



Diagnosis of developmental learning and attention disorders in adults: A review of clinical modalities

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ABSTRACT

ADHD and the specific learning disorders of dyslexia and dyscalculia form a class of neurodevelopmental disorders which are often undiagnosed in childhood, especially for adults born before these disorders were recognized. Recent research has revealed that the symptoms of these disorders can persist across the lifespan and cause substantial disabilities in work, school, and personal life. Moreover, these disorders may influence how neurodegenerative disease symptoms and pathology begin and spread. Despite the proliferation of diagnostic instruments for assessing ADHD and learning disorder during childhood, however, availability of validated modalities for the adult population is significantly limited. This is a critical research gap given the considerable adult disease burden (up to 6% of the population), the differences between adult and pediatric presentation, and the fact that the most promising treatments for neurodegenerative diseases will be initiated in minimally symptomatic adults. In this review, we describe the available self-report scales, neuropsychological tests, and structural imaging and genetic biomarkers that may allow accurate identification of adults with ADHD, dyslexia, and dyscalculia. Discussion of these instruments may provide clinicians with a set of tools to reduce cognitive disability in educational, occupational, and medical populations.

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1. Introduction

Specific learning disorders (SLDs) and attention-deficit hyperactivity disorder (ADHD) are neurodevelopmental disorders that begin in childhood but feature neural changes and functional impairment that persist into adult life (Kessler, 2006). Though SLDs predominantly affect a single function (reading, math, or writing), and ADHD is a more general disorder of executive function and cognitive efficiency, both substantially hinder lifelong assimilation of knowledge and skills, and result in unstable employment (Murphy & Barkley, 1996), reduced personal independence (Adelman and Vogel, 1990), impaired social relationships (Kessler, 2006), and even predisposition towards cognitive decline and dementia later in life (Seifan, Assuras et al., 2015; Seifan, Schelke, Obeng-Aduasare, & Isaacson, 2015). According to the DSM-5 the presence of ADHD precludes a diagnosis of "specific" learning disorder, but up to 50% of patients affected with a language or math learning disorder have concomitant ADHD (Jensen, Martin, & Cantwell 1997). As the psychosocial and neurologic consequences of these phenotypically heterogeneous disorders overlap, we group them together in this review under the umbrella term neurodevelopmental learning disorders (NLADs).

Though NLADs have traditionally been the domain of child learning specialists, it is critical for the adult neurologist and psychiatrist to identify and treat NLADs in adult patients presenting with cognitive complaints for three reasons. First, childhood NLADs persist well into adult life and between 30% to 70% of children with ADHD will remain symptomatic into adulthood (Murphy and Barkley, 1996). Second, NLADs complicate other neurologic and psychiatric conditions that produce cognitive dysfunction: a recent clinical study revealed that NLAD diagnosis is associated with atypical presentation of Alzheimer disease and may cause delay in Alzheimer diagnosis (Seifan, Assuras et al., 2015; Seifan, Schelke et al., 2015). Finally, as remediation for SLDs (Eden et al., 2004) and pharmacotherapy for ADHD (Spencer, 1995) are effective treatments for the disorders in adults, diagnosis of underlying NLADs can provide substantial improvement of cognitive dysfunction in the 6–10% of adults estimated to suffer from an NLAD (Wender, Lorraine, and Wasserstein, 2001) (Shaywitz, 1998). Compared to the plethora of diagnostic instruments validated in children, however, established markers of adult NLADs have not been widely developed. In this paper, we review the established clinical modalities for adult diagnosis of the three most common NLADs: ADHD, dyslexia, and dyscalculia.

Importantly, this review is limited to four modalities: self-report scales, neuropsychological testing, structural magnetic resonance imaging (MRI), and genetic testing. Though other experimental modalities are emerging (most notably functional MRI and electroencephalogram), these are either not routinely available in clinical practice or are not sufficiently validated in studies. By focusing on instruments of clinical utility, we hope that this review will stimulate increased use of these tools and increased attention to neurodevelopmental pathology in patients seeking neurological cognitive care.

2. Methods

The databases PubMed, and Medline were searched for the terms "attention deficit hyperactivity disorder", "dyslexia", and "dyscalculia" in combination with "self-report", "scale", "neuropsychology", "cognitive testing", "imaging", "MRI", and "genetics"; all were modified with "adult" (for example "dyslexia AND imaging AND adult"). 2476 articles were identified of which 532 were deemed relevant. The abstracts of these 532 articles were reviewed and 112 directly addressed the questions posed by this review. Of these, 76 were included in the final review as they directly examined the test performance of the various diagnostic modalities under consideration in the adult population of interest.

3. Results

3.1. ADHD

ADHD is a neurodevelopmental disorder that presents in early childhood with symptoms organized along the axes of inattention and hyperactivity. Neuroanatomically, the executive dysfunction and impulsivity of ADHD have been linked to altered development of the prefrontal cortex, basal ganglia, cerebellum, and white matter tracts (Valera, Faraone, Murray, & Seidman, 2007). Though most of the early research was focused on ADHD in the pediatric population, work in the past twenty years has established that ADHD can persist throughout adulthood and into late life, with symptoms similar to those found in children with the disorder (Seifan, Assuras et al., 2015; Seifan, Schelke et al., 2015). Though the presentation and neuropsychological features of the adult disorder are grossly similar to those of the pediatric disorder, at least three factors make diagnosis of ADHD in the adult population difficult. First, adult symptomatology has subtle but important differences. While hyperactivity and impulsivity remit

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