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Attention-deficit/hyperactivity disorder and post-traumatic stress disorder adult comorbidity: a systematic review

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Abstract

Background Both attention-deficit hyperactivity disorder (ADHD) and post-traumatic stress disorder (PTSD) are complicated illnesses that sometimes co-occur in children and adults with significant negative influence on a person's life and general well-being.

Aim This study aims to conduct a systematic review that investigates the comorbidity of PTSD and ADHD in the adult population.

Methods A comprehensive search was conducted across five electronic databases (PsycNET, Cochrane, PubMed, Google Scholar, and ClinicalTrials.gov) between October 5 and 20, 2023, using predefined keywords including "ADHD," "PTSD," and "comorbidity." Studies were included if they involved adult participants (≥ 18 years) with both ADHD and PTSD diagnoses. Two independent reviewers conducted screening and data extraction. No meta-analysis was performed due to heterogeneity in study designs. The results were synthesized qualitatively.

Results Out of 818 identified studies, 21 met the inclusion criteria. Studies reported an increased risk of developing PTSD in individuals with ADHD, with the prevalence of comorbidity ranging between 28 and 36%. ADHD in PTSD patients was associated with greater psychosocial impairment, more severe PTSD symptoms, and functional difficulties. Treatment approaches, including pharmacotherapy (atomoxetine, Vyvanse) and mindfulness training, showed potential benefits for managing comorbid symptoms.

Conclusions ADHD and PTSD commonly co-occur in adults, leading to more severe clinical outcomes. Early diagnosis and effective treatment of ADHD may reduce the risk of developing PTSD. Further research is needed to explore the underlying mechanisms and optimal treatment strategies for individuals with ADHD/PTSD comorbidity.

Systematic review registration PROSPERO CRD42023479631.

Keywords ADHD, PTSD, Comorbidity, Adults, Systematic review, Treatment

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Introduction

Attention-deficit hyperactivity disorder (ADHD) is a complicated clinical illness that has been difficult to diagnose and assess. Between 1 and 20% of kids are said to have ADHD, according to estimates [14]. Academic challenges are common in children with ADHD, and these include math underachievement as well as reading and math developmental issues. Additionally, they could act rudely to other students, be uncooperative, and engage in disruptive and inattentive behavior [18]. Despite being frequently linked to childhood, ADHD can also have an impact on adults. Adults with ADHD frequently struggle with issues related to concentration, impulsivity, and hyperactivity, which can have a significant negative effect on a variety of aspects of their lives. They could have trouble staying organized, managing their time, and maintaining their attention on assignments. Adults with ADHD may also struggle in their relationships, careers, and intellectual endeavors [8].

Post-traumatic stress disorder (PTSD) is a mental health condition that can develop in individuals who have experienced or witnessed a traumatic event. It is distinguished by a variety of symptoms that linger after the traumatic incident and seriously impair normal functioning [46–48]. Invading thoughts or recollections of the event, nightmares, flashbacks, severe emotional discomfort, avoiding reminders of the incident, hypervigilance, and changes in mood or cognition are all common symptoms of PTSD. These symptoms can be crippling and have a significant negative influence on a person's relationships, career, and general well-being [23].

A clear link between ADHD and PTSD has been seen in recent work. Clinical and epidemiological research has repeatedly demonstrated a strong link between PTSD and ADHD in adult populations. For instance, Shura et al. [40] observed that war veterans with PTSD were more likely to have ADHD, indicating that ADHD may be a risk factor for the development of PTSD. According to Bolstad, Lien, and Bramness [11], adults with PTSD experienced ADHD symptoms when they were children, compared to people without PTSD. Furthermore, there was a strong link between childhood ADHD levels and PTSD scale scores. According to Biederman et al. [9], the sample showed a bidirectional and significant risk between PTSD and ADHD, demonstrating that bias cannot account for the link.

The prevalence rates of ADHD range from 1 to 4% in adults [17]. On the other hand, psychological trauma is thought to be prevalent across a range of sociodemographic, national, and cultural groups, with a prevalence of 33 to 50%. According to research, people with ADHD are more likely to experience psychological stress. According to a recent study, people with ADHD had a much higher risk of developing PTSD than people without the disorder. The rates of psychiatric comorbidity were also greater in PTSD patients with ADHD [44, 46, 48]. Similar trends have been seen in pediatric studies, which suggests that PTSD and ADHD are both more prone to develop in young people. Youth with ADHD have a significantly higher chance of developing PTSD than controls without the disease, according to a longitudinal follow-up study of children with ADHD [9].

Significant clinical, scientific, and public health ramifications result from a greater comprehension of the connection between PTSD and ADHD. If ADHD makes people more likely to experience PTSD following traumatic events, this is important information for clinicians who work with children and adults who have ADHD. Additionally, it would affect how comorbid ADHD and PTSD clients are diagnosed and receive services [32]. Adults with ADHD should be regarded as a high-risk population for acquiring PTSD given the high frequency of the disorder and its correlation with impulsivity and mishaps. From a scientific standpoint, this information might help improve investigations into the underlying mechanisms of PTSD connected to ADHD [37].

The link between ADHD and PTSD in children has been the subject of a sizable body of systematic reviews; however, the same cannot be stated for adults. The co-occurrence, symptom profiles, and clinical implications of ADHD and PTSD in pediatric populations have been the subject of numerous systematic reviews [10, 13, 29]. The lack of systematic studies focusing on this issue in adults, however, points to a considerable knowledge gap in the field today. For thorough evaluation, precise diagnosis, and efficient treatment planning, it is essential to comprehend how ADHD and PTSD interact in adult populations.

The purpose of this review is to improve the knowledge of ADHD/PTSD comorbidity in order to offer crucial insights for diagnosis and treatment approaches. The scientific literature that currently exists investigating ADHD in adults with PTSD is critically analyzed in this review. The literature search and subsequent evidence synthesis were guided by the central question: (i) Is there a connection between ADHD and PTSD in adults? Additionally, the review addresses the following research inquiry in order to fully analyze the evidence: (ii) Does the degree of ADHD correlate with how severe PTSD symptoms are?

