Comparing Two Editions of Wechsler Intelligence Scales and Assessing Reading Skills in Children with Attention Deficit and Hyperactivity Disorder

Cihat ÇELİK[1], Gülsen ERDEN[2], Sevim ÖZMEN[3], Selma TURAL HESAPÇIOĞLU[4]

SUMMARY

Objective: This study aimed to examine the cognitive profiles of children with Attention Deficit and Hyperactivity Disorder (ADHD) with the Wechsler Intelligence Scales for Children-Revised (WISC-R) and the Wechsler Intelligence Scales for Children-Fourth Edition (WISC-IV), the latter of which was recently standardized in Turkey. In addition, the reading abilities and intelligence scores of these children were also investigated.

Methods: A total of 48 children with ADHD between the ages of 6 and 16 years who were outpatients in Muş State Hospital were included in this study. The children were administered the WISC-R, the WISC-IV, and the Oral Reading Skills and Reading Comprehension Test (ORCT).

Results: There were no significant differences between the WISC-R IQ scores and WISC-IV index scores. Moreover, reading comprehension skills (derived from ORCT scores) were predicted with significant accuracy by both the WISC-R Verbal IQ and the WISC-IV WMI (Working Memory Index).

Conclusion: Results of this study suggest that the WISC-R and the WISC-IV scale are not sufficient for obtaining a specific cognitive profile for ADHD – there is no significant difference between them. However, the four-factor structure of the WISC-IV is believed to provide more specific information. In addition, results of this study related to reading skills indicate that the importance of reading skills should not be overlooked when assessing children with ADHD.

Keywords: Wechsler Intelligence Scales for Children, attention deficit and hyperactivity disorder, reading ability, learning disorders

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder with prevalence rates between 3 and 12% in school-age children (Zametkin and Ernst 1999). Recently, several studies have suggested that ADHD is related to deficiencies in various cognitive domains, including working memory, executive functions, psychomotor speed and coordination, processing speed, and intelligence (Barkley 1997, Karatekin et al 2003, Mayes and Calhoun 2006, Thaler et al 2010). In this respect, direct observations, structured interviews, behavior rating scales, and multi-staged assessments are commonly used to identify the psychological, neuropsychological, or behavioral characteristics of ADHD and to diagnose children with the condition (American Academy of Child and Adolescent Psychiatry 2007). In addition, it has been suggested that intelligence scales be used when diagnosing ADHD in clinical practice; these scales can assess the strengths and weaknesses of children with ADHD and can be used to evaluate various cognitive functions, such as working memory and processing speed (Prifitera and Dersh 1993, Sattler 2002, Schwean and McCrimmon 2008).

Since they measure many features associated with cognitive functions, Wechsler intelligence scales for children (WISC) are among the most frequently used intelligence scales in

Received: 05.05.2015 - **Accepted:** 13.11.2015

[1]Psychologist, [2]Prof., Ankara University, Faculty of Language, History and Geography, Department Psychology, Ankara, [3]Psychologist, Provincial Health Directory, Mardin, [4]Assist. Prof., Yıldırım Beyazıt University, Faculty of Medicine, Department of Child and Adolescent Psychiatry, Ankara, Turkey.

e-mail: *psk.cihat@gmail.com*

clinical practice and in research (Flanagan and Kaufman 2009). Several published studies have used WISC to evaluate cognitive factors associated with ADHD; in addition, several studies have also used Intelligence Quotient (IQ) or index scores, profile analyses, or subtest assessments (Faraone et al 1993, Mayes et al 1998, Naglieri et al 2005, Snow and Sapp 2000, Tural-Hesapçıoğlu et al 2016).

In some study reported that children diagnosed with ADHD had lower Performance IQ (PIQ) scores (evaluate spcific attention tasks) than Verbal IQ (VIQ) scores, as evaluated by the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Evinç and Gençöz 2007). However, the majority of the published research regarding the WISC-R scores of ADHD-diagnosed children reveals conflicting results. For example, while some studies found that the PIQ scores of ADHD-diagnosed children were lower than their VIQ scores (Faraone et al 1993, Mahone et al 2003, Öngider et al 2008, Tripp et al 2002), other studies could not support these findings; this indicates that WISC scores cannot distinguish subsets of ADHD (Erdoğan-Bakar et al 2005, Erdoğan-Bakar et al 2011, Evinç and Gençöz 2007, Naglieri et al 2005).

Kaufman (1975) proposed a subtest pattern model that was adapted from the WISC and is associated with the specific cognitive structure of ADHD. According to the "Freedom from Distractibility (FFD)" index of this model, patients who obtain low scores on the WISC-R Arithmetic, Coding and Digit Span subtests are unable to sustain attention, while patients who obtain high scores on these subtests are able to sustain attention. A low score on the FFD index is thought to be a possible indicator of ADHD, and some studies have supported this finding (Anastopoulos et al 1994, Mayes et al 1998). Subsequent studies investigated other profiles, including ACID (Arithmetic, Coding, Information, and Digit Span subtests, which was generated from both the WISC-R and WISC-III subtests), SCAD (Symbol Search, Coding, Arithmetic, and Digit Span), Bannatyne categories, and ipsative approaches (Bannatyne 1979, Naglieri and Paolitto 2005, Schwean and Saklofske 2005, Snow and Sapp 2000, Tural-Hesapcioglu et al 2016).

In addition to profile analyses, WISC-III composite/index scores have been used to evaluate tasks associated with executive functions; a number of studies reported that there is a particular type of pattern in the scores from patients with ADHD (Anastopoulos et al 1994, Calhoun and Mayes 2005, Mayes et al 1998, Prifitera and Dersh 1993). Mayes and Calhoun (2006) reported that composite scores (Full Scale IQ, VIQ, and PIQ on WISC-R, and index scores on WISC-III or WISC-IV) provided reliable and significant data. On the contrary, subtest analyses yield more specific information that may be lost in factor analyses or assessments based on composite/index scores (Kramer 1993, Nyden et al 2001). Therefore, some researchers believe that specific information from assessments based on subtests may be more useful in understanding the strengths and weaknesses of a child, and may also be useful in guiding treatment and training plans (Hale et al 2001, Kaufman 1994, Sattler 2002).

Assessment of ADHD with the Wechsler Intelligence Scale for Children-IV (WISC-IV)

While the pros and cons of subtest assessments and profile analyses are still being debated, the introduction of the WISC-IV has inspired a general trend towards the use of composite or index scores for children with ADHD. Changes and modifications made to the fourth version of the WISC (WISC-IV) may be the reason for this trend. These changes include the addition of new factors and index scores that were not in previous versions, as well as the addition of new subtests and pair-wise comparisons between the index scores (Wechsler 2003).

