

ADHD and Comorbid Disorders in Childhood Psychiatric Problems, Medical Problems, Learning Disorders and Developmental Coordination Disorder

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Abstract

ADHD is a common disorder for children and is highly comorbid with a number of psychiatric and somatic disorders, which leads to important social impacts. Among common comorbid psychiatric disorders, mood, anxiety and conduct disorders are among the most frequently encountered in clinical practice. Furthermore, there is also some overlap between ADHD and addictive behavior, OCD, tics sleeping disorder and specific learning disorder. Likewise, autistic spectrum disorder and eating disorder are more and more recognized as comorbid entities. Lastly, links with PTSD and attachment disorder have been noted. Other medical issues should also be considered in the assessment of ADHD: brain injury, epilepsy and obesity for example. ADHD children with a co-occurring condition are severely impaired and treatment is more complex. A better comprehension of the high rates of comorbidities with ADHD is necessary to optimize treatment of this condition and prevent some of the negative outcomes associated with comorbid ADHD.

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Introduction

Attention deficit/hyperactivity disorder (ADHD) is a very common problem encountered in clinical practice. Its prevalence for children is 3-8% worldwide and is extremely comorbid; more than 2/3 of patients with ADHD have a psychiatric disorder associated. Therefore, it is important to screen for the presence of other comorbid disorders when a child is diagnosed with ADHD. Depending on the psychopathologies associated with ADHD, the clinical presentation may be more complex and it can represent a diagnostic challenge. Thus, a careful initial evaluation should be made to eliminate any possible differential diagnosis. In addition, the prognostic and the outcome of children with comorbid ADHD is worse than children with ADHD only [1-5].

It is important to recognize that ADHD presentations and

most of its common comorbid disorders change over time and developmental stages. During early childhood, one will often find oppositional defiant disorder (ODD), enuresis and language disorder as common comorbid entities. Symptoms of anxiety and tics are most often observed in the mid-school-age years. The beginning of adolescence is associated with the emergence of mood disorder, personality issues and substance use disorder. Furthermore, many children with ADHD have a specific learning disorder. In children with intellectual disabilities, borderline IQ or developmental disabilities, ADHD is three times more prevalent compared to the general population [6,7].

Thus, ADHD and its comorbidities represent frequent clinical problems and diagnostic challenges. In this paper, we will discuss the pathologies most frequently associated with ADHD and describe how psychiatric problems, medical problems and other problems such as learning disorder and developmental coordination disorder may affect ADHD presentations.

Psychiatric Problems

Disruptive behavior disorder

Behavioral problems are the most frequent comorbidities with ADHD. Among those disorders, oppositional defiant disorder (ODD) should be distinguished from conduct disorder (CD).

- **Oppositional defiant disorder**

The estimated prevalence for ODD is 5-10%. ODD is concomitant with ADHD in 25-75% of patients. In those cases, children are more impaired but effective treatments may reduce the risk of complications such as depression, CD or substance abuse. Among Verlinden et al (2015) ADHD and ODD behavioral problems at a young age may predispose children to bullying involvement in early elementary school. For ODD, the treatment usually involves the introduction of rules and aims to re-establish generational boundaries by a psycho educator or a special educator. Also, in order to optimize the pharmacotherapy of ADHD, it is recommended to combine medication approach with psychosocial, especially behavioral treatments which are supported empirically [8-11].

- **Conduct disorder**

CD has a prevalence of about 2-9% and even higher in low socioeconomic status groups [8]. CD is frequently comorbid with ADHD (1/3 of the cases), a situation that contributes to the severity of the condition [12]. Children with both conditions have a poor prognosis and in adulthood, the outcome often includes substance abuse and antisocial personality disorder [13]. The following hypotheses may explain the common association between CD and ADHD: they share the same risk factors, one disorder is a risk of developing the other, or similarly, one disorder is a precursor of the other [14].