Aim

The current work aims to conduct a systematic review that investigates the comorbidity of PTSD and ADHD in the adult population. The review will look at the prevalence of comorbidity, the clinical traits and symptom profiles of people who have both PTSD and ADHD, and how

this co-occurring condition affects many aspects of functioning and quality of life. This review aims to increase our knowledge of the connection between adult PTSD and ADHD, identify possible shared underlying mechanisms, and highlight the implications for the evaluation, diagnosis, and treatment of people with this comorbidity.

Methods

This systematic review followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (Supplement 1) [35]. The process included the following: (i) developing research questions, (ii) conducting a comprehensive literature search, (iii) selecting studies based on predefined inclusion criteria, (iv) extracting relevant data, and (v) synthesizing and reporting the findings.

Literature search

A comprehensive search was conducted across the following electronic databases: PsycNET, Cochrane, PubMed, Google Scholar, and ClinicalTrials.gov. between October 5 and 20, 2023. The search aimed to identify studies that reported on comorbid ADHD and PTSD in adults. Keywords used in various combinations with Boolean operators ("AND," "OR") included the following: "Attention Deficit Hyperactivity Disorder," "ADHD," "Post-Traumatic Stress Disorder," "PTSD," "comorbidity," "association," and "relationship." The search was restricted to peer-reviewed articles published in English. Additional studies were identified by reviewing the reference lists of selected articles. A full search strategy, including the specific search strings used for each database, is available in the supplementary materials (supplement S2).

Study selection

This review covered all research on ADHD/PTSD comorbidity, regardless of the publication year. Studies have to meet the following requirements in order to be included: (i) peer-reviewed journal publication, (ii) original empirical research reporting, and (iii) publication in English or detailed English abstract. The current review employed all papers which studied clients from the adult population (18 years old or more) who had confirmed diagnosis or showing clinical symptoms of ADHD and PTSD. Researchers excluded studies that only studied children (under 18 years of age). Whenever there was a question as to whether a study satisfied the inclusion criteria, the researchers reexamined the paper's title and abstract and came to a decision together.

PICO framework

The systematic review was structured using the PICO (population, intervention, comparison, and outcome) framework to guide the literature search and data extraction.

- Population (P): Adult individuals (aged 18 years and older) with confirmed diagnoses of attention-deficit/hyperactivity disorder (ADHD) and post-traumatic stress disorder (PTSD). Studies focusing on children or adolescents under 18 were excluded.
- Intervention/exposure (I): The presence of ADHD symptoms or diagnosis in individuals diagnosed with PTSD, assessing the impact on symptom severity, psychosocial functioning, and quality of life.
- Comparison (C): Studies comparing individuals with comorbid ADHD/PTSD to those with only PTSD, only ADHD, or healthy controls without these disorders, if available.
- Outcomes (O): Primary outcomes included the prevalence and severity of ADHD/PTSD comorbidity, impact on psychosocial and functional impairment, and treatment outcomes (e.g., symptom reduction, quality-of-life improvement) using interventions such as pharmacological or non-pharmacological therapies.

Data extraction

Data extraction was conducted using a standardized form in Microsoft Excel. Information was extracted on the following variables: authors, title, publication year, journal, sample size, study population, study design, ADHD/PTSD comorbidity rates, key results, and conclusions related to the ADHD/PTSD comorbidity. Two authors independently performed data extraction from all included studies to ensure consistency and accuracy. Any discrepancies between the authors were resolved through discussion and consensus, with a third author consulted when necessary. This process minimized bias and ensured the reliability of the extracted data.

Data sought and handling of missing data

In this systematic review, the primary outcomes sought included the prevalence of comorbid ADHD and PTSD, the severity of symptoms, and the effectiveness of interventions. Specifically, data were extracted on the prevalence of co-occurring ADHD and PTSD, measured through validated diagnostic tools, as well as the severity of both conditions using standardized symptom scales. Additionally, functional impairment, as reflected in participants' psychosocial functioning, was recorded where available. For treatment outcomes, we sought data on the effects of both pharmacological interventions and non-pharmacological approaches with an emphasis on symptom reduction and improvements in quality of life. For

studies with missing or unclear data, several strategies were employed. In cases where data for certain outcomes were not reported, these outcomes were considered missing and were excluded from the final synthesis. No attempts were made to impute missing data.

Data synthesis

A qualitative synthesis was performed to analyze the findings of the included studies. Given the significant heterogeneity in study designs, sample populations, and outcome measures, a meta-analysis was not feasible. Instead, we identified key themes and patterns related to ADHD and PTSD comorbidity, including the prevalence of co-occurrence, symptom severity, psychosocial impairments, and the effects of different treatment approaches. The results were synthesized narratively to provide a comprehensive understanding of the relationship between ADHD and PTSD in adult populations.

Critical appraisal

To assess the quality and risk of bias in the included studies, a critical appraisal was performed. For randomized controlled trials, we used the Cochrane risk-of-bias tool, while the Newcastle–Ottawa scale (NOS) was applied to evaluate observational studies. The appraisal focused on study design, sample size, measurement of outcomes, and control for confounding factors. Any discrepancies between reviewers were resolved through discussion. Additionally, the GRADE (Grading of Recommendations, Assessment, Development, and Evaluations) framework was employed to assess the certainty of evidence across studies. The GRADE evaluation considered factors such as study limitations, consistency of results, precision, and risk of publication bias. The results of this critical appraisal are summarized in Supplement S3.

Results

The search identified 816 articles, of which 810 endured after eliminating duplicates. The selection development is indicated as a flow chart in Fig. 1 (according to PRISMA). The final number of articles included in this review was 21 articles.

