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Research Article

Differential Profile of High-Performance Adults with Attention Deficit Hyperactivity Disorder

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Abstract

Objective: To compare the neurocognitive profile of a subgroup of patients with ADHD who have a high academic-occupational functioning vs. patients with low functioning.

Method: A total of 50 adults with ADHD, 10 with high academic-occupational functioning (ADHD/HF), 20 with low academic-occupational functioning (ADHD-LF), and 20 healthy controls were assessed with a standard neuropsychological battery. Independent sample tests and logistic regression were calculated to compare the performance of the three groups and to identify predictor variables.

Results: Statistically significant differences were found in the forward digits subtest between the subtypes of ADHD, but not between ADHD-HF and controls, nor between controls and ADHD-LF. In matrix reasoning subtest, significantly lower performances were registered between both ADHD groups compared to the control group. In the letter number subtest, ADHD-LF obtained a significant lower performance than the control group, but the ADHD-HF group do not differ with the other two groups. Finally, regarding to the binary logistic regression analysis, it could be observed that the only variable that best predicted belonging to these groups has been forward digits, which according to the data of the model would be a protection factor.

Conclusion: The profile of patients with high socio-occupational performance was characterized by a better conservation of working memory and the capacity for sustained attention, and a lower tendency to distraction.

Keywords: ADHD; high functioning; neurocognitive profile; executive functions

Introduction

ADHD includes the presence of inattention, hyperactivity, impulsiveness and deficits in the regulation and organization of behavior. It is estimated that the prevalence of ADHD is 2.5% in adults (Simon, 2009). At the cognitive level, adults diagnosed with ADHD usually present alterations in performance functions, domains monitored by the frontal lobe, particularly in working memory and processing speed (Barkley, 1992, Barkley, 1997a, Brown, 2000).

Adults with ADHD tend to achieve a low economic and occupational status, to present a low range of professional employment and labor difficulties, such as several troubles to fulfill work demands, completing tasks (Barkley, 2008; Joseph, Kosmas, Patel, Doll & Asherson, 2018; Voigt, Katusic, Colligan, Killian, Weaver, Barbaresi, 2017). Additionally, this population have poorer performance at job interviews and frequently tend to change jobs.

Due to the presence of repeated life experiences, adults with ADHD are exposed to life experiences that undermine their self-concept and self-esteem. These repetitive experiences are associated with negative cognitions about the self, which affect quality of life and emotional adjustment (Torrente et al., 2012).

Regarding to the neuropsychological variables associated with poor academic and occupational achievement, executive functions receive a priority interest. Deficits in these functions can be observed in poor management of time, motivation and self-discipline, contributing to the occupational problems of adults with ADHD (Barkley & Murphy, 2010). Many of the studies have found that children, adolescents and young adults with ADHD performed poorly on tasks that evaluated executive functions, such as behavioral inhibition, working memory, decision-making and planning (Barkley, Murphy, & Bush, 2001, Weyandt, et al., 1998; De Vito et al., 2008; Wilcutt, Doyle, Nigg, Faraone & Pennington, 2005).

At present, there are several studies that highlight the central role of executive functions in ADHD (Castellanos, Sonuga-Burke, Milham, & Tannock, 2006, Wilcutt, Doyle, Nigg, Faraone, & Pennington, 2005).

Barkley and Fischer (2011) presented the first study focused specifically on the relationship between executive functions and dimensions related to occupational performance such as, salary, the quality of work, the ability to self-manage and solve problems, motivation, percentages of jobs where the patient had problems with colleagues, percentages of jobs where he had problems with his own behavior, percentages of jobs in which he was fired, percentages of jobs in which he was reprimanded among others.

The cognitive performance of adults with ADHD is also characterized for deficits in the sustained, selective and divided attention (Magnin & Maurs, 2017). These authors describe other impaired functions, such as timing, memory storage and reaction time variability.

However, in clinical settings, a proportion of patients who fulfilling the ADHD diagnosis criteria, presents a successful academic and occupational history. These patients usually achieve a high academic level (graduate or postgraduate) and often have hierarchical positions and a greater job stability. This issue could be related to the results obtained by previous studies (Mannuzza, Klein, Bessler, Malloy and Hynes, 1997, Weiss, Hechtman, Perlman, Hopkins and Wener, 1979) in which no significant differences were found in employment status between subjects with a prior history of ADHD and control groups. In this sense, in a review by Hechtman (1999), 30% of adults with ADHD in childhood had a similar work performance than the control groups, characterized by attending and finishing the university, and by the achievement of a high work status. These findings could be explained for the presence of a subgroup of patients with ADHD, but the differential neuropsychological profile of this subgroup is still unknown.