With this comorbidity, medications for ADHD may be effective but they are not optimal to address severe aggressive symptoms. A combination of ADHD medication and other psychotropic drugs for treating extreme aggression may be helpful (e.g., alpha2 agonist or atypical antipsychotics). A multimodal treatment is strongly recommended with a psychosocial approach involving the individual, its family, school staff, legal instances, etc. A study by Burke refers to multi systemic therapy as the gold standard for these conditions [15].

Mood disorder

- **Major depression**

There is a clear connection between major depression (MD) and ADHD. For example, patients with MD show similarities with ADHD patients such as inattention, concentration deficiency, short-term memory problems, irritability, impulsivity, sleeping disorders and restlessness. However, there is a difference between the cognitive dysfunction in the presence of depressive symptoms and the deficits in organization in ADHD even when the mood is normal. Moreover, depressed mood or anhedonia are characteristics of MD but less of ADHD.

Prevalence of MD in children is 2% and 6-30% of ADHD children present with MD. ADHD symptoms were associated with

more severe depression and poorer quality of life. Overall, it is important to determine which disorder arose first. Patients with ADHD might become depressed because they have to face numerous difficulties and failures, or they might show dysphoria symptoms due to effects of medications. It is known that stimulant medication produces dysphoria in up to 30% of patients. Dose adjustments for stimulant medication can be effective to reduce dysphoric symptoms but when insufficient, switching to a different ADHD drug may be necessary. Furthermore, patients with ADHD may also present with a low self-esteem to the point where its persistence may lead to a depressed mood that meets criteria of depression.

When addressing ADHD comorbid with MD, it is recommended to stabilize the mood first. Even though the first line of treatment for MD remains cognitive-behavioral therapy (CBT) or interpersonal therapy, Antidepressants are often helpful for depressive symptoms but should be used with caution in children and adolescents. They may increase suicidal risk and therefore careful monitoring is necessary when they are prescribed [16-19].

- **Bipolar disorder**

Logorrhea, pressure of speech, psychomotor instability and distractibility can be found in both bipolar disorder and ADHD. However, most children with ADHD do not have bipolar disorder, the symptoms of which should include grandiose perception or psychosis, decreased need to sleep, tachypsychia, euphoria, and hypersexuality. Another differentiating point is the periodicity aspect of bipolar disorder as opposed to the continuous symptoms in ADHD. However, one should pay close attention to the fact that in early onset (prepuberty) bipolar disorder could be manifested with less clearly defined cycles.

In Van Meter's meta-analysis (2011) involving 16,222 subjects from 7 to 21 years-old, mainly adolescents, a prevalence of 1.8% was found for bipolar disorders I and II. Up to 20% of the cases of bipolar disorder co-occur with ADHD. When ADHD is comorbid with bipolar disorder, patients have a greater number of other comorbidities, more suicide attempts, less educational achievement, more legal problems and an overall worse prognosis. Similarly, in a study of N. more than 20% of bipolar disorder patients had an ADHD and when the two disorders was associated, patients had worse outcomes, possibly resulting from stressful early-life events.

The treatment of bipolar disorder and ADHD is complex. Mood stabilizers and ADHD medication are both necessary. However, stimulant medication can increase the risk of a manic episode. The management of both disorders may require the discontinuation of the stimulant, and when the mood is stabilized, stimulant medication may be carefully re-instituted [20-23].

- **Disruptive mood dysregulation disorder**

A new diagnostic has been described in the DMS-5(2013): the Disruptive Mood Dysregulation Disorder (DMDD). Further studies validating its prevalence and specific treatment approaches are still underway. DMDD is characterized by a chronic dysphoria associated with a minimum of three severe anger episodes per week over a period of a year. Anger episodes are associated with

severe and persistent irritability. Dysphoria and hypersensitivity to negative stimuli may be considered in order to differentiate DMDD from ADHD [25,26].

Prevalence for DMDD is 3.3% in subjects from 9 to 19 years-old, among which 1.8% are severe (American population). DMDD is highly comorbid with ADHD: in a study by Leibenluft (2002), 87% of DMDD children had ADHD concomitantly. Another clinical trial done by Dickstein (2005) showed that 93.8% of children with DMDD presented symptoms of ADHD [27-29].