The studies included in the review were created between 2004 and 2024 and has *three* identified themes: (i) Studies with direct investigation of the comorbidity of ADHD and PTSD in adults ($n=14$) [1, 2, 4, 12, 15, 22, 24, 28, 30–32, 36, 41, 44], (ii) studies with a sample of comorbid ADHD/PTSD diagnosis examining the effect of treatment on the symptoms of both ADHD and PTSD ($n=4$) [7, 26, 39, 43], and (iii) studies investigating the

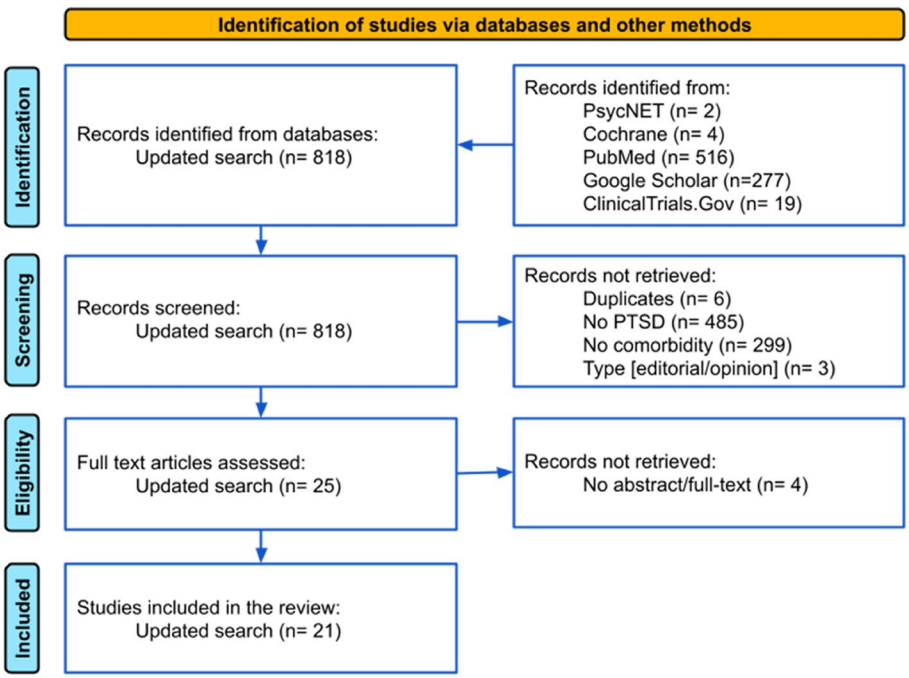

Fig. 1 Flow diagram of the search strategy, modified from Moher et al. (2009). A search across 5 databases turned up a total of 818 items. Twenty-one publications were selected for inclusion in the current review after screening and evaluation

relationship between ADHD and other psychological disorders including PTSD ($n=3$) [27, 34, 38]. Additionally, the results are arranged based on whether bivariate analyses or more advanced analytical techniques that accounted for potential confounding variables in the relationship between ADHD and CSA were used in the research. See Table 1 for detailed information about the listed research, and a critical appraisal of the included studies' risk of bias is summarized below and detailed in Supplement S3.

Sociodemographic and clinical characteristics

The range of participants for the studies included in the review was 1 in case studies to 79,006 adults in large national surveys. Of these, 2 studies (9.5%) are case studies with only 1 case of comorbid ADHD/PTSD diagnosis, 3 studies (14.3%) included a number of participants smaller than 100 (with a range between 11 and 44), 14 studies (66.7%) a number between 100 and 600 (with a range between 123 and 551), and 4 studies (9.5%) were much larger, with 4612 and 2,082,118 participants (Table 1).

Additionally, concerning study *location*, all studies were conducted in the USA except for six studies conducted in France [15], Korea [30], Northern Finland [31], Germany [32], Turkey [36], and Norway [38]. Two more studies with a sample from Europe [41] and an international sample were added [12].

In regard to *age and gender*, 15 studies (71.4%) frankly mentioned the age of participants either by range, mean, or median. The age ranges were all between 18 and 68 years of age. Four studies (19%) either just mentioned that their sample included adults or participant's age were implied in the form of them being veterans, army personnel, smokers, or university students [24, 28, 32, 44]. For gender, while most studies used a mixed gender approach, the two case studies (9.5%) included in the review had female subjects [7, 26], and three studies (14.3%) focused predominantly on male subject [1, 2, 27].

Regarding *subjects' background*, one study (4.8%) was conducted on university students [36], two studies (9.5%) used alcohol-dependent inpatients [15, 32], seven studies (33.3%) employed outpatient clients and individuals from the public [4, 7, 26, 31, 34, 38, 44], and nine studies (42.9%) focused principally on veterans, new army recruits, and military personnel on active duty [1, 2, 22, 24, 27, 28, 30, 39, 43].

Moreover, all included studies had participants with predetermined *diagnosis* of either ADHD, PTSD, or both or with either one officially diagnosed and the other

Table 1 Overview of studies included in the review

Reference	Study type	Sample	Sample type	Country
Adams et al. (2017) [1]	Cross-sectional	160	Veterans	USA
Adler et al. (2004) [2]	Cross-sectional	47	Veterans	USA
Antshel et al. (2013) [4]	Cross-sectional	329	Public	USA
Barreto et al. (2022) [7]	Case report	1	Public	USA
Cao et al. (2022) [12]	Analyzed genome-wide association studies	657,470	Public	Non-specific
El Ayoubi et al. (2021) [15]	Cross-sectional	551	Alcohol use disorder (AUD) inpatients	France
Harrington et al. (2012) [22]	Cross-sectional	222	Veterans	USA
Howlett et al. (2018) [24]	Cross-sectional	4612	US Army soldiers	USA
Kasahara et al. (2023) [26]	Case report	1	Domestic violence victim	USA
Kimbrel et al. (2017) [27]	Cross-sectional	140	Veterans	USA
Knight et al. (2023) [28]	Cross-sectional	313	Veterans	USA
Lee et al. (2012) [30]	Cross-sectional	224	New army recruits	Korea
Lu et al. (2008) [31]	Cross-sectional	630	Family-based sample of trios (an ADHD child and their parents)	Northern Finland
Luderer et al. (2020) [32]	Cross-sectional	341	Alcohol-dependent long-term residential treatment	Germany
Mitchell et al. (2012) [34]	Cross-sectional	123	Public	USA
Ozdemir et al. (2015) [36]	Cross-sectional	317	University students	Turkey
Peleikis et al. (2022) [38]	Cross-sectional	250	Outpatient	Norway
Rice et al. (2018) [39]	Cross-sectional	133	Active military duty and veteran	USA
Wang et al. (2022) [43]	Randomized placebo-controlled trial	44	Veterans	USA
Wendt et al. (2023) [44]	Cross-sectional	2,082,118	Public	USA
Song et al. (2024) [41]	Two-sample Mendelian randomization (MR) analysis	535,686	Public	Europe

condition being assessed against the criteria of the *Diagnostic and Statistical Manual of Psychiatric Disorders* (DSM). One study (4.8%) had children participants diagnosed with ADHD and their parents who met the criteria for both ADHD and PTSD diagnosis but were not in point of fact diagnosed [31]. Two studies (9.5%) included the genetic profiles from previous samples [12, 41].

