

Open Access Article **Review Article**

Language and cognitive deficits in attention-deficit/hyperactivity disorder. Stress and diversity in intellectual disability studies

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Key words: ADHD, ASD, Comorbidity, Language, Intellectual disabilities.

Citation: A. Argyriadi, C. Vlachou, A. Argyriadis. Language and cognitive deficits in attention-deficit/hyperactivity disorder. Stress and diversity in intellectual disability studies. Rev. Clin. Pharmacol. Pharmacokinet., Int. Ed. 2022, 36, 2-3, 65-71.

<https://doi.org/10.5281/zenodo.10050436>

Received: 12 December 2022

Accepted: 23 December 2022

Republished: 28 October 2023

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S u m m a r y. Introduction: Since attention-deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) are typically seen as disorders with early onset, the majority of research has placed a strong emphasis on those children. **Aim:** The aim of this study was to present the main cognitive and linguistic characteristics of children in the case of ASD and ADHD, considering their heterogeneity. **Method:** The literature review in digital and conventional databases was used and the literature research took place from June 2022 until November 2022. **Results:** The results of this study showed that attention-deficit/hyperactivity disorder is a neurodevelopmental disorder that shows cognitive and language deficits. People with ADHD more often show comorbidity with other developmental disorders and the main deficits focus on all levels of language (language, reading, written expression, pragmatics). **Conclusions:** To conclude, it is necessary to make a diagnosis as early as possible, and indeed a differential diagnosis, because due to the great heterogeneity of ADHD and its comorbidity with other neurodevelopmental and mental disorders, such as autism, anxiety disorder, antipsychotic challenging disorder but also learning difficulties, the diagnosis becomes particularly difficult and may cause confusion.

INTRODUCTION

Children with neurodevelopmental disorders may struggle with behavior, social interactions, learning, language, motor skills, attention, and other neuropsychological functions.¹ The term "neurodevelopmental disorders" has also been used by some researchers to refer to conditions like cerebral palsy and epilepsy as well as neuropsychiatric disorders like schizophrenia and bipolar disorder.^{2,3} Clinical diagnoses are based on the pattern and intensity of symptoms

presented by the individual at a particular period, with the assumption that they are brain-based. However, as children learn and grow up, the signs and behaviors connected to a specific neurodevelopmental disorder can alter. The diagnosis of these disorders can thus be complicated. Additionally, the treatment plan can vary depending on the child's age at the time of diagnosis and the severity of the disorder, the age of the child at the time of assessment, and may combine home and school-based programs, clinical interventions like behavior therapy, speech, and language therapy, or occupational therapy, and medication.^{4,5,6} Ten to fifteen percent of all births are affected by neurodevelopmental disorders and prevalence rates are rising globally.^{7,8}

However, more commonly than would be anticipated, neurodevelopmental disorders like autistic spectrum disorder, attention-deficit/hyperactivity disorder, developmental coordination disorder, developmental language impairment, reading disorders, and learning disabilities co-occur. The research literature suggests that genetic, epigenetic, neurological, and environmental factors may all have a role in this comorbidity.^{9,10}

Since attention-deficit hyperactivity disorder (ADHD) and autistic spectrum disorders (ASD) are typically seen as disorders with early onset, the majority of research has placed a strong emphasis on those children. In this study, we present the main cognitive and linguistic characteristics of children in the case of ASD and ADHD, considering their heterogeneity.

ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)

Attention Deficit Hyperactivity Disorder (ADHD) is defined by the DSM - V diagnostic manual as a progressive neurodevelopmental disorder, appearing before the age of 12 years. ADHD has a direct impact on a person's functioning and is noticeable throughout their life, appearing more often in boys.¹¹ In particular, it is a heterogeneous disorder with different severity (mild to severe), and depending on which symptoms predominate it is divided into the following subcategories, Inattentive Type, Hyperactive-Impulsive, Mixed or Combined ADHD (in the latter case, inattention coexists with hyperactivity/impulsivity). Finally, if the aforementioned criteria do not exist, it is classified as ADHD, Not Otherwise Specified (DSM - V).¹¹

The prevalence of ADHD at an international level is estimated from 2% to 7%, although not all countries present the same percentages, as this disorder is considered relatively underdiagnosed compared to others, while it becomes particularly difficult to diagnose in girls and adolescents or adults, because of the different symptomatology.¹² However, a gradual increase in diagnoses is observed. The heterogeneity that distinguishes it on an inter and intra -individual level, as well as its comorbidity with other neurodevelopmental and psychiatric disorders, makes its diagnosis particularly difficult.¹³

The diagnostic process for ADHD is a difficult task. Many of its symptoms, which belong to the diagnostic criteria, also appear in other neurodevelopmental disorders, while its clinical picture changes according to the individual's developmental stage.⁶ In many individuals, ADHD symptoms persist into adolescence (60-80%) and adulthood.¹⁴

People with ADHD more often show comorbidity with other developmental disorders. When there is comorbidity, the deficits presented are more severe.¹⁵ Researchers found out high rates of comorbidity of ADHD with the oppositional defiant disorder (50%), mood disorders, or anxiety disorders (30-50%), but also with learning difficulties.¹⁶ ADHD also co-exists to a large extent with dyslexia, particularly in children with a prominent inattentive type.^{17,18} Other studies identify comorbidity of ADHD with bipolar disorder,¹⁹ Tourette syndrome, but also with central auditory processing disorder.²⁰ Symptoms of autism are found in 20-50% of children with ADHD,²¹ symptoms of Asperger syndrome in 30-80% as well as the coexistence of ADHD with Developmental Language Disorder (DLD).²² In addition, research has shown that the symptoms of ADHD often overlap as they derive from a common biological basis, creating obstacles to the diagnosis of the disorder, as well as to intervention to improve it.^{23,24}

ADHD is associated with certain deficient cognitive functions that affect the academic as well as the social life of the individual. One of the key deficits of ADHD is found in attention and in particular sustained attention that appears in preschool age and is a strong indicator of the child's academic development.²⁵ Deficits in divided attention and more generally in the executive control of attention, i.e. the individual's difficulty in processing multiple sources of stimuli at the same time, appear especially in the combined form of ADHD. From these, it is concluded that the form of the attention deficit is shaped according to the ADHD subcategory.

Finally, attention deficit may be present in learning difficulties more generally and lie in blunted ability, confusion, and lack of interest. In this case, the specific deficit will be felt mainly at school work and will not affect the rest of the activities, on the contrary, if it occurs together with ADHD the distraction will affect all areas.¹¹

Another cognitive domain affected by ADHD is working memory. More specifically, the deficit concerns the central processor that contributes to the performance of a cognitive task and the parallel recording, storage, and recall of information that one receives from the environment.²⁶ This deficit has been present since childhood and persists during the person's adulthood, affecting their school performance and especially in the area of reading and arithmetic problem-solving.²⁷ Corresponding deficits in working memory are also observed in dyscalculia, dyslexia, and Oppositional Defiant Disorder.²⁸ In addition, children with autism also have problems with working memory.^{29,30} Furthermore, in the case of ADHD, deficits have been observed more in the field of visuospatial memory than verbal.

Among the executive function deficits that characterize ADHD is the dysfunction of inhibitory control. This is one of the core deficits of ADHD related to the individual's ability to focus on one stimulus and not be distracted by others (internally or externally), as well as "the inhibition of automatic responses" when bounded action is necessary or plan change. This deficit is related to the improper functioning of the rostral frontal circuit³¹ and undermines both the learning and social interaction of the individual.²⁵ Studies have shown that children with autism also show partial dysfunction in inhibitory control,³² as did children with oppositional defiant behavior. The inhibition deficit manifests itself on three levels: On a motor level, there is a lack of control over movement behavior, so it manifests itself in hypermobility. For example, when a child is in class and can't help but get up from the chair because he is tired of sitting. At the level of attention, the deficit manifests itself with restlessness and difficulty paying attention. For example, when the person is reading a book he is distracted because he hears the bell or sees the shadow of a pigeon through the window. At the behavioral level, the deficit manifests itself in impulsive behavior.

