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How IQ Profile in Wechsler-V Changes in Children with Autism Spectrum Disorders, Specific Learning Disorder and Attention-Deficit/Hyperactivity Disorder?

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Abstract

Autism Spectrum Disorder (ASD), Specific Learning Disorders (SLD), and Attention Deficit/Hyperactivity Disorder (ADHD) are three major types of neurodevelopmental disorders that cause the emergence of various impairments in the normal development of individuals. The main aim of the current research was to evaluate the IQ profile of the patients dealing with these three types of disorders and highlight the discrepancies and similarities among these categories. The information was collected from 67 individuals of which 15 were of typical development, 15 dealt with ASD-HF, 15 suffered from ADHD, and 22 were diagnosed with SLDm. The verbal comprehension, visual-spatial performance, fluid reasoning, working memory, processing speed, as well as full-scale IQ of all groups were precisely evaluated using the WISC-V (Wechsler Intelligence Scale for Children® Fifth Edition). The collected scores for primary and ancillary tests were statistically analyzed via the non-parametric approach of Kruskal–Wallis H test and the post-hoc method of the Mann–Whitney U test. Our result indicated that all three groups have different cognitive profiles in comparison with normal children. The autistic children possessed better cognitive conditions in comparison with the other two groups of patients. However, they revealed a weak processing speed performance. On the other hand, children with SLDm obtained the least scores in all intellectual indices. Particularly, they were severely impaired in skills related to working memory (digit span and picture span) and processing speed (coding and symbol search). The cognitive attributes of ADHD children were much closer to that of SLDm patients than the ASD-HF. Our intra/inter-category analysis underlined the discrepancies and similarities among the three groups suffering from different neurodevelopmental disorders, facilitating better characterization of the intellectual, cognitive, and behavioral attributes of these children.

Keywords: Cognitive profile, WISC-V, neurodevelopmental disorders

Introduction

Neurodevelopmental disorders are clinical disorders that share basic abnormalities in neurobiological development and cause impairment in personal, social, academic, or occupational functioning. These disorders share some common clinical and neuropsychiatric features (American Psychiatric Association, 2013) and are often characterized by the simultaneous presence of more than one clinical illness (comorbidity). Current research has clearly shown that sometimes different developmental problems occur simultaneously (Crissy, 2021). Neurodevelopmental disorders include specific learning disorders (SLD), attention deficit/hyperactivity disorder (ADHD), and autism spectrum disorders (ASD) (American Psychiatric Association, 2013). In the fifth edition of the Diagnostic and Statistical Manual of Psychiatric Disorders (DSM-5), learning disorders (reading, writing, mathematics), due to many common features in genetic, environmental, and developmental factors, accompanying disorders, and cognitive weaknesses, have been categorized in a single diagnostic class called specific learning disorders. Children with this disorder, despite their natural intelligence, are impaired in reading, writing, and calculation skills and have academic skills lower than the expected level (Franklin, 2018). Some researchers have reported that the cognitive performance of people with SLD is different from those with normal development. The results of studies have shown that in these children, the general ability index usually has a higher score than the cognitive skill index (Poletti, 2016). Also, people with SLD are often weak in active memory (Hasselhorn, 2010) and processing speed (Shanahan, 2006). In addition to the mentioned cases, people with different types of SLD also suffer from other specific weaknesses. For example, children with specific learning disorders accompanied with reading impairments show deficits in phonological processing, too (Willcutt, 2013). Children with this disorder who suffer from deficit in mathematics have also deficits in visual-spatial skills (Landerl, 2009).

Another neurodevelopmental disorder is attention-deficit/hyperactivity disorder (ADHD), characterized by a persistent pattern of inattention-hyperactivity (American Psychiatric Association, 2013). To be diagnosed with ADHD, symptoms must be present in both attention deficit and hyperactivity areas before the age of 12 and should have a negative impact on the individual's psychosocial functioning (American Psychiatric Association, 2013). So far, many theoretical models have been proposed to explain the neurocognitive mechanisms of ADHD. Pennington and Ozonoff (1996), were among the first ones to develop a theoretical model for the cause of ADHD. They suggested that the attention problems and impulsive behavior observed in people with ADHD are due to deficits in executive functioning. They also observed that some of the symptoms of ADHD are similar to those of patients with frontal lobe lesions, especially in the prefrontal cortex, and hypothesized that reduced function in the prefrontal cortex leads to executive function deficits in the individuals with ADHD. This hypothesis provided the basis for the subsequent models (Pievsky, 2018).