While the WISC-R had three composite scores (VIQ, PIQ, and Full Scale IQ), the WISC-IV has five index scores (Full Scale IQ [FSIQ], Verbal Comprehension Index [VCI], Perceptual Reasoning Index [PRI], Working Memory Index [WMI], and Processing Speed Index [PSI]). The calculation of WMI and PSI scores are the most notable changes for ADHD in the WISC-IV. Furthermore, the subtests in the indexes that were in the WISC-III were changed or replaced in WISC-IV. While the WISC-III FFD index consisted of Arithmetic and Digit Span subtests, the WISC-IV index consists of Digit Span and Letter-Number Sequencing subtests, which is now called 'WMI.' It has been suggested that an advantage of this version is that the time-limited Arithmetic subtest was transferred to the 'additional subtests' section, and is not used in calculating the WMI score (Mayes and Calhoun 2006). For both the WISC-III and WISC-IV, the Coding and Symbol Search subtests form the PRI index. In the WISC-IV, four core subtests in the WMI and PSI are used to calculate the FSIQ score (Wechsler 2003).

One study reported that the WMI and PSI scores were lower than the PRI and VCI scores for children with ADHD and ADHD + Learning Disability (LD) (Wechsler 2003). In accordance with that study, Mayes and Calhoun (2006) found that 88% of children (n = 111) diagnosed with ADHD had higher scores on PRI and VCI than on WMI and PSI. The authors went on to say that this pattern (seen in the WISC-IV) might be effective for clinical and diagnostic use. Another study revealed that the WISC-IV PSI score was lower than those of the other indexes (e.g. VCI, PRI) and was significantly more associated with the inattention scale, indicating ADHD predominantly inattentive type (Thaler et al 2013). These aforementioned studies indicate that WISC-IV index scores may be useful for identifying specific ADHD symptoms and problems. However, it should be noted that these studies had limitations such as small sample size, limited age

range, no control group, or including children with high IQ scores (Devena and Watkins 2012).

Recently, the effectiveness of two different index scores has been discussed. These scores are separate from the five indexes of the WISC-IV, and they are obtained from the sum of other index scores. One of these new indexes is the General Ability Index (GAI), which is produced from the sum of six subtest scores in the VCI and PRI (Raiford et al 2005), and the other is the Cognitive Proficiency Index (CPI; Weiss and Gabel, 2007), which is obtained from the sum of the WMI and PSI scores. Especially in ADHD and other neuropsychological disorders, it is important to consider differences in the GAI and CPI scores. It has been reported that the CPI scores of children with ADHD were lower than their GAI scores; however, these results were not sufficient for providing diagnostic accuracy, nor were they sufficient for distinguishing among the diagnostic groups (Devena and Watkins 2012, Weiss and Gabel 2007). Though it is not clear whether the WISC-IV can be used as a tool for diagnosing ADHD, it is thought that the WISC-IV may be useful for identifying the strengths and weaknesses of children with ADHD and may be useful in planning treatment programs (Schwean and McCrimmon 2008).

In Turkey, there are studies comparing two versions of the WISC for the assessment of ADHD (Mahone et al 2003, Mcmahon and Kunce 1981); however, to our knowledge, there is no comparative study between two versions with clinical samples since the Turkish standardization and 'norm' study of the WISC-III was not conducted. In studies comparing the WISC-R and WISC-III scores of children in normal and clinical samples, it was reported that their FSIQ scores decreased between 5 and 9 from the WISC-III to the WISC-R; this decrease was more apperant in the Performance IQ subtests (Bolen et al 1995, Wechsler 1991, Zimmerman and Woo-Sam 1997).

Another study comparing WISC-III and WISC-IV scores in ADHD patients indicated that WISC-IV was better a predictor for assessing the strengths and weakness of children with ADHD than the WISC-III (Mayes and Calhoun 2006). The same authors confirmed that the scores of verbal subtests and the FFD index or WMI in ADHD were more highly correlated with academic achievement than nonverbal subtests (Mayes and Calhoun 2007). Furthermore, it was stated that the FFD index (or WMI and PSI) was among the most powerful predictors of Specific Learning Disablity (SLD) in ADHD, and that subtests evaluating verbal IQ were more effective in predicting the level of academic achievement.

Specific Learning Disability and Reading Disability in ADHD

SLD is a prevalent disorder in childhood, and it is one of the most common comorbid disorders (70%) of ADHD (Karaman et al 2006, Miranda et al 2008, Rommelse et al 2009). Children with both SLD and ADHD are expected to have an increased incidence of some symptoms of both disorders. When the WISC-R scores and reading skills of children withADHD and ADHD+SLD were compared, it was observed that children in the ADHD+SLD group made more mistakes on reading skills, and had lower WISC-R scores than the other groups (Gomez and Condon 1999, Karaman et al 2006, Öngider et al 2008, Turgut et al 2010). These data suggest that the comorbidity between ADHD and SLD adversely affects cognitive performance (Karaman et al 2006, Mayes et al 2000).

Although disabilities in reading comprehension and listening comprehension skills are not among the key symptoms of ADHD, these disabilities and their associated academic problems are related to ADHD (Miller et al 2012). It has been reported that attention and working memory play an important role in reading comprehension skills (Jacobson et al 2011, Stern and Shalev 2012); since children with ADHD have disabilities in attention and working memory, they may also have problems in reading comprehension skills (Brock and Knapp 1996, Cherkes-Julkowski et al 1995, Stern and Shalev 2012).

Miller and colleagues (2012) observed conflicting results with regards to the reading comprehension skills of children with ADHD. While some studies reported that children with ADHD had difficulties in reading comprehension skills (Brock and Knapp 1996, Samuelsson et al 2004), others did not (Ghelani et al 2004). The authors concluded that these inconsistent results may be due to the diversity in the types of scales used, different control methods for word reading skills, and different types of control groups (Miller et al 2012). However, when evaluating the reading and reading comprehension skills of children with ADHD, one should consider that ADHD may cause problems associated with processing speed and working memory. Therefore, we believe that children with ADHD should be evaluated with an intelligence scale and should be assessed for reading skills.

To our knowledge, no study has compared two different versions of the Wechsler intelligence scales in a clinical sample in Turkey. Therefore, the main purpose of this study was to compare the WISC-R and WISC-IV scores of a sample of children with ADHD in Turkey. Furthermore, this study was conducted to determine whether WISC IQ scores, index scores, and subtest scores are effective and sufficient in assessing the intellectual abilities of children with ADHD. This study also examined the relationships between the WISC-R subtest and composite scores and the WISC-IV subtest and index scores. Finally, this study aimed to assess the reading skills of children with ADHD. As stated previously, ADHD is frequently comorbid with reading disabilities and SLD. Therefore, evaluating children with ADHD for reading

disabilities within an SLD dignosis group would provide important information that may lead to a reliable and valid reading assessment tool, which is believed to be lacking in Turkey. In this regard, the use of Wechsler intelligence scales together with a reading test for the assessment of ADHD would help to determine the relationship between intellectual factors and learning skills.

METHODS

Participants

The study sample consisted of ADHD-diagnosed children between the ages of 6 and 16 years who were referred to Muş State Hospital Child and Adolescent Mental Health and Diseases Clinic. ADHD diagnoses were made according to DSM-IV diagnostic criteria by a child psychiatrist at the hospital. Scores from the Turgay Disruptive Behavior Disorders Symptom Checklist (based on DSM-IV) and clinical interview findings were used in the diagnosis. Children were excluded from the study if they had a psychiatric diagnosis, any neurological disease, and/or any organic illness, such as hearing and vision loss. While children with a reading disability were not excluded from the study, those who had a WISC-R Full Scale IQ score under 80 were excluded.

