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Review Article

# The Challenge of Differential Diagnosis in ADHD and Psychological Trauma in Children: Critical Considerations Regarding Neuroanatomical Correlates and Symptoms

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**Received:** November 22, 2019; **Published:** November 29, 2019

**DOI:** 10.31080/ecpe.2019.08.00616

## Abstract

The similarities in symptoms in ADHD and psychological trauma in children has become a relevant topic in paediatric psychology and psychiatry. ADHD and psychological trauma exhibit similar symptoms among children, contributing to the misdiagnosis of these disorders. Children with psychological trauma are often misdiagnosed and receive treatment for ADHD, which leads to overtreatment and worsening of the condition [1]. Thus, it is fundamental to distinguish the etiologies of these two disorders, which aids in the correct diagnoses. This review outlines the differences between these two conditions based on anatomical correlates and differential diagnosis based on signs and symptoms, the most definitive being age-related.

***Keywords:*** *Abuse; Dopamine; Inattention; Neglect; Noradrenalin; Psychological Trauma*

## Abbreviations

ADHD: Attention Deficit Hyperactivity Disorder; DA: Dopamine; DBD: Disruptive Behavior Disorder; NCTSN: National Child Traumatic Stress Network

## Introduction

According to Tan et al. (2016), inattention, impulsivity, and hyperactivity among children are a result of slow processing in the frontal region of the brain and a slow rise in band activity. Reduced alertness among affected children is attributed to abnormal monoaminergic transmission in subcortical circuits [2]. The monoaminergic system is a target for drugs, such as anxiolytic, antidepressants, and antipsychotics, which are used to treat motor, neurological conditions, mood, and cognitive disorders [3]. The monoaminergic system is essential as cellular targets in various neuropsychiatric and neurological conditions. Drugs used to treat attention deficit hyperactivity disorder (ADHD) and psychological trauma are transmitted through the monoaminergic system. Giuseppe et al. (2016) noted that monoaminergic treatment has proved beneficial in Parkinson's disease, depression, and schizophrenia. ADHD shares many neurological correlates and symptoms as well as traumatized children [3]; however, each is a distinct condition requiring specific treatment. The misdiagnosis of ADHD or trauma can result in failed treatment and prolonged suffering for the affected children and their families. Thus, the differential diagnosis between the two conditions is paramount. The following review illustrates that patient and family history as well as age-dependent symptoms are vital considerations in determining correct diagnoses.

## Discussion

### Characteristics of ADHD in children

ADHD is associated with low levels of neurotransmitters (dopamine and noradrenaline) responsible for signal-transmission between the basal ganglia and prefrontal cortex [4]. Noradrenaline in the brain ensures alertness, arousal, memory retrieval, and vigilance. Also, noradrenaline contributes to anxiety and restlessness. Generally, noradrenaline is designed to mobilize the body and brain for action [5].

Dopamine (DA) is an organic chemical that functions as a neurotransmitter—either as an inhibitor or excitor—depending on where in the brain (and at which receptor site) it binds. The function of DA is to bring excitation impact to the neuron. The excitatory action of DA increases the likelihood that the neuron can fire a signal (referred to as the action potential) to the receiving neuron. The inhibitory action of DA prevents the firing of the signal to the receiving neuron. It is essential to understand the role of dopamine in inhibitory and excitatory roles.

DA is required to maintain attention. A low level of DA results in attention-deficit. It is inhibitory in that it inhibits unwanted action tendencies in a stop-signal task. Problems can occur based on the DA levels. An elevated level of dopamine—a state referred to as "dopamine storm"—results in delusions, hallucinations, mania, and agitation [4]. A depreciated level of DA can drive humans to alcoholism, cigarette smoking, or gambling. DA is contributory to a person's drive, interest, and motivation. When there is a deficit of DA, humans do not feel alive, cannot initiate specific tasks, and lack energy; also, they experience poor concentration and exhibit an inability to perform specific tasks.