Deficits have also been identified in terms of flexibility and planning skills (foresight, organization), planning, and making the right decisions every time.³³ Flexibility is related to receiving and responding to one or more stimuli and arranging them. This deficit is affected by the

different types of ADHD. In particular, it has been observed that individuals in whom hyperactivity and impulsivity predominate show more problems in complex cognitive processing, which presupposes abstract ability and flexibility. People with autism also show difficulties in cognitive flexibility and by extension in planning, in fact to a greater extent than people with ADHD.³⁴

A cognitive deficit that often occurs in ADHD and especially at younger ages is delay aversion. Children with this disorder resent long-term rewards even if they are of greater value and seek immediate ones. Variability in reaction time is also one of the cognitive deficits of ADHD. This means that the individual is unable to harness the appropriate amount of energy required to complete a task, resulting in a slower response than the average reaction time. Also, there is a wide variation in reaction times; the response times of children with ADHD are sometimes very fast due to their impulsivity and sometimes very slow when distracted. Therefore, it is perceived that depending on the subtype the children belong to, with ADHD, have a corresponding reaction to the task they are asked to perform. A similar deviation in reaction times in attention assessments has also been found in children with autism.³⁵

Optionally, one of the deficits of those with ADHD is an inability to perceive time. In particular, during their school term, it is observed that they have difficulty with the schedules, and the time limits of the instructions given to them, and they usually finish their assignments late. They do not value time correctly and this has a negative effect on their school performance and also on their daily life.³⁶ The perception of time is reduced to deficits in working memory and is due to structural abnormalities of the brain, as evidenced by neuroimaging studies.³⁷

The cognitive deficits of ADHD, combined with the heterogeneity that permeates them and their coexistence with other disorders create obstacles in the learning process and in general in psychosocial adaptation. It is therefore necessary to understand the deficit in each cognitive function, to have a corresponding neuropsychological intervention. Deficits in executive functions are associated with disorders such as conduct disorder and affective disorder, features of which appear in ADHD.

DEFICIT LANGUAGE FUNCTIONS

Attention-deficit hyperactivity disorder presents not only cognitive but also language deficits that become evident during the

individual's developmental course and their intensity varies according to the subtype of ADHD. In particular, deficits in expression, articulation, and speech are often observed. However, these deficits are not diagnostic criteria for this disorder, as there is no specific language profile for those with ADHD and they often coexist with other learning difficulties.³⁸ Language deficits are mainly found in reading, comprehension speed, narrative ability, pragmatics, morphology (grammar, spelling), and phonological verbal fluency of children with ADHD, and slow development of internal speech while associated with working memory.³⁹

Phonological verbal fluency

A percentage of 10 to 54% of children show problems in articulation, language expression, and during the preschool age in phonological awareness when they are asked to decode words while in general their speech is characterized as disorganized.³⁹ Also, in research carried out by Kim and Kaiser in 2000,⁴⁰ students with ADHD had below-average performance, both in articulation and sentence repetition, just like the children with Developmental Language Disorder who participated. This demonstrates that the problem is more pronounced in expressive vocabulary and indicates possible comorbidity with Developmental Language Disorder.

Expressive and receptive vocabulary

People with ADHD have difficulties with predictive vocabulary. And this lies in the cognitive deficit of attention as well as its dialectical relationship with language. More specifically, difficulty has been found in understanding causal relationships, conclusions, detecting errors, and assimilating information mainly in science courses, as well as an inability to perceive the action of the heroes of a story. In addition, cohesion and coherence are often absent from the speech of children with ADHD, as well as the ability to condense their answers by using special vocabulary, to a question (that is put to them). This happens mainly in the impulsive type of ADHD, but also the combined type, but the student with dyslexia, as well as the children with a developmental language disorder, show lack of understanding. People with a developmental language disorder show a lower performance compared to children with ADHD in repeating words.⁴¹

In research carried out by Redmond in 2005,⁴¹ it was found that there are children with ADHD who show in their speech the characteristics of a developmental language

disorder. Children with a developmental language disorder had lower performance compared to children with ADHD in the area of grammar, sentence recall of narrative speech, while children with ADHD presented stronger deficits in the area of pragmatics.