Of the participants, 77% (N = 37) were male and 22.9% (N = 11) were female. Their mean age was 13.66 years (S = 1.96, range = 6-14 years). The mean age of the participants at the time of WISC-R administration was 105.75 months (S = 24.69, range = 73-163 months) and the mean age at the time of WISC-IV administration was 116.35 months (S = 24.46, range = 80-173 months). The education levels of the children's mothers were as follows: 29.2% were elementary school graduates, 16.7% were junior high school graduates, 29.2% were high school graduates, and 25% were college graduates. With regards to the education levels of the children's fathers, 8.3% were elementary school graduates, 12.5% were junior high school graduates, 41.7% were high school graduates, and 37.5% were college graduates.

Instruments

Wechsler Intelligence Scale for Children-Revised [WISC-R (Wechsler, 1974)]: The Wechsler Intelligence Scale for Children (WISC) was revised (WISC-R) in 1974, and the scale is administered to children ranging in age from 6 to 16 years. The Turkish standardization study of the WISC-R was performed on a sample of 1639 children who were chosen from 11 city centers, and the scale was adapted to Turkish culture by Savaşır and Şahin in 1995. The WISC-R consists of 10 core subtests and 2 supplemental subtests, which are organized into verbal scales (Information, Similarities, Arithmetic, Comprehension, Vocabulary, Digit Span) and performance scales (Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding, Mazes). The WISC-R provides scores for Verbal IQ, Performance IQ, and Full Scale IQ, as well as standard scores for these subtests. It was determined that the scale produced reliable and valid results in both normal and clinical samples in Turkey (Çelik et al 2015, Çelik et al 2016). The mean IQ score is 100 and the standard deviation is 15. The mean score for all subtests is 10, and the standard deviation is 3.

Wechsler Intelligence Scale for Children-IV [WISC-IV (Wechsler, 1974)]: The WISC-IV is the fourth version of the WISC, and is an individually-administered intelligence test for children between the ages of 6 and 16 years (Wechsler 2003). It consists of 10 core subtests and 5 additional subtests. The WISC-IV provides four index scores, including VCI (Similarities, Vocabulary and Comprehension core subtests and additional Information and Word Reasoning subtests), PRI (Block Design, Picture Concepts and Matrix Reasoning core subtests and additional Picture Completion subtest), WMI (Digit Span and Letter-Number Sequencing core subtests and additional Arithmetic subtest), and PSI (Coding and Symbol Search core subtests and additional Cancellation subtest). In addition, the FSIQ score can be obtained from the sum of the 10 core subtest scores. The mean score for all index scores is 100, and the standard deviation is 15. In Turkey, 2225 children participated in the WISC-IV standardization study. In the norm group for each age range, seven geographical regions were equally represented in terms of population, sex (girls and boys), and socioeconomic status (low-medium-high) (Öktem et al 2013, Uluç et al 2011). The mean score for the subtests is 10, and the standard deviation is 3.

Oral Reading Skill and Reading Comprehension Test (ORCT): The ORCT is a comprehensive assessment tool that measures reading and reading comprehension skills. The test was developed as a result of a series of research (Erden 2012, Sarıpınar 2006, Gökçe Sarıpınar and Erden, 2010) that was done in order to evaluate the reading and reading comprehension skills of fifth-grade students attending primary school. The psychometric properties of the ORCT were examined, but the standardization study has not been completed (Özkök-Kayhan 2011). To determine the reliability of the test, coefficients of test-retest reliability, internal consistency, and split-half reliability were calculated. In the test-retest reliability, coefficients for reading speed and reading comprehension were 0.91 and 0.95, respectively. The internal consistency coefficient for the total scale was 0.84 (Erden 2012). The split-half reliability coefficient was 0.83.

The ORCT contains 11 reading texts that were developed based on experts' opinions regarding compatibility with Turkish language structure and language fluency; the texts differ in content, number of words, and degree of difficulty. In the current study, all of the children read the texts loudly.

They began reading the first text (first grade level), and then continued to read the other texts, as long as they did not make 10 errors. The time it took for the child to read the texts, the number of correctly-read words in the first minute, and the reading errors are recorded. After each text, multiple-choice questions based on the children's grade level with three or four multiple-choice answers are handed-out, and the children must choose the right answer. The ORCT scores reveal information regarding reading comprehension skill, reading speed, reading error, and reading fluency.

In the current study, the reading comprehension score represents the number of correct answers to the questions at the end of the text. The reading speed represents the number of words read correctly in the first minute of reading the texts. To calculate the reading speed score, the number of words read correctly in one minute for each text is added, and this score is divided by the number of texts read. The objective of this process is to calculate the arithmetic mean. Some studies calculate the reading speed score as the number of words correctly read in the first minute, while others calculate this score by dividing the total number of words by reading duration (Erden et al 2002, Meisinger et al 2010). ORCT reading speed scores from our current study were consistent with the literature.

The ORCT reading error score is calculated by dividing the total error for each text by the number of the texts read. Reading fluency is calculated by adding the converted/scaled reading error scores and converted/scaled scores of text reading speed. In the current study, these two scores were estimated based on a previous test norm that was developed in a sample of developmentally normal children.

Procedure

This study was approved by the Ankara University Ethics Board. Prior to enrolling their children in the study, parents were given necessary information about the tests. Then, those who wished their child to participate as a volunteer signed an informed consent form. The Child Development Information Form was used to obtain detailed information about the children – it was completed by the children's parents.

There were between 6 and 10 months separating the administration of the WISC-R and the WISC-IV for each child. The children were instructed not to use any methylphenidate or its derivative drugs at least 24 hours before the test administration. The WISC-IV was given first, and after a short break, the children were given the ORCT.

Each child was given the tests in the same order. Considering the length of the test times and the child's motivation, each child was given two or three breaks (ten minutes each). In accordance with the standards identified in the tests' administration manuals, the tests were administered by the first author of this study; this person has the administration proficiency for both tests, and a hospital psychologist helped to collect all of the research data.

The children were asked to read aloud the respective ORCT reading texts from the manual. The stopwatch was started when the first word of each text was read, and it was stopped one minute later. Both the number of words read and the time it took to read the full text were recorded. After each text was completed, the children were asked to answer multiple-choice questions regarding that text. The stopwatch was not used when the children were answering the questions.

RESULTS

Of the participants, 33.3% (N = 16) were in the ADHD predominantly inattention subtype, and 66.7% (N = 32) were in the ADHD combined subtype. Children diagnosed with the predominantly hyperactivity/impulsivity subtype were excluded from the study. The psychometric properties of the composite scores and index scores of the study participants are presented in Table 1.