DA controls emotions and moods. For instance, if a person is physically attracted to another person, DA is activated, serotonin is increased, and oxytocin is produced [6]. Oxytocin reduces perceived pain and enhances the emotional connection two persons have on each other. DA regulates the reward system of the brain. Hence, there is an increased amount of dopamine in the brain when a person experiences pleasurable events, such as sex or eating [4]. The reward center in the brain is associated closely with DA and can interact with other neurotransmitters, such as serotonin and histamine, during regulation of personal mood.

DA is vital in improving working memory and responsible for feelings of pleasure and reward. A low level of DA is associated with symptoms of ADHD, as neurons in the brain and nervous system have higher concentrations of proteins (dopamine transporters). Thus, medication for ADHD, such as Ritalin, helps boost the level of dopamine, which improves a person's focus. ADHD affects performance in children, mainly in executive-function tasks, such as setting goals, planning, task switching, decision-making, and inhibition of distracting information [7]. A decreased performance in executive function can be due to abnormalities in the dorsolateral prefrontal cortex. Dysfunction in the prefrontal cortex can lead to a shortened attention span, diminished alertness, reduced efficiency, compromised short-term memory, and difficulty in initiating and sustaining activities. As a result, children with ADHD typically have diminished focus due to prefrontal cortex dysfunction [8]. The prefrontal cortex controls behavior, emotional response, and judgment, and determines appropriate responses. It plans, initiates, and executes actions and corrections, overcoming any challenge that might hinder the success of a task [9]. Liji (2019) reported that children with ADHD have structural abnormalities in the brain, such as abnormal white matter, low-density gray matter, diminished cortical thickness (among adults), diminished size of specific brain parts, and slow maturation [9].

A study by Rodriguez et al. (2016) indicated that ADHD is shared among specific children of school-age. The study found that out of 499 children under study, 256 were diagnosed with ADHD, which represented more than half of the population in the study. Other studies have shown that symptoms associated with ADHD include disruptive behavior disorder (DBD), which constituted 40–70% of the symptoms experienced by children with ADHD [10].

## Characteristics of psychological trauma in children

According to Murray and Lopez (1997), psychological trauma among children is a psychiatric disorder with a lifetime risk of 20% [11]. It has a high level of morbidity and mortality, as depressed children have a higher risk (than healthy children) of diabetes, coronary artery disease, and other medical conditions, as reported by Kessler et al. (2005) [12]. Depression is a common comorbity with trauma. Depressed children do not relate well to their peers and family due to developmental behavior that is unfriendly or irritating. As a result, depressed children lack healthy relationships and face difficulties in forming and keeping new relationships. Also, recurrent or prolonged depression can result in further emotional disturbances and behavioral issues expressed as reckless behavior, substance abuse, and a decline in academic performance—and may lead to suicidal thoughts and ideation [13].

Szymanski et al. (2011) noted that traumatized children could be easily mistaken for having ADHD as they exhibit similar behavioral changes as ADHD children [14]. Traumatized children show difficulty in controlling their behavior; they shift moods rapidly and abruptly. Previously traumatized children were observed to drift into a dissociative state as they relived a horrifying memory or lose focus as they anticipate the next violation of their safety. These characteristics were also found in children with ADHD, although psychological trauma was indeterminate [14]. A study by the American Academy of Child and Adolescent Psychiatry (2017) established that children with ADHD have some structures in the brain that are smaller compared with children without ADHD, such as the frontal lobe, which has been found to mature some years later in people with ADHD [15]. The frontal lobe of the brain is responsible for problem-solving, language, memory, planning, motivation, and other related activities. It is located behind the forehead, as depicted in Figure 1 (below).