Seven studies (33.3%) refrained from mentioning the *type of trauma* participants had [4, 12, 30–32, 39, 41]. Other studies included the specific type of trauma participants experienced, including the following: Afghanistan war started in 2001, Iraq war started in 2003 [1, 2, 22, 24, 27, 43],sexual and physical assault [7], domestic violence [26], the September 11, 2001; attacks on the World Trade Center in New York, USA [28], the Van earthquake in Van, Turkey, in 2011 [36], and other nonspecific traumas [15, 34, 38, 44].

ADHD/PTSD comorbidity

Overall, all studies reported association between ADHD and PTSD, either those with an official diagnosis or who fit the criteria of the DSM for either or both. The relationship between ADHD and PTSD along with a summary of the noteworthy results for each study is shown in Table 2. On that dimension, authors divided the studies included in the review into four dimensions.

(i) Studies examine the comorbidity of ADHD in a sample with PTSD ($n=8$, 42.1%).
(ii) Studies examine the comorbidity of PTSD in a sample with ADHD ($n=4$, 21.1%).
(iii) Studies examine a sample with comorbid ADHD/PTSD ($n=5$, 26.3%).
(iv) Studies examine the genetics behind ADHD/PTSD comorbidity ($n=2$, 10.5%) (Table 2).

The data from various research were integrated in the systematic review to estimate the average comorbidity rates of PTSD and ADHD. The current research revealed that the prevalence of ADHD was roughly 28% in people with PTSD and approximately 36% in people with ADHD. These figures show how often the two disorders overlap and emphasize how important it is for professionals to check both conditions thoroughly when one is diagnosed.

ADHD in a sample with PTSD

Eight studies were found to examine a sample with PTSD for symptoms of ADHD. In the study of Adler et al. [2], in a sample of veterans ($n=47$), researchers found among two groups of PTSD ($n=25$) and panic disorder ($n=22$) matching criteria for childhood ADHD (36% vs. 9%) and current ADHD (28% vs. 5%). Those with childhood ADHD began to exhibit symptoms of ADHD before developing PTSD, perhaps as a result of the military-related nature of their trauma. On the other hand, none of the PTSD patients had a history of severe childhood trauma. These results offer strong evidence that in comparison to patients with panic disorder, those with PTSD were significantly more likely to have had ADHD as a child.

Furthermore, the study of Harrington et al. [22] ($n=222$) found that those who matched the criteria for current PTSD ($n=121$, 54.5%) also met the criteria for current adult ADHD ($n=14$, 6.2%). The intensity of ADHD and the extent of trauma exposure were important indicators of the severity of present PTSD. As well as this, Howlett et al. [24] uncovered that premilitary-placement ADHD was linked to a higher risk of post placement occurrence of PTSD after controlling for other risk variables. Also, in the study of Kimbrel et al. [27], the sample of male veterans ($n=140$), compared to veterans without PTSD ($n=62$, 44.3%) and veterans with PTSD ($n=78$, 55.7%), had a considerably higher likelihood of reporting symptoms of ADHD (36% vs. 11%).

Knight et al. [28] ($n=313$) discovered that on trails-number sequencing, veterans with both ADHD and PTSD proceeded noticeably worse than any other group. In comparison to other groups, veterans with PTSD alone ($n=140$, 44.6%) and with PTSD/ADHD ($n=27$, 8.6%) comorbid symptoms reported much lower functional status. Aside from this, another study by Lee et al. [30] on new army recruits in Korea ($n=224$) showed that PTSD symptoms during the first week of basic military training were significantly predicted by both past ($n=44$, 19.6%) and present ($n=4$, 1.8%) ADHD symptoms. After 5 weeks of basic military training, the first week's PTSD symptoms were also a significant risk factor for developing PTSD. Considering these results, authors were able to confirm the relationships between PTSD symptoms and previous and present ADHD symptoms.

In nonmilitary-base samples, the study of Luderer et al. [32] is on alcohol-dependent long-term inpatients in Germany ($n=341$). Patient's ADHD diagnosis ($n=66$, 19.4%) had higher frequency of potential traumatic exposure than those without ADHD (88% vs. 65%). They proposed that probabilities of PTSD were greater in patients with ADHD than in patients without ADHD. Additionally, there was a higher level of functional impairment and PTSD severity among ADHD individuals. Moreover, Mitchell et al. [34] studied a public sample with nonspecific traumas ($n=123$) and found that the group of smokers with PTSD ($n=55$, 44.7%) scored higher in Conners Adult ADHD Rating Scale (CAARS) and significantly more severe symptoms of DSM-IV inattentive (mean ± SD, 11.47 ± 5.76 vs. 5.50 ± 3.79) and hyperactive

Table 2 Overview of the main findings and highlights of studies included in the review organized by dimensions