Table 1. Psychometric Properties of WISC-R and WISC-IV Scores

WISC-R	Mean	Median	Mode	SD	Variance	Range	Min.	Max.
Verbal IQ	105.06	107	95	13.77	189.76	55	73	128
Performance IQ	106.37	103	92	16.82	283.04	72	74	146
Full Scale IQ	106.33	105	107	14.55	211.75	58	82	140
WISC-IV	**Mean**	**Median**	**Mode**	**SD**	**Variance**	**Range**	**Min.**	**Max.**
VCI	88.87	90	92	12.23	149.60	58	62	120
PRI	92.85	91	96	15.27	233.44	71	70	141
WMI	88.29	89.50	91	13.83	191.40	70	53	123
PSI	90.31	89.50	91	14.24	202.81	59	59	118
FSIQ	87.02	86	86	13.74	188.95	71	61	131

(IQ= Intelligence Quotient, VCI = Verbal Comprehension Index, PRI = Perceptual Reasoning Index, WMI = Working Memory Index, PSI = Processing Speed Index, FSIQ = Full Scale Intelligence Quotient, WISC-R = Wechsler Intelligence Scales for Children-Revised, WISC-IV = Wechsler Intelligence Scales for Children- Fourth Edition)

Table 2. Differences Between WISC-R and WISC-IV Scores

	WISC-R			WISC-IV				
	Mean	**SD**	**N**	**Mean**	**Mean difference**	**SD**	**N**	**t**
Verbal IQ/ VCI	106.33	14.55	48	87.02	13.74	48	19.31	13.28***
Performance IQ/PRI	105.06	13.77	48	88.87	12.23	48	16.18	10.11***
Full Scale IQ/FSIQ	106.37	16.82	48	92.85	15.27	48	13.52	6.91***
WMI	-	-	-	88.29	13.83	48		
PSI	-	-	-	90.31	14.24	48		
Information	10.25	2.62	48	-	-	-		
Similarities	10.47	3.98	48	8.41	2.87	48	2.06	3.36**
Arithmetic	10.52	2.51	48	-	-	-		
Vocabulary	11.41	2.77	48	8.22	3.06	48	3.18	7.46***
Comprehension	10.81	2.54	48	7.79	2.15	48	3.02	7.86***
Digit Span	8.84	2.87	44	7.68	2.33	48	1.20	3.03**
Picture Completion	10.06	2.63	48	-	-	-		
Picture Arrangement	10.89	3.57	48	-	-	-		
Block Design	10.41	3.05	48	8.16	2.91	48	2.25	5.56***
Object Assembly	11.41	3.31	48	-	-	-		
Coding	11.45	2.89	48	8.62	2.69	48	2.83	6.67***
Picture Concepts	-	-	-	9.20	3.00	48		
Matrix Reasoning	-	-	-	9.00	3.13	48		
Letter/Number Sequencing	-	-	-	8.39	3.15	48		
Symbol Search	-	-	-	8.12	2.77	48		

**p < .01; ***p < .001; (IQ= Intelligence Quotient, VCI = Verbal Comprehension Index, PRI = Perceptual Reasoning Index, WMI = Working Memory Index, PSI = Processing Speed Index, FSIQ = Full Scale Intelligence Quotient, WISC-R = Wechsler Intelligence Scales for Children-Revised, WISC-IV = Wechsler Intelligence Scales for Children- Fourth Edition)

Comparison of WISC-R and WISC-IV Scores

A paired sample t-test was conducted to determine whether there were significant differences between the WISC-R and WISC-IV IQ/index and subtest scores (Table 2).

As shown in Table 2, the WISC-R Full Scale, Performance, and Verbal IQ scores were significantly higher than those of the WISC-IV FSIQ (t = 13.28, p < .001), PRI (t = 6.91, p < .001) and VCI (t = 10.11, p < .001), respectively. Similarly,

Table 3. ANOVA Results of WISC-IV Index Scores

Source of Variance	Sum of Squares	Df	Mean Squares	F	p	Significant Difference
Between Groups	28826.19	47	613.32			
Measure	955.35	4	238.84	2.70	.032*	PRI - FSIQ
Error	16586.24	188	88.22			

(PRI = Perceptual Reasoning Index, FSIQ = Full Scale Intelligence Quotient, WISC-R = Wechsler Intelligence Scales for Children-Revised, WISC-IV = Wechsler Intelligence Scales for Children- Fourth Edition)

Table 4. Correlations Between WISC-R and WISC-IV Scores

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1) Verbal IQ	-							
2) Performance IQ	.52**	-						
3) Full Scale IQ	.85**	.90**	-					
4) VCI	.64**	.31*	.52**	-				
5) PRI	.49**	.65**	.65**	.48**	-			
6) WMI	.53**	.48**	.57**	.49**	.51**	-		
7) PSI	.24	.55**	.46**	.27	.36*	.37**	-	
8) FSIQ	.65**	.66**	.75**	.76**	.83**	.77**	.63**	-

*p < .05; **p < .01, N=48, (IQ= Intelligence Quotient, VCI = Verbal Comprehension Index, PRI = Perceptual Reasoning Index, WMI = Working Memory Index, PSI = Processing Speed Index, FSIQ = Full Scale Intelligence Quotient, WISC-R = Wechsler Intelligence Scales for Children-Revised, WISC-IV = Wechsler Intelligence Scales for Children- Fourth Edition)

Table 5. Correlations Between ORCT Subtests and WISC-R and WISC-IV Scores

		ORCT		
ORCT	**Reading Speed**	**Reading Comprehension**	**Reading Error**	**Reading Fluency**
Reading Speed	1	.49**	.44**	.88**
Reading Comprehension		1	.52**	.50**
Reading Error			1	.65**
WISC-R	**Reading Speed**	**Reading Comprehension**	**Reading Error**	**Reading Fluency**
Verbal IQ	.18	.51**	-.47**	.29
Performance IQ	-.07	.21	-.19	.03
Full Scale IQ	.06	.40**	-.37*	.18
WISC-IV	**Reading Speed**	**Reading Comprehension**	**Reading Error**	**Reading Fluency**
VCI	.13	.35*	-.35*	.17
PRI	-.05	.27	-.37*	.13
WMI	.25	.49**	-.41**	.41**
PSI	.17	.25	-.27	.17
FSIQ	.13	.45**	-.47**	.27

*p < .05, ** p < .01, (IQ= Intelligence Quotient, VCI = Verbal Comprehension Index, PRI = Perceptual Reasoning Index, WMI = Working Memory Index, PSI = Processing Speed Index, FSIQ = Full Scale Intelligence Quotient, WISC-R = Wechsler Intelligence Scales for Children-Revised, WISC-IV = Wechsler Intelligence Scales for Children- Fourth Edition)

scores from the WISC-R Vocabulary, Comprehension, Digit Span, Block Design, and Coding subtests were significantly higher than the same scores from the WISC-IV ($t = 3.36$, $p < .01$; $t = 3.18$, $p < .001$; $t = 7.86$, $p < .001$; $t = 3.03$, $p < .01$; $t = 5.56$, $p < .001$; $t = 6.67$, $p < .001$, respectively).

A repeated measures ANOVA was performed to determine whether there were significant differences between the WISC-R Full Scale, Performance and Verbal IQ scores; there were none ($F\ 2,98 = .45$, $p > .05$). In addition, another repeated measures ANOVA was performed to test whether there were significant differences between WISC-IV index scores (Table 3); there were significant differences between the PRI ($M = 92.85$, $SD = 15.2$) and FSIQ ($M = 87.02$, $SD = 13.74$) index scores ($F\ 4,188 = 2.70$, $p < .05$).

