

The Comorbidity of Specific Learning Disorders in Attention Deficit Hyperactivity Disorder

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ABSTRACT

Attention deficit hyperactivity disorder (ADHD) is a neurobiological disorder that begins in childhood, with symptoms continuing throughout life, negatively impacting an individual's cognitive, social, and academic functioning. Specific learning disability (SLD) is a developmental disorder characterized by its initial signs being noticeable during the preschool years. The broad category of SLD encompasses various skill deficits, but the most common symptoms are typically divided into three broad subcategories: reading disorder, written-language disorder, and mathematics disorder. Generally, there is an estimated comorbidity rate between SLD and ADHD ranging from 31% to 45%. While ADHD is conventionally defined as an externalizing disorder, children with this condition often exhibit learning difficulties and academic problems in addition to behavioral issues such as impulsivity, oppositional behavior, and conduct problems. These academic difficulties are frequently overlooked, as behavioral problems, often linked to impulsivity, tend to take precedence. The purpose of this review is to draw attention to these overlooked areas of concern in children diagnosed with ADHD, both in clinical practice and academic literature, and to review relevant literature studies.

Keywords: Attention deficit hyperactivity disorder, comorbidity, neurodevelopmental disorders, specific learning disorder

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INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurobiological disorder that typically begins in childhood, with symptoms persisting throughout life, negatively impacting cognitive, social, and academic functioning. Its core symptoms include inattention, hyperactivity, and impulsivity. ADHD, being a neurodevelopmental disorder, manifests differently across the lifespan, leading to different symptomatic presentations in accordance with each life stage.^[1,2]

Children diagnosed with ADHD are often reported to experience behavioral problems and learning difficulties at a higher rate. While ADHD is conventionally categorized as an externalizing disorder,^[3] these children frequently exhibit not only behavioral issues like impulsivity and conduct problems but also face learning difficulties and academic problems.^[1,3] However, academic difficulties are often overlooked due to the prominence of behavior problems associated with impulsivity. The purpose of this review is to draw attention to

these often overlooked comorbidities in children diagnosed with ADHD, both in clinical practice and academic literature, and to review relevant literature studies.

ADHD is a disorder that has been conceptualized as a disorder with an executive function deficit.^[4] Executive functions refer to high-level mental skills that enable a person to generate output and transform learned information into concrete actions, facilitating the achievement of goals. These functions encompass abilities such as planning, decision-making, problem-solving, and time management, which are necessary for successfully completing complex tasks. For instance, planning the stages of a project, prioritizing tasks, and managing the process effectively are examples of executive functions.^[3-5]

Children diagnosed with ADHD have a significantly higher likelihood of experiencing academic and scholastic problems such as grade repetition, special education requirements, and absenteeism compared to their peers. These children also exhibit symptoms related to learning difficulties. They



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may face specific academic failures such as reading, writing, listening, speaking, reasoning, and arithmetic operations.^[5,6] These learning deficits are independent of factors such as native language proficiency, cultural differences, or issues within the educational environment. Specific learning disorder (SLD) is a developmental disorder, and its first signs are typically noticed in the preschool years. Diagnosis of SLD, particularly in the areas of reading, writing, and arithmetic, is typically made during the early years of primary school when these skills are being acquired. Diagnosis of SLD, particularly in the areas of reading, writing, and arithmetic, is typically made during the early years of primary school when these skills are being acquired.

These learning deficits may manifest as speech difficulties, word confusion, difficulty learning letter-sound relationships, delayed language development, motor skill challenges (e.g., struggling to tie shoelaces, use scissors, draw geometric shapes, button clothes), and perceptual difficulties in understanding similarities and differences between events or situations. In elementary school, these symptoms become more pronounced. For example, children with SLD in reading may confuse letters, change their positions, skip letters, or mix up words. In terms of writing skills, they may struggle with holding a pen, having slow handwriting, mixing up letters, skipping letters, writing illegibly, writing words backward, and having difficulty copying assignments. In addition, they may face challenges in basic arithmetic operations, memorizing multiplication tables, learning the days of the week in order, and counting the months sequentially.^[7,8]

SLD is divided into three main categories

1. Reading disorder (dyslexia): characterized by reading skills below the expected level for a person's age. It includes difficulties in recognizing letter-sound correspondences, sound articulation (phonotactic dyslexia), slow or laborious reading (surface dyslexia), problems in phonological and orthographic processes (mixed dyslexia), poor comprehension of what is read, and difficulty retaining information.^[9]
2. Written language disorder (dysgraphia) refers to writing skills below the expected level for one's age. Dysgraphia is marked by significant difficulties in mentally representing written words, using small muscles adequately, and performing appropriate finger movements for writing.^[9]
3. Mathematics disorder (dyscalculia): Dyscalculia is defined as difficulties in specific parts of mathematics caused by impairments in certain brain functions related to mathematics without a general cognitive deficit.^[10]

