Current Developmental Disorders Reports (2022) 9:137–145
https://doi.org/10.1007/s40474-022-00256-2

ADHD (A AGGARWAL, SECTION EDITOR)

A Review of ADHD and Childhood Trauma: Treatment Challenges and Clinical Guidance

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Accepted: 29 September 2022 / Published online: 14 October 2022

Abstract

Purpose of Review There has been increasing interest about the link between attention-deficit/hyperactivity disorder (ADHD) and childhood trauma. This scoping review highlights the relationship between ADHD and trauma-related disorders across the areas of epidemiology, neurobiology, clinical features, assessment, and treatment.

Recent Findings A bi-directional relationship exists between trauma-related disorders and ADHD, with each predisposing to development of the other, and worsening the severity of the other. There are evidence-based psychosocial interventions for both ADHD and trauma-related disorders. There is evidence to support the use of alpha-2 agonists in both trauma-related disorders and ADHD.

Summary There are significant similarities between these two constructs. The treatment of this co-morbid presentation is complex as it depends on the age of the child, clinical presentation, social support, and available treatment. Distinct evidence-based psychotherapies are effective for each condition. Pharmacological treatments for these conditions should be considered based on symptom profile and associated impairment.

Keywords ADHD · Hyperactivity · Inattention · PTSD · Complex trauma · Childhood trauma

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common behavioral health conditions among youth in the USA [1]. The increasing rate of ADHD diagnosis over the last decade has coincided with an increase in interest about the effects of childhood trauma and adversity [2]. There is also some concern about over-diagnosis of ADHD [3•]. Indeed, there is some evidence to suggest that this over-diagnosis is due to misdiagnosing trauma-related disorders as ADHD [4, 5].

ADHD is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity which impacts functioning academically and socially. It is a neurodevelopmental disorder with symptoms typically observable by the time of school entry. According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM-5-TR), symptoms must manifest in more than one setting [6]. Low frustration tolerance, irritability, mood lability, and mild developmental delays often co-occur with ADHD [6] but may be related to other co-morbid disorders or stressors.

Childhood trauma is a broad construct referring to the distressing subjective experience and maladaptive psychological processing of adverse childhood experiences. Adverse childhood experiences (ACEs) have been defined as "childhood events, varying in severity and often chronic, occurring in a child's family or social environment that cause harm or distress, thereby disrupting the child's physical or psychological health and development"

This article is part of the Topical Collection on *ADHD*

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[7]. Some ACEs, like sexual assault, are more likely to induce trauma-related disorders than others [8, 9]. Trauma-related disorders, also called trauma-spectrum disorders, include post-traumatic stress disorder (PTSD), borderline personality disorder, and dissociative disorders [10]. The DSM-5-TR also includes reactive attachment disorder, disinhibited social engagement disorder, and prolonged grief disorder as part of the trauma and stressor related disorders [11]. PTSD refers to a specific clinical syndrome that develops after a traumatic experience that involves actual or potential death, serious injury, or sexual violence. It is characterized by intrusive thoughts, avoidance, mood and cognitive change, and arousal. Dissociative symptoms may also be prominent. Often, individuals have several symptoms of PTSD, but not enough to meet its diagnostic criteria. Given associated significant impairment, such patients may be assigned diagnoses of unspecified, or other specified, trauma, and stressor-related disorder [11]. Complex trauma, currently not recognized in the DSM-5-TR but listed in the International Classification of Diseases 11th Revision (ICD-11) as "Complex PTSD," refers to the effects of trauma that have become pervasive, affecting ability to regulate behavior and emotion, and even sustain interpersonal relationships [12]. Complex trauma is also referred to as type II trauma, toxic stress, disorders of extreme stress not otherwise specified (DES-NOS), developmental trauma disorder, and enduring personality change after catastrophic events (EPCACE).

It is important to recognize that issues with attention, impulse control, and hyperactivity are widespread. Most children will manifest some challenges in these areas when tired or when facing challenging cognitive demands. Impairing levels of these symptoms can be associated with ADHD or other disorders. For example, difficulties with focus and concentration can present in both ADHD and trauma-related disorders. Irritability is one of the most common behavioral health symptoms in children to the degree that some consider it to be a transdiagnostic construct [13, 14]. While up to 50% of children with ADHD manifest impairing levels of irritability, it should not be assumed that irritability means that ADHD is present, or even that the irritability directly relates to the ADHD of a child who carries that diagnosis [15].

This scoping review focuses on the relationship between ADHD and childhood trauma (specifically ACEs and PTSD) and will cover epidemiology, neurobiology, clinical presentation, assessment, and treatment recommendations. Existing literature was examined in the English language, including publications up to July 2022, using searches of MEDLINE and PsycInfo for the following categories: ADHD, trauma, children, adolescents, PTSD, adverse childhood experiences, neurobiology, prevalence, pharmacotherapy, medication, psychosocial intervention, and therapy. References from identified articles were reviewed to ensure that all relevant papers were included.

Epidemiology

ADHD affects 5 to 7% of school children worldwide, although up to 11% of parents in the USA report their child has been diagnosed with this condition [16, 17]. It is more common in males, at a ratio of approximately 2:1 [18]. ADHD is highly co-morbid with a range of disorders, many of which are associated with increased rates of ACE exposure, including oppositional defiant disorder (ODD), conduct disorder, substance use disorders, and anxiety disorders [19].