Reference	Findings	Highlights
Adler et al. (2004) [2]	In a sample of veterans ($n=47$) • In PTSD group ($n=25$) and panic disorder ($n=22$) Childhood ADHD (36% vs. 9%) and current ADHD (28% vs. 5%)	Significant association of PTSD with ADHD. ADHD may increase the vulnerability for developing PTSD
Harrington et al. (2012) [22]	In a sample of ($n=222$) • Current PTSD ($n=121$, 54.5%) • Current adult ADHD ($n=14$, 6.2%)	The intensity of ADHD influenced the severity of current PTSD
Howlett et al. (2018) [24]	• ADHD predeployment was 6.1% ($SE=0.4\%$) • Pre-deployment ADHD was associated with risk of post-deployment PTSD and adjusted odds ratio (AOR) = 2.13, 95% CI [1.51, 3.00], and $p<.001$ • Incidence among soldiers with no pre-deployment history of PTSD, $AOR=2.50$, 95% CI [1.69, 3.69], and $p<.001$	ADHD was associated with risk of post-deployment PTSD Pre-deployment ADHD was associated with risk of post-deployment PTSD
Kimbrel et al. (2017) [27]	In veterans' sample of ($n=140$) • Without PTSD ($n=62$, 44.3%) • With PTSD ($n=78$, 55.7%) Adult ADHD (36% vs. 11%) ($\chi^2=11.461$, $p=0.001$)	Male veterans with PTSD were significantly more likely to report ADHD symptoms than male veterans without PTSD
Knight et al. (2023) [28]	In a veterans' sample of ($n=313$) • PTSD alone ($n=140$, 44.6%) • PTSD/ADHD ($n=27$, 8.6%) Veterans with both ADHD + PTSD performed significantly slower than all other groups on trails-number sequencing ($\beta=-1.65$, $p=0.003$) Veterans with PTSD only and with PTSD + ADHD reported significantly worse functional status (β's = 13.56–24.74, p's < 0.0001), mood (β's = 7.87–17.30, p's < 0.0001), sleep quality (β's = 5.06–6.73, p's < 0.0001), and neurobehavioral symptoms (β's = 16.37–25.36, p's < 0.0001) compared to other groups	PTSD has a larger impact on cognitive performance, specifically processing speed, and functioning than ADHD alone When combined, ADHD and PTSD, resulting in worse functioning compared to veterans who have only ADHD or PTSD
Lee et al. (2012) [30]	In a new recruits' sample of ($n=224$) PTSD symptoms were associated with the following: • Past ADHD symptoms ($n=44$, 19.6%) ($OR=1.145$, $CI=1.054$–1.245, $p=0.001$) • Present ADHD symptoms ($n=4$, 1.8%) ($OR=1.049$, $CI=1.005$–1.095, $p=0.028$) PTSD symptoms in the first week were significant risk factor of PTSD after 5 weeks of basic military training ($OR=1.073$, $CI=1.020$–1.129, $p=0.006$)	• Past and present symptoms of ADHD are the risk factors of symptoms of PTSD in the first week. Symptoms of PTSD in the first week are also risk factor of PTSD symptoms on last weeks in Korean conscripts • ADHD symptoms might make an important role in PTSD symptoms liability in Korean conscripts
Luderer et al. (2020) [32]	In a sample of ($n=341$) • ADHD ($n=66$, 19.4%) • Non-ADHD ($n=275$, 80.6%) Higher frequency of potential traumatic exposure (88% vs. 65%, $p<0.001$) Patients with PTEs ($n=237$) and PTSD were higher in ADHD versus no-ADHD patients (OR 8.9, 95% CI 3.9–20.5)	• PTSD severity and functional impairment were increased in ADHD patients • ADHD is associated with a higher frequency of PTEs and PTSD with more severe and more impairing PTSD symptoms
Mitchell et al. (2012) [34]	In a smokers' sample of ($n=123$) • With PTSD (n = 55, 44.7%) • Without PTSD (n = 68, 55.3%) In CAARS • Inattentive (11.47 ± 5.76 vs. 5.50 ± 3.79) • Hyperactive (11.31 ± 4.71 vs. 6.82 ± 3.60)	• Smokers, especially those with PTSD, may experience exacerbated affective dysregulation difficulties due to ADHD symptoms • Individuals with higher levels of symptomatology for both ADHD and PTSD are more prone to an increased risk of smoking relapse

Table 2 (continued)

Reference	Findings	Highlights
Antshel et al. (2013) [4]	In a public sample of ($n=239$) • With ADHD ($n=206$, 62.6%) • Without ADHD ($n=123$, 37.4%) PTSD (9.7% vs. 1.6%)	PTSD over a person's lifespan was more frequent in adults with ADHD. The coexistence of PTSD and ADHD in adults increase clinical severity of additional psychiatric conditions and the overall functioning within social and psychological contexts
El Ayoubi et al. (2021) [15]	In a sample of ($n=551$) • With ADHD ($n=109$, 19.8%) • Without ADHD ($n=442$, 80.2%) PTSD (84% vs. 40%) ($p<.001$)	Adult with ADHD is associated with PTSD in AUD inpatients
Ozdemir et al. (2015) [36]	In a sample of ($n=317$) • ADHD symptoms and dissociation were significantly associated with PTSD	• ADHD comorbidity was not identified as a primary vulnerability factor in the onset of post-traumatic stress responses • ADHD could potentially act as an aggravating element following the establishment of PTSD
Peleikis et al. (2022) [38]	In a ADHD sample of ($n=250$) • With PTSD ($n=21$, 8.4%) • Without PTSD ($n=229$, 91.6%) Childhood trauma (85% vs. 44%) ($p<0.001$)	Recognizing childhood and adolescent trauma holds clinical significance for young to middle-aged adults diagnosed with ADHD
Adams et al. (2017) [1]	In a veteran sample of ($n=160$) • PTSD-only and ADHD + PTSD participants demonstrated deficits relative to controls • No cue dependency effects observed	Neurocognitive mechanisms associated with ADHD, PTSD, and the combination of ADHD and PTSD were confirmed
Barreto et al. (2022) Vyvanse [7]	In a case of comorbid ADHD/PTSD ($n=1$) • Vyvanse (lisdexamfetamine) helped control her intrusive thoughts and nightmares	Off-label use of psychostimulants for the treatment of PTSD
Kasahara et al. (2023) Atomoxetine [26]	In a case of comorbid ADHD/PTSD ($n=1$) • Atomoxetine (ATX) had significant improvements in patient's pain, quality of life, anxiety, depression, catastrophic thoughts, cerebral blood flow, and occupational functioning	ATX can improve chronic pain with PTSD and cerebral blood flow
Rice et al. (2018) In-person and virtual world mindfulness training [39]	In a veterans' sample of (133) • In-person group (IP) ($n=49$, 36.8%) • Virtual world group (VW) ($n=43$, 32.3%) • Control group (C) ($n=41$, 30.8%) ADHD symptoms decreased • IP (22.73 ± 19.19 to 13.47 ± 13.36) • VW (18.49 ± 18.98 to 14.40 ± 16.56) • C (8.63 ± 10.14 to 12.12 ± 12.57) PTSD symptoms decreased • IP (37.27 ± 17.72 to 32.73 ± 16.47) • VW (35.51 ± 17.44 to 32.60 ± 16.89) • C (30.15 ± 14.25 to 29.80 ± 14.76)	Mindfulness training decreased the number of overlapping symptoms of inattention (PTSD and ADHD)
Wang et al. (2022) Atomoxetine [43]	In a comorbid ADHD/PTSD sample of ($n=44$) • ADHD comorbid symptoms with PTSD correlated with diminished positive affect, elevated negative affect, increased emotion dysregulation, higher sensitivity to anxiety, and stronger tendencies to seek smoking as a means to boost positive emotions	Atomoxetine showed moderate effectiveness in alleviating ADHD symptoms. However, there was no observed impact on measures of quality of life or symptoms related to PTSD