Pearson correlation coefficients were calculated in order to examine the relationships between the WISC-R composite scores, and the WISC-IV index scores (Table 4). Analysis revealed that the relationships between the WISC-R IQ scores and the WISC-IV index scores were significantly and positively correlated, with the coefficients ranging from 0.64 to 0.75 at a level of $p < .05$.

Relationships between ORCT Scores and IQ/Index Scores

The relationships between ORCT reading speed, reading comprehension, reading error, and reading fluency scores and the WISC-R and WISC-IV scores are presented in Table 5.

The relationships between the WISC-R Verbal and Full Scale IQ and ORCT reading comprehension were positively and significantly correlated ($r = .51$, $p < .01$; $r = .40$, $p < .01$). In addition, the relationships between the WISC-R Verbal and Full Scale IQ and ORCT reading error were negatively and significantly correlated ($r = -.47$, $p < .01$; $r = -.37$, $p < .05$, respectively).

The ORCT reading comprehension score was positively correlated with the VCI, WMI, and FSIQ scores ($r = .35$, $p < .05$; $r = .49$, $p < .01$; $r = .45$, $p < .01$, respectively). ORCT reading error was negatively correlated with VCI, PRI, WMI and FSIQ ($r = -.35$, $p < .05$; $r = -.37$, $p < .05$; $r = -.41$, $p < .01$ $r = -.47$, $p < .01$, respectively). In addition, the relationship between ORCT reading fluency and WMI was significant ($r = .41$, $p < .05$) (Table 5).

Table 6. Results of Regression Analysis of ORCT Reading Error, Reading Comprehension, and Reading Fluency Scores

Predictive	**Predicted**	**R**	**R^2**	**Standard Error**	**B**	**βeta**	**F**	**t**
Verbal IQ	Reading Comprehension	.51	.26	.006	.01	.35	15.66***	2.39*
WMI		.58	.33	.007	.01	.31	10.72***	2.12*
Verbal IQ	Reading Error	.47	.22	.05	-.20	-.47	12.56**	3.54**
WMI	Reading Fluency	.41	.17	.02	.07	.41	8.80**	2.96**

* p < .05, ** p < .01, *** p < .001, (IQ= Intelligence Quotient, WMI = Working Memory Index)

Results of Regression Analysis

The correlation analyses indicated that ORCT reading comprehension and reading error scores were correlated with Verbal IQ, Full Scale IQ, VCI, PRI, WMI and FSIQ scores. Only the reading fluency score was significantly correlated with WMI. Based on the significant relationships found, a regression analysis was performed. In this context, hierarchical regression analysis using a stepwise method was performed to determine at what level the relevant variables predicted reading comprehension, reading error, and reading fluency scores. The intelligence scores were determined to be the predictable variables, while the reading error and fluent reading scores were determined to be the predicted variables (Table 6).

As shown in Table 6, ORCT reading comprehension was predicted by Verbal IQ and WMI ($F\ 2, 42 = 10.72$, $p < .001$), and these two scores accounted for 33% of the total variance. These data suggest that if Verbal IQ and WMI scores increase, the reading comprehension score will increase.

The ORCT reading error score was predicted by the Verbal IQ score ($F\ 1, 43 = 12.56$, $p < .01$), while accounted for 22% of the total variance. These data suggest that if the Verbal IQ score increases, there is a high possibility that the reading error will decrease. Our previous analysis revealed that ORCT reading fluency was associated with WMI. In the regression analysis, we found that reading fluency predicted only WMI ($F\ 1, 44 = 8.80$, $p < .01$), and it accounted for 17% of the variance.

DISCUSSION

WISC-IV is the fourth version of the WISC, and its initial 'norm' study has just been completed in Turkey. Although WISC-IV has not yet been used in clinical practice, it will replace WISC-R, a previous version of the scale. Compared to the WISC-R, the WISC-IV contains new subtests and index scores. Considering that WISC-IV has a new norm group and important structural changes, and because it was suggested by those in the field (specifically by Flanagan and Kaufman (2009)), we undertook this study to compare the two versions of the scale. We evaluated the composite/index and subtest scores of the two versions for similar intellectual structures and determined the relationships between them. The results revealed significant relationships between the WISC-R and WISC-IV with regards to composite/index scores. The significant relationships between the composite/index scores of the two versions indicate that there is consistency between the WISC-R and WISC-IV. Our data further indicate that both versions were equal in their assessment of IQ.

This study aimed to determine whether there were differences between WISC-R and WISC-IV scores, and our data showed that there were significant differences between the comparable scores of the two versions (see Table 2). Wechsler intelligence scales are often revised to include changes and improvements in the theoretical field, to improve psychometric properties of the scale, to balance the effect of increases in intelligence scores over time and is known as Flynn effect (Flynn 1987) and finally to provide new norms to the scale. Studies comparing the WISC-R and WISC-III scores of children in clinical and normal samples revealed that the Full Scale IQ score on the WISC-III was 5 less (14 vs 9) than it was when the same children were tested on the WISC-R scale (Bolen et al 1995, Mahone et al 2003, Wechsler 1991, Zimmerman and Woo-Sam 1997). The authors hypothesized that these score differences were expected, based on the Flynn effect. Similarly, the present study showed that there were significant differences between composite scores and index scores (see Table 2). The score difference was 19.31 for the FSIQ/Full Scale IQ, 16.18 for the VIQ/VCI, and 13.52 for the PIQ/PRI.

In Turkey, Uluç and colleagues (2014) confirmed that there was a 10-point difference between WISC-R and WISC-IV scores, and this difference was predictable by correcting for the Flynn effect. For the first time, the present study examined the score differences between the two versions of the scale in a clinical sample of ADHD-diagnosed children. We concluded that the differences between the scores in this study were higher than those reported in national and international studies. ADHD is a neuropsychological disorder associated with various intellectual domains, and therefore, increases in intelligence scores (Flynn effect) may not occur in this population.

Another aim of the current study was to determine whether there were significant differences between the WISC-R IQ scores and WISC-IV index scores; results showed no significant differences between these scores, which is consistent with the literature (Kılıç 2002, Kiriş and Karakaş 2004, Naglieri et al 2005). As stated previously in this paper, there are conflicting results regarding whether or not there are significant differences between the IQ scores of children with ADHD. In a number of studies conducted in Turkey, the IQ scores of ADHD-diagnosed children were compared with those of children with intellectually normal development, and it was found that there were significant differences in terms of IQ scores between these two groups (Evinç and Gençöz 2007, Kılıç 2002, Kiriş and Karakaş 2004). However, these studies reported no significant differences between the VIQ and PIQ scores of these two groups. These findings are consistent with the results of the present study, which revealed no differences between WISC-R IQ scores.

There are few studies investigating the differences between WISC-IV index scores in children with ADHD, and the results of studies showing a difference between these scores are controversial. Results of the present study showed that only the difference between the PRI and FSIQ was significant (see Table 2), and that the highest and lowest score among the WISC-IV index scores were the PRI and FSIQ, respectively.

