



(REVIEW ARTICLE)



The interplay of ADHD, social media usage, and dopamine receptors in adolescents: A literature review

Shanna Indira Fayzhia ¹ and Yunias Setiawati ^{2,*}

¹ Medical Study Program, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.

² Department of Psychiatry, Dr Soetomo General Academic Hospital, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.

World Journal of Advanced Research and Reviews, 2024, 23(02), 2698–2703

Publication history: Received on 20 July 2024; revised on 27 August 2024; accepted on 30 August 2024

Article DOI: <https://doi.org/10.30574/wjarr.2024.23.2.2625>

Abstract

ADHD is a neurodevelopmental disorder marked by symptoms such as inattentiveness, hyperactivity, and impulsivity, with a prevalence rate exceeding 5%. The pathophysiology of ADHD includes cognitive and functional brain abnormalities, particularly in the anterior cingulate gyrus and dorsolateral prefrontal cortex, as well as decreased activity in the frontostriatal region. Diagnosis involves comprehensive assessments based on behavioral criteria outlined in the DSM-5. Treatment primarily includes stimulant medications, which are effective in about 70% of patients, and non-stimulant options such as atomoxetine and antidepressants. The review explores the effects of social media on adolescents, highlighting both negative impacts, such as social isolation, depression, and cyberbullying, and positive aspects, such as enhanced communication and knowledge sharing. Adolescents with ADHD are particularly vulnerable to behavioral addictions due to their poor impulse control, making them susceptible to excessive social media use. Additionally, the role of D2-dopamine receptors in ADHD is discussed, noting that genetic components like the DRD2 gene can affect dopamine neurotransmission, impacting attention and pleasure experiences. The pleasure principle, as proposed by Freud, is also analyzed in the context of ADHD, suggesting that individuals with ADHD may engage in behaviors that provide immediate gratification to avoid discomfort. Therefore, this review underscores the correlation between ADHD symptoms, social media usage, dopamine receptor function, and the underlying psychological drives in adolescents, providing a comprehensive understanding of these interrelated factors.

Keywords: ADHD; Mental Health; Social Media Usage; Dopamine Receptors; Neurodevelopmental Disorders

1. Introduction

Attention Deficit Hyperactive Disorder (ADHD) is a prevalent neurodevelopmental disorder primarily affecting children and adolescents, characterized by symptoms of inattentiveness, hyperactivity, and impulsivity (Drechsler et al., 2020). With a prevalence rate exceeding 5%, ADHD often persists into adulthood, potentially leading to significant life challenges, such as academic failure, criminal behavior, and difficulties in employment and relationships (Faraone & Larsson, 2018). The disorder typically manifests before the age of 12 and is identified through behavioral actions that include difficulties in attention, concentration, organization, task completion, and memory retention, persisting for at least six months in multiple settings, such as home, school, and public spaces (Magnus et al., 2023).

The pathophysiology of ADHD involves cognitive and functional abnormalities in the brain. Specifically, the anterior cingulate gyrus and dorsolateral prefrontal cortex are smaller in individuals with ADHD, contributing to their behavioral deficits (Magnus et al., 2023). Functional magnetic resonance imaging (fMRI) studies have also shown decreased activity

* Corresponding author: Yunias Setiawati

in the front striatal region in ADHD sufferers, further elucidating the neurological underpinnings of the disorder (Magnus et al., 2023).

Diagnosing ADHD involves a comprehensive assessment that includes gathering information on prenatal, perinatal, and family history, evaluating school performance and environmental factors, and conducting a thorough physical and mental health examination (Wolraich et al., 2019). Behavior-rating scales, reported by teachers or parents, play a crucial role in assessing ADHD based on the behavioral criteria outlined in the DSM-5. The diagnosis also considers the presence of significant impairment in daily functioning (Wolraich et al., 2019). Pharmacological treatment remains the primary approach for managing ADHD, categorized into stimulants and non-stimulants. Stimulants, such as amphetamines and methylphenidates, act by blocking the reuptake of dopamine and have shown effectiveness in approximately 70% of patients (Magnus et al., 2023). Non-stimulant options, like atomoxetine and certain antidepressants, are used for patients who cannot tolerate stimulants or have coexisting anxiety (Magnus et al., 2023).

In parallel with understanding ADHD, this review explores the significant impact of social media usage among adolescents, particularly those with ADHD. Social media platforms have become ubiquitous, with both positive and negative effects on users. While they facilitate communication, information sharing, and socialization, excessive use can lead to social isolation, depression, stress, sleep deprivation, and exposure to inappropriate content (O'Reilly et al., 2018). Adolescents with ADHD may be particularly vulnerable to the addictive aspects of social media due to their poor impulse control and susceptibility to behavioral addictions (Settanni et al., 2018). Cyberbullying is another critical concern, where high engagement on social media can lead to harmful behaviors and significant psychological impacts (Giunetti & Kowalski, 2022).