ACEs are very common, with 57.8% of a representative US adult sample experiencing at least one ACE, and 21.5% experiencing lifetime prevalence of three or more [20•]. Physical assault is one of the most common ACEs, with a nationally representative US pediatric sample showing that over 50% had experienced a physical assault in the past year [21]. A substantial subset of young people exposed to significant adverse events develops PTSD. A trans-national study of trauma-exposed youth found that 15.9% developed PTSD [8]. Females are two to three times more likely to develop PTSD, with interpersonal violence conferring the highest risk [9]. The prevalence of PTSD varies based on level of trauma exposure. The US National Co-morbidity Surveys found lifetime prevalence of PTSD among adults of 6.8%, while it was 5% among adolescents [22, 23]. PTSD is highly co-morbid with anxiety and depressive disorders, substance use disorders, and self-injury [24, 25].

Given the high prevalence of ADHD, trauma exposure, and PTSD, it is likely that they frequently co-exist. Both conditions have overlapping psychiatric co-morbidities and significantly increase the risk of suicide-related behavior [26, 27]. A Turkish study found that among youth with PTSD, around 22% had co-morbid ADHD [28]. Other studies also found the prevalence of ADHD in traumatized children to be two to five times higher than that of non-traumatized children [29].

Earlier evidence suggested that ADHD was not a risk factor for the development of PTSD [29]. However, more recent evidence seems to contradict this viewpoint. A prospective 10-year study reported ADHD as a significant risk factor for development of PTSD (OR = 2.23) [30]. A meta-analysis by Spencer et al. [31••] found a bidirectional relationship between PTSD and ADHD, including the relative risk for PTSD in individuals with ADHD being four times that of normal controls, and the risk for ADHD in individuals with PTSD being twice that of normal controls. One study reported that childhood physical abuse may predispose to the persistence of ADHD into adulthood, while another reported that ADHD prevalence and severity increased with number

of ACEs [4, 32]. It can be challenging to draw causal associations from such studies though, especially since the date of diagnosis of ADHD is often appreciably different than the date of symptoms which were first identified, especially in adult populations [33].

Neurobiology

The neurobiological underpinnings of ADHD appear to be primarily related to fronto-striatal dysfunction. Saenz et al. [34] reviewed six meta-analyses of MRI volumetric studies in ADHD and reported overall reduced whole brain and grey matter volume. There were also reduced volumes in parts of the basal ganglia of individuals with ADHD, specifically the right lentiform nucleus and the caudate nucleus. It was noted that more recent work shows consistent abnormalities in connections between task networks and the default mode network. In a meta-analysis by Hart et al. [35], ADHD was associated with functional abnormalities related to attention, in the dorsolateral prefrontal cortex, parietal, and cerebellar areas. Functional abnormalities involved with inhibition were also noted in the inferior frontal and anterior cingulate cortices, and supplementary motor area. Newer findings [36] show impairments in several dorsal, ventral, and medial fronto-cingulo-striato-thalamic and fronto-parieto-cerebellar networks, with emerging evidence suggesting abnormalities in orbital and ventromedial prefrontal and limbic areas.

Catecholamine neurotransmitter function, particularly dopamine and norepinephrine, plays a key role in the fronto-striatal circuit abnormalities seen in ADHD. Medications that optimize catecholamine activity can improve regulation of attention, behavior, and emotion. Central nervous system (CNS) stimulants and atomoxetine enhance prefrontal cortical function by increasing noradrenergic and dopaminergic stimulation of alpha-2 and D1 receptors, while guanfacine mimics the enhancing effects of norepinephrine at the post-synaptic alpha-2 receptors, thereby enhancing network connectivity [37].

The neurobiology of PTSD seems driven by aberrant learning, and failure of fronto-limbic inhibition. It has been postulated that PTSD is characterized by exaggerated amygdala responses and diminished prefrontal cortical responses to trauma-related stimuli, as well as diminished hippocampal functioning [38]. Others have reported hyperactivation of the dorsal anterior cingulate cortex, lower activation of dorsomedial prefrontal cortex, and reduced amygdala-medial prefrontal cortex connection in youth [39]. However, it is not yet clear whether these findings represent an underlying vulnerability to PTSD, or are a consequence of trauma exposure. Neurochemical disruptions in PTSD include decreased serotonin in the dorsal and median raphe nuclei, decreased GABA activity, increased glutamate activity, and increased dopamine and norepinephrine levels [40]. Neuroendocrine dysfunction in PTSD centers around the HPA axis and hypocortisolism [41].

Childhood trauma can impair neurobiological development. A dose–response relationship exists between stress in early life and the risk of psychiatric morbidity [42]. Chronic fear leads to increased activation of the HPA axis, causing elevated baseline cortisol levels, and slower decline of cortisol levels after stress exposure. At elevated levels, cortisol has neurotoxic effects. In adolescence, lower cortisol levels and attenuated cortisol reactivity may develop. Chronic stress has been shown to reduce connectivity between the amygdala, hippocampus, and prefrontal cortex. Furthermore, maltreatment is inversely associated with executive function, particularly if such maltreatment begins early and recurs through several developmental periods [43].

In summary, both ADHD and PTSD are characterized by hypofrontality, with impairment of executive function present in both [44–46]. ADHD is a neurodevelopmental disorder, while PTSD develops after an intensely distressing traumatic experience. One may speculate that ADHD is a biological process that gives rise to psychological change. Despite there being neurobiological predispositions to development of PTSD, it may still be thought of as a psychological process that also causes biological change [47, 48]. However, this distinction between neurodevelopmental and experiential etiologies becomes blurred in early childhood because the experience of maltreatment causes impaired neurobiological development.