Patients with DMDD show a better response to pharmacological and non pharmacological treatments when those are used at the same time. A study by [30] demonstrated a good tolerability and efficacy for methylphenidate in children with DMDD and ADHD by associating this medication with cognitive remediation and behavioral therapy. However, it is important to stress that DMDD is a newly recognized condition and very few trials were conducted at the moment.

Addiction

• Substance use disorder

50% of adolescents with SUD have ADHD. Cannabis, alcohol, cocaine and nicotine are the substances consumed the most, but stimulants are also frequently misused. Wilsen has proposed various explanations to explain such of high prevalence of SUD among patients with ADHD: impulsivity, self-medication, lack of self-control and the similarities in neurological pathways described in craving behaviors and ADHD. Moreover, the presence of BD or CD comorbid with ADHD substantially increases the likelihood of developing SUD [31-33].

In a study of Miranda (2015), 40% of the Patients ADHD had used marijuana, versus 14% of Participants without ADHD. Several predisposing factors were found: a genetic predisposition, self-medication and personality factors (impulsivity, anger or high levels of sensation seeking) and psychosocial factors such as academic failure, social problems or a permissive parenting style (Cortese et al., 2015) [34-36].

Treatment strategies include a multimodal approach combined addiction and mental health interventions: addiction treatment should be undertaken as a priority, but concomitant treatments work best). Self-help groups and CBT may be helpful and pharmacological ADHD treatment should be managed carefully. Indeed, a longitudinal study of 10 years with young ADHD patients showed that 11% of patients sold their medication against ADHD for profit and 22% misused it [37, 38].

• Addiction without substance abuse

Patients with ADHD may be addicted not only to substances, but may also present with other forms of addictive behaviours such as gambling, video games and internet. In a study by [39] comparing the behavior of ADHD and control children playing video games, the former were more vulnerable to developing a dependence, particularly for a very specific category of games called massively multiplayer online role-playing games (MMORPG) [39]. This propensity to addictive behaviour in ADHD subjects is closely related to their impulsivity and their need for immediate

feedback. Clinicians assessing patients for ADHD should routinely enquire about all forms of addiction.

Anxiety Disorder

Generalized anxiety disorder, social anxiety disorder, separation anxiety disorder and specific phobias are the most common anxiety disorders (AD) found in youth. Anxiety is concurrent with ADHD in 33% of the cases, an association that aggravates inattention and concentration problems. On the other hand, concentration problems, irritability, sleeping disorders and restlessness may be caused by anxiety and not by ADHD. Furthermore, children with ADHD and AD may develop symptoms of lethargic cognitive tempo (e.g. slow response, easy confusion) and poor response inhibition (inhibiting a more favorable and task-appropriate automatic response) [40,41].

The most severe condition should be addressed in priority. ADHD medication may produce an increase in anxiety and as a result, a dose adjustment may be necessary to improve AD. Atomoxetine is the treatment of choice for the management of ADHD with AD. However, the co-administration of atomoxetine and serotonergic antidepressants should be used carefully because of the pharmacokinetic interaction on the cytochrome P450 (2D6 inhibition).

For AD, CBT is a recommended treatment but there are variances in its application depending on the disorder. CBT interventions for generalized anxiety disorder, social anxiety disorder and separation anxiety disorder should emphasize less on exposures and more on cognitive restructuring processes. However, children with ADHD and AD benefit less from CBT treatments than solely anxious children. Indeed, the former children's cognitive interventions are less effective due to their difficulties to pay attention, to stay involved and to be engaged in the task at hand. In the same way, distractibility and hyperactivity may interfere and decrease the effectiveness of behavioral therapy [41].

Post-traumatic stress disorder

Similarities in the symptoms of ADHD and PTSD make the differential diagnosis confusing and can lead to misdiagnosis. Those symptoms include hyperarousal, hypervigilance, irritability, sleep disorders, inattention and executive dysfunctions. Consequently, during the diagnostic interview, the patient's history should be thoroughly reviewed to ensure that no traumatic events are missed. The consequences of a misdiagnosis may include inadequate treatment such as potentially harmful interventions that focus on ADHD rather than PTSD [43].