Although this score difference was not significant, the WMI scores in the current study were lower than the PRI scores (see Table 2). It has been reported that WMI and PSI scores of children with ADHD or a neuropsychiatric disorder are lower than other index scores in the WISC-IV, compared to developmentally normal children (Mayes et al 2009, Mayes and Calhoun 2006, San MiguelMontes et al 2010, Thaler et al 2013). In the current study, only WMI scores were lower than the other index scores. Factors such as small sample size, inclusion of children with high intelligence levels, and gender are believed to influence the WISC-IV index scores. It should be noted that, in the literature, some studies were conducted with largely male sample groups, while other studies did not include children with high intelligence levels.

Another remarkable result from the current study was that the children had the lowest score of all of the subtests on the Digit Span subtest in both the WISC-R and the WISC-IV. This finding suggests that the Digit Span subtest in ADHD-diagnosed children may play an important role in their assessment, which is consistent with the results of the study by Tural-Hesapçıoğlu and colleagues (2016).

In this study, we compared ORCT scores on reading speed, reading comprehension, reading error, and reading fluency with related variables (see Table 5). Results indicate that reading speed was significantly and positively associated with reading comprehension; these results are supported by the related literature (Güzel-Özmen 2005, Sarıpınar 2006, Wise et al 2010). Similarly, significant correlations between the subtest scores of the ORCT indicate that this test is consistent and functional for the assessment of reading skill.

Results of the current study indicated that there were significant relationships between reading comprehension and error scores, as well as IQ scores, which is consistent with the literature (Cherkes-Julkowski et al 1995, Jacobson et al 2011, Miller et al 2012, Stern and Shalev 2012). Reading comprehension and error scores were highly correlated with comprehension of text content and short-term memory retention and reuse. Accordingly, it is an important result that both reading comprehension and error scores were associated with WISC-R VIQ and Full Scale IQ. It is especially important that these reading scores were associated with VIQ, as this indicates that later-learned skills, such as reading, are related to acquired information known as 'crystallized intelligence'; these data are consistent with the literature (Miller et al 2012). Regression analysis revealed that the best predictors of reading comprehension are VIQ and WMI, respectively (see Table 6).

Results of the current study and those from published studies indicate that WISC-IV VCI, WMI, and FSIQ scores are associated with reading comprehension and error scores. Reading comprehension skill was mostly associated with skills regarding verbal intelligence with both the WISC-R VIQ and the WISC-IV VCI. In addition, reading fluency scores were associated with WMI. Further, results indicating that WISC-IV WMI can be used to evaluate short-term memory or functions for working memory, which is associated with reading comprehension skill, was compatible with published results (Cain et al 2004, Jacobson et al 2011, Miller et al 2012, Schuchardt et al 2008). Given that a child having problems in working memory functions may also have difficulties in retaining what he/she has learned and read, it may be expected that he/she has lower performance in terms of reading comprehension and fulfillment of correct inferences from the text. In the current study, regression analysis revealed that WMI predicted both reading comprehension and reading fluency, which supported this expectation. The study by Miller and colleagues (2012) proved that "working memory" was the only predictor of reading comprehension skill. Considering the findings in relation to reading skills, we suggest, based our current study and the literature, that the WISC-IV produces more specific results than the WISC-R, and that the WISC-IV four-factor structure may be more functional.

In other respects, reading speed scores were not associated with intelligence scores. As stated previously, various methods for the assessment of reading speed are currently utilized. In some studies, reading speed is evaluated based on the total duration of the read text, while other studies evaluate reading speed based on the number of syllables or words read in the first minute (Erden et al 2002, Meisinger et al 2010, Wiederholt and Bryant 2001). Consequently, the method used in the current study (reading speed represents the number of words read correctly in the first minute of reading the texts) and properties of the participants are considered to play a role in the results. Full Scale IQ scores from both the WISC-R and the WISC-IV were associated with reading comprehension and error scores. This finding points out that a general intelligence factor (g factor) may be related to reading skill. It also suggests that the g factor may not be adequate for predicting reading skill. It should be considered that Verbal IQ scores effect the calculation of these scores (Ghelani et al 2004).

Conclusions and Implications

To our knowledge, this is the first study to compare two versions of the WISC in a clinical sample in Turkey. Although intelligence scales are not diagnostic tools for ADHD, they do provide an important way to assess a patient's strengths and weaknesses. Therefore, we expect that the results of this study will be helpful to other clinicians interested in obtaining information regarding the cognitive profiles of ADHD-diagnosed children.

Since ADHD-diagnosed children have difficulties in working memory, which plays an important role in reading comprehension, this study emphasized the assessment of reading skills in addition to other diagnostic assessments. We hope

that clinicians will consider assessing ADHD-diagnosed children for reading skills, as deficiencies in reading skills may lead to failure in other academic skills. It is known that reading disabilities are prevalent in children with ADHD, and therefore, these children should be assessed with the reading disability sub-domain along with a reading test; these measures will provide useful information in assessing the symptoms and cognitive features of ADHD. Further, future studies should determine the relationship between reading test scores and intelligence scores in children with ADHD; in addition, children should also be evaluated for SLD.

One limitation of this study is the small sample size; there were not enough participants to categorize and compare the subtypes of ADHD. Future studies should include a larger number of participants so that IQ scores can be compared in terms of ADHD subtypes. Another limitation is that there was no control group. It would be useful to include a control group in future studies so that it can be determined whether ADHD produces a different cognitive/intellectual structure in the mentioned scales. Furthermore, assessing or comparing the reading and learning skills by gender would give further insight into the role of gender differences in ADHD.

REFERENCES

American Academy of Child and Adolescent Psychiatry (2007) Practice parameter for the assessment and treatment of children and adolescents with attention-deficit/hyperactivity disorder. J Am Acad Child Adolesc Psychiatry 46: 894–921.

Anastopoulos AD, Spisto MA, Maher MC (1994) The WISC-III Freedom from Distractibility factor: Its utility in identifying children with attention deficit hyperactivity disorder. Psychological Assessment 6: 368–71.

Bannatyne A (1979) Spatial competence, learning disabilities, auditory-vocal deficits, and a WISC-R subtest recategorizations. J Clin Child Psychol 8: 194-200.

Barkley RA (1997) Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. Psychol Bull 121:65-94.

Bolen LM, Aichinger KS, Hall CW et al (1995) A comparison of the of cognitively disabled children on the WISC-R and WISC-III. J Clin Psychol 51:89-94.

Brock S, Knapp P (1996) Reading comprehension abilities of children with attention deficit hyperactivity disorder. J Atten Disord 1:173–86.

Cain K, Oakhill J, Bryant P (2004) Children's Reading Comprehension Ability: Concurrent Prediction by Working Memory, Verbal Ability and Component Skills. Journal of Educational Pyschology 96:31-42.

Calhoun SL, Mayes SD (2005) Processing speed in children with clinical disorders. Psychology in the Schools 42:333-43.

Cherkes-Julkowski M, Stolzenberg J, Hatzes N et al (1995) Methodological issues in assessing the relationship among ADD, medication effects and reading performance. Learning Disabilities: A Multidisciplinary Journal 6:21–30.

Çelik C, Yiğit I, Erden G (2015) Wechsler Çocuklar İçin Zekâ Ölçeği Geliştirilmiş Formunun doğrulayıcı faktör analizi: Normal zihinsel gelişim gösteren çocukların oluşturduğu bir örneklem. Turk Psikoloji Yazıları 18:21-9.