Clinical Features

ADHD is characterized by significant impairment in impulse control, excessive motor activity, and deficits in attention/concentration [6]. PTSD is characterized by symptoms of intrusion such as nightmares and intrusive memories, avoidance of trauma reminders, negative changes to mood and cognition, and symptoms of excessive arousal [11]. Although seemingly distinct, these symptoms overlap in several important ways. For example, avoidance symptoms of PTSD (efforts not to think about or be reminded of traumatic events) cause forgetfulness and distractibility, which mirror inattentive type ADHD symptoms [49]. Arousal symptoms in DSM-5-TR explicitly include problems with concentration, along with irritability, reckless or self-destructive behavior, and sleep disturbance, all of which may be present in patients with ADHD [11]. Moreover, diminished interest or participation in activities is also common in PTSD. This can easily mimic the functional impairment seen in ADHD where children may avoid activities which they find difficult or where they often receive negative feedback from peers, such as team sports. In young children, trauma re-enactment

through play, and loss of previously acquired milestones, may seem like the inability to follow instructions seen in ADHD. Finally, dissociation in PTSD (via flashbacks, amnesia, depersonalization, or derealization) may mimic the inattention of ADHD.

Complex trauma, as described earlier, may be even more challenging to distinguish from ADHD because of explicit characteristics of impulsivity and deficient emotion regulation. Additionally, these conditions overlap in terms of having high rates of psychiatric co-morbidities, such as anxiety and substance use disorders. Importantly, co-existence of PTSD and ADHD leads to worsening symptoms of each disorder [29, 49].

Assessment

Given overlapping symptoms and high rates of co-morbidity, youth with symptoms suggestive of either ADHD or PTSD should be assessed for both diagnoses, as well as for safety concerns [50]. Because there are several symptoms present in both conditions, such as inattention and irritability, clinicians should assess for more diagnosis-specific symptoms. For example, impulsive behavior during day-to-day activities is typical of ADHD. Impulsive behavior with emotional dysregulation precipitated by trauma reminders would be more in keeping with PTSD.

Thorough history to obtain timelines of symptom onset and exacerbation is crucial. ADHD is a neurodevelopmental disorder, with symptoms starting in childhood, even when they may not be significantly impairing. In contrast, PTSD symptoms are precipitated by a significant traumatic event. The presence of symptoms specific to one condition may not exclude co-existence of the other. In a case where symptom clusters of both conditions emerge, paying attention to the timeline of first symptom manifestation, and subsequent symptom exacerbation in relation to ACE exposure, will be imperative. For example, hyperactivity in a child who later has a first-time ACE would support an ADHD diagnosis, even if the hyperactivity is exacerbated by the ACE. Conversely, a typically developing child who experiences an ACE, then develops attention problems and decline in school performance, is more likely to have this symptom associated with a trauma-related disorder than from new onset ADHD.

During assessment, experiences like motor vehicle accidents or isolated sexual assault are easily identifiable as significant traumatic events. However, it is more challenging to assess chronic ACEs and their impact. Take for example, a child who grows up in poverty, in a single-parent household and witnesses domestic violence, and in a neighborhood of high community violence and substance use, this child may experience ACEs essentially from birth, continuing throughout childhood to adulthood. He might have occasional intrusive memories of violence, from which he might distract himself, but does not believe that these affect his functioning. His concentration and academic performance may be low, but he performs about average when compared to peers in his understaffed school. Assessment should therefore include thorough biopsychosocial evaluation.

In cases where the timeline is unclear, attribution of overlapping symptoms to one disorder or the other may not be possible. Diagnosis of unspecified or other specified trauma and stressor-related disorder should be considered for youth with ADHD exposed to ACEs who do not meet criteria for PTSD, but whose behavioral symptoms are not fully explained by ADHD or another co-morbidity [11]. A child with ADHD who has been bullied but whose only trauma-related symptoms are trauma re-enactment and nightmares may fall into this category. Diagnosis as such will allow for monitoring of symptoms, and referral for effective treatment.

Treatment

Evidence-based psychosocial and pharmacological interventions exist for both ADHD and trauma-related disorders. A comprehensive treatment plan should be created based on multiple key factors including patient age, level of cognitive development, the most concerning symptoms, co-morbidities, social support, caregiver resources, patient and family values, treatment preferences, and treatment availability. Thorough safety assessment is recommended during every interaction. Treatment options should start with those that offer the best risk–benefit ratio for the specific diagnosis, followed by progressive advancement through a treatment algorithm when concerning impairment persists. Our proposed treatment algorithm has been highlighted in Fig. 1.