Table 2 (continued)

Reference	Findings	Highlights
Cao et al. (2022) [12]	All illnesses generate pairs of features with a close companion; only Tourette syndrome (TS) is a reasonably unique syndrome. Higher up, OCD, AN, and TS cluster together, whereas MDD, ANX, ADHD, ASD, and PTSD cluster together. The 10 mental disorders can be inferred to be classified genetically, which may biologically inform the present diagnostic criteria and mental disorder treatment plans	PTSD has a moderately positive correlation with ADHD ($r = 0.48$)
Lu et al. (2008) [31]	In a family-based sample of ($n = 630$) • The *CNR1* gene may be a risk factor for ADHD and possibly PTSD	The CNR1 gene may contribute to shared underlying ADHD, PTSD, and possibly other co-morbid conditions (such as mood disorder)
Song et al. (2024) [41]	In a population of ASD (18,381 patients and 27,969 controls), PTSD (23,212 cases and 151,447 controls), and ADHD (38,691 cases and 275,986 controls) • The genetic components shared by ASD, PTSD, and ADHD were examined using genetic correlation analysis and showed a strong positive association between PTSD and ASD ($rg = 0.34$), as well as ADHD ($rg = 0.70$). Moreover, genetic vulnerabilities to ASD ($OR = 1.04$; *CI*, 1.01–1.08; $p = 0.014$) and ADHD (odds ratio (OR) = 1.14; 95% (CI), 1.06–1.24; $p = 7.88 \times 10 - 4$) were linked to a higher chance of getting PTSD in later life, according to the Mendelian randomization analysis	Later-life development of PTSD has been linked to genetic susceptibilities to ASD and ADHD. Nevertheless, there was no proof that a genetic predisposition to PTSD would increase the likelihood of ASD or ADHD
Wendt et al. (2023) [44]	In a population-based sample of ($n = 2,082,118$) • ADHD and PTSD had consistent regression (range, 0.43–0.52; $p < 0.001$) • ADHD genetic liability was causally linked with increased risk for PTSD ($\beta = 0.367$; 95% *CI*, 0.186–0.552; $p = 7.68 \times 10 - 5$) • Found no consistent associations between PTSD genetic liability and ADHD risk • Individuals diagnosed with ADHD were at a higher risk for developing PTSD than their undiagnosed sibling (hazard ratio = 2.37; 95% *CI*, 1.98–3.53)	Early and effective treatment of ADHD as prevents future PTSD diagnosis

ADHD (mean ± SD, 11.31 ± 4.71 vs. 6.82 ± 3.60) than the group without PTSD ($n = 68$, 55.3%).

PTSD in a sample with ADHD

Four studies investigated PTSD in samples of patients with ADHD; all of them were nonmilitary-based samples. The study of Antshel et al. [4] investigated a sample of the public ($n = 329$) and found that among participants with ADHD ($n = 206$, 62.6%) and without ADHD ($n = 123$, 37.4%), the prevalence of PTSD was higher in the ADHD group (9.7% vs. 1.6%). They also confirmed that compared to control participants, adults with ADHD had a considerably greater lifetime incidence of PTSD. Adults with co-occurring PTSD and ADHD have higher levels of clinical severity when it comes to psychosocial functioning and mental comorbidity.

In addition, the study conducted by El Ayoubi et al. [15] on clients with alcohol abuse in France ($n = 551$) revealed that between case ($n = 109$, 19.8%) and control samples ($n = 442$, 80.2%), the incidence of PTSD was higher with ADHD case sample (84% vs. 40%). When age, gender, and marital status were considered, the intensity of PTSD was connected with symptoms of adult ADHD and was linked to more traumatic occurrences. As well as this, the study of Ozdemir et al. [36] also studied a public sample of university students ($n = 317$) and revealed a link between signs of ADHD to PTSD. Taking into account the multidimensional relationships among dissociation, PTSD, and ADHD, symptom overlaps led to strong connections between PTSD and ADHD.

Also, in Peleikis et al. [38]'s study, the outpatient sample with ADHD in Norway ($n = 250$) had subjects with PTSD ($n = 21$, 8.4%) who have been found to have high prevalence of childhood trauma more than other subjects without PTSD (85% vs. 44%). These results imply that knowledge of childhood and adolescent trauma is clinically significant among young to middle-aged adult ADHD patients, as prevalence of childhood traumas was associated with considerable functional impairment and a higher chance of concurrent panic disorder, anxiety disorders, PTSD, and two or more comorbid psychiatric disorders.

A sample with comorbid ADHD/PTSD

Five studies had participants with comorbid ADHD/PTSD diagnosis. In the study of Adams et al. [1] studying combat veterans ($n = 160$) to consider cue-dependent learning and response inhibition as behavioral and neurocognitive factors underpinning PTSD and ADHD, they revealed that the most pronounced were the cue reliance effects in the control and PTSD + ADHD groups. The majority of indicators of inhibitory functioning, reaction time, and reaction time variability showed group differences, with PTSD-only and ADHD + PTSD subjects showing deficits compared to controls. No matter the cue condition, participants in the ADHD-only and PTSD-only groups showed comparable percentage of inhibitory failures to no-go trials. Accordingly, they relied on limited power as the reason for the absence of expected group differences for the ADHD-only group.