In addition to the mentioned disorders, autism spectrum disorder (ASD) is also one of the neurodevelopmental disorders characterized by the limited, repetitive, and stereotyped communications, social skills, behaviors, and interests. In this neurodevelopmental disorder, the term spectrum is used to emphasize the heterogeneity of clinical features. Also, the severity of this disorder can vary from very mild to severe and is divided into three levels from 1 to 3. Meanwhile, people with level 1 ASD previously called "high functioning" (ASD-HF) have intelligence and language within the normal range (Rabiei, 2019).

One of the most widely used tests used to evaluate students' intelligence is the Wechsler intelligence test. In the fifth edition, the perceptual reasoning index is divided into visual-spatial index and fluid reasoning index. Moreover, in this edition, the norms have been updated and there are 21 sub-tests compared to 15 sub-tests in the fourth edition (Wechsler, 2014).

To date, very few studies have analyzed the different neuropsychological profiles of children with neurodevelopmental disorders. For example, Willcutt et al.'s (2010) research showed that people with reading disabilities were more impaired in verbal reasoning and active memory compared to people with ADHD. Also, a study was conducted by Kim and Song (2020) in which they compared two groups of ASD-HF and ADHD and found that verbal comprehension was significantly lower in the ASD-HF group. NEPSY and Wechsler are two well-known and valid tests to detect differences in the areas of executive attention and cognitive performance in children with different psychopathology diagnoses. The aim of the present study is to investigate the cognitive profile of children with specific learning disorder (SLD), attention deficit/hyperactivity disorder (ADHD) and children with autism spectrum disorder level 1 (ASD-HF) and a control group of healthy children (TD) by examining the similarities and differences between the cognitive profiles of these groups with the Wechsler test, fifth edition, to determine whether specific and/or common deficits can be identified for the groups.

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Instruments and methods

The clinical sample studied in this research included 67 children between 7 and 12 years of age selected in collaboration with a specialized counseling center in learning disorders and a child and adolescent counseling center (Zehn Barter, Shahin Shahr, Isfahan, Iran). Next, these children were classified into three groups with a diagnosis of ADHD, SLD, or ASD-HF based on DSM-5 (American Psychiatric Association, 2013). Normal children were also selected from the primary schools. All children in the SLD group were clinically diagnosed as SLD cases with major disorders in mathematics and indicated throughout the text as SLDm. The information of all four groups studied in this research has been presented in detail in **Table 1**.

Table 1. Demographic description of the sample by group

	SLD with Problems in Arithmetic Group (n= 22)	**ADHD Group (n= 15)**	**ASD Group (n= 15)**	**CONTROL Group (n= 15)**
Sex				
Male	**16(72.72%)**	**10(66.66%)**	**10(66.66%)**	**8(53.33%)**
Female	**6(27.28%)**	**5(33.34%)**	**5(33.34%)**	**7(46.67%)**
Age				
7–9.11 years	**11(50%)**	**11(73.33%)**	**9(60%)**	**8(53.33%)**
10–12.12 years	**11(50%)**	**4(26.67%)**	**6(40%)**	**7(46.67%)**
Parental education				
Lower education level	**4(18.18%)**	**1(6.67%)**	**0(0%)**	**1(6.67%)**
Medium education level	**5(22.73%)**	**4(26.66%)**	**3(20%)**	**1(6.67%)**
High education level	**9(40.91%)**	**9(60%)**	**6(40%)**	**8(53.33%)**
Highest education level	**4(18.18%)**	**1(6.67%)**	**6(40%)**	**5(33.33%)**

All participants were Iranian and none had any diagnosed neurological disease. Exclusion criteria for all participants were: history or concurrent diagnosis of other neurodevelopmental disorders, history of neurological problems, current use of medication, medical illness requiring immediate treatment, ongoing psychological treatments, or a confirmed IQ below 90.

After obtaining written consent from the parents of children to participate in the study, children in the control group were examined by the fifth edition of the Wechsler Intelligence Scale for Children during two different sessions in a quiet room outside the classrooms.

