



Child attachment and ADHD: a systematic review

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Abstract

Attention Deficit/Hyperactivity Disorder (ADHD) is a frequent neurodevelopmental disorder in children. ADHD has a multifactorial origin, combining genetic and environmental factors. Several studies suggested an influence of early parent–child relationships on the symptomatic expression of ADHD. In this review, we examine the studies that have investigated the links between attachment and ADHD in children. We searched for studies published between January 2000 and November 2019 on PsychInfo, PubMed, and Scopus. Selected studies included a theoretically based measure of attachment and an explicit measure of ADHD symptoms or an ADHD diagnosis. Studies that included children from adoption, institutionalization, or mistreatment were not included. We found only 26 studies meeting the inclusion criteria. Almost all these studies indicated a link between the attachment type and the presence of attentional difficulties and hyperactivity. However, associations were better explained, in several studies, by confounding factors such as comorbidities, cognitive difficulties, or contextual factors. The method used to assess attachment and parental mental health also had an impact. An increasing number of studies show a link between the type of attachment and the presence of attentional difficulties and hyperactivity in children. However, the nature of this link remains unclear. Implications for future research are discussed.

Keywords ADHD · Attachment · Child · Review

Introduction

Attention Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by the presence of persistent signs of inattention and/or hyperactivity–impulsivity that impair functioning or development [1]. ADHD is one of the most common neurodevelopmental disorders with a prevalence of approximately 5–8% [2]. Its origin is

multifactorial with both genetic and environmental factors [3]. The attachment theory provides a useful conceptual framework to investigate how a child manages his or her relationships and how parent–child relationships influence social investment, cognitive development, and possible psychopathology [4]. This theory is also considered by several authors as a framework for emotional and behavioral regulation [5, 6]. A few studies have investigated the influence of attachment in children with ADHD symptoms, despite the importance of early relationships in child development.

In this article, we conducted a systematic review of the literature that examines the association between ADHD symptoms and the quality of attachment in children. To clarify the different terms and assessment tools used in the literature, we will first present a short overview of the main concepts of the attachment theory and its assessment. We will then focus on attachment and ADHD.

Attachment theory

Attachment describes the singular relationship between infant behavior and the primary caregiver and how the child seeks proximity when he/she is in a stressful situation [7].

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Attachment is considered as an innate need to construct a basis of security for the child. By promoting proximity with the caregiver, it helps the child to explore the environment [8, 9]. Attachment behaviors are intimately linked to emotional regulation which is largely organized during early childhood and is essential in developing close emotional proximity in relationships with others [10]. During early childhood, four categories of attachment patterns have been described: secure, insecure avoidant (also named dismissive), insecure ambivalent (also named resistant), and disorganized [11, 12]. In late childhood, the patterns are described at a representational level and are then identified as secure, dismissing, preoccupied, or disorganized strategies [13]. Children with a secure attachment can easily express positive and negative experiences, can adequately regulate their emotions when faced with a stressful situation, and can easily adapt to new situations [14]. Children with an avoidant attachment strategy manage stressful situations by inhibiting their emotional system particularly for negative emotions [14]. In early childhood, these children give the impression of not being affected by stressful situations such as separations with the caregiver. In middle childhood, these children may express their relationships with others in an idealized manner and cannot recognize the presence of negative emotions [13]. Ambivalent attachment represents a hyperactivation of the emotional regulation system [14]. Children with an ambivalent attachment often have major difficulties with managing separations and can react with significant distress. They typically express their anxiety through impulsivity, fears, and psychosomatic disorders [13]. Avoidant and ambivalent attachment are not pathological conditions per se, but they represent behavioral mechanisms developed by the child to regulate his or her own mental state and anxiety consecutive to the unavailability of the attachment figure [4]. Disorganized attachment is considered as a failure in the development of emotional regulation [15]. In early childhood, disorganized children tend to present disoriented or contradictory behaviors with the absence of an organized relational strategy [13]. This lack of a coherent attachment strategy can evolve towards behaviors that aim to take control of the relationship [16]. Disorganized attachment is often seen as the result of traumatic relationships, but other factors such as neurological disturbances could also explain disorganized behaviors [17]. The quality of the attachment can evolve throughout the course of life, depending on significant positive or negative life events. However, the first attachment relationships remain the prototypes of subsequent relationships [6]. When the child faces a stressful situation, the attachment figure represents a source of regulation for managing negative emotions through a process of emotional and behavioral synchronization [18]. Through this experience, which is repeated many times, the child develops his or her own capacities to calm down by internalizing at

least part of these regulation processes and by mobilizing his or her resources for physiological regulation [19]. In addition, the quality of attachment relationships supports the development of mentalization skills, which are defined as the ability to understand that one's behaviors as well as those of others are underpinned by mental states [20].