In a study by [44] the prevalence of PTSD with ADHD is 5.2%. This prevalence increases up to 23.1% in sexually abused children. The co-occurrence of ADHD and PTSD in children leads to greater clinical severity in terms of other comorbid psychiatric disorders and psychosocial functioning. CBT is the treatment recommended for PTSD with its cognitive components being an important part of the treatment. Medication for ADHD follows the same principles as for other AD with a preferential treatment response with atomoxetine [42,44].

Obsessive Compulsive Disorder and Tics

Obsessive compulsive disorder

Children with obsessive compulsive disorder (OCD) have ADHD in 33% of the cases. Some studies showed that the two disorders are characterized by an opposite pattern of brain activity, in which OCD is associated with frontostriatal hyperactivity and ADHD with frontostriatal hypo activity. In the study of [47] patients OCD with ADHD appeared more impulsive behavior [45-47].

Although treatment differs for ADHD and OCD, they should take place simultaneously. For OCD, CBT should be the first approach with exposure and response prevention (ERP) combine with family counseling and psychoeducation [48].

Tics and tourette's syndrome

Tics can have a phonic or a movement aspect (blinking being the most common). Tourette's syndrome (TS) is a disorder with onset in childhood, characterized by multiple physical (motor) tics and at least one vocal (phonic) tic. TS is a neurodevelopmental disorder with frequent comorbidity with ADHD; the co-occurrence of ADHD with TS is 55% [49]. When TS is comorbid with ADHD, the latter is more likely to have a greater impact on the child's outcome.

Stimulant medication may contribute to the appearance of tics. However, for children with ADHD and TS stimulants could still be administered because of their effectiveness on ADHD symptoms. The potential negative consequences of stimulants on tics should be carefully monitored and concomitant medication is often necessary in those cases. Besides, atomoxetine shows a tendency to the decrease of tics. Clonidine and guanfacine (alpha-2-adrenergic agonists) have been shown effective against tics, in particular for TS when comorbid with ADHD. Other medications like atypical antipsychotics may be used for their positive impact on tics. For TS, treatment should aim at combining medication and psychosocial intervention with education and habit reversal therapy [50,51].

Autistic Spectrum Disorder

The DSM-IV made the concomitant diagnosis of ADHD and autistic spectrum disorder (ASD) impossible. However, the publication of DSM-5 officially recognized this comorbidity and classified them under neurodevelopmental disorders. There are genetic, clinical and neuropsychological overlaps between these two disorders. As much as 58% of children with autism and 85% of children with a continuum ASD show a clinical picture of ADHD. The presence of comorbid TSA with ADHD is likely to generate substantial impairment, and therefore, it is crucial to enquire about symptoms of ADHD when assessing patients for ASD. The study of [54] showed that ASD symptom severity was positively correlated with inattention/impulsive symptoms [52-54].

The treatment of ADHD may facilitate the implementation of behavioral management for children with ASD. Management of ADHD symptoms in ASD may associate psychoeducation, behavioral therapy and medication. ASD patients with ADHD

may respond adequately to ADHD medication, but it should be administered cautiously to minimize adverse effects such as dysphoria [55]. Psychostimulants should be considered if hyperactivity and impulsivity are the most important manifestations associated with ASD. Atomoxetine is usually used for attention deficit disorder with anxiety and ASD. Guanfacine XR, is more and more used for symptoms of hyperarousal, impulsivity, aggressiveness and tics associated with ASD. Lastly, Antipsychotics such as haloperidol, risperidone and aripiprazole, are supported by research trials for behavior disorders associated with ASD [56].