A more recent study (Torralva, Gleichgerrcht, Lischinsky, Roca & Manes, 2012) has compared the diagnostic utility of standard cognitive assessment and a more ecological battery of tests. The authors divided patients with ADHD in high and low functioning according to their performance in the standard cognitive assessment. Their results suggest that ecological tests (Hotel Test and computerized tests of inhibitory control and working memory) are more sensitive to differentiate between adults with high functioning ADHD and healthy control group. However, this study did not look at the differential performance of the subgroup of ADHD patients with high academic and occupational functioning.

For this reason, and considering the lack of knowledge in this topic, the main objective of this study is to describe the neurocognitive differences of the subgroup of patients with ADHD with high academic-occupational functioning that would differentiate them from most patients with ADHD.

As specific objectives we propose: 1) to evaluate performance differences in neurocognitive tests among adult patients with ADHD who have a high academic-occupational functioning (ADHD/HF), a group of patients with ADHD who have a low academic-occupational functioning (ADHD/LF) and a healthy control group, and 2) to identify the distinctive neuropsychological profile of adult patients with ADHD/HF.

According to the aforementioned, specific hypotheses of this study consider that **a**dults with ADHD with high academic-occupational performance achieve a significantly higher performance in neuropsychological tests than the low-functioning group diagnosed with ADHD, particularly in tests that evaluate attention change, inhibitory control and working memory. In other words, **a**dults with ADHD with high academic-occupational performance, although they register alterations in some neurocognitive dimensions when compared with the healthy control group, are characterized by a greater conservation of cognitive domains compared with adults diagnosed with ADHD with low academic performance.

Method

Design

Retrospective *ex post facto* design according to León y Montero (2015) classification.

Participants

Three independent samples were selected through an intentional, non-parametric sampling. The first sample consisted of 10 adults between 30 and 60 years of age diagnosed with ADHD performed by a specialized psychiatrist, rigorously following the diagnostic criteria proposed in the Diagnostic and Statistical Manual of Mental Disorders, fourth revised edition (APA, 2010). The diagnosis was made through a structured interview with the patient and a family member, self-report instruments and a neuropsychological evaluation. The subjects should not be under any psychopharmacological treatment at the time of the evaluation and should meet the following additional criteria, according to the studies on the field (Barkley, 2002), at a high level of academic-occupational achievement: tertiary and/or university degree complete, they should also perform in hierarchical positions and/or should work as a university/tertiary professional, and should have a job stability (less than 3 job changes in the last 10 years). This information was collected through a demographic data sheet, duly checked by the professional who evaluated the patient.

The second sample consists of 20 adults between 18 and 60 years of age with a diagnosis of ADHD who do not meet any of the high-performance criteria. Neither should they receive any psychopharmacological treatment at the time of the evaluation. The evaluation of these patients included the same steps described for the previous sample.

Finally, the third sample consists of 20 adults between 18 and 60 years without relevant psychiatric diagnosis at present. Furthermore, they should not receive any psychiatric treatment at the time of the evaluation. The evaluation process followed the same criteria that were used for the two previous samples.

Materials and procedures

Patients were evaluated exhaustively through a diagnostic process that involves different stages:

Structured interview according to the diagnostic criteria of the DSM-IV or DSM-V addressed to the patient and a family member 1) Evaluation through self-administered questionnaires of the patient and family member 2) Neuropsychological Evaluation

The two subgroups with ADHD in depressive symptomatology through the Beck II Depression Inventory (BDI-II, Beck, Steer, & Brown, 1996) were compared to evaluate possible differences that could affect the comparisons in the cognitive domains.

The neurocognitive evaluation included the following instruments and domains:

Standard neuropsychological battery

1. Intelligence:

Subtest Matrix Reasoning of the WAIS (Wechsler, 2002): It evaluates abstract and fluid reasoning. It is a test with low influence of cultural factors and language. It consists of four types of items: completion of continuous and discrete patterns, classification, reasoning by analogy and serial reasoning. Some items depend on visual-perceptual skills, while those of greater complexity involve the consideration of several rules implicit in the conformation of the series, which requires reasoning and working memory.

Word Stress Test (WAT) (Del Ser, Gonzalez-Montalvo, Martinez-Espinosa, Delgado-Villapalos, & Bermejo, 1997): This test is a useful measure to estimate premorbid intellectual functioning. The subject must read a list of low frequency words written in capital letters and without their respective accent marks. This situation presumably requires a certain degree of lexical knowledge.