Assessment of attachment quality

Within the framework of the attachment theory, several tools have been developed to assess the quality of attachment in children. Attachment can be assessed at three levels: behavioral, representational, and perceptual [21]. In early childhood (under 36 month), the attachment quality can be assessed using behavioral observations in specific situations, such as the "Strange Situation Procedure" (SSP): the child's behavior is observed during brief episodes of separation/reunion with his or her attachment figure, generally the mother [11, 12]. As the child grows, attachment behaviors are more difficult to observe. The quality of relationships is gradually internalized as patterns of attachment representations defined as "internal working models" [4]. Several specific tools have been developed to assess the quality of these representations. Three methodologies can be distinguished in early and middle childhood: projective (including story stem and picture response procedures), interviews, and questionnaires [21]. Among story stem and picture response procedures, the "Attachment Story Completion Task" (ASCT) [22] and the "Separation Anxiety Test" (SAT) [23] are the more commonly used. In the ASCT, the child must complete the beginning of stories requesting the attachment system. Using small figurines, different themes such as the departure of parents are evoked. Attachment representations are assessed in particular by the narrative consistency and the ability to give a positive outcome to the story. In the SAT, the child looks at pictures that present hypothetical situations of separation between characters. The child must explain his or her feelings and reactions. In middle childhood, the increase in the child's verbal and cognitive capacities allows for assessing attachment representations through narrative procedures such as the "Child Attachment Interview" (CAI) [24]. The CAI is a semi-structured interview in which the child describes relationship episodes with his or her different attachment figures. Finally, the perception of attachment can be assessed using self-report questionnaires such as the Attachment Security Scale [25, 26], in which the child's belief in the availability and the sensitivity of a specific caregiver is assessed. There is currently no consensus on the most efficient tools for assessing attachment in middle childhood. The correlations between the different measures of attachment are often small-to-moderate as questionnaires and representational measures of attachment do not

necessarily assess the same processes (e.g., strategic processes and more automatic processes) [21].

Attachment and ADHD

Children with ADHD usually exhibit behavioral characteristics similar to children with insecure or disorganized attachment, such as hyperactivity, impulsivity, and difficulties with emotional regulation [27–30]. In addition, several authors have suggested that the quality of the child attachment could influence the clinical expression of ADHD [29, 31]. For example, in a population of adopted children, the duration of the early relational deprivation seems to influence the future development of attentional symptoms and hyperactivity [32, 33]. A previous review has identified an association between ADHD and attachment quality in adults and children including notably adopted samples with deprivation [34]. However, children with early trauma or deprivation seem to present an ADHD profile distinct from that observed in the general population [35]. To clarify the nature of the association between child attachment and ADHD symptomatology, we conducted a systematic review of studies that do not include adopted, mistreated, or deprived children. The different studies will be presented in a summary form. We will discuss the limitations of each study and the specificity of the associations.

Methods

To conduct our systematic review, we used PRISMA recommendations (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) [36] with the following combination of keywords in all fields: (“ADHD” OR “attention deficit disorder” OR “executive functions” OR “executive control” OR “cognitive control” OR “hyperactivity” OR “inattention”) AND (“attachment” OR “parent–child relationships” OR “parent–child interactions”). Studies published between January 2000 and November 2019 were included. We limited our search to publications in English. An article had to fulfil the following criteria to be eligible for inclusion: (1) the participants of the study had to be children or adolescents; (2) the children had to present with a clinical diagnosis of ADHD, or an ADHD symptomatology, as assessed by a validated questionnaire (e.g., ADHD-Rating Scale); and (3) the research must include a measure of child attachment. Exclusion criteria were: (1) articles not published in English; (2) single case studies; and (3) studies carried out on adopted, institutionalized or mistreated children or children with neurodevelopmental disorders other than ADHD. A total of 1597 articles were identified from the literature search (PsycINFO = 413; PubMed = 306; Scopus = 878). After removing duplicates, there were 992

articles potentially relevant for inclusion. After screening titles and abstracts, 66 full-text articles were retrieved and scanned for eligibility. Twenty-four studies met the inclusion criteria and two studies were added manually after searching in the bibliography of relevant articles. The methodology of research is presented in Fig. 1.