Psychopharmacology

There are multiple medications approved by the US Food and Drug Administration (FDA) for ADHD, including CNS stimulant and non-stimulant options. The CNS stimulant group primarily includes methylphenidate or mixed amphetamine salt preparations. Non-stimulants include alpha-2 agonists (clonidine and guanfacine) and the norepinephrine reuptake inhibitors (atomoxetine and viloxazine). Pharmacological intervention as monotherapy or with psychotherapy is a reasonable initial treatment option for children six and above who experience persistent impairment as a result of ADHD [51, 52]. Effect sizes for stimulants are generally larger than for non-stimulants [53]. In the Multimodal Treatment of Attention Deficit Hyperactivity Disorder (MTA) study [54], medication (methylphenidate) use alone, and the combination of medication treatment and psychotherapy were consistently

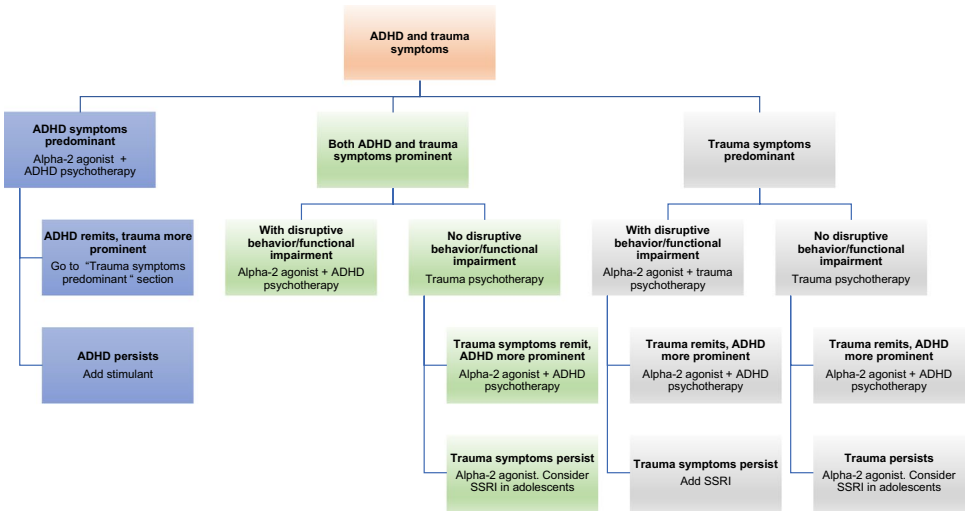

Fig. 1 Treatment algorithm for co-existing ADHD and trauma-related disorders

superior in reducing ADHD symptoms when compared to psychotherapy alone and community care alone. Regarding other areas of functioning such as anxiety symptoms, academic performance, and parent–child relations, combination treatment was better than community care, but medication alone or psychotherapy alone were not. Follow-up study of the MTA dataset showed that stimulant medication is helpful for improving irritability in patients with ADHD [55]. All pharmacological options have class specific adverse effects, and require regular monitoring.

Compared to ADHD, evidence-based pharmacological treatment options for PTSD in children are limited. There are currently no FDA-approved medications for the treatment of PTSD in children, and only two medications, paroxetine and sertraline, are approved for adults [56]. Small randomized clinical trials [57–59] have consistently found no evidence of efficacy of selective serotonin reuptake inhibitor use in the pediatric population. Clinicians therefore often choose a medication based on co-morbidities, clinical experience, or prominent symptoms. For example, SSRIs may be used in patients with co-morbid major depressive disorder or generalized anxiety disorder. Similarly, alpha-2 agonists may be selected for PTSD with prominent arousal symptoms. In an open-label study [60], guanfacine extended-release (mean dose of daily dose of 1.19 mg ± 0.35 mg) over 8 weeks was well-tolerated, with reductions in intrusion,, and arousal symptoms. Prazosin is often used in clinical practice for nightmares associated with PTSD. One retrospective study [61] showed efficacy of prazosin for both sleep disturbances and nightmares in children and adolescents with PTSD. However, one-fourth of participants had treatment emergent adverse effects including dizziness, anxiety, and headache, with the dose range of prazosin of 1–15 mg at bedtime, with 35% of participants receiving ≥ 5 mg/day.

Psychosocial Interventions

There are multiple evidence-based psychosocial interventions for ADHD. Psychotherapy for ADHD centers around behavior modification for younger children, with a focus on working with the caregivers to improve their child's behavior. Psychotherapy is the recommended initial treatment intervention for preschoolers, and may also be utilized for school-aged children and adolescents. With older patients, the therapy should include working with both patients and caregivers. For adolescents, it is essential to respect their autonomy and identify treatment goals that are meaningful to them [62]. It is particularly important to consider psychosocial interventions when pharmacological interventions are inadequately effective, cause adverse effects, or there are other co-morbid behavioral disorders such as ODD. Classroom supports can also be helpful for improving academic and behavioral functioning [51, 52].

There are also evidence-based psychosocial interventions for PTSD including trauma-focused cognitive behavior therapy (TF-CBT) and eye movement desensitization and reprocessing (EMDR) [63]. TF-CBT involves progressive components summarized by the acronym PRACTICE. This stands for psychoeducation, parenting skills, relaxation skills, affective modulation skills, cognitive coping skills, trauma narrative and processing, in-vivo mastery of trauma reminders, conjoint youth-parent sessions, enhancing safety, and future developmental trajectory [58]. EMDR consists of focusing on a traumatic memory, and paying attention to the emotion and physical sensation connected to it, in combination with bilateral stimulation such as saccadic eye movements [64]. Child-parent psychotherapy (CPP) has shown effectiveness in young children [65]. CPP is a dyadic intervention focused on attachment quality and addressing difficulties within the context of the primary attachment

relationship. Targets include responses to trauma reminders, maladaptive internal representations of self and others, and maladaptive behavior.

These psychosocial interventions should also be considered in youth who may have symptoms suggestive of trauma-related disorders, but do not meet full PTSD criteria. If there are symptoms related to borderline personality disorder, dialectical behavior therapy (DBT) should be considered. DBT utilizes cognitive and behavioral techniques such as exposure, contingency management, and cognitive restructuring along with validation and mindfulness, all delivered via individual sessions, group skills training, therapist consultation teams, and telephone coaching as-needed [66].