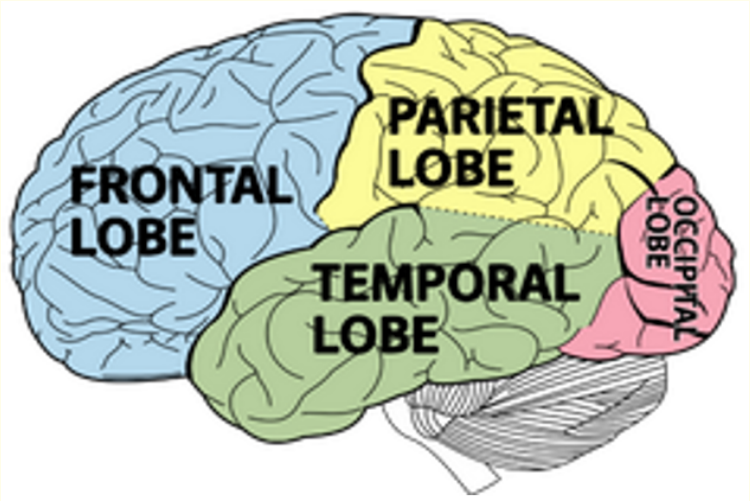


***Figure 1:*** *Depiction of the location of the prefrontal cortex. Note. The American Academy of Child & Adolescent Psychiatry (2017) [15].*

Children with ADHD show differences in neurological networks, brain development, brain size, and neurotransmitters. Psychological trauma in children also affects neural pathways and development, which can lead to long-lasting or permanent changes in the areas of the brain that regulate stress (prefrontal cortex, hippocampus, and amygdala). Traumatized children live in a state of fear and anxiety, as they feel danger is ever present. They remain in an state of fight or flight response as the sympathetic nervous system remains activated due to hormone (epinephrine) release. The ventromedial prefrontal cortex region of the brain remains active in traumatized children; this segment of the brain regulates emotional responses [16].

A traumatic event will result in an "adrenalin rush" through the body. As a consequence, the memory of the traumatic event is imprinted into the amygdala (a part of the limbic system), leading to hormonal imbalance. Subsequently, the ability to perceive danger or feel safety is negatively impacted, the emotional response-ability of the affected person is diminished as well as and the discretion of bad from good, as the control impulse has been damaged [17].

## The challenge in the differential diagnosis of ADHD and psychological trauma in children

Thomas (1995) reported the presence of mixed symptoms, similar in both ADHD and psychological trauma, and argued that such symptoms overlap, which can lead to a misdiagnosis of ADHD in traumatized children. Other overlapping signs include hyperactive, inattentive, and impulsive behaviors, which—rather than being a result of ADHD—can be attributable to neglect, abuse, or domestic chaos [18]. Thomas argued that facing such behaviors, physicians could quickly and mistakenly diagnose ADHD, which might not be the correct diagnosis. Figure 2 (below) depicts overlapping symptoms that challenge the differential diagnoses between ADHD and psychological trauma [18].