Çelik C, Yiğit I, Erden G et al (2016) Zihinsel gelişim geriliği olan çocuklarda Wechsler Çocuklar İçin Zekâ Ölçeği Geliştirilmiş Formunun faktör yapısının incelenmesi. Çocuk ve Gençlik Ruh Sağlığı Dergisi (In Press).

Devena SE, Watkins MW (2012) Diagnostic utility of WISC-IV general abilities index and cognitive proficiency index difference scores among children with ADHD. Journal of Applied School Psychology 28:133-54.

Erden G (2012) Sesli Okuma Becerisi ve Okuduğunu Anlama Testi (SOBAT) geçerlik güvenirlik çalışması. Unpublished research article.

Erden G, Kurdoğlu F, Uslu R (2002) İlköğretim okullarına devam eden Türk çocuklarının sınıf düzeylerine göre okuma hızı ve yazım hataları normlarının geliştirilmesi. Türk Psikiyatri Dergisi 13:5-13.

Erdoğan-Bakar E, Soysal AŞ, Kiriş N et al (2005) Dikkat eksikliği hiperaktivite bozukluğunun değerlendirilmesinde Wechsler Çocuklar için Zekâ Ölçeği geliştirilmiş formunun yeri. Klinik Psikiyatri 8:5-17.

Erdoğan-Bakar E, Soysal AŞ, Kiriş N et al (2011) Wechsler Çocuklar için Zekâ Ölçeği yeniden gözden geçirilmiş formunun dikkat eksikliği hiperaktivite bozukluğunda ölçtüğü özellikler. Çocuk ve Gençlik Ruh Sağlığı Dergisi 18:155-74.

Evinç GŞ, Gençöz T (2007) Dikkat eksikliği hiperaktivite bozukluğu tanısı alan çocukların WISC-R profillerinin, farklı bir psikiyatrik tanı alan ve herhangi bir tanısı olmayan çocuklarla karşılaştırılması. Turk Psikiyatri Derg 18:109-17.

Faraone SV, Biederman J, Lehman BK et al (1993) Intellectual performance and school failure in children with attention deficit hyperactivity disorder and in their siblings. J Abnorm Psychol 102:616-23.

Flanagan DP, Kaufman AS (2009) Essential of WISC-IV Assessment. (2nd ed.). New York: Wiley, p. 3-7.

Flynn JR (1987) Massive IQ gains in 14 nations: What IQ tests really measure. Psychol Bull 101:171-91.

Ghelani K, Sidhu R, Umesh J et al (2004) Reading comprehension and reading related abilities in adolescents with reading disabilities and attention deficit/hyperactivity disorder. Dyslexia 10:364–84.

Gomez R, Condon M (1999) Auditory processing ability in children with ADHD and without learning Disabilities. Journal of Learning Disabilities 32:150-58.

Gökçe-Sarıpınar E, Erden G (2010) Okuma güçlüğünde akademik beceri ve duyusal-motor işlevleri değerlendirme testlerinin kullanılabilirliği. Türk Psikoloji Dergisi 25:55-6.

Güzel-Özmen R (2005) Öğrenme güçlüğü olan öğrencilerin okuma hızlarının metinlerde karşılaştırılması. Eğitim Bilimleri Dergisi 25:1-8.

Hale JB, Fiorello CF, Kavanagh JA et al (2001) WISC-III predictors of academic achievement for children with learning disabilities: Are global and factor scores comparable? School Psychology Quarterly 16:31-55.

Jacobson LA, Ryan M, Martin RB et al (2011) Working memory influences processing speed and reading fluency in ADHD. Child Neuropsychology 17:209–24.

Karaman D, Türkbay T, Gökçe FS (2006) Özgül öğrenme bozukluğu ve dikkat eksikliği hiperaktivite bozukluğu binişikliğinin bilişsel özellikleri. Çocuk ve Gençlik Ruh Sağlığı Dergisi 13:60-8.

Karatekin C, Markiewicz SW, Siegel MA (2003) A preliminary study of motor problems in children with attention-deficit/hyperactivity disorder. Percept Mot Skills 97:1267-80.

Kaufman AS (1975) Factor analsis of the WISC-R at age levels between 6,5 and 16,5. J Consult Clin Psychol 43:135-47.

Kaufman AS (1994) The "validity" factors: Freedom from Distractibility and Processing Speed. In Intelligent testing with the WISC-III (pp. 209–268). New York: Wiley.

Kılıç BG (2002) Dikkat eksikliği hiperaktivite bozukluğunda mini dikkat test bataryası ile ölçülen bilgi işleme süreçleri. Yayınlanmamış Tıpta Uzmanlık Tezi. Ankara, Gazi Üniversitesi Tıp Fakültesi.

Kiriş N, Karakaş S (2004) Dikkat eksikliği hiperaktivite bozukluğunun zekâ testlerinden ve ilgili diğer nöropsikolojik araçlardan yordanabilirliği. Klinik Psikiyatri Dergisi 7:139-52.

Kramer JH (1993) Interpretation of individual subtest scores on the WISC-III. Psychological Assessment 5:193-6.

Mahone EM, Miller TL, Koth CW et al (2003) Differences between WISC-R and WISC-III performance scale among children with ADHD. Psychol School 40:331-40.

Mayes SD, Calhoun SL (2006) WISC-IV and WISC-III profiles in children with ADHD. J Atten Disord 9:486-93.

Mayes SD, Calhoun SL (2007) Wechsler Intelligence Scale for Children-Third and fourth edition predictors of academic achievement in children with attention-deficit/hyperactivity disorder. School Psychology Quarterly 22:234-49.

Mayes SD, Calhoun SL, Chase GA et al (2009) ADHD subtypes and co-occurring anxiety, depression, and oppositional-defiant disorder: Differences in Gordon Diagnostic System and Wechsler Working Memory and Processing Speed Index scores. J Atten Disord 12:540-50.

Mayes SD, Calhoun SL, Crowell EW (1998) WISC-III Freedom From Distractibility as a measure of attention in children with and without attention deficit hyperactivity disorder. J Atten Disord 2:217-27.

Mayes SD, Calhoun SL, Crowell EW (2000) Learning disabilities and ADHD; overlapping spectrum disorders. J Learning Disabilities 3:417-24.

McMahon RC, Kunce JT (1981) A comparison of the factor structure of the WISC and WISC-R in normal and exceptional groups. J Clin Psychol 37:408-10.

Meisinger EB, Bloom JS, Hynd GW (2010) Reading fluency: implications for the assessment of shildren with reading disabilites. Annuals of Dyslexia 60:1-17.

Miller AC, Keenan JM, Betjemann RS et al (2012) Reading comprehension in children with ADHD: Cognitive underpinnings of the centrality deficit. J Abnorm Child Psycho 1-11.

Miranda A, Soriano M, Fernández I et al (2008) Emotional and behavioral problems in children with attention deficit hyperactivity disorder: Impact of age and learning disailities. Learning Disability Quarterly 31:171-85.

Naglieri JA, Goldstein S, Delauder BY et al (2005) Relationships between the WISC-III and the Cognitive Assessment System with Conners' Rating Scales and Continuous Performance Tests. Arch Clin Neuropsychol 20:385-401.