2. Attention:

Direct Digit Subtest of the WAIS (Wechsler, 2002): This test is related to the efficiency of sustained attention and the absence of distraction. The subject must repeat immediately after hearing it, a series of digits that increase their number as the test progresses. The numbers must be repeated in the same order in which they are presented. The initial series is 2 digits and the longest one reaches 9 digits.

Trail Making Test A Form (Partington, 1949): It involves the union of 25 circles that the subject has to connect. In *A* Form the circles must be connected in numerical order from 1 to 25, as quickly as possible. This instrument measures motor skills, visual-spatial visual search and sustained attention.

3. Memory:

Rey Auditory Verbal Learning Test (Rey, 1958): it allows the evaluation of long-term memory. It analyzes the retention and immediate evocation, the learning of a list of words, and the number of items that the subject remembers after a work of non-mnemonic interference (deferred recall). It consists of the auditory presentation of a list of 15 words during 5 trials (learning stage). After each presentation the patient is asked to try to remember the words in the order he wants (free recall). Next, a second word list (proactive interference measure) is presented once and his free recall is requested. After this test, the memory of the first list of words is recalled (deferred memory) and the influence that *B* list had on it (retroactive interference) is observed. The long-term retention of *A* list can be examined after a period of 20 or 30 minutes. Finally, the recognition is evaluated. The score of each essay is the number of words correctly remembered. The total score can also be calculated by the sum of the 5 trials.

Test of the Complex Rey Figure (Rey, 1941): It is evaluated through the deferred memory of the figure. Without prior notice and without the help of the model, the examinee must immediately reproduce the same figure again at 30 minutes in order to assess his capacity for non-verbal material recall allowing comparison between the visual-constructive capacity and his visual memory.

4. Praxis:

Test of the Complex Rey Figure (Rey, 1941): The copy of the figure of Rey brings into play the perceptive, organizational and analytical activity. It informs us about the degree and fidelity of visual memory. This test consists of asking the subject to copy a complex figure by hand and without a time limit by evaluating the capacity for organization and planning of strategies for solving problems as well as their visus-constructive capacity. Subsequently, as stated above, without prior notice and without the help of the model, the examinee must immediately reproduce and at 30 minutes again the same figure, in order to assess their capacity for non-verbal material recall, allowing comparison between the ability visus-constructive and its visual memory. Finally, the subject is shown a series of figures and asked to indicate which of them corresponds to the figure he originally copied.

5. Executive functions:

Verbal Fluency (Benton, Hamsher and Sivan, 1983): It evaluates the ability to access the lexicon and retrieve semantic and formal information about words. Other factors such as attention and memory, planning and change control skills are also at stake. It is used for the measurement of executive functions. It is explored through tasks that require subjects to produce as many different words as possible during a stipulated period of time. The different measures of verbal fluency are differentiated by the type of response - oral or written - and by the type of information to which production must be restricted: phonological or semantic. In the case of the present study, the Phonological Fluency test was used, which requires the subjects to name in 60 seconds, as many words as possible that start with a certain letter.

Go-no Go tasks (Zimmermann & Fimm, 1995): This test evaluates the subject's ability to inhibit inappropriate responses. It is a computerized bacterium that includes tasks of reaction time of low complexity that allows evaluating the inhibitory control.

IOWA Gambling task (Bechara, 1994): It was elaborated to measure the phenomenon of the somatic marker in laboratory conditions. This test consists of a game with four decks of cards. It tells the subject that he must choose a letter and that each time he makes the choice of a letter he will win a certain amount of money, but that he will also lose each time. It is the subject himself who determines, through the successive moves, which decks are "good" and which are "bad". The final score determines if the subject played more times the good decks or the bad decks. Healthy people are learning what the good decks are as they go through the plays.

Subtest of Arithmetic of the WAIS (Wechsler, 2002): It implies an understanding of the abstract concept of the number and the arithmetical operations. It also supposes a solution search situation that allows the subject to abstract the numerical operations of the matrix problem. It is influenced by cognitive variables such as concentration and working memory.

Subtest of Symbols Search of the WAIS (Wechsler, 2002): It consists of a series of pairs of symbol groups. The pair consists of a group of "target" symbols and a group of "search" symbols. The subject must mark in the appropriate place if any of the "objective" symbols appear in the group of "search" symbols.

Subtest of Backward Digits of the WAIS (Wechsler, 2002): The subject listens to increasingly long series of digits and must repeat them in the reverse order. The initial series is 2 digits and the maximum series is 8 digits. It is considered a test of working memory, involving the central executive, and as such requiring the participation of attention control or executive attention.