Two studies examined the effect of ADHD medication on the symptoms of PTSD in two female cases of comorbid ADHD/PTSD diagnosis. Studies of Barreto et al. [7] and Kasahara et al. [26] investigated the effect of Vyvanse and atomoxetine, respectively. Both studies showed promising results on the outcomes and the possibility of using psychostimulants off-label to treat PTSD symptoms such as anxiety, depression, catastrophic thoughts, and quality of life in the case of Vyvanse, and the possibility of atomoxetine to enhance cerebral blood flow and chronic discomfort associated with PTSD.

Similarly, Wang et al. [43] examined the effect of atomoxetine on a sample of veterans ($n = 44$) with comorbid ADHD/PTSD diagnosis and revealed that atomoxetine showed a moderate degree of efficacy in treating ADHD symptoms in veterans who also had PTSD; quality-of-life assessments and PTSD symptoms were unaffected. Such studies on medications' effect on both symptoms enhance the understanding of co-occurrence of both ADHD and PTSD diagnoses in the light of biological theories.

Rice et al. [39] also investigated the effect of mindfulness training, virtual versus in person, on a sample of comorbid ADHD/PTSD diagnosis ($n = 133$) and revealed that the in-person and virtual groups' post-training levels of ADHD symptoms decreased (22.73 ± 19.19 to 13.47 ± 13.36 and 18.49 ± 18.98 to 14.40 ± 16.56, respectively), while the control group experienced no change in symptoms (8.63 ± 10.14 to 12.12 ± 12.57). Likewise, particularly for the IP group, the data demonstrated significant and useful decreases in PTSD symptoms (37.27 ± 17.72 to 32.73 ± 16.47) with no change in the control group (30.15 ± 14.25 to 29.80 ± 14.76). The researchers also expanded the results by merging the two groups into a unified mindfulness training group. Attendees in the training program who had strong beginning symptoms of ADHD improved, but the control group did not.

Genetic composition of ADHD and PTSD

The genetic foundations of the comorbidity of PTSD and ADHD are starting to become clearer according to recent studies. The implications of this comorbidity are profound, necessitating a thorough understanding of the interplay between these disorders. Four studies examined the genetics associated with ADHD and PTSD. In the family-based sample ($n = 630$) of Lu et al. [31] who

explored the genetic relationship for ADHD in families (a child with ADHD and their parents), they found the CNR1 gene to possibly cause ADHD/PTSD comorbidity. While Wendt et al. [44] found that in their population-based sibling comparison study (n = 2,082,118) a causal link between ADHD genetic predisposition and a higher incidence of PTSD. They could not, nevertheless, discover any reliable links between the risk of ADHD and PTSD genetic liability. PTSD was more common in people with ADHD diagnoses than in their siblings without the diagnosis. Their results provide evidence in favor of the necessity of treating ADHD patients early and effectively because they have a markedly increased chance of developing PTSD in the future.

Moreover, the study of Cao et al. [12] identified significant genetic overlap between ADHD and PTSD, as well as specific genetic loci contributing to their comorbidity. Despite this overlap, distinct genetic profiles were also observed, indicating that while these disorders share some genetic risk factors, they also possess unique genetic components. Another recent evidence from a study by Song et al. [41] has provided deeper insights into the genetic associations between ADHD, ASD, and PTSD. Their research utilized genetic correlation and Mendelian randomization analyses to explore these relationships. They found significant positive genetic correlations between PTSD and both ADHD ($r = 0.70$) and ASD ($r = 0.34$). Furthermore, their Mendelian randomization analysis indicated that genetic liabilities to ADHD and ASD are associated with an increased risk of developing PTSD, with odds ratios of 1.14 and 1.04, respectively.

Certainty of the evidence

The certainty of evidence for the included studies was evaluated using the GRADE approach, which considers factors like study design, risk of bias, consistency, precision, and publication bias. Randomized controlled trials started with a high certainty rating, while observational studies began with a low rating. Adjustments were made based on identified study limitations. Key findings on risk of bias include the following: low risk of bias, studies with well-defined randomization, comprehensive reporting (e.g., [39, 41]), and high risk of bias, studies with small sample sizes or insufficient control for confounders (e.g., [7]). Overall, most included studies were rated as having moderate certainty of evidence. Variability in treatment protocols and small sample sizes were common limitations. Detailed risk-of-bias assessment is available in Supplement S3. The GRADE approach highlighted that findings on ADHD and PTSD comorbidity were consistent across most studies, but some variability in results due to differences in study design and participant characteristics impacted overall certainty. Confidence intervals for some outcomes were wide, reflecting lower precision. No strong evidence of publication bias was found. Further research, especially larger randomized controlled trials, is needed to strengthen the evidence and increase confidence in the findings.

Discussion

The present systematic review focuses on examining the co-occurrence of PTSD and ADHD in the adult population by providing a comprehensive analysis of the existing literature on this comorbidity. The inclusion characteristics revealed a consistent, albeit limited, number of research articles addressing this topic published in peer-reviewed journals. Nineteen studies documented this phenomenon over the past 19 years; however, it is worth noting that there has been a recent upsurge in interest regarding the relationship between ADHD and PTSD. This is exemplified by the fact that 13 of these studies ($n = 13$, 68.4%) were published within the last 10 years and 8 in the last 5 years ($n = 8$, 42.1%). Moreover, a substantial proportion of studies utilized a sample with PTSD ($n = 13$, 68.4%) who were mostly veterans and military personnel ($n = 9$, 47.4%). The focus on males in some studies were attributed to the genetic differences and liability, which were well-established in the case of ADHD [5].

The majority of studies ($n = 17$, 89.5%) identified a significant correlation between PTSD and ADHD or symptoms of one with the other. Despite the well-established high rates of co-occurrence between ADHD and PTSD in children [42], two studies ($n = 2$, 10.5%) did not report a significant association. To explore potential reasons for the lack of significance in the remaining studies, one possible explanation could be the insufficient statistical power of the studies for the various tests in one study and no effect of atomoxetine on patients with co-diagnosis in the other. Atomoxetine's selective effectiveness on ADHD symptoms may be explained by its mode of action, which mainly affects noradrenergic pathways linked to attention and impulse control without significantly altering the complex brain networks responsible for PTSD symptomatology.

