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Review

Psychological Assessment in Neurodevelopmental Disorders

Mi-Young Oh

Department of Psychiatry, Hanyang University Medical Center, Seoul, Korea

Neurodevelopmental disorders are characterized by impaired development that causes adjustment problems. The spectrum of developmental impairment varies and includes intellectual disabilities, communication and social interaction challenges, and attention and executive function deficits. The neurodevelopmental disorders include intellectual disability, communication disorder, autism spectrum disorder, attention-deficit/hyperactivity disorder, neurodevelopmental motor disorders, and specific learning disorder. The differential diagnosis of neurodevelopmental disorders is important, comprehensive psychological assessmentsare required for individuals who may have a neurodevelopmental disorder. This paper focuses on intellectual, neuropsychological, adaptive behavior, and autism diagnostic assessments and psychiatric comorbidities. These assessments accurately screen for neurodevelopmental disorders and aid in differential diagnosis. The goals of psychological assessment include facilitating therapeutic planning, and suggesting prognosis. Further research is required to clarify each aspect of neurodevelopmental disorders and optimize psychological assessment tools accordingly.

Key Words: Psychological Tests; Symptom Assessment; Intelligence; Executive Function; Autistic Disorder

Correspondence to: Mi-Young Oh
Department of Psychiatry, College of Medicine, Hanyang University, 222-1 Wangsimni-ro, Seongdong-gu, Seoul 04763, Korea
Tel: +82-2-2290-8429
Fax: +82-2-2290-8429
E-mail: crony_80@hanmail.net

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INTRODUCTION

Neurodevelopmental disorders are characterized by impaired development that causes adjustment problems. The spectrum of developmental impairment varies and includes intellectual disabilities, communication and social interaction challenges, and attention and executive function deficits [1].

Intellectual disability is marked by limitations in intellectual functioning and adaptive behavior. Communication disorder is signified by problems in language, pronunciation, or fluency. To be diagnosed with Autism Spectrum Disorder (ASD), individuals need to display symptoms of problems in communication and social interaction, and stereotyped, repetitive behavior, interests, or activities. In the case of Attention-Deficit/Hyperactivity Disorder (ADHD), the significant clinical symptoms include inattention and hyperactivity-impulsivity. Neurodevelopmental motor disorders may be diagnosed when clumsiness in motor skills or tic symptoms appear. Specific learning disorder refers to difficulties that affect the acquisition and use of reading, writing, and math skills [1].

The differential diagnosis of these disorders is important in psychological assessment [2]. For example, intellectual disability is characterized by deficits in general mental ability; these deficits result in impairments in adaptive functioning. On the other hand, learning disorder may be found in people with normal intelligence and lead them to experience problems with acquiring learning skills and using them. Neurodevelopmental disorders often co-occur. For instance, ASD is present with intellectual disability and children with ADHD have learning disorder in many cases [1].

Several important considerations should inform the assessment process. The first step of the assessment process is to review with parents the child's early developmental history and current concerns [2]. Additionally, the comprehensive psychological evaluation of individuals at risk of neurodevelopmental disorder must be part of the assessment. This paper focuses on intellectual, neuropsychological, adaptive behavior, and autism diagnostic assessments and psychiatric comorbidities.

INTELLECTUAL ASSESSMENT

Intellectual assessment provides a framework for evaluating individuals who may have neurodevelopmental disorders. The major purpose of intellectual assessment is to appreciate cognitive strengths and weaknesses of individuals with neurodevelopmental disorders [2]. Intellectual assessment may provide clinically useful information for diagnostic process [3]. For example, individuals with intellectual disability have intelligence quotient scores that are at least two standard deviations below the population mean [1]. However, individuals with learning disorders have scores within the normal range on the intelligence scale [4]. Individuals with learning disorders have difficulty learning and using academic skills, and exhibit substantially poorer performance of academic skills than expected for their level of intellectual functioning [1].

Communication disorders are domain-specific. Children who have a communication disorder do not show deficits in intellectual and adaptive behavior [1]. Children with motor impairment have difficulty with tasks involving visual-motor coordination and psychomotor speed [3]. Individuals with ASD report intellectual or language impairments in many cases. Those who have average or superior intelligence generally have imbalanced cognitive functional profiles [1]. The levels of intellectual functioning in people with ASD are associated with symptom severity and adaptive functioning [5].