When Both Conditions Co-exist

Distinct psychotherapies are effective for each condition. Parents/caregivers are a critical focus of behavioral interventions for ADHD. While engaging caregivers in treatment is impactful for trauma, it is important to engage the patient regardless of age. Psychosocial interventions should be considered as first-line treatment in patients presenting with symptoms of both conditions, as these interventions are proven to be effective in both. Furthermore, psychosocial interventions may be particularly impactful for children at increased risk for adverse effects with medication by reducing the dose of stimulant medication needed for optimal control of ADHD symptoms [67].

When both conditions are present and clearly impairing, alpha-2 agonists may be considered, given their favorable side effect profile (especially regarding sleep when compared to CNS stimulants), approved indication for use in ADHD, and safety and efficacy data for managing symptoms of PTSD [60]. There are no contraindications to the use of CNS stimulants in patients with trauma-related disorders; however, their capacity to reduce appetite and increase sleep latency could potentially be harder to tolerate in children already struggling with appetite or sleep disturbance due to exposure to trauma. These medications have been found to be equally effective in youth with ADHD and low or high levels of irritability [55]. However, there have been no controlled studies of CNS stimulants in pediatric patients with ADHD and PTSD.

Conclusion

ADHD and PTSD are common disorders. The overall evidence suggests a concerning cycle of childhood trauma and ADHD. In youth with symptoms of both ADHD and trauma-related disorders, attributing such symptoms to one diagnosis or the other may be challenging. Often, both conditions are present, which poses a challenge to treatment planning. The treatment of the child with both ADHD and a trauma-related disorder is complex, as it depends on the clinical presentation, social supports, and available treatments. There are evidence-based psychosocial interventions for both ADHD and trauma-related disorders, and these should be considered first-line treatment. Evidence-based pharmacological treatments for ADHD and trauma-related disorders should be considered based on symptom profile and associated impairment.

Declarations

Conflict of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

Role of Funder/Sponsor NA

Clinical Trial Registration NA

References

Papers of particular interest, published recently, have been highlighted as:
• Of importance
•• Of major importance

1. Centers for Disease Control and Prevention: data and statistics on children's mental health. https://www.cdc.gov/childrensmentalhealth/data.html (2022). Accessed August 15, 2022.
2. Davidovitch M, Koren G, Fund N, Shrem M, Porath A. Challenges in defining the rates of ADHD diagnosis and treatment: trends over the last decade. BMC Pediatr. 2017;17(1):218. https://doi.org/10.1186/s12887-017-0971-0.
3.• Kazda L, Bell K, Thomas R, McGeechan K, Sims R, Barratt A. Overdiagnosis of attention-deficit/hyperactivity disorder in children and adolescents: a systematic scoping review. JAMA Netw Open. 2021;4(4): e215335. https://doi.org/10.1001/jamanetworkopen.2021.5335. **This study provides evidence of overdiagnosis of ADHD**.
4. Brown NM, Brown SN, Briggs RD, Germán M, Belamarich PF, Oyeku SO. Associations between adverse childhood experiences and ADHD diagnosis and severity. Acad Pediatr. 2017;17(4):349–55. https://doi.org/10.1016/j.acap.2016.08.013.
5. Schilpzand EJ, Sciberras E, Alisic E, Efron D, Hazell P, Jongeling B, et al. Trauma exposure in children with and without ADHD: prevalence and functional impairment in a community-based study of 6–8-year-old Australian children. Eur Child Adolesc Psychiatry. 2018;27(6):811–9. https://doi.org/10.1007/s00787-017-1067-y.
6. Neurodevelopmental Disorders. In: DSM Library. 2022. doi: https://doi.org/10.1176/appi.books.9780890425787.x01_Neurodevelopmental_Disorders#BCFHAEIJ. https://dsm.psychiatryonline.org/doi/full/10.1176/appi.books.9780890425787.x01_Neurodevelopmental_Disorders#BCFHAEIJ. Accessed March 18, 2022.