Children with the aforementioned neurodevelopmental disorders were also examined at the Child and Adolescent Counseling Center during two sessions by the fifth edition of the Wechsler Intelligence Scale for Children. For some computer-based tasks, children sat in front of a computer screen and each session lasted approximately 1 hour.

Measurements

In this study, Wechsler's 5th edition scale was used to evaluate children. Compared to the previous editions, in the fifth edition, the structure of intelligence has been changed from a four-factor model to a five-factor model, including primary and secondary indicators. In the fifth edition, the perceptual reasoning index is divided into visual-spatial index and fluid reasoning index. Also, in this edition, the norms have been updated and there are 21 sub-tests compared to 15 sub-tests in the fourth edition. 6 sub-tests (image comprehension, naming speed literacy, naming speed value, immediate symbol translation, delayed symbol translation, symbol recognition translation) were created and 2 sub-tests (vision puzzle test, weight recognition) from the fourth edition were added with changes in the content of the questions. In this test, there is the possibility of short execution using 7 main sub-tests and due to the reduction of the number of tests from 10 to 7 sub-tests, the execution time is also reduced from 60 to 48 minutes to obtain the total intelligence (Wechsler, 2014). Also, this scale enjoys good reliability and validity. Using split-half and test-retest reliability in the general sample at the level of primary indicators: Verbal comprehension index is 92%, visual-spatial index is 92%, fluid reasoning index is 0.93, active memory index is 92%, processing speed index is 88% and general intelligence is 96%. The concurrent validity reported for Wechsler's Technical Guide and Interpretation for Children, 5th Edition, with other intelligence tests is also at a favorable level (Wechsler, 2014).

Statistical analysis

The obtained scores for each subtest were utilized in WISC-V to calculate the main indices (i.e., VCI, VSI, FRI, WMI, PSI, and FSIQ). The obtained scores were reported as mean ± standard deviation. The means were first analyzed via the non-parametric Kruskal–Wallis H method to identify the presence of significant differences among groups ($p < 0.05$) which was followed by a post-hoc Mann-Whitney U test. All of the analyses were performed in IBM SPSS version 17.0.

Results

Intra-category comparisons

The intragroup comparisons of main components of the Wechsler-V cognitive profile for children with ASD, ADHD, and SLDm are reported in **Fig 1.** As can be observed, children with ASD-HF (**Fig 1a**) possessed a moderate FSIQ (102.46). They also obtained average performance scores on FRI (103.00) and WMI (101). The highest performance in this group was related to their great Visual Spatial Index (106.40), while autistic children revealed a low performance in the processing speed index with a score of 95.93. Children with SLDm (**Fig 1b**), on the other hand, revealed a different cognitive pattern, where a relatively low FSIQ (94.22) was obtained. In this group, the highest performance was observed in the case of FRI and VCI with average scores of 95.36 and 95.31, respectively, while these children suffered from a low PSI (91.59) and WMI (90.45). Among these three categories, the ADHD group stood somewhere in the middle in terms of the WISC-V cognitive profile (**Fig 1c**). The moderate FSIQ score of 97.0, the high FRI of 102.0, and the weak WMI of 93.0 were some characteristics of these children. They also possessed moderate VCI (99.73), VSI (98.6), and PSI (96.46) which were not significantly different from each other (P> 0.05).