Numerous published intelligence scales are available for use in evaluating an individual with neurodevelopmental disorders. Regarding intellectual assessment, the Wechsler intelligence scales are the most widely used throughout the world, and have been standardized in many countries [6].

The Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition (WPPSI-IV) is an individualized, standardized intelligence test for children aged from 2 years 6 months to 7 years 7 months. At ages from 2 years 6 months to 3 years 11 months, the WPPSI-IV subtests are organized as follows: 1) The Verbal Comprehensive Index (VCI) from the Receptive Vocabulary and Information subtests, 2) The Visual Spatial Index (VSI) from the Block Design and Object Assembly subtests, and 3) The Working Memory Index (WMI) from the Picture Memory and Zoo Locations subtests. One supplementary subtest – Picture Naming – is provided [7].

At ages from 4 years to 7 years 7 months, the WPPSI-IV subtests are organized as follows: 1) The VCI from the Information and Similarities subtests, 2) The VSI from the Block Design and Object Assembly subtests, 3) The Fluid Reasoning Index (FRI) from the Matrix Reasoning and Picture Concepts subtests, 4) The WMI from the Picture Memory and Zoo Locations subtests, and 5) The Processing Speed Index (PSI) from the Bug Search and Cancellation subtests. Five supplementary subtests – Vocabulary, Animal Coding, Comprehension, Receptive Vocabulary, and Picture Naming – are provided [7].

The Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV) is the latest version of the most frequently used intelligence test for children aged from 6 years to 16 years 11 months. The WISC-IV core subtests produce four indexes: 1) The VCI from the Similarities, Vocabulary, and Comprehension subtests, 2) The Perceptual Reasoning Index (PRI) from the Block Design, Picture Concepts, and Matrix Reasoning subtests, 3) The WMI from the Digit Span and Coding Subtests, and 4) The PSI from the Letter-Number Sequencing and Symbol Search subtests. Five supplementary subtests – Information, Word Reasoning, Picture Completion, Arithmetic, and Cancellation – are provided to substitute for core subtests as necessary [4]. Children with ADHD are more likely to receive low scores on the WMI and PSI [8]. Children with high-functioning autism scored above normal on the VCI and PRI, but scored below normal on the WMI and PSI [9].

The Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) is an individualized, standardized intelligence test for adults and older adolescents. The WAIS-IV core subtests produce four indexes: 1) The VCI from the Similarity, Vocabulary, and Information subtests, 2) The PRI from the Block Design, Matrix Reasoning, and Visual Puzzles subtests, 3) The WMI from the Digit Span and Arithmetic subtests, and 4) The PSI from the Symbol Search and Coding subtests. Five supplementary subtests – Letter-Number Sequencing, Figure Weights, Comprehension, Cancellation, and Picture Completion – are provided [10].

NEUROPSYCHOLOGICAL ASSESSMENT

Attention problem and executive dysfunction are among the most replicated cognitive deficits in individuals with neurodevelopmental disorders [11]. Attention is a multidimensional construct that encompasses several components, including focusing, sustaining, and shifting operations. The executive function domain includes cognitive flexibility, planning, organization, inhibition, mental representation and self-monitoring [12,13].

Several measures are available for assessing attention and execu-

tive function. The omission, commission, and latency errors of the Continuous Performance Test (CPT) are intended to measure visual/auditory sustained attention, vigilance, and impulsivity [14,15]. The color-word score of the Stroop test is intended to measure response inhibition [8]. The Trail Making Test (TMT) has two versions: 1) TMT A measures visual search and perceptual motor speed; 2) TMT B measures executive function and set shifting [11]. The WMI of the Wechsler intelligence scales measures attention and working memory [7,10].

The Wisconsin Card Sorting Test (WCST) is the most widely used executive function test throughout the world. It measures cognitive flexibility and set shifting. Subjects are asked to sort cards based on an undisclosed sorting rule (by either shape, color, or number). They are given feedback about whether they are sorting correctly or incorrectly. Once the individual has correctly completed 10 sorts, the rule is changed without any warning or comment, and the individual is expected to shift to a new sorting set. The most relevant score is the number of perseverative responses, defined as the number of sorts that use an old sorting rule despite feedback that it is incorrect [16].