Subtest of Digits-Symbols of the WAIS (Wechsler, 2002): It is considered a test of speed of information processing and of sustained attention. It consists of a sheet that has printed on the top a model that contains a series of 9 small squares numbered from 1 to 9, each of which has under a different symbol for each number. Then, the subject must complete with the corresponding symbols according to the model.

Subtest letter-number order of the WAIS (Wechsler, 2002): It is an attention control test and work memory. Processes of sequencing, planning, manipulation and visualization of stimuli intervene. It is a measure sensitive to frontal dysfunction. It consists of the reading, on the part of the examiner, of a combination of numbers and letters in random order, which must be repeated by the patient, but respecting the following order: first he must say the numbers listened to, ordered from least to greatest, and then the letters in alphabetical order. The length of series increases progressively starting with a series of two elements. Three trials of the same length are presented. A raw score is obtained from the total number of correctly answered trials, which later becomes a scale score.

Trail Making Test Form B (Partington, 1949): It evaluates mainly mental flexibility and divided attention. It is associated with the following processes: to distinguish between numbers and letters, the integration of two independent series, the ability to learn an organizational principle and apply it systematically, retention and serial integration, to solve the verbal problem, and to plan. It demands flexibility for continuous alternation.

Wisconsin Card Sorting Test (Berg, 1948): Initially it was designed to evaluate abstract reasoning and flexibility of thought- evidenced as the ability to change cognitive strategies in response to eventual environmental modifications. It is a measure of the skill required to develop and maintain the problem-solving strategies necessary to achieve a goal. Its resolution requires the participation of several processes such as: cognitive flexibility, working memory, maintenance of attention and ability to inhibit irrelevant or incorrect responses. The subject has a series of 128 cards that must be turned one at a time, and paired or associated with one of the 4 reference cards that are on the table, based on 3 possible criteria (color, shape or number). The patient must deduce by the positive or negative reinforcement of the examiner what the category is with which he is expected to perform the pairing, since it varies throughout the test on several occasions. The success or failure in the overall resolution of the test is taken into account for the interpretation of the test.

Statistical analysis

The demographic data and those from the results of neuropsychological instruments were analyzed through independent sample comparison tests. Only Chi-Square was used to test the independence of the gender variable with respect to the group variable. In cases where the assumptions of normality and equality of variances were met, ANOVA was used. For the distributions that did not meet the normality assumption, but for the equality of variances, the Mann-Whitney U test was calculated to compare two independent samples, and the Kruskal Wallis test for comparisons involving more than 2 groups. Finally, in the cases in which none of the two assumptions was met, the Mediana test was carried out. Both the cases in which ANOVA was calculated and those ones that Kruskal Wallis was calculated, multiple *post hoc* comparisons were carried out. *Statistix* statistics packages-version 8.0 and SPSS 20.0- have been used.

Correlations were calculated in order to evaluate the associations between demographic variables and depressive symptoms with performance in cognitive tests. According to the distributions of the scores, the correlations were calculated through the Spearman coefficient.

Subsequently, a binary logistic regression analysis was carried out in forward steps in which the variables that showed statistically significant differences were included, in order to identify which of these variables better predicted the probability of belonging to the group of high academic performance at work and normative group of ADHD.

Results

Thirty adults who met the diagnostic criteria for ADHD and 20 healthy controls were evaluated. For the purpose of the study, the clinical sample was divided into 2 groups: high-functioning ADHD (ADHD-HF) (n = 10) and low-functioning ADHD (ADHD-LF) (n = 20).

According to the Chi-Square test, the group variable is not associated with the gender variable. With respect to the demographic data of the three samples, no statistically significant differences were recorded in the age variable (see table 1). On the other hand, statistical differences were recorded in the education variable ($KW_{2, 47} = 6.91$, $p = .032$), a difference that could be expected by the criteria for shaping the samples. In this sense, the differences were found between the high functioning ADHD group and the ADHD-LF group. The healthy controls did not differ statistically from either of the two groups diagnosed with ADHD.

When comparing both clinical groups in severity of depressive symptomatology, no statistically significant differences were found ($U_{24} = 43$, $p = .318$).

Demographic data of the three samples are detailed in table 1.

	ADHD-HF N=10	ADHD-LF N=20	Control group N=20	p
Sex	2f/8m	10f/10m	12f/8m	.115
Age	42.3 (8.87)	46.55 (11.43)	48.4 (11.82)	.477
Years of education	17.8 (3.08)	14 (3.32)	15.5 (2.82)	.032
BDI-II	15.14 (11.42)	18.24 (12.06)	-	.318

Table 1: *Demographic data. Means and Standard Deviations*

The associations between demographic variables and depressive symptoms were evaluated with performance on cognitive tests.