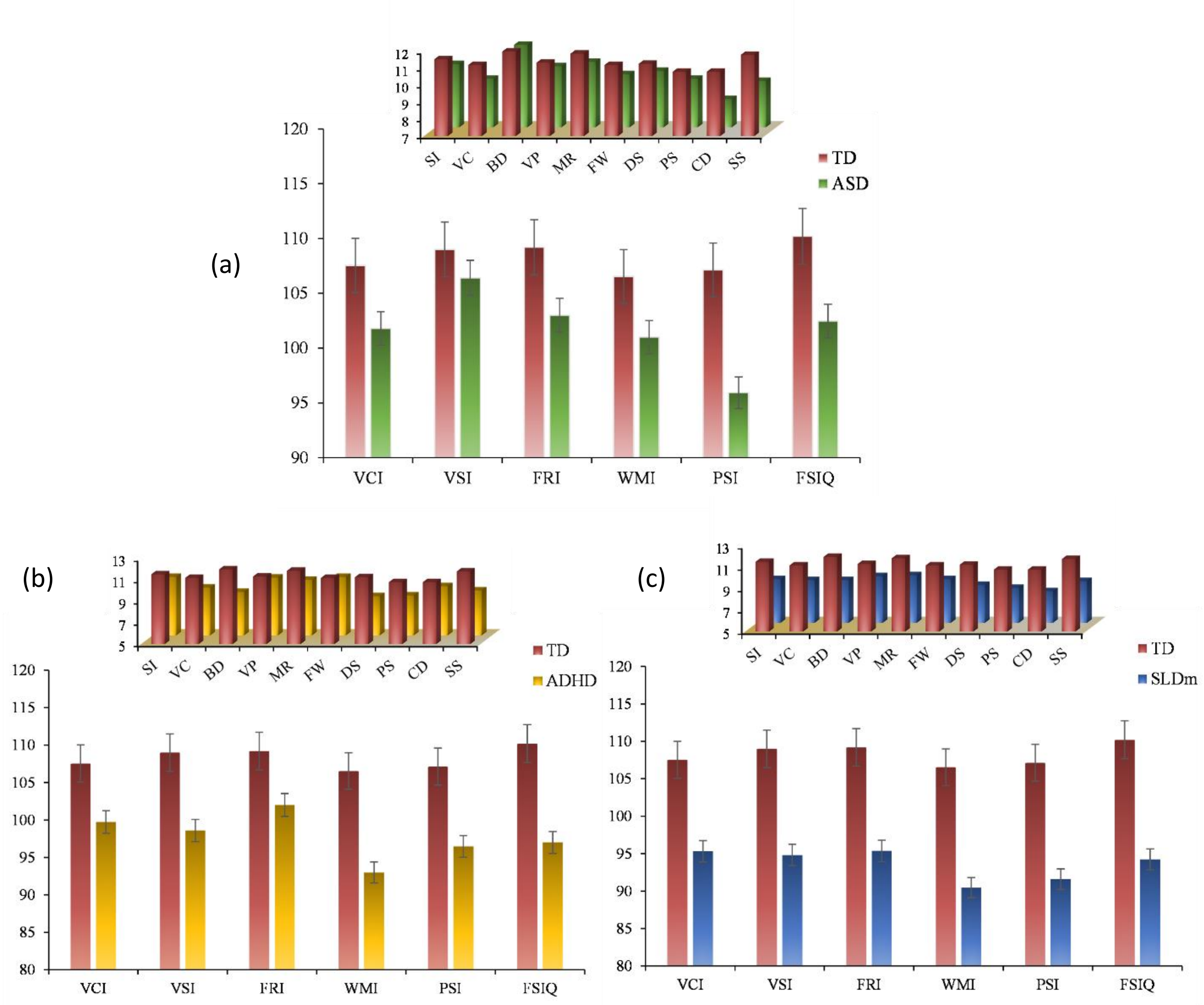

Fig 1. The primary and ancillary WISC-V scores of children with ASD-HF (a), SLDm (b) and ADHD (c)

Inter-category comparisons

Table 2 has represented the results of comparative analysis among various categories (i.e., TD, ASD, ADHD, and SLDm). As it can be clearly observed, the Kruskal-Wallis test corroborated the presence of a significant difference ($p < 0.01$) in all Wechsler cognitive components (i.e., FSIQ, VCI, VSI, FRI, and WMI) among the categories. Post-Hoc analysis through the Mann-Whitney U test corroborated the significantly lower scores of FSIQ in SLDm and ADHD groups when compared to the normal children ($p < 0.01$) (**Table 3**). In terms of VCI, ADHD and SLDm groups possessed significantly lower scores than the normal children ($p < 0.01$). However, children in the ASD-HF group obtained better verbal comprehension scores almost comparable to that of the TD group and there was also no significant difference between the VCI of the SLDm and ADHD groups ($p > 0.05$). A similar trend was observed in the case of visual-spatial index of under-study groups where the high-function autistic children and normal children revealed identical scores, and no significant difference was found between SLDm and ADHD groups ($p > 0.05$). Nonetheless, children who suffered from ADHD and SLDm had remarkably lower VSI performance than the control group ($p < 0.01$). In comparison with normal children, all groups obtained lower scores in terms of the fluid reasoning index. In this case, except for children with ASD-HF and ADHD who performed similarly in FRI, all other pairwise comparisons revealed significant differences ($p < 0.01$). In this context, the SLDm children with an average score of 95.36 showed the weakest performance. The variations in the working memory index among children studied in this research were as follows: normal children > ASD-HF > ADHD > SLDm with average scores of 106.53,

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101.00, 93.00, and 90.45. As can be observed, the scores obtained by autistic children were almost comparable to the TD group. However, the children with ADHD obtained the low working memory score of 99.73. Again, the SLDm children were the weakest group in terms of working memory.