7. Kalmakis KA, Chandler GE. Adverse childhood experiences: towards a clear conceptual meaning. J Adv Nurs. 2014;70(7):1489–501. https://doi.org/10.1111/jan.12329.
8. Alisic E, Zalta AK, van Wesel F, Larsen SE, Hafstad GS, Hassanpour K, et al. Rates of post-traumatic stress disorder in trauma-exposed children and adolescents: meta-analysis. Br J Psychiatry. 2014;204:335–40. https://doi.org/10.1192/bjp.bp.113.131227.
9. McLaughlin KA, Koenen KC, Hill ED, Petukhova M, Sampson NA, Zaslavsky AM, et al. Trauma exposure and posttraumatic stress disorder in a national sample of adolescents. J Am Acad Child Adolesc Psychiatry. 2013;52(8):815-30.e14. https://doi.org/10.1016/j.jaac.2013.05.011.
10. Bremner JD, Wittbrodt MT. Stress, the brain, and trauma spectrum disorders. Int Rev Neurobiol. 2020;152:1–22. https://doi.org/10.1016/bs.irn.2020.01.004.
11. Trauma and stressor-related Disorders. In: DSM Library. 2022. doi: https://doi.org/10.1176/appi.books.9780890425787.x07_Trauma_and_Stressor_Related_Disorders#BABJAEHE. https://dsm.psychiatryonline.org/doi/full/10.1176/appi.books.9780890425787.x07_Trauma_and_Stressor_Related_Disorders#BABJAEHE.
12. Cloitre M. ICD-11 complex post-traumatic stress disorder: simplifying diagnosis in trauma populations. Br J Psychiatry. 2020;216(3):129–31. https://doi.org/10.1192/bjp.2020.43.
13. Baweja R, Mayes SD, Hameed U, Waxmonsky JG. Disruptive mood dysregulation disorder: current insights. Neuropsychiatr Dis Treat. 2016;12:2115–24. https://doi.org/10.2147/NDT.S100312.
14. Klein DN, Dougherty LR, Kessel EM, Silver J, Carlson GA. A transdiagnostic perspective on youth irritability. Curr Dir Psychol Sci. 2021;30(5):437–43. https://doi.org/10.1177/09637214211035101.
15. Shaw P, Stringaris A, Nigg J, Leibenluft E. Emotion dysregulation in attention deficit hyperactivity disorder. Am J Psychiatry. 2014;171(3):276–93. https://doi.org/10.1176/appi.ajp.2013.13070966.
16. Thomas R, Sanders S, Doust J, Beller E, Glasziou P. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. Pediatrics. 2015;135(4):e994-1001. https://doi.org/10.1542/peds.2014-3482.
17. Visser SN, Danielson ML, Bitsko RH, Holbrook JR, Kogan MD, Ghandour RM, et al. Trends in the parent-report of health care provider-diagnosed and medicated attention-deficit/hyperactivity disorder: United States, 2003–2011. J Am Acad Child Adolesc Psychiatry. 2014;53(1):34-46.e2. https://doi.org/10.1016/j.jaac.2013.09.001.
18. Xu G, Strathearn L, Liu B, Yang B, Bao W. Twenty-year trends in diagnosed attention-deficit/hyperactivity disorder among US children and adolescents, 1997–2016. JAMA Netw Open. 2018;1(4): e181471. https://doi.org/10.1001/jamanetworkopen.2018.1471.
19. Baweja R, Waxmonsky JG. Updates in pharmacologic strategies for emotional dysregulation in attention deficit hyperactivity disorder. Child Adolesc Psychiatr Clin N Am. 2022;31(3):479–98. https://doi.org/10.1016/j.chc.2022.02.003.
20.• Giano Z, Wheeler DL, Hubach RD. The frequencies and disparities of adverse childhood experiences in the U.S. BMC Public Health. 2020;20(1):1327. https://doi.org/10.1186/s12889-020-09411-z. **This study illustrates the high frequency of ACEs**.
21. Finkelhor D, Ormrod R, Turner H, Hamby SL. The victimization of children and youth: a comprehensive, national survey. Child Maltreat. 2005;10(1):5–25. https://doi.org/10.1177/1077559504271287.
22. Department of Health Care Policy: National Comorbidity Survey. https://www.hcp.med.harvard.edu/ncs/index.php (2005). Accessed.
23 Merikangas KR, He JP, Burstein M, Swanson SA, Avenevoli S, Cui L, et al. Lifetime prevalence of mental disorders in U.S. adolescents: results from the National Comorbidity Survey Replication-Adolescent Supplement (NCS-A). J Am Acad Child Adolesc Psychiatry. 2010;49(10):980–9. https://doi.org/10.1016/j.jaac.2010.05.017.
24. Lewis SJ, Arseneault L, Caspi A, Fisher HL, Matthews T, Moffitt TE, et al. The epidemiology of trauma and post-traumatic stress disorder in a representative cohort of young people in England and Wales. Lancet Psychiatry. 2019;6(3):247–56. https://doi.org/10.1016/S2215-0366(19)30031-8.
25. Copeland WE, Keeler G, Angold A, Costello EJ. Traumatic events and posttraumatic stress in childhood. Arch Gen Psychiatry. 2007;64(5):577–84. https://doi.org/10.1001/archpsyc.64.5.577.
26. Dickerson Mayes S, Calhoun SL, Baweja R, Mahr F. Suicide ideation and attempts in children with psychiatric disorders and typical development. Crisis. 2015;36(1):55–60. https://doi.org/10.1027/0227-5910/a000284.
27. Miranda-Mendizabal A, Castellví P, Parés-Badell O, Alayo I, Almenara J, Alonso I, et al. Gender differences in suicidal behavior in adolescents and young adults: systematic review and meta-analysis of longitudinal studies. Int J Public Health. 2019;64(2):265–83. https://doi.org/10.1007/s00038-018-1196-1.
28. Ünver H, Karakaya I. The assessment of the relationship between ADHD and posttraumatic stress disorder in child and adolescent patients. J Atten Disord. 2019;23(8):900–3. https://doi.org/10.1177/1087054716677818.
29 Ford JD, Connor DF. ADHD and posttraumatic stress disorder (PTSD). Curr Atten Disord Rep. 2009;1(2):60–6. https://doi.org/10.1007/s12618-009-0009-0.
30. Biederman J, Petty C, Spencer TJ, Woodworth KY, Bhide P, Zhu J, et al. Is ADHD a risk for posttraumatic stress disorder (PTSD)? Results from a large longitudinal study of referred children with and without ADHD. World J Biol Psychiatry. 2014;15(1):49–55. https://doi.org/10.3109/15622975.2012.756585.
31.•• Spencer AE, Faraone SV, Bogucki OE, Pope AL, Uchida M, Milad MR, et al. Examining the association between posttraumatic stress disorder and attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. J Clin Psychiatry. 2016;77(1):72–83. https://doi.org/10.4088/JCP.14r09479. **This study shows the bi-directional relationship between PTSD and ADHD**.
32. Ferrer M, Andión Ó, Calvo N, Ramos-Quiroga JA, Prat M, Corrales M, et al. Differences in the association between childhood trauma history and borderline personality disorder or attention deficit/hyperactivity disorder diagnoses in adulthood. Eur Arch Psychiatry Clin Neurosci. 2017;267(6):541–9. https://doi.org/10.1007/s00406-016-0733-2.
33. Oliva F, Malandrone F, Mirabella S, Ferreri P, di Girolamo G, Maina G. Diagnostic delay in ADHD: Duration of untreated illness and its socio-demographic and clinical predictors in a sample of adult outpatients. Early Interv Psychiatry. 2021;15(4):957–65. https://doi.org/10.1111/eip.13041.
34. Albajara Sáenz A, Villemonteix T, Massat I. Structural and functional neuroimaging in attention-deficit/hyperactivity disorder. Dev Med Child Neurol. 2019;61(4):399–405. https://doi.org/10.1111/dmcn.14050.
35. Hart H, Radua J, Nakao T, Mataix-Cols D, Rubia K. Meta-analysis of functional magnetic resonance imaging studies of inhibition and attention in attention-deficit/hyperactivity disorder: exploring task-specific, stimulant medication, and age