Dopamine plays a crucial role in the brain's reward system, and the D2-dopamine receptors are integral in regulating motor and non-motor functions, including motivation, cognition, and emotion (Mishra et al., 2018). Genetic components, such as the DRD2 gene, are associated with the functionality of these receptors and have been implicated in ADHD. Individuals with ADHD may have defective DRD2 genes, resulting in impaired dopamine neurotransmission, which affects their ability to regulate attention and experience pleasure (Blum et al., 2008). The pleasure principle, as formulated by Sigmund Freud, suggests that individuals are driven to seek pleasure and avoid pain, aiming for immediate gratification (Carr, 2016). This principle is particularly relevant to understanding the behaviors of children with ADHD. They may exhibit disruptive behavior to gain immediate rewards or avoid discomfort, highlighting the importance of managing these behaviors through appropriate parental responses and therapeutic interventions (Watkins & Watkins, 2019).

This literature review aims to provide a comprehensive understanding of the interactions between ADHD, social media usage, dopamine receptor function, and the pleasure principle among adolescents. By examining these interrelated factors, this review seeks to elucidate the complexities of ADHD and its broader implications on the mental health and social behaviors of affected individuals.

2. Review Content

2.1. ADHD

2.1.1. Definition of ADHD

Attention Deficit Hyperactive Disorder or abbreviated as ADHD is a neurodevelopmental disorder based on the behavioral action that showed as the symptoms, with a total of prevalence over 5% and is a disorder that is usually within children and adolescents. (Drechsler et al., 2020). These condition results in emotional and behavioral issues in children. The disorder is characterized by three main symptoms: inattention, hyperactivity, and impulsivity, which usually appear before the age of 12 and can sometimes continue into adulthood (Setyanisa et al., 2022). According to Magnus, sufferers of ADHD behavioral actions that show are including high levels of inattentiveness, hyperactivity, and impulsivity. ADHD symptoms appeared in persons from the age before 12 years old by showing their lackness in attention, concentration, organization, finishing tasks, and remembering things. These symptoms show up for at least six months in more than one location such as home, school, and public spaces (Magnus et al., 2023). With prevalence approximately 5%, two-thirds children who have ADHD, usually can carry this disorder into their adulthood and are more likely to risk their life in adulthood such as failing in school, becoming a criminal, failing to get a job, failing in their marriage, and many more (Faraone and Larsson, 2018).

2.1.2. Pathophysiology of ADHD

Based on the pathophysiology, ADHD is associated with deficits of cognitive and functional abnormalities in the brain. The size of the anterior cingulate gyrus and dorsolateral prefrontal cortex are smaller than the normal one, it is pointed as the result of the deficits in ADHD sufferer's behavior. According to fMRI measurement, the activity of the frontostriatal region in ADHD sufferers also decreased (Magnus et al., 2023). Additionally, the genus *Dialister* is recognized for its potential in influencing the gamma-aminobutyric acid (GABA) neurotransmitter, which might be involved in the development of ADHD. Previous study propose that this genus could serve as a biomarker for patients treated with ADHD medication. Further research is needed to compare individuals who have never used ADHD medication with those who have, to determine if there are any significant differences between the two groups (Sukmajaya et al., 2021).

2.1.3. Diagnosis of ADHD

While the diagnostic criteria for ADHD have undergone changes over time, the assessment methods and tools for evaluation have remained largely unchanged. ADHD continues to be predominantly diagnosed through clinical evaluation. The current recommendations for diagnosing ADHD involve conducting a comprehensive assessment that includes gathering information on prenatal, perinatal, and family history, as well as evaluating school performance, environmental factors, and conducting a thorough physical examination. During the physical examination, special attention should be given to vital signs, such as cardiovascular, skin, thyroid, and neurological systems, including assessing motor coordination. Additionally, a mental health assessment should be conducted to explore the presence of any comorbid conditions. The use of behavior-rating scales reported by teachers or parents originated in the late 1960s, and the focus now lies on assessing ADHD based on the behavioral criteria outlined in the DSM-5. Determining the presence of significant impairment is also a crucial factor in the diagnostic process (Wolraich et al., 2019).