Eating Disorder

As early as 5-12 twelve years-old, ADHD has been found to be a predictive factor of eating disorders (ED), especially in girls. In a study by [57], patients with ADHD had 1.82 times more risk to develop ED compared to those without ADHD. Bulimia nervosa and binge eating disorder which are associated with impulsive behaviors are the most frequently found in ADHD subjects. Another clinical trial [58] showed that the association between ADHD and ED primarily exists in relation to binge eating and anorexia nervosa, the purging type. Recently, the co-occurrence of ADHD with obesity, probably associated with patient's impulsivity and tendency for addictions, has been described and patients with both disorders showed a significantly more severe binge eating pathology [57,58].

When ADHD co-occurs with anorexia, clinicians should recognize that psychostimulants could be abused by patients in order to lose weight. In a study by [59], 4.4% of college students used stimulants not for medical reason but to achieve weight loss. In another study by Jeffers [60], 11.7% of students reported used a prescription stimulant for weight loss. These participants had greater appearance-related motivations for weight loss, lower self-esteem, a more compromised appraisal of outside stressors and influences, and were more likely to report eating disordered behaviors.

Patients with ADHD and ED have more psychiatric comorbidities (MD and AD in particular) than patients with ADHD only. Similarly, patients with ADHD and ED have a higher frequency of SUD than patients with ED only [61]. Therefore management of ED associated with ADHD required an individual multimodal approach.

Attachment Disorder

ADHD is described as a multifactorial disease with a well-studied genetic vulnerability. Early environmental factors were also shown to play an important role in the development and course of ADHD early during the childhood. The quality of early interactions, central to the concept of attachment, may be considered as an early developmental factor impacting ADHD. There is an overlap in many respects between ADHD and attachment disorder. Emotional dysregulation and difficult temperament are common to both ADHD and attachment disorder. A secure attachment requires regulation of emotions and is important in the development of early attention processes. Difficult temperament can disturb the process of attachment and is associated with higher risk for ADHD [62,63].

Caregiving qualities (e.g., maternal sensitivity, positive parenting practices) may be affected by ADHD and those qualities are crucial for the attachment process. The type of attachment may play a role in the development of ADHD; and insecure attachment is well known risk for externalized behaviors during childhood [64,65].

Therefore, the perinatal period plays an important role in the development of attachment disorder and ADHD. Common perinatal factors, such as smoking during pregnancy or prematurity, are risk factors for the development of ADHD but have also been shown to contribute to early interactions impairment. Furthermore, prenatal stress or maternal depression could impact epigenetic mechanisms involved in the durable alterations of the hypothalamo-pituitary-adrenergic (HPA) axis. The implication of HPA axis was proposed to explain the biologic disturbances found in situations of insecure attachment (e.g., increase of salivary cortisol). Disturbances of HPA axis were also described in children with attention disorders [66-68].

The understanding of the overlap between ADHD and attachment disorder could be helpful in developing prevention programs. Moreover, because of the importance of the perinatal period, prevention such as prenatal intervention and early guidance should be addressed with high risk caregivers and could provide important benefits to the child's development.

Personality Disorder

• Borderline personality disorder

ADHD symptoms overlap with Borderline Personality Disorder (BPD). Since ADHD presents earlier than BPD, ADHD might be either a risk factor or a prodromal stage in the development of BPD or in the reinforcement of its symptoms. The study of [69] showed that both disorders share deficits in attention, impulsivity, emotional dysregulation, connectivity impairments in prefrontal and limbic areas and brain volume reductions. However ADHD patients had more outwardly expressed symptomatology, with dysfunction in ventrolateral prefrontal regions and difficulties in inhibition control. Patients with BPD showed a more mixed picture of externalizing clinical features with emotionally conditioned cognitive disturbances and dysfunction in dorsolateral prefrontal and orbitofrontal regions.

When BPD is comorbid with ADHD, treatment of BPD should be undertaken first because it is the most disabling condition. Those patients will benefit from a multimodal treatment (psychosocial intervention and cognitive-behavioral therapy). It should be noted that ADHD medication may improve the patient's engagement in psychosocial treatment for personality disorder by reducing impulsivity and psychological distress [18].