ADHD AND SLD COMORBIDITY

The discussion surrounding the relationship between ADHD and SLD can be traced back to the early 20th century when both disorders were categorized under the minimal brain dysfunction classification. This concept refers to a group of children characterized by hyperactivity, excessive impulsivity, and academic underachievement and is attributed to the neurobiological origins of both disorders. However, diagnostic terminology has evolved over time. In the Diagnostic and Statistical Manual of Mental Disorders (DSM II: American Psychiatric Association [APA], 1968) and later in DSM III (APA, 1980),^[11,12] research diagnostic criteria were detailed, differentiating ADHD from learning difficulties. Despite these developments in diagnostic terminology, distinguishing between behavioral symptoms and cognitive symptoms in children affected by both disorders remains challenging.

ADHD diagnosis is primarily defined by behavioral problems, namely hyperactivity and impulsivity, while SLD emphasizes cognitive issues and executive function deficits. However, cognitive problems and executive functions are among the core symptoms of ADHD within the dimension of attentional dysregulation.

DSM-5 (2013) reevaluated the concept of learning disorders and introduced the term "SLD." It emphasized that SLD can be observed in individuals with normal or above-average intelligence levels. SLD emerges when a child's academic performance is significantly lower than expected, taking into account their age, intellectual abilities, and education. This academic difficulty can persist throughout one's life and is considered a neurobiological disorder that negatively affects various aspects of life.^[7,13]

These symptoms are often associated with ADHD. Among different subcategories, children with reading disorders (RD) are the most extensively researched within all learning disorders (SLD), with a comorbidity rate ranging from 25% to 48%. Particularly, a subset of SLD involving difficulties in word recognition and decoding, known as dyslexia, is frequently co-occurring with ADHD, with a comorbidity rate between 25% and 40%. The comorbidity rates between intellectual disability and ADHD range from 55% to 64%, while the rates between mood disorders and ADHD range from 11% to 30%. Overall, there is an estimated comorbidity rate between LDs and ADHD ranging from 31% to 45%.^[5,9,10]

In many studies, researchers have investigated the neuropsychological factors that could be shared between SLD and ADHD. Willcutt and colleagues, in a study comparing ADHD,

SLD, and a group with both diagnoses to a control group, attempted to identify six cognitive phenotypes. These phenotypes were defined as phonological awareness, processing speed, rapid automatized naming, response inhibition, verbal reasoning, and working memory impairments. In the SLD group, they found more impairments in phonological awareness, verbal reasoning, working memory, and rapid automatized naming measures compared to the ADHD group.^[14]

In another study conducted by McGrath and colleagues, a structural equation model was used to determine which cognitive structures predict SLD and ADHD symptoms in common and which are specific to each disorder. They showed that phonemic awareness and impairment in rapid automatized naming predicted SLD, while impairment in response inhibition predicted ADHD symptoms. Impairment in processing speed was found to be a common feature in both disorders.^[15]

ADHD and dyscalculia are conditions that have been diagnosed together in children, but there is limited research assessing the neuropsychological profiles of children with this dual diagnosis. Children with both conditions often exhibit weaknesses in calculation, mathematical problem-solving, and reasoning. Recent studies have indicated a closer relationship between attention deficits and deficiencies in mathematical skills. When examining the neuropsychological profile of this comorbid condition, researchers have suggested that it may stem from deficits in visual-spatial memory, numerical working memory, and processing speed.^[16,17]

Capano and colleagues compared four groups of children with ADHD to other groups (ADHD, ADHD + RD, ADHD + dyscalculia, and ADHD + RD + dyscalculia). They found that children with ADHD + dyscalculia generally exhibited weak arithmetic skills but showed stronger receptive and expressive language performance compared to the ADHD + RD + dyscalculia group.^[10] Children with RD and dyscalculia typically show weaknesses in processing speed and working memory, although these deficits can manifest in different neuropsychological domains. For instance, RD is primarily defined as a language-based disorder with significant phonological processing weaknesses associated with verbal working memory. In contrast, children with dyscalculia struggle with visual-spatial working memory.^[10,16] Children diagnosed with ADHD are at a higher risk of experiencing difficulties in written expression, particularly in the areas of visual-motor integration and fine-motor coordination. In addition, issues related to attention, working memory, organization, and planning can negatively impact the writing process.^[5,9]

GENETIC RELATIONSHIP

Findings from twin studies indicate that children diagnosed with ADHD and reading disorder have a strong genetic predisposition to these disorders. Twin studies have reported high genetic correlations, estimated at 70% to 80% for ADHD and 40% to 60% for RD. This suggests that children from families with RD or ADHD are much more likely to develop one or both of these disorders than children from unaffected families. In twin studies, strong genetic correlations (0.85–0.88) for specific academic skills and moderate to high correlations (0.60–0.90) between reading, language, and math skills have been found. While some research studies have not been successful in distinguishing genes specific to RD and ADHD, research findings from twin studies indicate a genetic overlap (0.50–0.76) between math skills and reading comprehension in children with RD and ADHD. This is likely associated with shared neuropsychological features common to both disorders, such as working memory.^[17]