2.1.4. Treatment of ADHD

Pharmacological treatment remains the primary approach for managing ADHD. It can be categorized into two main groups: stimulants and non-stimulants. Stimulants can be further divided into amphetamines and methylphenidates. Both types of stimulants act by blocking the reuptake of dopamine at both pre- and postsynaptic membranes. Amphetamines additionally stimulate the direct release of dopamine. Stimulants are the primary treatment choice for ADHD and have shown effectiveness in approximately 70% of patients. The number needed to treat is 2, indicating a favorable treatment response. Various formulations of stimulants are available, including immediate-release, extended-release, long-acting, or sustained release options. Side effects of stimulants may include changes in blood pressure, decreased appetite, sleep disturbances, and a potential risk of dependency. However, it is important to note that treating ADHD with stimulants has been shown to reduce the overall lifetime risk of substance abuse, despite the increased risk of substance use in individuals with ADHD. Non-stimulant options for ADHD treatment include antidepressants and alpha agonists. Atomoxetine, a selective norepinephrine reuptake inhibitor, is the most well-known non-stimulant option. It has demonstrated efficacy in several trials as an ADHD treatment, although it is not as effective as stimulants. Atomoxetine also has minimal antidepressant effects and is commonly used in children who cannot tolerate stimulants or have anxiety. Other antidepressants, such as bupropion, target both dopamine and serotonin systems, while tricyclic antidepressants (TCAs) are considered last-choice options and primarily target norepinephrine (Magnus et al., 2023).

2.2. Social Media

2.2.1. Social Media Usage Side Effects on Adolescent

The side effects on social media usage are various depending on what purposes the users try to achieve in using social media. It is worrying how much people spend their time online despite being used as a communication and socializing facility. This internet-based channel caused less real life interactions and resulted in social isolation, stress, depression, sleep deprivation, harmful behavior, and bad for mental health. Social media builds easy access for everyone and is also resulting in a high risk on how much information on the internet is exposed to children and adolescents. They can access inappropriate online content that is not suitable for them such as pornography, negative comments, and privacy violations (O'Reilly et al., 2018). Social media impact on children and adolescents are big, they can communicate and make friends online, somehow through social media, they can become popular among their community, but it is also a risk leading to cyberbullying. The high engagement on social media can expose the target and thousands of people can do the same to the target, cyberbullying including mean messages and inappropriate posts and the impact of cyberbullying will affect various age groups (Giumetti and Kowalski, 2022).

Beside the negative effects, there are also positive effects of social media usage specifically for students. In this technology era, they are able to share information, data, ideas, programs, and creativity from a young age, resulting in the advancement and increase of knowledge of students. Easy access to communication and socialization can give them

an opportunity to start a social discussion by sharing ideas, pictures, posts, etc. with digital media and social networking as the updated methods (Abbas et al., 2019).

2.2.2. Social Media Usage on Adolescent with ADHD

Social Media is a popular platform among adolescent these days. The usage of social media itself has been increased year by year. There are various platforms to use with various functions. Numerous studies have indicated that medical students are more susceptible to stress and anxiety compared to their peers. With the increasing prevalence of smartphones, university students often use them as a means to divert attention from their stress. Nonetheless, excessive smartphone use can result in addiction (Femmy et al., 2023). Adolescent with ADHD are also engaged to use social media just like other people, and it becomes part of their daily life as well to use social media. Daily usage of social media is increasingly regarded as typical behavior due to its widespread use, however excessive use of these platforms has lately been labeled as a behavioral addiction condition due to its potential for harming users' personal, relational, and professional lives. ADHD is one of the known characteristics that might increase a person's risk of developing behavioral addictions. Due to their weak impulse control, people with ADHD may get addicted to substances or to certain activities in an effort to deal with their restless behaviors and intrusive thoughts (Settanni et al., 2018).

2.3. D2-Dopamine Receptor

2.3.1. Definition

Dopamine is a type of neurotransmitter called a monoamine catecholamine. It belongs to a group of 7 transmembrane G proteins-coupled receptors (GPCRs), and it has a significant role in controlling various aspects of our body and mind. This includes motor functions as well as non motor functions like motivation, cognition, emotion, and neuroendocrine secretion. Dopamine interacts with dopamine receptors to precisely regulate both motor and non-motor functions. The D2-like dopamine receptor family consists of three subfamilies: D2, D3, and D4. Within the D2R subtypes, there are two isoforms known as D2-short and D2-long receptors. These receptors are primarily found in various regions of the brain, including the striatum, external globus pallidus (GPe), core of the nucleus accumbens (NAcc), amygdala, cerebral cortex, hippocampus, and pituitary. The mRNA expression of D2R is also observed in the prefrontal, temporal, and entorhinal cortex, as well as in the septal region, ventral tegmental area (VTA), and substantia nigra (SNpc) where dopamine neurons are located. Activation of this receptor family typically inhibits the activity of AC (adenylyl cyclase) and reduces the levels of cAMP (cyclic adenosine monophosphate) and PKA (protein kinase A) production (Mishra, Singh and Shukla, 2018).