The processing speed index also revealed different patterns among the categories studied in this research. In this regard, the TD group with a high PSI of 107.13, stood out among all groups. The weakest performance was related to the SLDm children with a remarkably low PS index of 91.59. However, children with ASD-HF and ADHD obtained comparable scores of 95.93 and 96.47 and had no significant difference in terms of processing speed ($p > 0.05$). The alterations in the FSIQ of four groups, which indicates the general intellectual ability of the children, were a combination of changes in other WISC-V parameters. As expected, normal children with the relatively high FSIQ score of 110.20 performed best among all groups. In this context, autistic children, ADHD, and SLDm groups with scores of 102.47, 97.00, and 94.23 ranked after normal children, respectively. Except for SLDm and ADHD children who showed identical FSIQ scores, all other pairwise comparisons were significant ($p < 0.01$).

Table 2. Kruskal–Wallis analysis results of normal children and children with different disorders

Cognitive profile indices	Groups				Kruskal–Wallis Test		
	TD (M ± SD)	ASD-HF (M ± SD)	SLDm (M ± SD)	ADHD (M ± SD)	Test Statistic	*df*	Significance
VCI	107.53 ± 4.26	101.80 ± 5.07	95.32 ± 2.90	99.73 ± 10.74	34.41	3	0.000
VSI	109.00 ± 3.70	106.40 ± 3.56	94.82 ± 4.96	98.60 ± 9.85	36.60	3	0.000
FRI	109.20 ± 5.72	103.00 ± 4.94	95.36 ± 5.61	102.00 ± 7.91	29.12	3	0.000
WMI	106.53 ± 5.05	101.00 ± 6.90	90.45 ± 4.21	93.00 ± 6.39	36.47	3	0.000
PSI	107.13 ± 5.85	95.93 ± 5.18	91.59 ± 3.96	96.47 ± 7.32	33.75	3	0.000
FSIQ	110.20 ± 5.32	102.47 ± 3.40	94.23 ± 4.31	97.00 ± 8.12	38.09	3	0.000
Core subtests of cognitive functioning							
Similarities	11.53 ± 0.99	10.73 ± 1.39	9.09 ± 0.81	10.47 ± 1.88	30.73	3	0.000
Vocabulary	11.20 ± 1.01	9.87 ± 0.83	9.00 ± 0.69	9.47 ± 2.20	26.36	3	0.000
Block Design	12.00 ± 0.85	11.87 ± 1.19	9.00 ± 0.93	9.07 ± 1.71	41.20	3	0.000
Visual Puzzles	11.33 ± 0.90	10.60 ± 0.91	9.36 ± 1.26	10.40 ± 2.16	20.23	3	0.000
Matrix Reasoning	11.87 ± 1.06	10.87 ± 0.99	9.45 ± 1.06	10.20 ± 1.66	25.48	3	0.000
Figure Weights	11.20 ± 1.37	10.13 ± 0.92	9.09 ± 1.11	10.47 ± 1.60	20.59	3	0.000

Digit Span	11.27 ± 1.22	10.33 ± 1.18	8.55 ± 1.47	8.67 ± 1.45	29.77	3	0.000
Picture Span	10.80 ± 1.01	9.87 ± 1.19	8.27 ± 0.98	8.73 ± 1.03	32.01	3	0.000
Coding	10.80 ± 1.08	8.67 ± 0.82	7.95 ± 0.84	9.60 ± 1.64	35.72	3	0.000
Symbol Search	11.80 ± 1.26	9.73 ± 1.58	8.91 ± 0.87	9.20 ± 1.37	28.98	3	0.000

VCI: Verbal Comprehension Index; VSI: Visual Spatial Index; FRI: Fluid Reasoning Index; WMI: Working Memory Index; PSI: Processing Speed Index; FSIQ: Full Scale IQ.