Children with ADHD have displayed behavioral characteristics similar to executive dysfunction [11,12]. The essential feature of ADHD is inattention and hyperactivity-impulsivity that disturbs with functioning or development. Inattention manifests behaviorally as paying attention to details, focusing on a task, or prioritizing assignments and activities. Hyperactivity-impulsivity refers to running excessively, answering questions in class before the teacher is finished speaking, and not being able to wait for his/her turn [1].

Neuropsychological deficits are persistent over time in children with ADHD [17]. Preschoolers with ADHD compared to healthy preschoolers display deficits in response inhibition, attention, and goal-directed behavior, and perform poorly on visual/auditory vigilance tasks [13,18]. Extensive research has been conducted into the neuropsychological functioning of elementary school age children with ADHD [11]. Many studies indicate that children with ADHD underperform on various tasks of working memory, set shifting, organization, and complex problem solving compared with normal children [19].

Executive dysfunction is frequently associated with ASD and has been linked to reduced adaptive functioning and greater symptoms. Children with ASD have impairments on key aspects of executive function [20]. They are relatively good at rote, mechanical, and visual-spatial processing; however, they have trouble performing high-level conceptualization such as abstract reasoning [12]. They are able to perform simple memory and language tasks acceptably while they experience difficulties taking care of complex assignments. Neuropsychological assessment may clarify the individuals' cognitive strengths and weaknesses and provide significant clinical information for developing treatments and education programs [2].

Neuropsychological assessment is able to clearly explain the causes of behavioral problems and adjustment failures in schools. For instance, deficits in cognitive flexibility and excessive concentration on unnecessary details interrupt the school adaptation and lead children with ASD to anxiety or frustration [2]. It appears plausible that executive dysfunction causes the symptom of ASD. Stereotyped and repetitive behavior and excessive sensitivity to change are essential features of ASD [12].

ADAPTIVE BEHAVIOR ASSESSMENT

Adaptive behavior is defined as everyday skills needed to function independently and meet the demands of one's environments including home and school. The assessment of adaptive behavior is always carried out with intelligence tests, because the diagnosis of an intellectual disability requires both a standardized intelligence test assessment and adaptive behavior assessment. The evaluation of adaptive behavior is also important to develop useful treatment plan goals [2].

The most widely used scale to measure adaptive behavior is the Vineland Adaptive Behavior Scale (VABS). The revised edition of the VABS, the Vineland Adaptive Behavior Scale-2nd Edition (Vineland-II), was published in 2005. Vineland-II is available in two forms: interview and parent/caregiver rating; both forms have the same questionnaire content. For the interview form, a trained examiner interviews the child's primary caregiver using a semi-structured interview format and measures the adaptive behaviors of the child. For the parent/caregiver rating, the child's primary caregiver completes the questionnaire and assesses their child's adaptive behaviors. Similar to the VABS, the Vineland-II measures adaptive functioning in 4 domains: communication, daily-living skills, socialization, and motor skills. The motor skills domain is only applicable to children under 6-years-old. A composite score of adaptive behavior is calculated as the sum of the standard scores from the 4 domains [21,22].

It has been reported that there is a generally high correlation between the cognitive functioning score of intelligence tests and real-life functioning [23,24]. However, high-functioning children with ASD score lower in adaptive functioning than they do in intelligence tests [25,26]. The typical patterns of the adaptive behavior of children with ASD include severe shortfalls in socialization, mid-level deficits in communication, and relatively mild deficits in daily-living skills [25,27]. On the other hand, children suffering from Down syndrome, who are also diagnosed with intellectual disability, perform moderately better in the socialization domain [28].

Impairment in adaptive functioning is one of the necessary criteria for intellectual disability diagnosis [1]. Many studies have been conducted to research the aspects of adaptive impairments in individuals with an intellectual disability and compared them against those with ASD. For instance, children with Angelman syndrome and severe to profound intellectual disability showed similar deficits in adaptive behavior. There was a strong positive correlation between adaptive behavior and intelligence quotient score [29]; however, adaptive impairments in children with ASD were reported to be more severe than what was expected in cognitive functioning deficits [30].