• Antisocial personality disorder

Children with ADHD and CD are at risk of developing an antisocial personality disorder (ASPD) as soon as 15 years of age and it is essential to identify childhood predictors of adult ASPD in order to provide early intervention. According to Frick, a new subtype of CD points the lack of prosocial emotions as one of the major risk factor in the development of ASPD [70]. ADHD medication may decrease impulsivity but psychosocial intervention is often

necessary to address the other symptoms of ASPD such as the absence of empathy or aggressiveness [18].

Medical Problems

Sleep disorders

Multiple clinical and research reports suggest extensive sleep disturbances in children with ADHD. It appears that sleep disorders not only co-occur but are intrinsic to ADHD. Indeed, in neuroimaging studies, ADHD and sleep problems show similar disturbances in the cortical arousal [71]. Particular attention should be paid to the differential diagnosis of sleep issues associated with ADHD, i.e., the clinical situations where ADHD symptoms are mimicked by a primary sleep disorder. In particular, clinicians should consider the restless legs syndrome and sleep-disordered breathing, like sleep apnea.

A diversity of sleep problems is experienced by ADHD children in both the transient and persistent trajectories. Risk factors for persistent sleep problems include co-occurring internalizing and externalizing disorders and a greater ADHD symptom severity. Risk factors for transient sleep problems include co-occurring internalizing and externalizing disorders and parental mental health problems. Early prevention should target children at risk for persistent sleep problems [72].

Picchiatti and Walters suggest a possible increased prevalence of periodic limb movements (PLM) during sleep in children with ADHD. Similarly, an association exists between the restless legs syndrome (RLS) and ADHD. For unmedicated children with ADHD, research data shows increased night-time activity, reduced rapid eye movement sleep and significant daytime somnolence. Thus, screening questions to assess sleep should be systematic at each visit for children with ADHD. According to measuring serum ferritin levels may be indicated if there are clinical elements suggesting a diagnosis of RLS-PLM, since those children have been reported to have low serum ferritin levels. Iron sulfate treatment could decrease PLM. Medication-free ADHD children and sleep-onset insomnia (SOI) presents a delayed evening increase in endogenous melatonin levels [73-76].

Data suggests the effectiveness and tolerability of melatonin (3–6 mg/day); improvement in sleep-onset delay is noted but there are no significant effects on daytime ADHD symptoms [77]. Furthermore, it has been suggested that stimulants used in the treatment of ADHD trigger sleep disturbances. In particular, stimulants have effects on sleep-onset delay, shorter sleep duration and night awakenings. It appears that quality of sleep is better with atomoxetine than with stimulants, but both medications decreased night-time awakenings to a certain degree [72].

Brain injury

Because of their impulsivity and inattention, ADHD children are at high risk of physical injury. Furthermore, brain injury can either aggravate ADHD's symptoms or produce a syndrome named Secondary-ADHD (S-ADHD). As a matter of fact, 20% of children with brain injury develop ADHD and the more severe the head trauma, the higher the risk [78]. The meta-analysis of [79] showed strong evidence for an association between ADHD

and brain injury but the directionality of this association remains unclear. The meta-analysis provides a stronger evidence for the hypothesis that brain injury leads to subsequent ADHD than there is for the idea that ADHD leads to subsequent brain injury.

Medication used to treat ADHD can help alleviate ADHD impairments in the majority of patients with brain injury. Medication should be carefully administered because of the sensitivity to side effects in those patients [80].

Epilepsy

Studies suggest that ADHD is frequently concurrent with epilepsy in childhood. A study by Hermann (2007) indicates that ADHD is significantly more prevalent in new onset epilepsy than healthy controls (31% versus 6%). In the majority of cases, those children are characterized predominantly by the inattentive variant and with onset antedating the diagnosis of epilepsy [81].

ADHD in childhood epilepsy is associated with academic underachievement and neuropsychological consequences with differences in executive function. ADHD and epilepsy are associated with a diversity of academic, cognitive, behavioural and social difficulties that antedate most epilepsy onset. The cerebral MRI of ADHD patients with epilepsy shows significantly increased gray matter in the frontal lobe and significantly smaller brainstem. Those difficulties appear to be related to neurodevelopmental abnormalities in brain structure [82].

