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RESEARCH ARTICLE / *ARAŞTIRMA*

Evaluation of Children with Attention Deficit Hyperactivity Disorder on the Wechsler Intelligence Scale for Children-IV

Dikkat Eksikliği Hiperaktivite Bozukluğu Olan Çocukların Wechsler Çocuklar İçin Zeka Ölçeği-IV ile Değerlendirilmesi

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ABSTRACT

Objective: The aim of this study was to evaluate the cognitive performance and clinical characteristics of children and adolescents with Attention Deficit Hyperactivity Disorder (ADHD) who had attended a tertiary center.
Method: Fifty-six children and adolescents aged 7-16 years with ADHD who had been admitted to the Child and Adolescent Psychiatry clinic between June 2020 and March 2021 were retrospectively included in the study. A semi-structured interview form for the Affective Disorders and Schizophrenia Interview Schedule-Present Version for School-Age Children was used to determine mental disorders. The Clinical Global Impression Scale (CGIS) was completed to assess the severity of ADHD symptoms. The Wechsler Intelligence Scale for Children-IV (WISC-IV) was used in the assessment of cognitive skills.
Results: The median age of the participants was 13 and 71.4% of them were male. The Working memory index (s=83.3) and Full-Scale IQ (FSIQ) (s=84) were found to be the lowest scores. According to the comparisons between CGIS, the FSIQ score (χ^2=0.736; p=0.947), verbal comprehension index (χ^2=2.882; p=0.578), perceptual reasoning index (χ^2=1.412; p=0.842), working memory index (χ^2=1.980; p=0.739), processing speed index (χ^2=1.673; p=0.796) were not found to be statistically different between the groups.
Conclusion: The WISC-IV scale, which is increasingly preferred in the clinic use, could help to obtain information about cognitive performance in children with ADHD, regardless of the severity of ADHD symptoms.

Keywords: Wechsler intelligence scale for children, fourth edition, attention deficit hyperactivity disorder, symptom severity

ÖZ

Amaç: Bu çalışmanın amacı, üçüncü basamak bir merkezde değerlendirilerek Dikkat Eksikliği Hiperaktivite Bozukluğu (DEHB) tanısı almış çocuk ve ergenlerin bilişsel performanslarını ve klinik özelliklerini incelemektir.
Yöntem: Haziran 2020-Mart 2021 tarihleri arasında Çocuk ve Ergen Psikiyatrisi kliniğine başvuran 7-16 yaş arası DEHB'li 56 çocuk ve ergen geriye dönük olarak çalışmaya dahil edildi. Ruhsal bozuklukları belirlemek için yarı yapılandırılmış bir görüşme formu olan Okul Çağı Çocukları için Duygulanım Bozuklukları ve Şizofreni Görüşme Çizelgesi-Şimdi Versiyonu uygulanmıştır. DEHB semptomlarının şiddetini değerlendirmek için Klinik Global İzlenim Ölçeği (KGİÖ) tamamlandı. Bilişsel becerilerin incelenmesinde Wechsler Çocuklar İçin Zeka Ölçeği-IV (WÇZÖ-IV) kullanılmıştır.
Bulgular: Katılımcıların ortanca yaşı 13 idi ve %71,4'ü erkekti. Çalışma belleği indeksi (s=83,3) ve Tüm Ölçek IQ (TÖIQ) (s=84) en düşük puanlar olarak bulundu. TÖIQ puanı (χ^2=0,736; p=0,947), sözel kavrama indeksi (χ^2=2,882; p=0,578), algısal akıl yürütme indeksi (χ^2=1,412; p=0,842), çalışma belleği indeksi (χ^2=1,980; p=0,739), işlemleme hızı indeksi (χ^2=1,673; p=0,796) açısından KGİÖ grupları arasında istatistiksel olarak farklı bulunmadı.
Sonuç: Klinik kullanımda giderek daha fazla tercih edilen WÇZÖ-IV, DEHB semptom şiddetinden bağımsız olarak DEHB'li çocuklarda bilişsel performans hakkında bilgi edinmeye yardımcı olabilir.

