SELECTIVE SEROTONIN REUPTAKE INHIBITORS (SSRIs) IMPACT ON ADOLESCENT DEVELOPMENT AND EMOTIONAL REGULATION

Mentee: Maame-Abena Dwumfuoh

Mentor: Caitrin Burke

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Abstract

Adolescence is a significant period in an individual's life, affecting their emotional regulation, coping skills, and brain development. The long term usage of SSRIs for teens raises concerns for many parents and guardians. This review examined the usage of fluoxetine and fluvoxamine on adolescents aged 6 through 18. Data of emotions, adverse effects, and changes in fMRI scans were collected and displayed in different trials. Results show fluoxetine and fluvoxamine both led to negative emotions caused by disorders. However, most individuals during the study received positive feedback from the usage of SSRIs but was at risk for adverse effects such as activation cluster adverse events, suicidal thoughts, and insomnia. In addition, after taking medication, the right lateral prefrontal cortex, which is responsible for emotional processing, has increased activity. These results indicate that SSRIs will be able to significantly help adolescents long term, but are advised to monitor symptoms as it has negative effects.

Introduction

Anxiety disorders affect approximately 284 million people globally. (Gustavo, 2021). In more recent decades, new technologies and innovations have been created to relieve symptoms and effects of similar disorders for individuals of all ages. SSRIs, also known as selective serotonin reuptake inhibitors, are an FDA approved antidepressant most commonly used to treat severe depression and various anxiety disorders. In the 1950s, while scientists were experimenting to create a cure of tuberculosis, their accidental experimental results showcased patients feeling happier. With efforts such as these, the first antidepressants like MAOIs and tricyclics were released to the public. These antidepressants came with toxic side effects and made patients vulnerable to overdose. Scientists then focused on the concept of

serotonin to increase the amount in patients' brains. With trials and errors, scientists finally introduced SSRIs that were effective but carried non dangerous side effects like Prozac (James Greenblatt, 2023). As a result of positive outcomes while taking SSRIs, more than 1 in 10 individuals take selective serotonin reuptake inhibitors today (Cleveland Clinic, 2025). Selective serotonin reuptake inhibitors work by increasing levels of serotonin in the body–a neurotransmitter associated with mood regulation. When serotonin is done carrying its message, the body naturally reabsorbs the serotonin (Chu, 2023). If reabsorbed, lower levels of serotonin are left inside the synaptic cleft, a small space between two nerve cells used to communicate and send messages. Lower levels in synaptic cleft leads to intractable symptoms related to depression and anxiety disorders. To prevent this, SSRIs block uptake by inhibiting the serotonin transporter. When blocked, a significant amount of serotonin is left in the synaptic cleft alleviating depression-like symptoms (Chu, 2023). With the introduction of SSRIs to society, it is able to alleviate depression-like symptoms for millions of people. While the usage of SSRIs in adults is fairly common to alleviate symptoms, concerns of the use of SSRIs in adolescents are rising. Adolescence is a significant period in individuals' emotional and social development that directly affects their well-being. Habits such as exercising, having healthy sleeping patterns, and experiencing emotions allow teenagers to grow and mentally develop into adulthood. Mental health, especially depression, can lead to these habits deteriorating and weakening. Factors of mental health could include media influence, quality of home life, relationships, and many more (World Health Organization, 2024). During adolescence, the brain undergoes neurological changes in areas responsible for emotional and social experiences. For example, the prefrontal cortex continues to develop and mature during these years. Due to new changes neurologically and emotionally, mental health can be challenging to manage for teens. It is crucial to learn about medications and ways to help adolescents because by doing so, it can significantly improve an individual's

quality of life. Although SSRIs are a common choice of medication, existing research implies mixed findings on the effectiveness. Some clinical trials report that it improves emotional regulation and well-being, while others show that SSRIs pose dangerous risks and adverse symptoms to patients. This gap of understanding demonstrates the need for extensive examination. This paper aims to examine clinical trials relating to SSRI usage, neurological changes from SSRIs, and to evaluate the extent to which long-term usage of SSRIs impact an adolescent's brain development and emotional regulation over time.