Results

Studies can be classified into two categories: studies that considered ADHD as a categorical diagnosis ($N = 12$) and those that considered ADHD in a dimensional perspective and were carried out within community samples ($N = 14$). We also distinguished studies according to the type of attachment measure and instruments: behavioral, representational, and perceptual [21]. Tables 1 and 2 present a summary of the selected studies on attachment and ADHD. Among the studies using a categorical diagnosis of ADHD, seven studies assessed attachment representations [37–43] and five assessed attachment perceptions using questionnaires [44–48]. Among the studies within community sample, five studies used a behavioral measure of attachment in childhood [49–53], eight studies assessed attachment representations [54–61], and one assessed attachment perceptions with a questionnaire [62].

Attachment in clinical ADHD

Two studies using a response-to-picture procedure, such as the Separation Anxiety Test (SAT) [63], suggested an association between clinical ADHD and insecure or disorganized attachment. A comparative study with children aged 5–10 years showed that ADHD children present more insecure or disorganized attachment than typically developing children (TDC) [37]. Compared to TDC, ADHD children expressed more hostile or aggressive strategies to deal with separation situations evoked by pictures from the SAT. Descriptions of parent–child relationships are also described more negatively in response to separations. Responses from ADHD children suggested more insecure attachment, particularly of the ambivalent or disorganized type. This study has several limitations including the presence of comorbidities in ADHD patients, such as learning disabilities, depressive symptoms, or behavioral problems that could have affected the expression of emotions. However, these results have been reproduced in a recent study investigating the presence of an insecure attachment with the SAT in children aged 4–5 years at risk for ADHD and in children aged 7 years with a diagnosis of ADHD [42]. Compared to the TDC group, ADHD children and those at risk for ADHD had more insecure attachment with difficulties in appropriately expressing negative emotions, such as fear or anger over