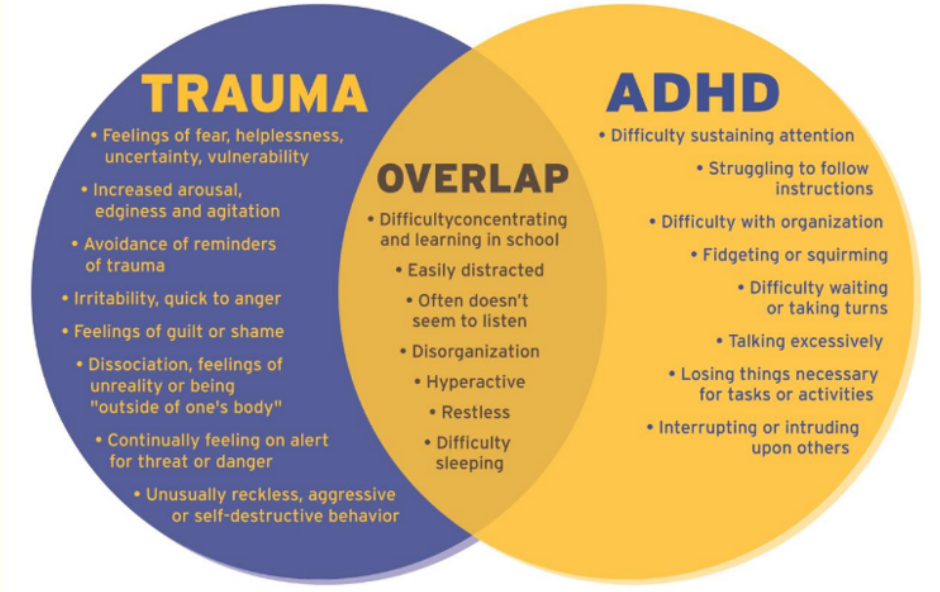


***Figure 2:*** *Depiction of overlapping symptoms that challenge the differential diagnosis between ADHD and psychological trauma. Note. NCTSN (2016) [17].*

According to Faraone (2018), children with ADHD are more likely to develop psychological trauma, unlike those without ADHD [19]. Misdiagnosis between the two conditions (ADHD and psychological trauma) occurs due to an overlap of symptoms, such as disruptive and hyperactivity behaviors. Hyperactivity can be mistaken for agitation, nervousness, and alert symptoms as found in children with trauma [20]. This overlap of symptoms challenges correct diagnosis and treatment. Furthermore, symptoms of other types of mental illness, such as oppositional defiant disorder and conduct disorder, have symptoms that overlap with those of ADHD and trauma [18]. Children with these conditions can display signs of stress and anger control, anxiety, behavioral issues, depression, and learning disabilities. Barkley (2002) noted that children with trauma might develop symptoms in various stages of life [21]. Misdiagnosis could result in inappropriate treatment and ineffective medicines [22]. The symptoms shared by ADHD children and trauma victims make it challenging to diagnose either condition correctly and provide accurate and effective treatment.

### Improving the diagnosis protocol for ADHD and psychological trauma

There is a lack of specificity in symptoms to help differentiate between ADHD and trauma. A critical factor in differentially diagnosing the two conditions is specific behaviors at different stages, depending on the age of the patient [23]. ADHD and trauma patients exhibit different types of symptoms at different ages. For children, the diagnosis of ADHD should be based on a comprehensive assessment of the child's history. This comprehensive assessment should include the medical history of both parents and the child's behavior since childbirth. ADHD can, at times, be genetically transferred, as put forth by Shyu et al. (2015) [24]. The differential diagnosis of ADHD comes down to scrutiny of the child patient and family history. However, the patient's family history might prove challenging to obtain in some cases, such as in separated parents or adoption.

## Conclusion

ADHD and psychological trauma in children are easily confused and misdiagnosed. Both conditions mimic each other in nearly similar symptoms. The most appropriate way of distinguishing these disorders is through a thorough history, including detailed information about the child since birth, and parents. Information obtained from teachers at various stages of the child's life as well as the child's parents or close relatives is most most helpful.

Applied drugs and treatment results thereof can factor into the working diagnosis and differential diagnosis of ADHD or psychological trauma. The outcomes of specific drug treatment can contribute to diagnosis of exclusion. In other words, treat appropriately for one of the conditions. If treatment fails, then, the condition might be the other condition. However, this approach is problematic and has risk for the patient.

The pharmacological treatments, rationales for such, and pathways are a broad topic and are left for subsequent research and publication or the reader's investigation. The purpose of this review is primarily to enhance the specificity in the diagnose of each condition. However, past treatment and results thereof could be vital to a correct diagnosis of either condition, ADHD or trauma.

Notwithstanding the advancements in understanding and treating ADHD and trauma, much remains uncertain. Thus, accurate diagnosis is vital in the management of ADHD and trauma. The challenge remains in the differential diagnosis of ADHD and psychological trauma in children, the fundamental differentiating factors being patient and family history and age-dependent symptoms.

## Conflict of Interest Statement

The authors declare that this paper was written in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

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**Volume 8 Issue 12 December 2019**