2.3.2. Function

D2 receptors have a significant impact on postsynaptic receptor-mediated behavior and extrapyramidal activity. These receptors function as autoreceptors, meaning they can either be somatodendritic autoreceptors, which reduce neuronal excitability, or terminal autoreceptors, which primarily inhibit dopamine synthesis, packaging, and release. There is evidence suggesting that during the embryonic stage, D2 autoreceptors may contribute to the development of dopamine neurons. Additionally, D2 receptors activate pathways related to cell proliferation, such as the mitogen-activated protein kinase (MAPK) and Akt (also known as protein kinase B) signaling pathways (Mishra, Singh and Shukla, 2018).

2.3.3. Role in ADHD

ADHD is a neurodevelopmental disorder with genetic components, characterized by impulse control difficulties and imbalances in neurotransmitters. One specific gene implicated in ADHD is the DRD2 gene, which is associated with D2 receptor function. People with ADHD may have at least one defective DRD2 gene, leading to impaired responsiveness of neurons to dopamine. This impairment affects the regulation of attention and the experience of pleasure, both of which are influenced by dopamine neurotransmission (Blum et al., 2008).

2.4. Pleasure Principle

2.4.1. Definition

The pleasure principle, as formulated by Sigmund Freud, proposes that individuals make choices with the aim of minimizing or alleviating pain while seeking out or amplifying pleasure. This principle serves as the fundamental basis for all the decisions we make. It is through personal past experiences that we interpret and understand pain and pleasure, shaping our perception and decision-making processes. We are driven to pursue immediate gratification and reward ourselves with pleasure. Simultaneously, the pleasure principle suggests that individuals also strive to avoid or

escape from situations that cause pain. For those who find conflict particularly distressing, they will go to great lengths to avoid it. Although allowing a negative situation to persist may be detrimental and cause pain, the prospect of confronting and dealing with the conflict itself is perceived as even more agonizing. In essence, the pain pleasure principle emphasizes that people are motivated by a desire for pleasure and the avoidance of pain. It aligns with Freud's pleasure principle, which posits that individuals seek pleasure and attempt to minimize discomfort or unpleasant experiences. The concept of immediate gratification and the instinctual drive to seek pleasure and evade pain are central to both the pain pleasure principle and Freud's pleasure principle (Carr, 2016).

2.4.2. Pleasure Principle in ADHD

Based on the explanation of Freud Pleasure Principle, it is defined as when an individual's instinct is to minimize pain by seeking pleasure. It is implied in children with ADHD, when a child consistently receives what they desire after crying or rebelling against being told "no," they are being conditioned to believe that refusing to cooperate will lead to obtaining what they want. However, if parents were to respond differently by imposing additional consequences for the child's disobedience, the child would learn that acting out does not result in obtaining their desires. This principle highlights how a child's behaviors are directly linked to what brings them pleasure or aims to satisfy their own needs. Considering that a child's primary motivation is to seek pleasure and avoid pain, it can be reasonably assumed that every action they take is driven by the pursuit of pleasure or the avoidance of discomfort. Therefore, when a child exhibits disruptive behavior or struggles to function in society, it is crucial to examine whether they perceive their actions as pleasurable. The pleasure principle lies at the core of understanding the challenges associated with ADHD (Watkins and Watkins, 2019).

3. Conclusion

In conclusion, ADHD is a prevalent neurodevelopmental disorder marked by symptoms of inattentiveness, hyperactivity, and impulsivity. It persists from childhood into adulthood and is associated with significant cognitive and functional brain abnormalities. Effective management of ADHD requires comprehensive assessment and treatment, including behavioral evaluations and pharmacological interventions. The use of social media by adolescents with ADHD introduces additional complexities. While social media facilitates communication and information sharing, it also heightens the risk of behavioral addictions due to impulsivity and poor self-control in ADHD sufferers. Excessive social media use can worsen ADHD symptoms, leading to greater social isolation, depression, and other mental health problems. Additionally, the risk of cyberbullying poses further challenges, emphasizing the need for balanced and mindful social media usage among adolescents with ADHD.

Compliance with ethical standards

Acknowledgements

The authors would like to thank all the supervisors, enabling the successful implementation of this study.

Disclosure of conflict of interest

The authors report that there are no competing interests to declare.

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