As we expected, an association was found between Premorbid Intelligence and the Symbols Search, Digits Forward of the WAIS and WCST subscales (r_s=-.563; $p<.01$; r_s=-.427; $p<.05$ y r_s=-.388; $p<.05$ respectively).

Likewise, a correlation was observed between years of formal education and the subscales of Symbols Search and Letters-Numbers of the WAIS (r_s = .434, $p <.01$ and r_s = -. 353; $p < .05$ respectively). In addition, there was a direct correlation between years of education and phonological fluency (r_s = .368; $p <.05$). Finally, years of education also correlated with the TMT-B scores (r_s = -. 424; $p <.01$), the WCST (r_s = .331; $p <.05$) and the copy of the Rey figure (r_s = .357; $p <.05$).

The matrix correlation is summarized in table 2

	Education	WAT	BDI-II
Attention			
Digit Forward	0.09	.427*	-.352
Trail Making A	-2.61	-.135	-.034
Memory			
Rey's List			
Immediate	.137	.147	.003
Distractive list	.114	.132	.047
Deferred	-.075	.214	-.063
Recognition	.023	.073	-.175

False positives	-279	.065	.202
Intrusions B	-.230	-.071	.275
Rey's Figure Deferred	.260	.347	-.303
Praxias			
Rey's Figure Copy	.357*	.271	-.004
Executive Functions			
Arithmetic (WAIS)	.253	.362	-.145
Symbol Search (WAIS)	.434*	.563**	-.479
Digits backward	.145	.246	.111
Digits – Symbols (WAIS)	.354	-.105	-.191
Phonological fluency	.368*	.321	.052
Go no Go			
Go no Go Correct	-.120	.334	-.090
Go no Go Incorrect	.386	.371	-.296
Go no Go Reaction time	-.201	.158	.279
IOWA	.207	-.083	-.337
Letters Numbers (WAIS)	.353*	.274	-.497*
Trail Making B	.424**	-.229	.065
WCST categories	.331*	,388*	-.148
Note: * p<.05, **p<.01			

Table 2: *Correlation Matrix*

There were no differences between the 3 groups in premorbid intelligence ($KW_{2,28}$ = 3.68, *p* = .159). Regarding to reasoning with matrixes, there were significant differences between group ($KW_{2,47}$ = 16.97, *p* <.001).

Additionally, statistically significant differences were recorded in the subtests of forward digits ($KW_{2,47}$ = 9.04, *p* = .011), ordering of numbers and letters ($KW_{2,47}$ = 7.48, *p* = .024), and in digit-symbols ($KW_{2,47}$ = 5.98; *p* = .05) of the same instrument. Likewise, statistically significant differences were found when comparing the results between the different groups in the distracting list of the Rey Auditory Verbal Learning Test ($\chi2$ = 11.58, *p* = .003).

The post hoc tests of multiple comparisons of the Kruskal Wallis test indicate that in the reasoning subtest with matrices, significantly lower performances were registered between both groups of ADHDs compared to the group of healthy controls.

Regarding to the subtest of forward digits, there were statistically significant differences between the subtypes of ADHD, but not between ADHD-HF and controls, nor between controls and ADHD-LF. That is, the adults with high functioning ADHD were those who registered a significantly higher performance with respect to the ADHD-LF group in this test. When controlling for educational level between both clinical groups, the difference remained significant. In the subtest of ordering of numbers and letters, statistically significant differences were found between the group ADHD-LF and the group of healthy controls, obtaining the latter the best performance. The ADHD-HF group does not differ from either group.

On the other hand, in the digit-symbol subtest the healthy control group obtained a significantly higher performance than those of the ADHD-HF group. However, there were no differences between these two groups and that of ADHF-LF.

Finally, although it was not possible to calculate post hoc tests for the Median test for the Rey List, Distractive list, it can be seen in Table 1 that the group that had the best performance was the group of control subjects followed by the group ADHD-HF, while the ADHD-LF group recorded the lowest scores (Table 3).