Methodology

An extensive observational review was conducted to answer the objective of the paper, to what extent did long-term usage of SSRIs impact an adolescent's brain development and emotional regulation over time. With the use of Google Scholar and Pudmed- a free archive of biomedical and life sciences, adolescent behaviour as well as brain development from different SSRIs were examined from primary sources. With clinical evidence, adolescents (6-18 years old) taking SSRIs were used in trials to observe and collect data. Clinical trials ranging from 30 to 10 years were found from July 28th to August using keywords such as SSRIs, Adolescent, and serotonin. All clinical publications conducted trials that examined emotional and developmental regulation in adolescents.

Key studies used to deepen understatement of SSRIs effect on emotional regulation such as “Activation Adverse Events Induced by the Selective Serotonin Reuptake Inhibitor Fluvoxamine in Children and Adolescents” conducted by Shauna P Reinblatt, Susan dosReis, John T Walkup, and Mark A Riddle, ran a controlled trial testing the effects and efficacy of fluvoxamine, a specific SSRI at several high prestige universities. 128 adolescent individuals with anxiety disorders such as social anxiety or separation anxiety were randomly given either fluvoxamine treatment or a placebo and monitored over an 8 week period. Dosage

levels administered by the advisor altered depending on youth experiencing adverse effects that changed how they function due to the fluvoxamine dosage.

Similarly, “A double-blind, randomized, placebo-controlled trial of fluoxetine in children and adolescents with depression” organized by G J Emslie, A J Rush, W A Weinberg, R A Kowatch, C W Hughes, T Carmody, J Rintelmann randomized 96 adolescents to 20 mg of fluoxetine or placebo for 8 weeks. After randomization, age groups were evenly disturbed to ensure accurate data. Weekly check ups were provided to adolescent teens and participants of the trial. Behaviors and depressive symptoms were recorded. All together, researchers agreed fluvoxamine and fluoxetine were an effective way to treat anxiety based disorders and mood swings but still carried adverse side effects when dosage fluctuated.

Addintionaly, “Suicidal adverse events in pediatric randomized, controlled clinical trials of antidepressant drugs are associated with active drug treatment: a meta-analysis” preformed by Andrew D Mosholder and Mary Willy conducted a clincal trial using provided information from pediatrics clinics. Data was collected and reviewed for adverse side effects from SSRIs and evaluated.

Lastly, a clinical study monitored by Julie Maslowsky, Karin Mogg, Brendan P Bradley, Erin McClure-Tone, Monique Ernst, Daniel S Pine, Christopher S Monk named A Preliminary Investigation of Neural Correlates of Treatment in Adolescents with Generalized Anxiety Disorder tested changes in brain function due to SSRI treatment. In the procedure, 14 adolescents with generalized anxiety disorder and 10 healthy adolescents in the same age range were tested. fMRI scans, centered on the right ventrolateral prefrontal cortex were performed on individuals' brains before and after the trial at comparable times. These fMRI scans were used to test responses from certain threats and emotions. Along with this, weekly check ups were done. While researching non-English studies, studies including clinical trials

not centered on adolescent clinical trials using anything but SSRIs, and secondary sources were avoided. Trials with adolescents results, articles in English, and peer-reviewed journal articles were included.