Table 3. Pairwise comparisons of different groups through Mann-Whitney U Post-Hoc analysis

Cognitive profile indices	ADHD – SLDm	ADHD – ASD-HF	ADHD – TD	SLDm – ASD-HF	SLDm – TD	ASD-HF – TD
VCI	0.051	0.157	0.001 **	0.000 **	0.000 **	0.047 *
VSI	0.114	0.011 *	0.000 **	0.000 **	0.000 **	0.342
FRI	0.010 *	0.644	0.013 *	0.002 **	0.000 **	0.044 *
WMI	0.223	0.017 *	0.000 **	0.000 **	0.000 **	0.117
PSI	0.061	0.865	0.000 **	0.040 *	0.000 **	0.001 **
FSIQ	0.315	0.027 *	0.000 **	0.001 **	0.000 **	0.031 *

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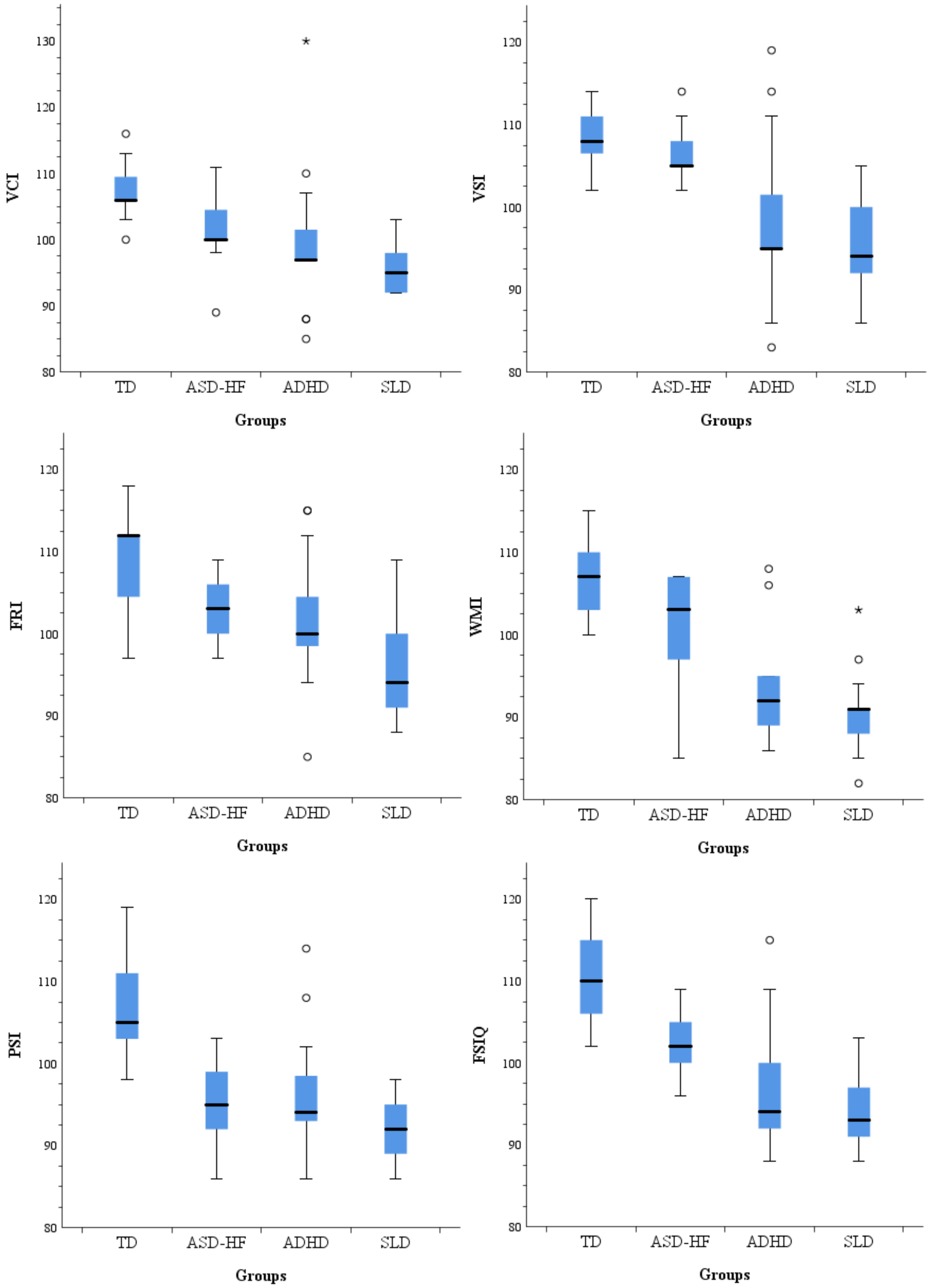