Means and Standard Deviations.				
	ADHD-HF N=10	ADHD-LF N=20	Control group N=20	p
Intelligence				
Matrix (WAIS)	12.5 (2.83)	11.37 (2.75)	16.86 (3.06)	<.001
WAT BA	39.9 (1.52)	36.44 (4.88)	38.36 (2.46)	.062
ttention				
Digit forward	7.2 (0.63)	5.95 (1.1)	6.57 (1.07)	.011
Trail Making A	30.9 (10.9)	31.55 (12.74)	30.9 (13.54)	.985
Memory				
Rey List				
Immediate	48.3 (9.67)	43.45 (9.95)	50.58 (10.29)	.09
Distractive list	6.6 (2.37)	5.2 (1.76)	8.5 (3.43)	.003
Deferred	9.2 (3.16)	7.75 (3.37)	9.53 (3.72)	.26
Recognition	12.8 (2.15)	12.10 (3.11)	13.79 (1.72)	.086
False Positives	0.22 (0.44)	1.05 (3.41)	1.38 (2.33)	.66

Intrusions B	1 (2)	0.79 (1.18)	1.13 (2.23)	.88
Rey Figure				
Deferred	20.11 (5.77)	17.9 (6.39)	22.26 (7.41)	.172
Praxias				
Rey Figure				
Copy	35.89 (0.33)	34.56 (2.39)	34.95 (1.22)	.099
Executive functions				
Arithmetic (WAIS)	11.67 (2.91)	9.6 (3.29)	12 (2.71)	.149
Symbol Search (WAIS)	8.78 (3.11)	10 (3.25)	12.43 (2.29)	.107
Digits backward	6.9 (0.32)	5.84 (0.9)	6.58 (0.96)	.087
Digits – Symbols (WAIS)	7.89 (1.83)	9.38 (3.04)	11.33 (2.5)	.05
Phonological fluency	18.6 (5.46)	17.1 (4.97)	18.38 (5.33)	.678
Go no Go				
Correct	93.75 (17.68)	96.2 (8.49)	93.5 (7.51)	.895
Incorrect	18.33 (16.44)	3.75 (1.5)	3.75 (1.5)	.594
Reaction time	460 (204.8)	439. 44 (121.93)	405.67 (19.4)	.259
IOWA	7 (18.84)	-7.5 (25.55)	15.6 (24.03)	.072
Letters Numbers (WAIS)	10.67 (3.16)	8.4 (2.38)	11.19 (2.88)	.024
Trail Making B	73.56 (30.1)	71.95 (23.94)	66.95 (23.05)	.791
WCST categories	6 (0)	5.5 (1.4)	5.68 (0.75)	1

Table 3. *Comparison of neuropsychological scores.*

On the other hand, the scores of depressive symptomatology correlated inversely with the subscale of Numbers and Letters of the WAIS (r_s = -.497; *p* <.05), giving account of a greater deterioration in working memory and attention control associated with the symptoms depressed.

Finally, a binary logistic regression analysis was carried out in forward steps (Table 4) to establish which of the neuropsychological variables better predicted the probability of belonging to one or another group of patients with ADHD. In this sense, it could be observed that the only variable that best predicted belonging to these groups has been forward digits, which according to the data of the model would be a protection factor.

		B	T.E.	Wald	df	p	Exp (B)	C.I. 95% for EXP (B)	
								Lower	Upper
Step 0	Constant	.693	.387	3.203	1	0.74	2.00		
Step 1	Digit Forward	-2.67	.124	4.647	1	.031	.765	.6	.976
	Constant	3.036	1.189	6.525	1	.011	20.823		
Variables not included in the equation (Step 1)									
					Score		df		Sig.
Step 1	Variables	Rey List – Distractive list			1.323		1		.25
		Letters Numbers (WAIS)			1.891		1		.169
	Global statistics				2.865		2		.239

Table 4: *Forward Stepwise Logistic Regression Model*

Discussion

Several studies argue that adults with ADHD are characterized by deficits in social and occupational functioning (Davids, Krause, Specka & Gastpar, 2004): lower formal educational level, access to low-level jobs, greater labor instability and a greater number of legal problems than adults without this diagnosis (Barkley, 2002; Barkley, 2008; Joseph, Kosmas, Patel, Doll & Asherson, 2018; Mannuzza et al., 1993; Voigt, Katusic, Colligan, Killian, Weaver, Barbaresi, 2017). Longitudinal studies also support deficits in different areas of life, particularly in occupational functioning (Barkley, Murphy, & Fischer, 2008). According to these authors, adults diagnosed with ADHD are characterized by lower occupational status and lower average annual salaries than controls, worse job performance, higher average layoffs, greater number of job changes, less adequate for meet job demands, less ability to work independently, greater difficulties in the relationship with the bosses and worse performance in job interviews (Barkley et al., 2008).