Results

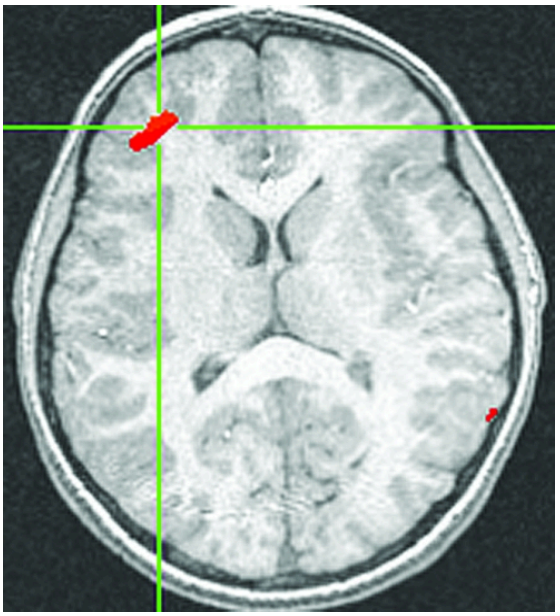
1. SSRI EMOTIONAL REGULATION

Following research conducted to answer the impact SSRIs has on teens emotional regulation and development, clinical trials show detailed results. Clinical data measures SSRIs impact on adolescents emotional regulation. *A double-blind, randomized, placebo-controlled trial of fluoxetine in children and adolescents with depression* conducted by G J Emslie et al. (1997), measured that out of a sample size of 48, 27 out of adolescents using fluoxetine reported having improved on the clinical global impressions scale. 16 out of 48 adolescents not on fluoxetine reported having improved on the clinical global impressions scale. However, 31% of fluoxetine receiving patients noted not experiencing symptom remission. Additionally, In *Activation Adverse Events Induced by the Selective Serotonin Reuptake Inhibitor Fluvoxamine in Children and Adolescents* by Shauna P Reinblatt et al. (2009), 10 out of 20 participants who were treated with fluvoxamine experienced activation cluster adverse events while 1 out of 23 In the placebo group experienced activation cluster adverse events. These events came along with symptoms such as hyperactivity, insomnia, panic attacks, and fidgetiness. In a separate trial, *Suicidal adverse events in pediatric randomized, controlled clinical trials of antidepressant drugs are associated with active drug treatment: a meta-analysis* by Andrew D Mosholder et al. (2006), 78 out of 2298 pediatric subjects faced adverse suicidal indicents, making the incidence ratio across the trial 1.89. However, no completed suicides were recorded.

2. SSRI IMPACT ON BRAIN DEVELOPMENT

In terms of brain development, “A Preliminary Investigation of *Neural Correlates of Treatment in Adolescents with Generalized Anxiety Disorder* by Julie Maslowsky et al. (2010), both testing groups did not Have significant differences in reaction time or accuracy from fMRI tests. Anxiety symptoms did improve in both treatment groups and after medication was given and the right lateral prefrontal cortex showed increased activity as well as in the amygdala region.

FIG. 1



After medication, the right lateral prefrontal cortex has increased activity.

Discussion

The findings in the study reveal that fluvoxamine and fluoxetine are beneficial and are used to treat depression and anxiety disorders. These SSRIs can significantly improve emotional regulation and mental health. However, selective serotonin reuptake inhibitors carry risks such as an individual having increased suicidal thoughts and activation of cluster adverse events. This set of data demonstrates the efficiency of SSRIs for adolescents who are struggling with disorders or depression. With the help of medication, individuals can regulate their mood and well-being long-term. Although these types of medications can help adolescents, SSRIs may produce adverse effects. These were shown in the results of clinical trials. These results are shown because selective serotonin reuptake inhibitors block the serotonin transporter, leaving a large amount of serotonin in the synaptic cleft. While taking medication, cluster adverse events can be caused because SSRIs affect areas of the brain to increase serotonin. This might affect other parts of the brain, leading to adverse events. In terms of the neurological side of SSRIs, serotonin reuptake inhibitors are proven to show increased activity in the right lateral frontal cortex after taking medication. In Figure 1, this is displayed with an image of the right lateral frontal cortex having activity from an fMRI. The right lateral front cortex is often associated with emotion regulation and mood in our brain. When antidepressant medications are used, they increase serotonin, giving the effect of fewer depressive symptoms. This shows that long-term usage of SSRIs changes the activity of sections of the brain.

3. LIMITATIONS

During this study, multiple limitations were noted. First, many sample sizes used in clinical trials were relatively small, altering the effectiveness of the trial and limiting the needed results in the adolescent population. Furthermore, Most studies performed on adolescence ran

for only 8 to 12 weeks. This short amount of time could not actually capture long term effects SSRIs have on adolescents. Another limitation that was noted is the different dosages, sample size, and specific SSRIs used in each trial. This would make comparison between different trials difficult. Also, clinical trials had self reported studies and data. This might present bias. Lastly, this review incorporated only English studies, limiting other types of reliable data which could have been used.

Conclusion

This study investigated the long term effects of SSRIs on adolescent brain development and emotional regulation. Findings suggest that both fluoxetine and fluoxetine can be used to relieve negative emotions and disorders long term but carry risks. Brain scans also prove activity in the right lateral prefrontal cortex, responsible for emotions. As a result of short trial periods, to fully capture SSRIs effects on adolescents, longer trial periods are recommended. Future research dive deeper on the effects of ssris and use different medications in that category to ensure the safety of adolescents.

Sources

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