Fig 2. Variations in Wechsler-V indices within various groups

Discussion

The main aim of this work was to assess how IQ profile in Wechsler-V changes in children with autism spectrum disorders, specific learning disorders, and attention-deficit/hyperactivity disorder. For this purpose, we evaluated the verbal comprehension index, visual-spatial index, fluid reasoning index, working memory, processing speed index, and full-scale IQ score of children classified under these three categories, and compared their indices with a group of children with typical development patterns as the control. Hopefully, our results will shed light on the neuropsychological characteristics of children dealing with these widespread cognitive disorders.

In this research, the SLDm children represented the weakest performance almost in all studied cognitive indices. The least score in SLDm children was related to their WMI and PSI. These findings were in accordance with the results of (Poletti, 2016; Poletti et al., 2018; Toffalini et al., 2017). Poletti (2016), during investigating the impairments in the intellectual behavior of Italian children dealing with SLDm reported that the main problem of these children was related to their ability in coding, digit span, and letter-number sequencing, which overall results in the impairment in their working memory. Likewise, Poletti obtained average scores for BD, and MR subtests and concluded that the cognitive concept (here FRI) related to these parameters could not be concidered as deficient. Moreover, it was observed that children with SLDm had more problems in coding subtest than in symbol search where they obtained scores of around 7.95 and 8.91 for these two experiments, respectively. This observation could be related to the different natures of these two subtests. SS can be considered a facile scan of the objects with eyes that needs little hand-eye coordination skills and demands a minimum of graphomotor performance. In contrast, coding is more complicated and requires additional visual rummages and greater memory to remember the constituents. Thereby, it could be expected that children with specific learning disorders prove more difficulties with coding than SS.

On the contrary, autistic children (ASD-HF) revealed an almost normal IQ profile. In particular, they possessed acceptable abilities in aechiving and using learned vocabulary and appraising the objective elements to comprehend the visual-spatial associations. However, they showed severe difficulty with fast visual recognition, making quick decisions as well as implementing their decisions which was well reflected in their low processing speed index. The low score of PSI in autistic children has also been reported by (Mayes & Calhoun, 2008; Mouga et al., 2016). They outlined that the intensified deficiency in sensory processing in children with ASD-HF leads to their low PSI. Moreover, our results indicated a high score of similarity, an average value of vocabulary from the VCI concept, and an acceptable matrix reasoning from the FRI test. Overall, these findings demonstrate that autistic children could prove their abilities more consistently when they were asked to respond to the questions in short answers or perform untimed activities. The average FRI in these children was mostly relevant to their undesirable potential in collecting meaningful data from visual details and inability in applying their obtained knowledge to a set of similar phenomena. In line with the results obtained in our study, (Audras-Torrent et al., 2021) reported that patients with autism demonstrate significantly higher scores of VCI, VSI, and FRI than WMI, PSI, and FSIQ. They further elucidated that ASD patients are more potent in performance reasoning indices (Girardot et al., 2012; Mayes & Calhoun, 2008; Scheuffgen et al., 2000) possibly due to the motor-free nature of the intellectual examinations that were applied. Moreover, (Nader et al., 2016) and (Charman et al., 2011) corroborated the greater VSI scores of people with autism and mentioned it as a particular indicator of the intellectual behavior of ASD patients. Besides, children dealing with ASD-HF lack appropriate social relationships and their parents complained about their inability in making relationships with other children. This was mainly due to the mood disorders of autistic children caused by their anxiety and depression.