However, a proportion of patients who consult institutes specializing in the diagnosis and treatment of ADHD present a successful academic-occupational history. This phenomenon generates the necessity to identify neurocognitive factors that contribute to the discrimination of patients with ADHD who have high academic-occupational performance and patients with low-functioning ADHD. There are previous studies that have suggested the presence of this subtype of patients, but the authors have not described the distinctive characteristics of it (Mannuzza, Klein, Bessler, Malloy and Hynes, 1997, Weiss, Hechtman, Perlman, Hopkins and Wener, 1979). In these studies, no significant differences in employment status were found between subjects with a prior history of ADHD and control subjects.

In relation to the above, and within the framework of the objectives proposed for the present study, it was proposed as a general hypothesis that there are differences in the neuropsychological profile, particularly in relation to executive functions, among adults with ADHD with high academic-occupational performance and adults with low functioning ADHD. More precisely, it was expected that the both groups differed in tests that evaluated attention change, inhibitory control and working memory. These differences in the neuropsychological profiles would contribute, to a certain extent, to the dissimilar performance of these subjects in the formal academic-occupational setting. There are numerous studies describing the deficient functioning of adults with ADHD (Müller et al., 2007, Krabbendam & Jolles, 2007, Mc Lean et al., 2004). However, there are very few references regarding adults with ADHD with high academic-occupational functioning. These subjects are characterized by a high level of studies achieved, an average job stability and performance in hierarchical positions. In the present study, subjects were selected whose diagnosis of ADHD was made by highly specialized professionals in the field, who corroborated conclusively the compliance through a structured interview of the diagnostic criteria of the Diagnostic Statistical Manual which are the most accepted at present, beyond their limitations. It is important to clarify in this regard that the criteria of the aforementioned manual do not indicate the mandatory presence of clinically significant deficits in the academic-occupational area, but rather in two different social contexts. In this sense, Weiss & Murray (2003) report that many adults with ADHD have poor planning skills, such as in the administration of finances, dangerous driving behaviors, unstable relationships, social isolation and participation in activities of leisure activities that are highly absorbent or stimulating (for example, alpine skiing and high contact sports, as well as excessive surfing on the internet). They also have difficulties organizing home issues such as cooking and cleaning regularly and caring for children. The latter can be observed in the difficulty of maintaining a regular feeding of the children or of taking them on time to their formal activities, for example. These patients usually present problems in several areas of their lives. It is also common that they consult for problems related to their partners and/or their children. The consultations for psychic and/or anxious symptomatology are also frequent.

In effect on the neuropsychological differences between the ADHD groups, sufficient evidence has not been found indicating that these groups differ in attention change according to the results obtained in the Trail Making Test Form B. Nor statistically significant differences have been found when evaluating inhibitory control. The studied ADD /ADHD groups achieved similar performance in the *WCST* and *Go no Go* tests. However, it is important to note that the difference recorded in the distracting list of Rey's auditory-verbal learning test could indicate a differential functioning with respect to inhibition of interference (Spreen & Strauss, 1998), a function linked to the attention-execution of tasks. For this reason, we could think in the presence of some deficit of the attention-inhibitory level that would account for a greater lability to the interference in the of the ADHD-LF group. This idea becomes stronger if we add the differences obtained in the WAIS subtest of letters numbers, designed for the evaluation of attention control. With respect to working memory, statistically significant differences have been found in tests that evaluated-to a greater or lesser extent- this cognitive domain.

The subtest of letters numbers, in addition to evaluating attention control, is also a test widely used for the evaluation of working memory. It also evaluates characteristics related to the sequencing, planning and manipulation of stimuli. In this case, it could be thought that the adults with ADHD of high academic-occupational functioning would have more conserved these domains than the low-functioning ADHD group. Undoubtedly, the skills evaluated by this subtest are crucial in the performance of a person in the work environment and in studies of high academic level. At the academic-occupational level, the capacity to plan the times of and the good administration of the same is central. It is important to consider the inverse correlation between scores of depressive symptomatology and the subscale of Numbers and Letters, because this result is compatible with studies that argue that depressive symptoms have an impact on executive functions in general and on working memory (Harvey et al., 2004; Rogers, Bradshaw, Pantelis & Phillips, 1998).

In the matrix reasoning subtest of the WAIS, both the adults of the ADHD-HF group and the ADHD-LF group differed significantly with respect to the controls. Both groups had a significantly lower performance in this test compared to the healthy control group. This subtest evaluates, as previously described-in addition to abstract and fluid reasoning-working memory. This is the only case in which both groups with ADHD had a significantly lower performance compared to the healthy control group.

In relation to the above, Mesulam (2002) argues that another important task in the evaluation of working memory is the span of digits backwards. This test requires internalized information manipulation and is related to memory recovery. In this test, patients with ADHD usually show poor performance. In this study, although a statistically significant difference has not been reached ($p = .087$), it is a fact that should be considered due to the small sample sizes. An increase in such sizes could make this difference significant.