DIAGNOSIS

The diagnosis of SLD has conventionally been made using a discrepancy model. According to this model, a child's performance on standardized achievement tests is defined as lower than expectations (1 to 2 standard deviations below the mean based on age, education, and intelligence level, or if there are accompanying factors) if there is a difference of more than 2 standard deviations between achievement and IQ. However, these criteria have often been criticized for their reliability and validity shortcomings.^[18]

The diagnosis of SLD involves a detailed psychiatric examination, gathering detailed information from various sources, such as family, school, and relatives, regarding the areas in which the child is experiencing difficulties, and conducting neuropsychological assessments. The most commonly used tests in clinics for this purpose include the Wechsler Intelligence Scale for Children, the Bender Gestalt Visual Motor Test, the Peabody Picture Vocabulary Test, the Visual-Auditory Digit Span Test, the Line Orientation Test, and the Specific Learning Disability Battery. Early diagnosis of SLD is important not only for determining the way to the individual's academic success but also for addressing potential social and emotional problems.^[6,18]

In assessments aimed at determining the psychological, neuropsychological, or behavioral characteristics of ADHD and aiding in diagnosis, direct observations, structured interviews, behavioral assessment scales, and multi-stage evaluations are commonly used. During these interviews, it

is important to establish collaboration between the school and family to obtain a detailed developmental history and evaluate the behavioral characteristics in both school and home settings. In clinical practice, structured interviews and behavioral assessment scales are also used when diagnosing ADHD. The Wechsler intelligence tests, which are also used in SLD diagnosis, serve the purpose of measuring cognitive functions such as working memory and processing speed; these neuropsychologic features are shared both by ADHD and SLD, as well as identifying the child's strengths and weaknesses. Tests such as the D2 Attention Test, Burdon Attention Test, Stroop Test, Moxo Test, and Connors Attention Test, in addition to detailed psychological assessments, should be conducted to determine the child's behaviors, emotional, and social characteristics.^[6]

TREATMENT FOR ADHD AND COMORBID SLD

In the treatment of ADHD, coexisting disorders are commonly encountered due to the nature of this disorder, and their management requires clinical experience. When prioritizing and sequencing treatment decisions, it is essential to consider which condition is causing the most distress and which conditions are most responsive to effective interventions. In the treatment of ADHD, it is important not to overlook psychosocial treatment alongside pharmacotherapy, depending on the severity of symptoms and how they negatively impact the child's life. In psychosocial therapy, collaboration with the school and family is established, psychoeducation is provided to the family, and family therapy, when necessary, has a positive impact on the treatment process. Taking into account the child's individual characteristics and problem areas, necessary academic and social skills training, psychotherapy for emotional and social problems, and physical activities aimed at controlling excessive motor activity and impulsivity should be included in the treatment.^[19]

For individuals diagnosed with SLD, it is important to consider that they will have different individual characteristics. Therefore, after identifying the child's strengths and weaknesses, the development of individualized education programs (IEPs) becomes crucial. IEPs focus on emotional, social, perceptual, motor, language, and cognitive areas. Activities in these areas are integrated into the regular curriculum. If necessary, additional learning methods such as peer tutoring and paired reading are also used.^[19,20]

In the treatment of SLD, it is important to support the child at home, provide special attention at school, and create

an appropriate environment and conditions for positive results. Many studies on children with SLD have indicated that integrative education is the best educational environment for these children. It is emphasized that teachers should acknowledge the difficulties the child is facing, exhibit a positive and understanding attitude towards the child, and implement effective and supportive teaching methods adapted to the child's needs.^[21]

A comprehensive assessment should be carried out in the diagnosis of ADHD and SLD, and a personalized therapeutic approach within a wide range of therapies should be adopted, preferably through a multidisciplinary team approach. This team should include teachers, psychologists, and school counseling psychologists who collaborate with families. Individuals with comorbid ADHD and SLD can benefit significantly not only from interventions focused solely on core symptoms by psychiatrists and psychologists but also from the skills of therapists, psychotherapists, and family therapists specializing in special education. In therapeutic interventions, the analysis of this comorbid condition begins with a thorough examination of a larger system that includes the family.

Pharmacotherapy for ADHD is effective, especially in improving cognitive symptoms and executive functioning-related symptoms, and it leads to significant improvement in problems related to working memory, which is common with learning disabilities. Clinicians should also encourage interventions that promote participation in the school environment and support environmental changes, including endorsing the use of effective classroom management strategies. In treatment, factors such as the child's negative and positive characteristics affecting their success, the characteristics of family and peer relationships, self-esteem, and attention processes should be taken into account. Educational programs that support emotional and social challenges involving school, family, and expert collaboration, taking into account the needs of children, should be implemented.

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