Anahtar Kelimeler: Wechsler çocuklar için zeka ölçeği, dördüncü sürüm, dikkat eksikliği hiperaktivite bozukluğu, belirti şiddeti

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INTRODUCTION

Cognitive assessment is an important part of the clinical and educational evaluation of children and adolescents experiencing problems in the academic area. Scores obtained from tests used to evaluate cognitive performance are used to make a differential diagnosis of the child (e.g., to make a differential diagnosis of learning disability and cognitive developmental delay) and/or to determine the strengths and impairment in their cognitive performance (1). In clinical practice and research, the Wechsler Intelligence Scales for Children (WISC) are one of the most frequently used intelligence tests, as they measure many characteristics within cognitive functions. Although WISC is common in clinical use, it has a fairly old research history. Since the first version of the test (Wechsler Bellevue (1946)), new versions of the scale have been developed considering the changes in clinical practice and the findings in the research; WISC-R;III; IV (2). The validity of WISC-IV was formalised in 2011 in Turkey (3). Consequently, WISC-IV is increasingly being implemented in clinical use.

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common diagnosis groups in which cognitive evaluation is applied among children and adolescents who do not have a delay in cognitive development and who usually show normal cognitive performance. ADHD is a multifactorial and heterogeneous neurodevelopmental disorder. The prevelance is approximately 5-10% of children worldwide and shows multifactorial inheritance(4). Inattention and/or hyperactive/impulsive behaviors may bepresented in ADHD(5). These clinical signs often cause serious interpersonal, academic, and social impairments.

The neurophysiology of ADHD is not exactly known, but imaging studies have shown that there are dysfunctions in the prefrontal cortex area (6). The prefrontal cortex is the region responsible for executive functions of the brain, and these executive functions include cognitive skills such as planning, inhibition, and working memory (7). Deficiencies in these executive functions may be responsible for the development of ADHD symptoms (8). Also, the amount of impairment in these executive functions affects the emotional and behavioral problems of the patients (9). Intelligence and executive functions are interrelated concepts. Although there is no commonly held definition of IQ, Wechsler (1954) characterized it as a global capacity required to take purposeful action, think rationally, and deal effectively with one's environment(10). It is seen that executive function skills are included in this definition. In this direction, executive functions are also evaluated in intelligence tests and the general intelligence level measured by tests is affected by executive functions skills. When the studies examining the general intelligence level with ADHD were examined, contradictory results were obtained (10). Although there are studies showing that the general intelligence level is lower in ADHD, there are studies indicating that there is no difference (11, 12). In fact, it is stated that among the reasons for the low level of intelligence in ADHD, the impairment of executive functions in ADHD is caused by the effect of the calculation of the general IQ score. After all, it was considered important to find out the cognitive strengths and impairments of children and adolescents with intelligence tests in children with ADHD and to intervene in these areas (13).

There is no diagnostic test, laboratory technique or imaging method for the diagnosis of ADHD. The diagnosis is made with information obtained from the family and the teacher (14). However intelligence tests are frequently used for the cognitive follow-up of patients and for differential diagnosis (15). In the literature, there are studies in which the WISC-R test, which is one of the previous versions of the Wechsler test, was conducted on children with ADHD. In a study in Turkey, showed that intelligence subtest standard scores can distinguish between those children with some form of psychiatric diagnosis and those without. However, it was found that it did not selectively differentiate ADHD (1). In another study, WISC-R performance in ADHD, Specific Learning Disorder (SLD) and ADHD-SLD comorbidity was investigated by Baykal et al. The findings of this study stated that the WISC-R test could be a useful tool for distinguishing between these disorders (16). Studies evaluating the WISC-IV in children and adolescents with ADHD are few in number because the test is relatively new.Across the WISC-IV composite scores, it was suggested that there was a relationship between impaired processing speed index and inattention, and that WISC-IV profiles could help predict the symptomatology and outcomes in children with ADHD (17). A recent study investigatedthe WISC-IV performances of children with ADHD and SLD. When compared with ADHD, children with both neurodevelopmental disorders had more severe impairments in the total and composite scores (verbal comprehension, perceptual reasoningand working memory) (18).