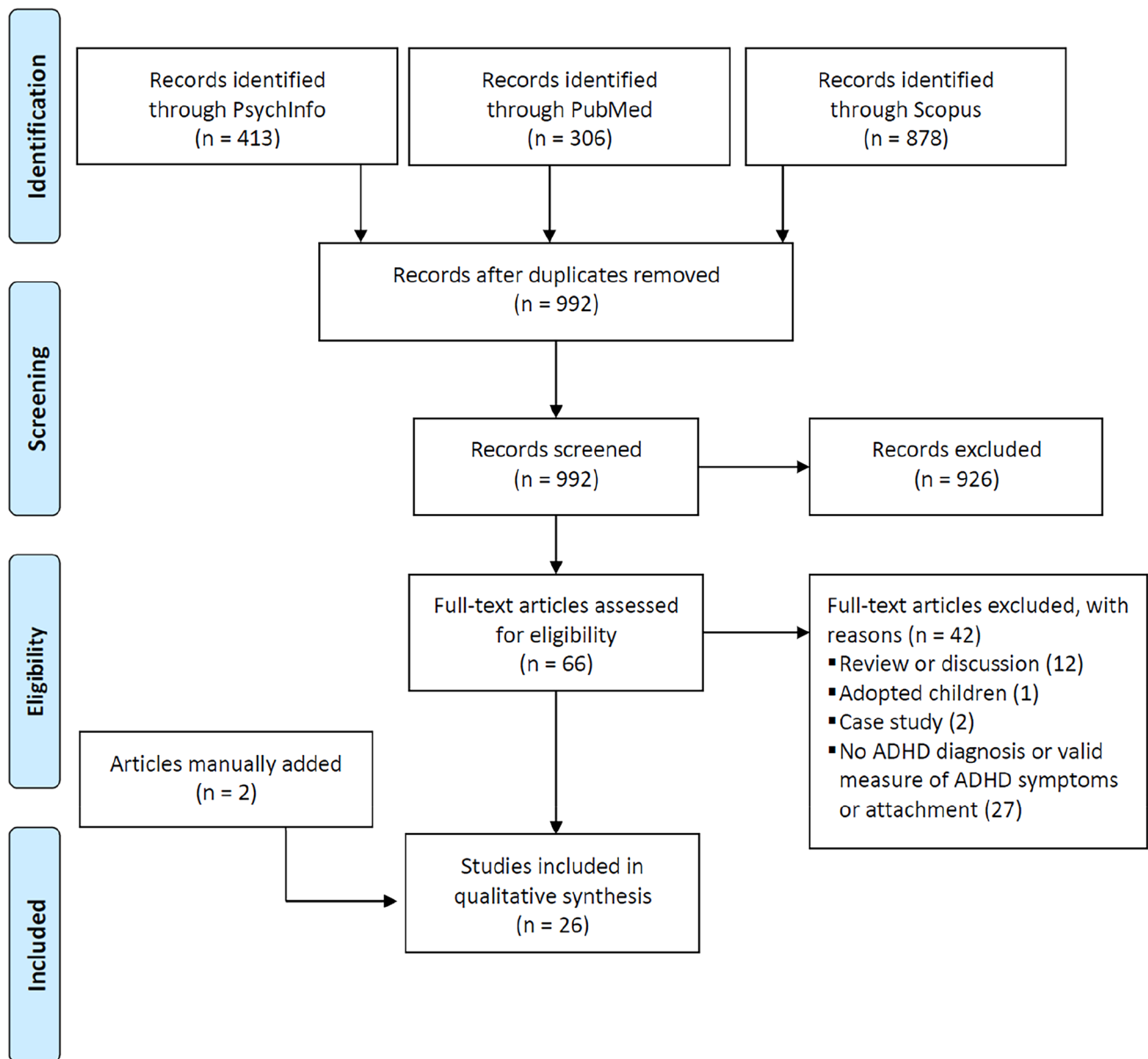


Fig. 1 Methodology of research

separation. They also displayed more avoidance behavior when discussing separations.

Two studies have assessed the links between ADHD and attachment representations using story-stem methods. A study using the Manchester Child Attachment Story Task (MCAST) [64] has also shown that ADHD children have more representations of insecure or even disorganized attachment [39]. However, their population sample was recruited in a large group of children presenting behavioral disorders. A recent study using the Attachment Story Completion Task (ASCT) [22] compared the distribution of attachment representations between children with and without ADHD (predominantly inattentive presentation) [38]. In

the TDC group, 57.8% of the children had a secure attachment, which is comparable to what has been observed in the previous studies [24]. In the ADHD group, only 20.8% had a secure attachment and 33% had a disorganized attachment. The distribution of attachment categories significantly differed between the two groups. However, regression analyses showed that there was no effect of attachment on ADHD when comorbid behavioral disorders were considered. The association between ADHD and attachment, thus, appears to be explained by the presence of behavioral disorders. Some authors also suggest that the difficulties in the narrative coherence regularly observed in ADHD children, in both the attachment and the non-related attachment story-stem

Table 1 Studies on attachment in clinical ADHD children

First author	Year	<i>N</i>	Ages	Attachment measures	ADHD measures
<i>Representational measures of attachment</i>					
Clarke [37]	2002	9 ADHD 7 ADD	5–10 years	Separation Anxiety Test (SAT) Family Drawing Self-Interview	DSM-IV Revised Conners' Parent Rating Scale (RCPRT)
Franke [38]	2017	93 ADD	5–9 years	Attachment Story Completion Task (German version – SCPDP)	ICD-10 Children Behavior CheckList 4–18 (CBCL 4–18) German ADHD-Rating Scale (FBB-HKS)
Green [39]	2007	61 OP/CD	4–9 years	Manchester Child Attachment Story Task (MCAST)	DSM-IV
Guttman-Steinmetz [40]	2011	50 ADHD 29 TD	6–12 years	Attachment Script Representation Task (ASRT)	Diagnostic Interview for Children and Adolescent (DICA) Child Behavior CheckList 4–18 (CBCL 4–18)
Rasmussen [41]	2019	67 ADHD	7–12 years	Child Attachment Interview (CAI) Adult Attachment Interview (AAI)	K-SADS-PL ADHD-Rating Scale (ADHD-RS)
Sempio [42]	2016	12 ADHD-I 12 ADHD-C 12 TD	4–5 years 7 years	Family-Separation Anxiety Test (F-SAT) School-Separation Anxiety Test (S-SAT)	DSM-5 ADHD-Rating Scale (ADHD-RS) Disruptive Behavior Disorders (DBDRS)
Storebo [43]	2014	25 ADHD 22 TD	8–12 years	Child Attachment Interview (CAI)	K-SADS-PL
<i>Perceptual measures of attachment</i>					
Al-Yagon [44]	2017	11 ADHD 39 ADHD + SLD 50 TD	11–12 years	Attachment Security Scale (ASS)	Children Behavior CheckList-Youth Self-Report (CBCL-YSR)
Al-Yagon [45]	2016	91 ADHD + SLD 90 SLD 98 TD	15–17 years	Attachment Security Scale (ASS)	Children Behavior CheckList-Youth Self-Report (CBCL-YSR)
Çuhadaroğlu-Çetin [46]	2013	34 ADHD 26 CWPD	13–16 years	Relationship Scale Questionnaire (RSQ)	K-SADS-PL
Finzi-Dottan [47]	2006	25 ADD 40 ADHD	7–15 years	Children's Attachment Style Classification Questionnaire (CASCQ)	DSM-IV Conners Rating Scale (CRS) for parents and teacher
Hornstra [48]	2019	45 ADHD 57 TD	8–12 years	Emotional Close Relationship-Revised Child version (ERC-RC)	Diagnostic Interview Schedule for Children and Adolescent (DISC-IV)