Crucially, research on the risk of PTSD in people with ADHD has consistently demonstrated that people with ADHD have a markedly increased risk of getting PTSD. This detection implies that a higher rate of exposure to traumatic events in this group is not the only reason why people with ADHD have an elevated risk of developing PTSD. Additionally, compared to controls who had experienced equal degrees of stress, those with PTSD had a twofold increased risk of ADHD [44]. This suggests that the increased prevalence of ADHD in PTSD not only is a result of exposure to trauma but also linked to the

presence of PTSD itself. The finding that the onset of ADHD was consistently earlier than the commencement of PTSD in studies assessing the temporality of the two diseases supports the concept that ADHD is a predecessor risk factor for PTSD [29], even though statistical relationship does not suggest interconnection. Together, these results show that while trauma exposure may be a necessary component, it is not sufficient to fully explain the relationship between PTSD and ADHD.

Mutually, most of studies examined in this review indicate that ADHD is prevalent among individuals with PTSD and appears to be associated with more severe PTSD symptoms. There was an association between not only ADHD and PTSD symptomatology seen in objective neuropsychological testing but also PTSD patients self-reported this relationship. As a result, it seems that PTSD sufferers with ADHD both subjectively perceive and objectively assess the condition. When investigating attention problems in individuals with PTSD, current research mostly highlights particular forms of attention based on the different elements of attention, such as divided, selective, focused, and alternating attention [16, 20, 45]. Studies on ADHD in PTSD must carefully address the various types of criteria of ADHD relying on different assessment tests and distinguish between these aspects in order to fully understand the specific deficits and their implications for PTSD symptomatology, given the diversity of features of ADHD diagnostic component and their involvement in various functional-connectivity networks at the neuroscientific level.

Prior studies have indicated that trauma is linked to the emergence of ADHD, or that ADHD may play a role in a person's susceptibility to developing PTSD. These theories, however, are mostly based on research showing that people with ADHD have an increased chance of acquiring PTSD [3], and that those with PTSD have higher levels of (childhood) ADHD [33]. However, it is possible that there is additional complexity to the co-occurrence of these two disorders. Adults with PTSD may receive a diagnosis of ADHD, particularly when they exhibit pronounced hyperarousal symptoms that include significant attentional difficulties. Research has shown that poor sustained attention is not unique to ADHD and can also be shown in a number of other mental illnesses, including PTSD [25]. Thus, by early detection and treating ADHD, there is a chance that symptoms and affective elements of PTSD may be lessened. It is imperative that future research explore these concepts further, especially in relation to PTSD, given the hypothesized relationship between the intensity of PTSD symptoms and ADHD.

Regarding genetics, studies investigating medication and therapy effect of patients with comorbid ADHD/PTSD along with other studies suggesting genetic predisposition in co-occurring diagnosis can be used as evidence of genetic association between ADHD and PTSD. Recent findings from preclinical studies, neuroimaging research, and genetic investigations have started to shed light on the underlying factors contributing to the vulnerability to PTSD in individuals with ADHD. In a Finnish study, it has been observed that nicotine exposure leads to ADHD characteristics in offspring, which is also impaired in individuals with PTSD [21]. This suggests a potential link between ADHD and PTSD vulnerability and raise the possibility that specific neural circuits affected in ADHD may contribute to an increased susceptibility to both ADHD and PTSD. Genetic factors may also play a role in explaining the association between ADHD and PTSD. Both disorders have a heritable component, and genome-wide studies have revealed significant shared genetic variations among various psychiatric disorders [6]. ADHD and PTSD also share specific genetic risk factors, such as variations in the dopamine transporter gene's 3′-untranslated region and the cannabinoid receptor gene [19].

Importantly, genetic studies did not find evidence that genetic liability to PTSD increases the risk of ADHD or ASD. Findings suggest that ADHD may predispose individuals to PTSD, highlighting the importance of early intervention and tailored treatment strategies for individuals with these neurodevelopmental disorders. Such findings underscore the importance of considering genetic factors in the diagnosis and treatment of comorbid ADHD and PTSD. Further research is needed to fully understand the clinical implications of the shared genetic and neurobiological foundations of ADHD and PTSD. These studies may aid in the identification of brain circuits that are susceptible to damage, which may guide the creation of PTSD prevention and treatment plans.

Conclusion

In conclusion, the evaluated studies consistently show a strong correlation and possible genetic properties between PTSD and ADHD. The results show that people with PTSD are more likely to have experienced signs of ADHD as children. Furthermore, higher degrees of functional impairment, greater psychosocial impairment, and more severe PTSD symptoms are all linked to the existence of ADHD in PTSD patients. Reducing the chance of acquiring PTSD later in life may require early and efficient treatment of ADHD. Moreover, a higher frequency of childhood trauma and a higher chance of acquiring multiple comorbid psychiatric disorders are also associated with the co-occurrence of ADHD and PTSD. For those with co-occurring PTSD and ADHD, treatment approaches like mindfulness training and medication

(atomoxetine and Vyvanse) show promise in symptom reduction and quality-of-life enhancement.

Limitations

However, our review does have certain limitations. There is always a chance that some studies will be unintentionally missed due to database selection, search strategy limitations, or screening process errors, even with best efforts to include all pertinent studies (using major databases and having proper search strategy). Furthermore, authors were unable to perform a meta-analysis, look at significant moderators, or determine the strength of the connection between ADHD and PTSD due to the heterogeneity of the included studies' measurements, samples, and designs.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13643-025-02774-7.

Supplementary Material 1: Supplement S1. PRISMA Checklist.

Supplementary Material 2: Supplement S2. Full Search Strategy.

Supplementary Material 3: Supplement S3. Risk of bias assessment for selected studies is available S3.

Authors' contributions

HM and MZ planned the study and made substantial contributions to conception and design, acquisition of data, and interpretation of data. HM, AA MZ, and AI were major contributors in writing and drafting the manuscript. HM, ME, HE, and MZ were major contributors in writing the "Discussion" section. All authors have given final approval of the version to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Data availability

The data that support the findings of this study are available on request from the first and corresponding authors.

Declarations

Competing interests

The authors declare that they have no competing interests.

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