In the literature, only a few studies have yielded comparisons of the WISC-IV results of patients with ADHD in the child and adolescent age group. In this context, we expected that this assessment to be completed here in Turkey would contribute to the field. The aim of the study was to investigate the cognitive performance and clinical features of an ADHD diagnostic group who had been evaluated in our clinic and who were then asked to complete an evaluation of their intelligence during the diagnosis or treatment process. We hypothesized that WISC-IV contributedto differential diagnosis, and there may be a correlation between clinical severity and test performance.

MATERIALS AND METHODS

The current study population was comprised of children and adolescents with ADHD. The sample consisted of 89 participants, with an age range of 7 to 16 years, who had been admitted to the Department of Child and Adolescent Psychiatry, between June 2020 and March 2021.The research ethics committee of Health Sciences University Kanuni Training and Research Hospital approved the study (2021/11253). A diagnostic interview was conducted with all cases by an experienced specialist in child and adolescent psychiatry. The clinical information obtained in these interviews was evaluated retrospectively by the specialist who followed

each patient. In the first evaluation, the WISC-IV results of 89 patients diagnosed with ADHD were analyzed. In the second evaluation, patients whose clinical data could be accessed from the electronic medical record system and who did not use psychiatric drugs were included in the study. Participants who were diagnosed with an intellectual disability following WISC-IV analysis and clinical evaluation were excluded from the study. As additional exclusion criteria: History of head trauma, neurological disease or chronic physical disease requiring long-term follow-up was determined. As a result of the second evaluation, it was possible to include 56 children and adolescents in the final study.

Clinical information was provided via a form including the child's age, gender, psychiatric diagnoses, ADHD clinical severity score, and WISC-IV composite and total scores, which had been created by the researchers.

A semi-structured interview form for *Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present version*(K-SADS-P) was applied to confirm the diagnosis of ADHD and determine comorbidity. K-SADS-P was developed to determine mental disorders of children and adolescents according to the Diagnostic and Statistical Manual of Mental Disorders IV (19). Gökler et al. made the reliability and validity study of the Turkish version (20). The K-SADS-P was only used to assess the current psychopathologies in our study.

The Clinical Global Impression Scale was completed to assess the severity of ADHD symptoms. This scale, scored by the clinician, was developed in order to evaluate patients in clinical studies and to observe the changes caused by the treatment during the follow-up period (21). The Clinical Global Impression Scale (CGI) consists of three questions including disease severity, improvement, and severity of side effects. CGIS is a 7-valued Likert-type scale. The person with a psychiatric disorder is scored between 1 and 7 points according to the severity of the disturbance when the scale is filled: not at all ill, borderline ill, mild ill, moderately ill, marked ill, severely ill, and extremely ill. In the current study, the first dimension of the scale, disease severity, was used.

WISC-IV, which was administered by an experienced psychologist, was used in the assessment of cognitive skills. WISC-IV tests were administered by the same psychologist. WISC-IV consists of four different composite scores and total scores: verbal comprehension index, perceptual reasoning index, working memory index and processing speed index, and Full-Scale IQ (FSIQ). Each composite index consists of subtests: *Verbal Comprehension subtests* "similarities, vocabulary, comprehension, general knowledge (additional subtest), word finding (additional subtest)"; *Perceptual Reasoning subtests* "drawing with cubes, picture concepts, logic squares, picture completion (additional subtest)"; *Working Memory subtests* include "number string, letter-digit strings, arithmetic (additional subtest)", *Processing Speed subtests* "password, symbol search, draw-out (additional subtest)". Standardization and norm study in our country were carried out by the Turkish Psychologists Association (3). The estimated application time varies between 90 and 120 minutes depending on the child's working speed. In our study, composite scores and FSIQ were analyzed.

Statistical analysis

SPSS (Statistical Package for Social Sciences) for Windows 21.0 (SPSS Inc, Chicago, IL) was used to analyze the data. The mean (±) standard deviation, median (minimum-maximum), frequency distribution and percentage were used to show descriptive statistics. Data distributions were analyzed using visual (histograms) and analytical methods (Shapiro-Wilk; Kolmogorov-Smirov). Non-parametric Kruskal-Wallis tests were used for comparison between groups. As a result of the power analysis, the lowest number of participants to be included to complete the study with the Minitab 17.0 program with 95% power was determined as 39.