ADHD Attention Deficit Hyperactivity Disorders, *CD/OP* Conduct Disorders/Oppositional Disorders, *CWPD* Clinic Without Psychiatric Diagnosis, *DSM-IV* Diagnostic and Statistical Manual 4th edition, ICD-10; *K-SADS-PL* Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children–Present and Lifetime (K-SADS-PL), *ICB-10* International Statistical Classification of Diseases and Related Health Problems (ICD) 10th edition, *TD* typically development

procedures, could more easily lead to classify these children as disorganized [60].

Three studies also investigated attachment representations of ADHD children using a narrative procedure. Two studies [41, 43] using the Child Attachment Interview (CAI) [24] observed that only 7–15% of ADHD children presented a secure attachment. Again, the differences in the results between these studies and the studies using story-stem methods could be explained by the characteristics of the samples. In the study by Franke et al. [38], the sample only included ADHD children with a predominantly inattentive

presentation, while in the other studies, the samples mainly included children with a combined presentation [43] or ADHD children that were recruited in mental health services where the influence of maternal problems cannot be excluded [41]. Another study using the Attachment Script Representation Task [65], investigated the association of attachment security between mothers and their school-aged children with and without ADHD [40]. The symptoms of the ADHD children were negatively correlated to the security of attachment. Moreover, in the TDC group, the security of attachment of the mother and that of the child were

Table 2 Studies on attachment in children with ADHD symptoms

First auteur	Year	N	Ages	Attachment measures	ADHD measures
<i>Behavioral measures of attachment</i>					
Fearon [49]	2004	918	T1: 15 months T2: 54 months	T1: Strange Situation Procedure (SSP)	Child Behavior Checklist (CBCL)
Lavigne [50]	2016	344	4 years	Attachment Q-Sort (AQS)	Child Symptom Inventory (CSI) Early Checklist Inventory-4: Teacher Checklist (ECI-4)
Low [51]	2015	1004	T1: 36 months T2: 6 years	T1: Strange Situation Procedure (SSP)	Child Behavior CheckList (CBCL)
Niederhofer [52]	2009	101	3–17 years	Parent–Child Reunion Inventory (PCRI)	Hypescheme
Pinto [53]	2006	52 dyads still-birth 52 dyads control	T1: 1 year T2: 6–8 years	T1: Adult Attachment Interview (AAI); Strange Situation Procedure (SSP) T2: Manchester Child Attachment Story Task (MCAST)	ADHD-Rating Scale (ADHD-RS)
<i>Representational measures of attachment</i>					
Bohlin [54]	2012	65	T1: 5 years T2: 8 years	Attachment Doll Play Classification System (ADPS)	Child Behavior Questionnaire (CBQ)
Borelli [55]	2010	97	T1: 5 years T2: 8 years	Child Attachment Interview (CAI)	Child Behavior Checklist 4/18 (CBCL) Child Symptom Inventory-Parent Checklist (CSI)
Forslund [57]	2019	105	6–7 years	Separation Anxiety Test (SAT)	ADHD-Rating Scale (ADHD-RS)
Forslund [56]	2016	184	6–7 years	Separation Anxiety Test (SAT)	ADHD-Rating Scale (ADHD-RS)
Goldwyn [58]	2000	31	5–7 years	Adult Attachment Interview (AAI) Manchester Child Attachment Story Task (MCAST) Separation Anxiety Test (SAT)	Child Behavior Checklist 4/18 (CBCL)
Salari [59]	2017	105	T1: 8 years T2: 18 years	Attachment Doll Play Classification System (ADPCS)	ADHD-Rating Scale (ADHD-RS)
Scholtens [60]	2014	89	6–10 years	Attachment Doll Play Classification System (ADPCS)	ADHD-Rating Scale (ADHD-RS)
Thorell [61]	2012	100	T1: 8.5 years T2: 9.5 years	Attachment Story Completion Task (ASCT)	ADHD-Rating Scale (ADHD-RS)
<i>Perceptual measures of attachment</i>					
Scharf [62]	2014	508	13.7 years	Experiences in Close Relationships (ECR)	Conners–Wells Adolescent Self-Report Scale (CASS)

significantly related, but it was not the case for ADHD children. The authors suggested that behavioral characteristics of ADHD children have repercussions on the construction of the parent–child relationship and on the transmission of attachment security.