Naglieri JA, Paolitto AW (2005) Ipsative comparisons of WISC-IV scores. Applied Neuropsychology 12:208-11.

Nyden A, Billstedt E, Hjelmquist E et al (2001) Neurocognitive stability in Asperger syndrome, ADHD, and reading and writing disorder: A pilot study. Dev Med Child Neurol 43:165-71.

Öktem, F, Gençöz T, Erden G, et al (2013) Wechsler Çocuklar İçin Zeka Ölçeği-IV (WÇZÖ-IV) Uygulama ve Puanlama El Kitabı Türkçe Sürümü. Ankara: Türk Psikologlar Derneği Yayınları.

Öngider N, Baykara B, Pekcanlar-Akay A (2008) Bir çocuk psikiyatrisi polikliniğinde ayaktan izlenen olgulardan DEHB ve/veya ÖÖB tanısı konan çocukların WISC-R testi sonuçlarının karşılaştırılması. New/Yeni Symposium Journal 46:17-22.

Özkök-Kayhan E (2011) İlköğretim birinci kademe çocuklarında okuduğunu anlama ile sözcük bilgisi, görsel algı ve kısa süreli bellek arasındaki ilişki. Yayınlanmamış Yüksek Lisans Tezi. Ankara Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

Prifitera A, Dersh J (1993) Base rates of WISC-III diagnostic subtest patterns among normal, learning-disabled, and ADHD samples. Journal of Psychoeducational Assessment WISC-III Monograph: 43–55.

Raiford SE, Weiss LG, Rolfhus EL et al (2005) Wechsler Intelligence Scale for Children-Fourth Edition, General Ability Index (Technical Report No. 4). San Antonio, TX: Harcourt Assessment.

Rommelse NNJ, Altink ME, Fliers et al (2009) Comorbid problems in ADHD: Degree of association, shared endophenotypes, and formation of distinct subtypes. Implications for a future DSM. J Abnorm Child Psychol 37:793-804.

Samuelsson S, Lundberg I, Herkner B (2004) ADHD and reading disability in male adults: is there a connection? J Learning Disabilities 37:155–68.

San Miguel Montes LE, Allen DN, Puente AE et al (2010) Validity of the WISC–IV Spanish for a clinically referred sample of Hispanic children. Psychological Assessment, 22: 465-9.

Sarıpınar EG (2006) Özgül Öğrenme Güçlüğü: Okuma Güçlüğünde Akademik Beceri ve Duyusal-Motor İşlevleri Değerlendirme Testlerinin Kullanabilirliği. Yayınlanmamış Yüksek Lisans Tezi. Ankara Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

Sattler JM (2002) Assessment of children: Behavioral and Clinical Applications (4th ed.). San Diego, CA: Jerome M. Sattler, p. 268-72.

Savaşır I, Şahin N (1995) Wechsler çocuklar için zekâ ölçeği uygulama kitapçığı, [çev. Savaşır, I.; Şahin, N.], Ankara: Türk Psikologlar Derneği.

Schuchardt K, Maehler C, Hasselhorn M (2008) Working memory deficits in children with specific learning disorders. J Learning Disabilities 41:514-23.

Schwean VL, McCrimmon A (2008) Attention-deficit/hyperactivity disorder: Using the WISC IV to inform intervention planning. In A. Prifitera, D. H. Saklofske, & L. G. Weiss (Eds.), WISC-IV clinical assessment and intervention (pp. 193–215). San Diego, CA: Academic Press.

Schwean VL, Saklofske DH (2005) Assessment of Attention-deficit/hyperactivity disorder with the WISC-IV. In A. Prifitera, D. H. Saklofske, & L. G. Weiss (Eds.), WISC-IV clinical use and interpretation (pp. 235–280). San Diego, CA: Academic Press.

Snow JB, Sapp GL (2000) WISC-III subtest patterns of ADHD and normal samples. Psychol Rep 87:759–65.

Stern P, Shalev L (2012) The role of sustained attention and display medium in reading comprehension among adolescents with ADHD and without it. Res Dev Disabil 34:431–39.

Thaler NS, Allen DN, McMurray JC et al (2010) Sensitivity of the test of memory and learning to attention and memory deficits in children with ADHD. Clinical Neuropsychologist 24:246-64.

Thaler NS, Bello DT, Etcoff LM (2013) WISC-IV profiles are associated with differences in symptomatology and outcome in children with ADHD. J Atten Disord 17:291-301.

Tripp G, Ryann J, Peace K (2002) Neuropsychological functioning in children with DSM-IV combined type attention deficit hyperactivity disorder. Aust N Z J Psychiatry 36:771-9.

Tural-Hesapçıoğlu S, Çelik C, Özmen S et al (2016) Dikkat Eksikliği Hiperaktivite Bozukluğu bulunan çocuklarda Wechsler Çocuklar İçin Zekâ Ölçeği Gözden Geçirilmiş Formunun (WÇZÖ-R) incelenmesi: Alt testlerin, Kaufman ve Bannatyne sınıflandırmalarının yordayıcı gücü. Turk Psikiyatri Derg (In Press)DOI: 10.5080/u7985.

Turgut S, Erden G, Karakaş S (2010) Özgül Öğrenme Güçlüğü (ÖÖG) Dikkat Eksikliği Hiperaktivite Bozukluğu (DEHB) birlikteliği ve kontrol gruplarının ÖÖG bataryası ile belirlenen profilleri. Çocuk ve Gençlik Ruh Sağlığı Dergisi 17:13-25.

Uluç S, Öktem F, Erden G et al (2011) Wechsler Çocuklar için Zekâ Ölçeği-IV: Klinik bağlamda zekânın değerlendirilmesinde Türkiye için yeni bir dönem. Türk Psikoloji Yazıları 14:49-57.

Uluç S, Şahin Ö, Korkmaz B (2014) Flynn etkisinin Türk örnekleminde değerlendirilmesi: WÇZÖ-R ve WÇZÖ-IV Zekâ Bölümü (ZB) puanlarının karşılaştırılması. Türk Psikoloji Dergisi 29:60-9.

Wechsler D (1991) Wechsler Intelligence Scale for Children (3rd ed.). New York: Psychological Corporation.

Wechsler D (2003) WISC-IV technical and interpretive manual. San Antonio, TX: Psychological Corporation.

Weiss LG, Gabel AD (2007) Using the cognitive proficiency index in psychoeducational assessment (Technical Report No. 6). San Antonio, TX: Harcourt Assessment.

Wiederholt JL, Bryant BR (2001) Gray Oral Reading Tests Examiner's Manual. USA: Pro-Ed (p. 1-26).

Wise JC, Sevcik RA, Morris RD et al (2010) The relationship between different measures of oral reading fluency and reading comprehension in second grade students who evidence different oral reading fluency difficulties. Language, Speech and Hearing Services in Schools 41:340-48.

Zametkin AJ, Ernst M (1999) Problems in the management of attention-deficit–hyperactivity disorder. N Engl J Med 340:40-6.

Zimmerman IL, Woo-Sam JM (1997) Review of the criterion-related validity of the WISC-III: The first five years. Percept Mot Skills 85:531–46.