RESULTS

A total of 56 children and adolescents with ADHD (40 boys, 16 girls; age range 7-16 years; median age=13 years), participated in this study. The most common comorbidities were oppositional defiant disorder with 16.7% and specific learning disorder with 13.3%. The clinical characteristics of patients are shown in Table 1.

Table 1. Clinical characteristics of the participants

Parameters	%	n
Age	Median 13 (7-16)	56
Gender		
Male	71.4	40
Female	28.6	16
Primary Diagnosis	100	56
DEHB	100	56
ADHD *CGIS*		
Severely ill (6)	11.7	7
Marked ill (5)	18.3	11
Moderately ill (4)	41.7	25
Mild ill (3)	20.0	12
Borderline ill (2)	6.7	4
Comorbidity		
ODD	16.7	10
SLD	13.3	8
Language and Speech Disorders	8.3	5
Anxiety Disorders	8.3	5
Elimination Disorders	1.7	1
Tic Disorders	1.7	1
Obsessive-Compulsive Disorders	1.7	1
Autism Spectrum Disorder	1.7	1

CGIS: Clinical Global Impression Scale, ADHD: Attention Deficit Hyperactivity Disorder, ODD: Oppositional Defiant Disorder, SLD: Specific Learning Disorder

In the visual and analytical tests performed, it was found that the WISC-IV parameters did not show normal distribution within the study group and the scores of each participant are shown in Figure 1. Working memory index (s=83.3) and FSIQ (s=84) were found as the lowest scores. Table 2 shows the WISC-IV scores.

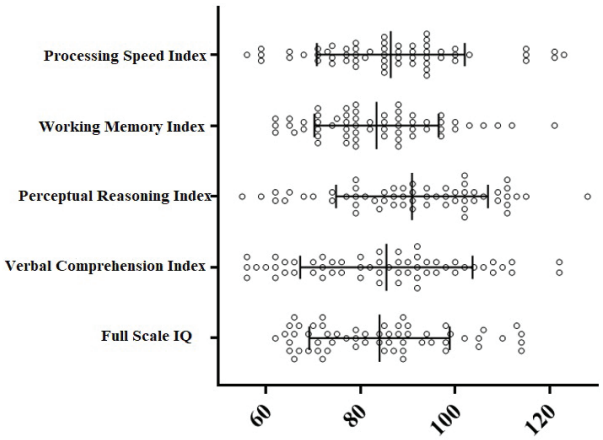

Figure 1. Distribution of WISC-IV Parameters in ADHD.

ADHD clinical severity scores were analyzed in five different groups (2-6), and the WISC-IV scores were compared between groups. According to the comparisons, FSIQ score (χ^2=0.736; p=0.947), verbal comprehension index (χ^2=2.882; p=0.578), perceptual reasoning index (χ^2=1.412; p=0.842), working memory index (χ^2=1.980; p=0.739), and processing speed index (χ^2=1.673; p=0.796) were not found to be statistically different between the groups (Table 3). To evaluate the effect of SLD comorbidity on this finding, forty-eight children without SLD were compared again. There was still no statistically significant relationship between the ADHD clinical severity score groups and WISC-IV scores (p>0.05). There was no significant difference between WISC-IV index scores and FSIQ score (p>0.05).

DISCUSSION

The present study researched the intelligence assessment of children and adolescents with ADHD using WISC-IV, and a comparison was made in terms of ADHD severity. The lowest index score was working memory, and the highest index score was perceptual reasoning. There was no significant relationship between ADHD clinical severity scores and WISC-IV scores. It was also found that SLD comorbidity, which was shown to affect cognitive performance, did not make any difference in our study.

Previous studies showed a relationship between ADHD and impaired cognitive performance in children. The phenotypic relationship between ADHD symptoms and IQ was weak. And it was shown that the correlation between ADHD and IQ was found to be very high (22). Furthermore, it was investigated whether ADHD was a valid diagnosis in the presence of high IQ. Children with upper IQ and ADHD had cognitive, psychological, and social traits consistent with the ADHD group with average IQ. Also, ADHD was found to be valid also among high-intelligence children (23). In a meta-analysis, children with ADHD showed an intelligence performance which was approximately nine points lower than children without this diagnosis, however, statistically significant findings were found in less than half of the investigations (11). Children and adolescents diagnosed with ADHD via WISC-R in Turkey suggested that the evaluations based on the test should be done carefully due to the diagnoses made with the accuracy