effects. JAMA Psychiat. 2013;70(2):185–98. https://doi.org/10.1001/jamapsychiatry.2013.277.
36. Rubia K. Cognitive neuroscience of attention deficit hyperactivity disorder (ADHD) and its clinical translation. Front Hum Neurosci. 2018;12:100. https://doi.org/10.3389/fnhum.2018.00100.
37. Arnsten AF, Pliszka SR. Catecholamine influences on prefrontal cortical function: relevance to treatment of attention deficit/hyperactivity disorder and related disorders. Pharmacol Biochem Behav. 2011;99(2):211–6. https://doi.org/10.1016/j.pbb.2011.01.020.
38. Rauch SL, Shin LM, Phelps EA. Neurocircuitry models of posttraumatic stress disorder and extinction: human neuroimaging research–past, present, and future. Biol Psychiatry. 2006;60(4):376–82. https://doi.org/10.1016/j.biopsych.2006.06.004.
39. Wolf RC, Herringa RJ. Prefrontal-amygdala dysregulation to threat in pediatric posttraumatic stress disorder. Neuropsychopharmacology. 2016;41(3):822–31. https://doi.org/10.1038/npp.2015.209.
40. Sherin JE, Nemeroff CB. Post-traumatic stress disorder: the neurobiological impact of psychological trauma. Dialogues Clin Neurosci. 2011;13(3):263–78.
41. Panagiota Pervanidou, Chrousos GP. Neuroendocrinology of ost-traumatic stress disorder. Prog Brain Res. 2010;182:149–60. https://doi.org/10.1016/S0079-6123(10)82005-9.
42. Norman RE, Byambaa M, De R, Butchart A, Scott J, Vos T. The long-term health consequences of child physical abuse, emotional abuse, and neglect: a systematic review and meta-analysis. PLoS Med. 2012;9(11): e1001349. https://doi.org/10.1371/journal.pmed.1001349.
43. Cross D, Fani N, Powers A, Bradley B. Neurobiological development in the context of childhood trauma. Clin Psychol (New York). 2017;24(2):111–24. https://doi.org/10.1111/cpsp.12198.
44. Rubia K, Overmeyer S, Taylor E, Brammer M, Williams SC, Simmons A, et al. Hypofrontality in attention deficit hyperactivity disorder during higher-order motor control: a study with functional MRI. Am J Psychiatry. 1999;156(6):891–6. https://doi.org/10.1176/ajp.156.6.891.
45. Bremner JD, Staib LH, Kaloupek D, Southwick SM, Soufer R, Charney DS. Neural correlates of exposure to traumatic pictures and sound in Vietnam combat veterans with and without posttraumatic stress disorder: a positron emission tomography study. Biol Psychiatry. 1999;45(7):806–16. https://doi.org/10.1016/s0006-3223(98)00297-2.
46. Brown TE. ADD/ADHD and impaired executive function in clinical practice. Curr Psychiatry Rep. 2008;10(5):407–11. https://doi.org/10.1007/s11920-008-0065-7.
47. Admon R, Milad MR, Hendler T. A causal model of post-traumatic stress disorder: disentangling predisposed from acquired neural abnormalities. Trends Cogn Sci. 2013;17(7):337–47. https://doi.org/10.1016/j.tics.2013.05.005.
48. Roeckner AR, Oliver KI, Lebois LAM, van Rooij SJH, Stevens JS. Neural contributors to trauma resilience: a review of longitudinal neuroimaging studies. Transl Psychiatry. 2021;11(1):508. https://doi.org/10.1038/s41398-021-01633-y.
49. Szymanski K, Sapanski L, Conway F. Trauma and ADHD — association or diagnostic confusion? A clinical perspective. J Infant Child Adolesc Psychother. 2011;10(1):51–5. https://doi.org/10.1080/15289168.2011.575704.
50. Pliszka S, Issues AWGoQ. Practice parameter for the assessment and treatment of children and adolescents with attention-deficit/hyperactivity disorder. J Am Acad Child Adolesc Psychiatry. 2007;46(7):894–921. https://doi.org/10.1097/chi.0b013e318054e724.
51. Wolraich ML, Hagan JF, Allan C, Chan E, Davison D, Earls M, et al. Clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. Pediatrics. 2019;144(4). https://doi.org/10.1542/peds.2019-2528.
52. Wolraich ML, Hagan JF, Allan C, et al; Subcommittee on children and adolescents with attention-deficit/hyperactive disorder. Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents. Pediatrics. 2020;145(3). https://doi.org/10.1542/peds.2019-3997.