AUTISM DIAGNOSTIC ASSESSMENT

ASD is marked by consistent difficulties with social communication and social interaction in varied contexts, and symptoms of stereotyped and repetitive behaviors, interests, and activities. Individuals with ASD have trouble developing, maintaining, and understanding social relationships, and demonstrate problems integrating verbal and non-verbal communication. Moreover, they commonly have a rigid fixation for routines, fixed and limited interests that are abnormal in intensity and focus, and are either over-responsive or under-responsive when processing sensory information [1].

There are important aspects to consider for the process of assessing ASD. First, understanding the process of normal development is critical. This knowledge helps when examining the severity of a developmental delay or deviance [31]. The diagnostic information for ASD can be collected by clinical impressions, history-taking through parent interviews, interactions with children, and direct observation [2]. The assessment tools most widely used in clinical practices to diagnose people with ASD are listed below.

The Childhood Autism Rating Scale (CARS) is a 15-item structured observation tool that assesses the child's symptoms based on direct observation of the behavior. Each item is rated on a 7-point scale and the scores range from 0 to 60. To be diagnosed with ASD, the total score should be higher than 30; however, for adolescents, a lower cut-off score is suggested [32-34]. The CARS was designed to measure and assess development through direct observation. The observed behavior of the children is assessed and compared to that of typically developed children at the same age. If abnormal behavior is observed, the child's age, characteristics, frequency of the behavior, and severity of the behavior should be collected when considering a diagnosis [35].

The Autism Diagnostic Interview-Revised (ADI-R) is a comprehensive parent-interview tool that is used to assess symptoms of ASD. The ADI-R is administered by trained clinicians in a semi-structured interview format [36,37]. Clinicians gather information through parent's report of the child's noticeable behavior and development. The ADI-R questionnaire comprises questions that distinguish ASD from other developmental disorders, and it measures the following 3 domains: social interaction; communication; and stereotyped, repetitive, and fixated behavior patterns. Additionally, the ADI-R provides algorithm scores [38].

The Social Communication Questionnaire (SCQ), which is based on the ADI-R, works as a parent-report screening-instrument to diagnose individuals at risk for ASD. The SCQ is a 40-item questionnaire that was revised to help parents understand without any further elaboration needed. There are two versions of the SCQ: lifetime and current. The lifetime version is typically used for distinguishing individuals who might have ASD, or for an evaluative diagnosis. The current version is more suitable to assess changes in symptoms over time. A cut-off score over 15 suggests the individual is likely to have ASD [39].

PSYCHIATRIC COMORBITIES

Individuals suspected to have a neurodevelopmental disorder may display various emotional and behavioral problems that interfere with their daily functioning. These include negative emotions, maladaptive activity level, and poor anger management. Numerous factors affect the varied emotional and behavioral problems of individuals who have been diagnosed with a neurodevelopmental disorder and these factors complicate the diagnosis. The Child Behavior Checklist (CBCL) is widely used to assess emotional and behavioral problems during preschool, childhood, and ado-

lescence. The CBCL is standardized in many different languages and are cost-effective when compared to interviews because the survey is completed by the primary caregivers [40,41].

The CBCL Preschool Form is intended for preschoolers between 1.5-5 years old. The primary caregiver rates the preschooler on a scale from 0 to 2 for each question. Items are scored on 3 main scales including internalizing problems, externalizing problems, and total behavior problems, and 7 sub-scales including emotional reactivity, depression/anxiety, social withdrawal, somatic symptoms, sleeping problems, attention problems, and aggressive behavior [40]. The CBCL School-Age Form measures various emotional and behavioral problems among children and adolescents between 6-18 years old. The CBCL is conducted by the primary caregiver who rates the child or adolescent on a scale from 0 to 2 for each question. Problematic behavior syndrome is rated on 3 main-scales of internalizing, externalizing, and total behavior problems, and 8 sub-scales of social withdrawal, somatic symptom, depression/anxiety, social immaturity, logic-based problems, attention problems, aggressiveness, and rule breaking [41].

CONCLUSION

In this article, intellectual, neuropsychological, adaptive behavior, and autism diagnostic assessments and psychiatric comorbidities were reviewed. These assessments accurately screen for neurodevelopmental disorders and aid in differential diagnosis. The goals of psychological assessment include facilitating therapeutic planning, and suggesting prognosis. Further research is required to clarify each aspect of neurodevelopmental disorders and optimize psychological assessment tools accordingly.

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