On the other hand, the cognitive profile of the ADHD children stood in the range of normal. As stated earlier, ADHD children studied in this study suffered from low working memory and processing speed. Indeed, such weaknesses in these two areas are typical of individuals with ADHD (Barkley, 1997; Biederman et al., 2004). The impairment in the working memory of children with ADHD was first reported by Barkley (1997). In this regard, (Shimoni et al., 2012) also studied the deficiencies in the cognitive behavior of boys dealing with ADHD and outlined that the lower working memory of ADHD individuals is closely related to their limited executive functioning. In another attempt, (Jiang et al., 2015) employed WISC-IV to study the cognitive profile of males with ADHD and obtained similar low scores in terms of PSI and WMI. They concluded that the sole appearance of low PSI is related to the inability of these patients in concentrating their attention whereas, the co-emergence of low PSI and WMI was related to the deficit in behavioral functions.

From the inter-category comparisons, it was concluded that all three groups of disorders were in normal domains of general intellectual functions, which was well reflected in their FSIQ scores. Moreover, in comparison with normal and autistic children, those with SLDm and ADHD obtained remarkably lower scores in different WISC-V cognitive tests. Moving beyond the surface, the analysis of WISC-V cognitive components indicated that children with ASD-HF possessed the highest verbal and processing speed skills performance. This was in accordance with the results reported by (Oliveras-Rentas et al., 2012) and (Rabiee et al., 2019) who achieved acceptable VCI scores for children suffering from high-functioning ASD. However, the pairwise comparisons (**Table 3**) revealed all three groups of patients possess significantly lower verbal skills in comparison with normal children. As it has been already known, verbal deficiencies are a main problem in children with neurodevelopmental disorders, and DSM IV has also indicated it as an important diagnostic criterion. Similar impairment in verbal skills in patients with ADHD and autism has been reported by (Koyama et al., 2006) and (Li et al., 2017). The interesting point was the significantly higher VSI score of ASD-HF children in comparison with the other two patient groups. More importantly, the visual-spatial index of autistic children was almost identical to that of the normal group. This was in accordance with the results of (Oliveras-Rentas et al., 2012) and (Mayes & Calhoun, 2008). They reported that, in general, high-functioning autistic children are more skillful in verbal and visual performances, particularly when the rapidity of the action is not momentous. Simultaneously, they are virtually incapable of focusing attention, and weak in activities with time limits which results in their lower PSI index.

Apart from the above, the pairwise comparisons well indicated that ADHD and SLDm patients possessed the weakest abilities in all skills when compared to the control group. In particular, these patients demonstrated the least performance in working memory and processing speed examinations. The deficit in working memory is consistent with numerous previous reports (De Clercq-Quaegebeur et al., 2010; De Weerdt et al., 2013; Peng et al., 2012; Poletti, 2016; Schuchardt et al., 2008; Willcutt et al., 2013) intensifies the importance of more focusing on this area for intellectual rehabilitation programs. Besides, the weaker performance of SLDm and ADHD children than the normal group in processing speed index was previously reported by (Fassbender et al., 2011; Gau & Chiang, 2013; Jiang et al., 2015). Indeed, impaired hand-eye coordination, as well as weak short-term visual memory might involve in the lower PSI of these patients. In another attempt, (Shanahan et al., 2006) studied the processing speed index of children with ADHD and SLDm. In line with our results, they also declared that this index is a common problem among children suffering from either disorder.

Limitations and concluding remarks

The main focus of the present work was investigating how the IQ profile of children with ASD-HF, SLDm, and ADHD vary in Wechsler-V. For this purpose, the main concept of WISC-V plus its subtests were evaluated for control children and those suffering from above mentioned disorders. Our results indicated the better performance of autistic children in comparison with the other two groups in all intellectual performances. However, the weak performance in processing speed was still a pullback among these children. The ADHD and SLDm groups shared many difficulties. Specifically, they both suffered from low working memory and processing speed indices. The least scores in the subtests were related to the picture and digit span examinations both contributing to the impairment in the working memory of the patients. The impaired working memory in the patients suffering from neurodevelopmental disorders studied in this work corroborates the importance of more focusing on this area for future cognitive rehabilitation programs. Despite the valuable results obtained from this work, some limitations were inevitable and should be considered for future endeavors. For instance, we did not statistically compare the emotional and behavioral variations of the children categorized under these three groups. This, in addition, facilitates the implication of correlation tests among the emotional and behavioral features of patients with Wechsler-V indices and could shed light on more dark spots of the potential symptoms present in these children. Furthermore, another drawback was the limited number of patients in each group. Certainly, expanding the sample size and including more statistical analysis could open windows to new horizons in the realm of neurodevelopmental disorders.

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