Finally, five studies have also investigated the links between ADHD and the perception of attachment style using questionnaires. A first study assessed the influence of ADHD clinical presentation on the attachment style, measured by the Children's Attachment Style Questionnaire [66], in children and adolescents aged 7–15 years [47]. The results showed that ADHD children with combined or hyperactive presentation were more insecure than children with inattentive presentation. Despite the absence of a control group, the authors suggested that the attachment may be related to hyperactivity but not to attentional symptoms. Using the Relationship Scale Questionnaire (RSQ) [67],

another study compared the style of attachment in adolescents (13–16 years old) with a diagnosis of ADHD with and without comorbidities (unspecified psychiatric disorder). The control group included adolescents without a psychiatric diagnosis but who had previously consulted for a psychiatric complaint [46]. Compared to the control group and the ADHD adolescents without comorbidity, adolescents with ADHD and comorbidities had more insecure pre-occupied attachment. There was no difference between the control group and ADHD adolescents without comorbidities. Again, these results suggest again that the association between ADHD and an insecure attachment style could be linked to the presence of comorbidities. More recently, using the Attachment Security Scale [26], Al-Yagon et al. [44, 45] have investigated the security of attachment in ADHD children to both the father and to the mother. They observed that ADHD children with and without comorbid learning

disabilities (LD) had a lower sense of trust with their mother and more insecure attachment relationships with their father compared to TDC [44, 45]. This result, however, was not observed in another study [48].

Attachment and ADHD symptoms

The associations between ADHD symptoms and behavioral measures of attachment were investigated in five studies. A prospective longitudinal study assessed the influence of the maternal attachment representations during pregnancy and child attachment in early childhood on future ADHD symptoms of the child. Maternal attachment was investigated with the Adult Attachment Interview (AAI) and child attachment at 12 months with the Strange Situation Procedure (SSP). ADHD symptoms were rated at the age of 7 years using rating scales completed by mother, teacher, and in a structured play procedure rated by authors [53]. The total sample of this study includes 104 mother–child dyads (52 from a target cohort of women whose previous pregnancy ended in stillbirth and 52 from a control cohort of primigravidae women). At 7 years, children were considered as having possible or probable ADHD according to the results of the three rating scales. The authors found a correlation between the intensity of the disorganization of attachment behaviors in the SSP at the age of 12 months and the symptoms of hyperactivity at the age of 7 years rated by the teacher. Moreover, a possible ADHD diagnosis was predicted by an unresolved mourning assessed with the AAI during pregnancy. However, these results cannot be generalized to the ordinary population as half of the children that participated in the study came from mothers who have had traumatic perinatal experiences. Two other studies, however, also observed that children with disorganized attachment at 15 and 36 months of age had more inattentive symptoms when compared with secure children at 54 months and 8 years, respectively [49, 51]. In middle childhood, another study also observed that insecure or disorganized attachment was associated with more symptoms of inattention and hyperactivity [52]. However, an important limitation of these studies is that they do not provide any information on the parental mental health despite the fact that the presence of ADHD or depression in parents has been shown to contribute to the child's symptoms [68, 69]. A study investigating the contribution of several factors (contextual, parental, and child factors including attachment) on ADHD symptoms in preschool children, rated by parents and teachers, showed that less attachment security was linked to more ADHD symptoms [50]. However, hierarchical regression analyses showed that ADHD symptoms rated by parents were better explained by other child factors such as effortful control and sensory regulation, and by contextual factors such as parental stress and family conflict. ADHD

symptoms rated by the teachers were mainly explained by parental depression and temperament.