READING

Attention deficit, even hyperactivity when presented as a prominent symptom of ADHD, are a predictive factor for a child's reading ability. In particular, if the predominant symptom is attention deficit. Also, children with problematic behavior in kindergarten and reading difficulties have reduced chances of improvement compared to children who only have reading problems.⁴² In addition, a percentage of 15% to 40 the ADHD disorder also presents some specific learning difficulties in reading. More specifically, these students have difficulties in the field of phonological processing but also in reading decoding. They still have difficulty recalling information, understanding the meaning of a story, determining causal relationships, retelling, and concluding. They read single words and pseudowords more slowly. It has been stated that reading difficulties are mainly related to the inattentive type of ADHD rather than the hyperactive or impulsive type of the disorder. Nevertheless, Purvis & Tannock⁴³ argue that impulsivity also exacerbates reading difficulties in children with ADHD due to their deficits resulting in low academic skills.¹³ In fact, a high rate of comorbidity of ADHD with dyslexia has been found, 25 to 48%.⁴²

WRITTEN EXPRESSION (SPELLING-SYNTAX)

One of the most common difficulties in children with ADHD is the one found in the written word, more specifically, they produce texts after a slow or hurried approach, depending on whether the symptom of inattention or impulsivity predominates. Their writing is messy and hard to read and is not the product of planning and organization. Also, the structure is loose, and the logical sequence between causes and conclusions is absent. Problems also exist in spelling morphology, especially in children whose primary symptom is attention deficit, the problem is more pronounced in spelling processing Spelling.⁴³ The conditions required for writing a text such as the organization, the connection of the sentences burden the working memory of the student with ADHD. At the same time, problems are found in the fine motor skills of children with

ADHD, a deficit that is found not only in dyslexia but also in dysgraphia. While it may also coexist with dyspraxia. Finally, ADHD is associated with movement disorders and deficits in gross and fine motor skills as well as visuomotor coordination, which affects the way they write.

PRAGMATOLOGY

In the pragmatic domain, people with ADHD often show behavior that is not appropriate for their age and does not respond adequately to communicative situations.⁴⁴ The inner speech is a consequence of the language skills which, however, have not been sufficiently developed in the students with ADHD and this hinders their self-guidance as well as their academic development.

CONCLUSIONS

Attention-deficit/hyperactivity disorder is a neurodevelopmental disorder that shows cognitive and language deficits that occur in childhood, but is not limited only to this age phase, and is also present in the person's adulthood, affecting all aspects of their daily life. For this reason, it is necessary to make a diagnosis as early as possible, and indeed a differential diagnosis, because due to the great heterogeneity of ADHD and its comorbidity with other neurodevelopmental and mental disorders, such as autism, anxiety disorder, antipsychotic challenging disorder but also learning difficulties, the diagnosis becomes particularly difficult and may cause confusion.

All of this is consistent with the fact that a careful neuropsychological assessment must be done and there must be interdisciplinary collaboration, taking into account the heterogeneity of the disorder. The neuropsychological assessment is a thorough assessment that allows for a better approach to developmental disorders and early detection of deficits from infancy. In particular, it examines the child collectively and in terms of intellectual, cognitive, and psychological functions, taking into account both inter-individuality and intra-individuality. With neuroimaging images, the brain function is examined and at the same time, the stimuli surrounding the child (family, school) are investigated, formulating personalized interventions and programs.

Conflicts of Interest: The author declares no conflicts of interest regarding the publication of this paper.

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