

1. Edmonds, Molly. "Are Teenage Brains Really Different from Adult Brains?" *HowStuffWorks*. How Stuff Works, 26 Aug. 2008. Web. 12 Dec. 2013.
2. Hatch. "Education." *Study: Students More Stressed Now than during Depression?* N.p., 12 Jan. 2010. Web. 11 Dec. 2013.
3. Help Guide. "Anxiety Medication.": *What You Need to Know About Drugs for Anxiety*. Help Guide, 2013. Web. 09 Dec. 2013.
4. IvyWise. "Resources." *Admission Statistics*. N.p., 2013. Web. 12 Dec. 2013.
5. Rampell, Catherine. "Data Reveal a Rise Among College Degrees in Americans." *The New York Times*. N.p., 12 June 2013. Web. 12 Dec. 2013.
6. Mayo Clinic. "Selective Serotonin Reuptake Inhibitors (SSRIs)." *Mayo Clinic*. Mayo Foundation for Medical Education and Research, 09 July 2013. Web. 09 Dec. 2013.
7. McGill. "THE BRAIN FROM TOP TO BOTTOM." *THE BRAIN FROM TOP TO BOTTOM*. McGill, 2013. Web. 11 Dec. 2013.
8. Modell, Jack, M.D. "Benzodiazepines:- How They Work." *Benzodiazepine's How They Work*. N.p., 2013. Web. 12 Dec. 2013.
9. National Institute of Mental Health. "Anxiety Disorders." *NIMH RSS*. NIH, 2013. Web. 10 Dec. 2013.