In middle childhood, eight studies investigated the associations between ADHD symptoms and attachment representations. Six studies found that children with more symptoms of inattention and hyperactivity presented more insecure or disorganized attachment representations using story-stems methods [54, 58–61] or a narrative procedure [55]. However, while these results suggest that insecure or disorganized attachment is associated with ADHD symptoms, some authors have estimated that the link between attachment and ADHD could be due to the presence of behavioral disorders that are also regularly associated with ADHD [70]. For instance, two studies using the Separation Anxiety Test showed that disorganized attachment was more associated with oppositional symptoms rather than ADHD symptoms [56, 57]. Nonetheless, other studies using story-stems methods have observed that the link between the disorganization of attachment representations and the symptoms of ADHD persists even after controlling for neuropsychological functioning [54, 59, 60] and the presence of behavioral disorders [61]. Therefore, the relationships between attachment and ADHD could also depend on the method used to assess the attachment.

Finally, one study investigated the associations between ADHD symptoms and attachment perception in adolescents [62]. Again, a secure attachment style is associated with fewer symptoms of ADHD. However, the comorbidities such as anxiety, depression, or behavioral disorders were not explored in this study.

Attachment and ADHD: an attempt of integrated summary

Table 3 displays the number of selected studies showing an association between ADHD and attachment, and those suggesting that contribution of attachment is not specific to ADHD. Studies are presented according to clinical or symptomatic ADHD, and methodology used to assess attachment.

Among the studies with clinical ADHD children, none had used a behavioral measure of attachment. This could be explained by the difficulty of observing attachment behaviors beyond 6 years old, and to diagnose ADHD before this age. An association between attachment and ADHD is observed in nine studies using representational or perceptual measures of attachment. However, in three studies, the influence of comorbidities (e.g., conduct problems) [37, 39] or maternal mental health [41] cannot be totally excluded. After removing these studies, a 2:1 ratio in favor of an association is observed. Among studies investigating associations between attachment and ADHD symptoms, ten showed an association. However, in two studies, the presence/absence of comorbidities was not explored [52, 62].

Table 3 Number of selected studies that showed an association between ADHD and attachment, and those suggesting that contribution of attachment is not specific to ADHD

Attachment level	Population			
	Clinical ADHD		ADHD symptomatology	
	Association	Contribution not specific	Association	Contribution not specific
Behavioral	0	0	3 ^f (1) ^g	1 ^h
Representational	3 ^a (3 ^b)	1 ^c	5 ⁱ	3 ^k
Perceptual	3 ^d	2 ^e	0 (1 ^l)	0
Total	6 (3)	3	8 (2)	4

In parentheses, studies not controlling for comorbidities or maternal mental health. (a) [40, 42, 43]; (b) [37, 39, 41]; (c) [38]; (d) [44, 45, 47]; (e) [46, 48]; (f) [49, 51, 53]; (g) [52]; (h) [50]; (i) [54, 55, 58, 59, 61]; (k) [56, 57, 60]; (l) [62]

Again, after removing these studies, a 2:1 ratio in favor of an association is observed.

Discussion

The relationships between child attachment and ADHD symptomatology have been investigated in this systematic review of literature. Contrary to a previous review [34], which suggested an association between child attachment and the presence of attentional difficulties and hyperactivity, our work shows that the nature of this link remains debated. After removing studies not explicitly controlling for comorbidities or maternal mental health (see Table 3), we found a 2:1 ratio between studies showing an association between ADHD and attachment, and those suggesting that contribution of attachment is not specific to ADHD. This 2:1 ratio was observed both for studies on clinical and symptomatic ADHD. If we take into account the publication bias in favor of significant results [71], this ratio seems to confirm that the nature of the link between ADHD and attachment still remains unclear, especially in the presence of comorbidities. Indeed, studies have found that, compared with studies with non-significant results, the ratio of citation rate for studies with significant results was 1.63 with 95% CI ranging from 1.32 to 2.02 [72].

Most studies tend to consider ADHD as a homogeneous entity. However, it is important to remember that ADHD is a heterogeneous and multifactorial disorder, often associated with comorbidities, and where the search for a unique explanatory factor has been abandoned.

Several studies, for instance, have found that the link between attachment and ADHD symptomatology is better explained by various child characteristics and contextual factors [50] or by the presence of comorbid behavioral disorders [38, 56, 57]. Another study, on the contrary, found that the link persists even after controlling for behavioral difficulties [61]. This suggests that treating the comorbidities could improve symptomatic expression of ADHD and reduce functional impairments. A parenting skills training program could be particularly adequate for parents of ADHD children with comorbidities, such as non-compliant and oppositional behaviors [73]. Therefore, considering the presence of comorbidities (e.g., anxiety, depression, and behavioral disorders) and contextual factors in future research is essential.