53. Stuhec M, Munda B, Svab V, Locatelli I. Comparative efficacy and acceptability of atomoxetine, lisdexamfetamine, bupropion and methylphenidate in treatment of attention deficit hyperactivity disorder in children and adolescents: a meta-analysis with focus on bupropion. J Affect Disord. 2015;178:149–59. https://doi.org/10.1016/j.jad.2015.03.006.
54. A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. The MTA Cooperative Group. Multimodal Treatment Study of Children with ADHD. Arch Gen Psychiatry. 1999;56(12):1073–86. https://doi.org/10.1001/archpsyc.56.12.1073.
55 Fernández de la Cruz L, Simonoff E, McGough JJ, Halperin JM, Arnold LE, Stringaris A. Treatment of children with attention-deficit/hyperactivity disorder (ADHD) and irritability: results from the multimodal treatment study of children with ADHD (MTA). J Am Acad Child Adolesc Psychiatry. 2015;54(1):62-70.e3. https://doi.org/10.1016/j.jaac.2014.10.006.
56. Akiki TJ, Abdallah CG. Are there effective psychopharmacologic treatments for PTSD? J Clin Psychiatry. 2018;80(3). https://doi.org/10.4088/JCP.18ac12473.
57. Robb AS, Cueva JE, Sporn J, Yang R, Vanderburg DG. Sertraline treatment of children and adolescents with posttraumatic stress disorder: a double-blind, placebo-controlled trial. J Child Adolesc Psychopharmacol. 2010;20(6):463–71. https://doi.org/10.1089/cap.2009.0115.
58. Cohen JA, Mannarino AP, Perel JM, Staron V. A pilot randomized controlled trial of combined trauma-focused CBT and sertraline for childhood PTSD symptoms. J Am Acad Child Adolesc Psychiatry. 2007;46(7):811–9. https://doi.org/10.1097/chi.0b013e3180547105.
59. Robert R, Tcheung WJ, Rosenberg L, Rosenberg M, Mitchell C, Villarreal C, et al. Treating thermally injured children suffering symptoms of acute stress with imipramine and fluoxetine: a randomized, double-blind study. Burns. 2008;34(7):919–28. https://doi.org/10.1016/j.burns.2008.04.009.
60. Connor DF, Grasso DJ, Slivinsky MD, Pearson GS, Banga A. An open-label study of guanfacine extended release for traumatic stress related symptoms in children and adolescents. J Child Adolesc Psychopharmacol. 2013;23(4):244–51. https://doi.org/10.1089/cap.2012.0119.
61. Keeshin BR, Ding Q, Presson AP, Berkowitz SJ, Strawn JR. Use of Prazosin for pediatric PTSD-associated nightmares and sleep disturbances: a retrospective chart review. Neurol Ther. 2017;6(2):247–57. https://doi.org/10.1007/s40120-017-0078-4.
62. Baweja R, Soutullo CA, Waxmonsky JG. Review of barriers and interventions to promote treatment engagement for pediatric attention deficit hyperactivity disorder care. World J Psychiatry. 2021;11(12):1206–27. https://doi.org/10.5498/wjp.v11.i12.1206.
63. Diehle J, Opmeer BC, Boer F, Mannarino AP, Lindauer RJ. Trauma-focused cognitive behavioral therapy or eye movement desensitization and reprocessing: what works in children with posttraumatic stress symptoms? A randomized controlled trial. Eur Child Adolesc Psychiatry. 2015;24(2):227–36. https://doi.org/10.1007/s00787-014-0572-5.

64. Rodenburg R, Benjamin A, de Roos C, Meijer AM, Stams GJ. Efficacy of EMDR in children: a meta-analysis. Clin Psychol Rev. 2009;29(7):599–606. https://doi.org/10.1016/j.cpr.2009.06.008.
65. Lieberman AF, Van Horn P, Ippen CG. Toward evidence-based treatment: child-parent psychotherapy with preschoolers exposed to marital violence. J Am Acad Child Adolesc Psychiatry. 2005;44(12):1241–8. https://doi.org/10.1097/01.chi.0000181047.59702.58.
66. Linehan MM, Korslund KE, Harned MS, Gallop RJ, Lungu A, Neacsiu AD, et al. Dialectical behavior therapy for high suicide risk in individuals with borderline personality disorder: a randomized clinical trial and component analysis. JAMA Psychiat. 2015;72(5):475–82. https://doi.org/10.1001/jamapsychiatry.2014.3039.
67. Pelham WE, Burrows-MacLean L, Gnagy EM, Fabiano GA, Coles EK, Wymbs BT, et al. A dose-ranging study of behavioral and pharmacological treatment in social settings for children with ADHD. J Abnorm Child Psychol. 2014;42(6):1019–31. https://doi.org/10.1007/s10802-013-9843-8.