ADHD medication may be used for most patients with this comorbidity. However, they should be cautiously instituted given the fact that psychostimulants may lower seizure threshold and may increase the effects of phenobarbital, phenytoin and primidone (drug interactions increase the plasma concentration of antiepileptic) [82].

Others Problems

Specific learning disorder

Learning Disorders are now classified as specific learning disorders (SLD) in the DSM-5 and are listed under the neurodevelopmental disorders, alongside with ADHD, ASD, communication disorders, coordination disorders and intellectual disability. In the DSM-5, SLD is a standalone category with specifies (reading, writing and mathematics) [25]. Comorbidity of ADHD and SLD is high, i.e. between 31% and 45% [83] and both disorders present with similar complains. Children SLD manifest difficulties to stay attentive on tasks as do ADHD children who show deficits in executive function. Their academic performances are often under their full potential. Thus, clinicians assessing patients for ADHD should routinely enquire about SLD and vice versa. For children with SLD, it is necessary to screen for other disorders such as auditory processing disorders or motor disorders that could aggravate difficulties. For children ADHD, in the cases of speech and language difficulties, clinicians should also screen for auditory processing disorders [18].

In order to optimize treatment, it is important to distinguish academic difficulties linked to ADHD from difficulties due to SLD. ADHD children with academic skill deficits must be accommodated in school setting. Similarly, SLD children should be in classrooms

that will address the individual's learning impairments. Finally, when ADHD co-occurs with SLD, patients need to be treated for both disorders with interventions in school and home settings [18].

Developmental coordination disorder

Developmental coordination disorder (DCD) is a neurodevelopmental and chronic physical health condition with persisting motor problems. The consequence of this disorder is a disability that restricts the ability of an individual to perform daily activities in self-care and academics. Dyslexia and poor handwriting are often associated with DCD.

Prevalence is estimated from 2% to 5%. However, most of those children are never diagnosed with DCD. The comorbidity of DCD and ADHD is high: as much as 50% of DCD patients have ADHD. The presence of both ADHD and DCD is an early predictor for further mental health problems [84-87].

In addition to the treatment of ADHD, DCD should also be managed. Cognitive orientation to daily occupational performance (CO-OP) focuses on the cognitive domain and helps to improve problem-solving skills and organizing of daily activities. Neuromotor Task Training (NTT) and Nintendo Wii Fit Training (Wii training) are both task-based interventions used to help children with motor coordination problems [88,89].

Conclusion

ADHD is highly comorbid with a number of psychiatric and somatic disorders. ADHD is probably more a group of conditions, rather than a single homogeneous clinical entity. A better understanding of the interplay between ADHD and different comorbidity may lead to identify different etiologies, risk factors and outcomes. Among the most disabling comorbidities, one should screen for mood, anxiety and conduct disorders. Similarly, there is some overlap between ADHD and addictive behavior, sleeping disorder and specific learning disorder. Lastly, links with PTSD and attachment disorder have been noted and should lead to the development of early intervention and prevention programs for high risk families. Follow-up studies of children with ADHD indicate that subjects with ADHD and a comorbid disorder have an important psychological impact on the development of their self-esteem, poorer prognosis and have more difficulties in terms of social. Possible explanations proposed for such a high association between ADHD and other clinical life entities are that both disorders show similar risk factors (genetic and psychosocial vulnerability) or one disorder may be a subtype of the other. Questions persist as to whether comorbid conditions is secondary to ADHD symptoms, or if other psychiatric disorders masquerade as attention problems. Alternatively, distinct subtypes of ADHD may exist and each may have its specific comorbidity. Investigation of overlaps between ADHD and other disorders should help clarify the etiology, course and outcome of ADHD. Ideally, it would lead to identify specific treatment algorithms for ADHD.

Compliance with Ethics Guidelines

No conflict Interest Masi L and Gignac M declare that they have no conflict of interest.

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.

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