Table 2. WISC-IVparameterscoresof ADHD

	Mean	SD	Minimum	Maximum
Full Scale IQ	84.0	14.8	62.0	114.0
Verbal Comprehension Index	85.4	18.2	56.0	134.0
Perceptual Reasoning Index	90.9	16.0	55.0	128.0
Working Memory Index	83.3	13.1	62.0	121.0
Processing Speed Index	86.4	15.6	56.0	123.0

Table 3. Intelligence scores comparison by ADHD severity

	Clinical ADHD Severity					p
	Severely ill (n=7)	Marked ill (n=11)	Moderately ill (n=25)	Mild ill (n=12)	Borderline ill (n=4)	
Full Scale IQ	93 (65-110)	79 (64-105)	84 (65-114)	87 (62-114)	78 (71-98)	0.947
Verbal Comprehension Index	102 (60-122)	86 (56-112)	84 (56-134)	85 (70-104)	82 (66-94)	0.578
Perceptual Reasoning Index	87 (62-111)	91 (70-109)	94 (55-128)	91 (79-115)	95 (79-106)	0.842
Working Memory Index	77 (62-111)	79 (62-100)	88 (62-121)	82 (62-112)	79 (71-94)	0.739
Processing Speed Index	79 (59-115)	81 (59-100)	88 (56-123)	88 (65-121)	86 (85-97)	0.796

Note: Kruskal-Wallis test was used.

rates at a near chance level (24). When diagnosing ADHD, the evaluation made via WISC-R might not be sufficient and the diagnosis based on this evaluation alone might be erroneous (25).The findings from the current research also support that cognitive performance measurement made via WISC-IV alone may not be sufficient. Also, there was no significant difference between index scores. Some studies have found that impairment in processing speed is higher than other indexes in individuals with ADHD (15, 26). In the present study, the lowest two composite indexes were found to be verbal comprehension and working memory. Working memory is a cognitive system that can store a limited quantity of information while keeping it readily accessible and available for conversion according to rules and methods, as well as updating it on a regular basis. In working memory impairments, individuals cannot perform cognitive tasks such as reasoning, problem solving, speaking, and understanding language effectively (27). The Verbal comprehension index measures a person's verbal concept formation, reasoning skills, conceptualization, and the ability to evaluate and use experience (28). Both indexes may be affected by executive dysfunction in ADHD (22). However, inconsistencies in the literature suggest that WISC-IV may not have a specific index for ADHD.

In this study, as one of the few studies in the literature, the relationship between ADHD severity and cognitive performance was researched. There was no significant relationship between FSIQ and index scores, which evaluate cognitive performance, and ADHD severity. Karaman et al. emphasized the comorbidity of SLD and ADHD, and it was reported this association negatively affected cognitive performance (29). Therefore, in our study, children without SLD comorbidity were evaluated and no relationship was found between ADHD severity and cognitive performance. İçmeli et al. investigated the diagnosis of ADHD in children and adolescents with mental retardation whereby a significant relationship was found between intelligence groups and ADHD symptoms. Children with moderate ADHD were common in the borderline intelligence group. It was observed that children with moderate and mild mental retardation had more severe ADHD symptoms(30). WISC scores had low relationships with the severity of ADHD symptoms, inattention, and impulsive-hyperactive behaviors, according to Naglieri et al. (31). While studies consistently show the relationship between executive functions and intelligence, a consistent relationship between severity of ADHD symptoms and intelligence has not been shown. The current study results support studies showing there is no statistically significant correlation between ADHD severity and intelligence (32).

As a result, we suggested that WISC-IV analysis, which is increasingly preferred in clinic use, could help to obtain information about cognitive capacity in children and adolescents with ADHD, regardless of the severity of the diagnosis. The strengths of our study are the use of a test that has recently become widespread in Turkey in the evaluation of cognitive performance, and the fact that children diagnosed with ADHD do not use medication. Short-acting stimulants may have an insignificant and negligible effect on IQ (33). In this context, studies investigating the efficacy and comorbidity in larger groups will be needed in the future.

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