Moreover, observed differences between studies concerning the association between insecure or disorganized attachment and ADHD could be the result of the methodology used to assess attachment [56, 57, 60]. It seems important to replicate the results of the different studies using simultaneously different procedures to assess attachment within the same sample of children.

In addition, the associations between attachment and ADHD symptoms could be observed in children with hyperactivity presentation but not with attentional difficulties alone [38, 47]. Behavioral and cognitive difficulties frequently observed in ADHD could also more easily lead to classifying these children as insecure or disorganized [17, 60, 74]. For instance, pharmacological treatment in ADHD children is associated with a decrease in the percentage of attachment representations considered as disorganized [75]. Therefore, a causal link between insecure or disorganized attachment and the development of ADHD symptoms cannot be concluded with certainty [44]. More prospective longitudinal studies of children with ADHD symptomatology, including an assessment of attachment and cognitive functioning, at different times could help to clarify the possible mutual influences between these factors. It is also crucial to control for verbal or cognitive factors such as the quality of verbal production, but also attention or impulsivity, to discriminate an attachment disorder from a measurement error of the assessment tool, due to cognitive deficits.

The mechanisms by which early relationships between the child and his or her caregiver could influence the development of attentional and self-regulatory capacities remain uncertain. On a cognitive perspective, early impairments in executive functions or social cognition, especially social perception and emotional regulation, observed in ADHD could impact the development of attachment security [44, 74, 76]. Another hypothesis might be that early deficits in emotional regulation linked to attachment quality, such as observed in disorganized children [15], would disrupt the development of other neurocognitive functions necessary for behavioral

regulation and social–cognitive abilities. At a neurophysiological level, the early attachment experiences of a child can contribute to his or her neurobiological development particularly by the activation of the hypothalamic–pituitary–adrenal (HPA) axis involved in stress regulation [77, 78]. Early and regular stressful situations, caused for example by repeated episodes of separation or neglect, can permanently alter the development of the HPA axis [79, 80]. The stress reactivity of the HPA axis is associated with attachment security [81–83]. Early disturbances in stress-regulating mechanisms could lead to primary dysfunction of limbic structures that could interfere with the development of other brain structures, such as the frontal regions, that largely underlie executive functions and contribute to behavioral and emotional regulation [84–86]. These cascading dysfunctions would then generate behavioral symptoms similar to those observed in ADHD [87]. A recent animal study has shown that the presence of early stress, induced by separation from the mother, causes a dysfunction of the dopaminergic circuits and a hypoactivation of the prefrontal cortical areas, which appears to be linked to the presence of behavioral symptoms similar to those seen in patients with ADHD [88]. Neurophysiological and neuroimaging studies are needed to clarify these mechanisms. In addition, it is essential to distinguish genotypic and phenotypic ADHD which might have different neurobiological mechanisms. However, due to the complexity of causes leading to ADHD, making this distinction remains difficult [89]. An intergenerational prospective study with children at risk of familial ADHD and children at risk for developing ADHD symptoms, such as preterm children [90], could help disentangling the impact of attachment in idiopathic (familial) and phenotypic (preterm children) ADHD. Such studies should include measures of attachment and ADHD symptoms of children and parents at different times throughout childhood. Recent research tools such as the ADHD Polygenic Risk Score could also help examine the association between attachment and the genetic risk for developing ADHD (for a review, see [91]).

Future studies on ADHD symptomatology and attachment should also systematically assess the early relationships and parental history of ADHD because of its strong heritability [92]. ADHD is observed in at least one parent in 40% of cases [93]. Early relationships could act as a minimizing or amplifying factor for the genetic component underlying the phenotypic expression [31]. Educational practices, parental support, and maternal sensitivity are clearly linked to building attachment security [94, 95]. The distinction between phenotypic traits due to nature from the ones due to nurture is a complex task. The use of a prospective longitudinal design including a control group in which parents and children are not genetically related (adopted children) could help disentangle the association between attachment and nature- or nurture-related ADHD symptomatology (i.e.,

[96]). However, when attachment difficulties appear, other factors, such as physiology or cognitive skills, can also play a role [97, 98].

Finally, because ADHD is a neurodevelopmental syndrome whose manifestations change across the lifespan [99], future studies should also investigate relationships between attachment and ADHD symptoms at different ages, including adulthood [59]. For instance, in adults with ADHD, attachment relationships have been found to mediate the association between coping strategy and ADHD symptoms [100].

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Declarations

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