Therefore, it could be thought that adults with high functioning ADHD have a better performance in some tasks that evaluate working memory, in comparison with low functioning adults with the same diagnosis. This could indicate that the working memory would contribute to some extent in the differentiation of high and low academic-occupational functioning patients.

As explained in the introduction, working memory is the ability to keep information available in the mind for manipulation and it is present in a large number of the activities that individuals perform in their daily lives. Thus, it is necessary to achieve adequate planning and organization to keep in mind our goals and objectives in the short and long term and even in simpler skills such as mental calculation. All these skills are even more important in the academic-occupational setting.

Deficits in working memory would make it difficult for adults with ADHD to access high-level academic studies and hierarchical work positions. It could even be thought that hyperactivity would begin to be an inconvenience when subjects access middle management positions. These positions require that people remain seated, involve the handling of a large amount of information simultaneously and the organization of the work of others. In this aspect, subjects with deficits in working memory would find their work difficult, while those with high functioning subjects would respond more efficiently to these issues.

The central role that working memory would have in the differentiation between the ADHD groups is even stronger if we consider the studies that directly relate to working memory with academic-occupational performance. For example, Schweitzer, Hanford & Medoff (2006) argue that working memory is important for cognitive functioning as well as for social and academic activities. Other authors point out the importance of working memory in carrying out important cognitive tasks such as understanding of language, reading and thinking. (Tiparu-Ustárroz, Muñoz-Céspedes, & Pelegrín-Valero, 2002)

In addition, it should be added that the adults with lower functioning are more sensitive to interference in learning than those with high performance. For example, before a certain activity, the subject can be distracted by the presence of some stimuli generating a displacement of the center of attention. Adults with high functioning ADHD would have a better performance and greater attention-executive control in this aspect.

In relation to the above, the fact that adults with high functioning ADHD have a better performance in sustained attention and a lower tendency to distractibility take on a transcendental importance, a question that can be inferred in the best performance of the group ADHD-HF in the forward digits test. It is noteworthy, as can be observed in the results, that the performance in the forward test of the adults with high functioning ADHD was higher than that of the healthy control group. Added to this, as observed in the stepwise regression model, the forward digit test was the only one that obtained a significant coefficient when predicting the membership of one or another group of patients with ADHD. According to the regression model, this variable would be a protective factor of belonging to the ADHD-LF group.

Mannuzza et al. (1993) point out that attention processes and memory recover a particular importance in the practical functioning of adults with ADHD, which to a certain extent could explain their deficient performance. These effects, according to the author, are of primary interest in research on ADHD in adults. Returning to the academic-occupational performance of adults with ADHD, it is characterized throughout the lifespan as an erratic path from the beginning of formal schooling to their performance in the workplace (Barkley, 2002, Frazier et al., 2007, Heiligenstein et al., 1998, Wender, 1987). This can be observed due to a deficient curricular performance, significantly lower grades than subjects without this diagnosis, greater behavior problems and greater a school dropout. At work level, they tend to have higher absenteeism and higher labor turnover than the control group (Barkley, 2002).

To understand these controversial results, Faraone et al. (2000) give a possible answer. They argue that frontal dysfunction is very complex in the case of ADHD and further deepening in this idea, Sergeant, Geurts & Oosterlaan (2002) suggest that ADHD may not be associated with a global deficit in executive functions, but with a specific deficit.

All of the above shows the heterogeneity of ADHD. Hence, it is necessary to make a selection of subjects with clear criteria to facilitate comparison between studies. In many cases there is no precise differentiation in the samples of adults with ADHD with and without hyperactivity. That is why in this study, emphasis was placed on the homogeneity of each of the samples knowing that this would bring the selection of small samples as a difficulty.

According to the review carried out for the present study, this work represents the first attempt to evaluate differential neuropsychological profiles of ADHD patients with high academic-occupational functioning compared to adults with low-functioning ADHD and the healthy control group.

In this sense, referring to the central hypothesis of the work, it can be affirmed that there are differences in the neuropsychological profile of patients with ADHD of high academic-occupational functioning when compared with adults with low functioning ADHD and in many cognitive domains present a performance very similar to healthy controls, or even higher. The greatest differences between both subtypes of patients with ADHD are given in tests that evaluate working memory, attention-executive processes and sustained attention.

No differences were found between the 3 groups in premorbid intelligence. This finding contradicts the result of Milioni et al 2017, who affirm that the high intelligence could be a mask for executive deficits.

Relevance of our results are related with the possible implications in the evaluation of this subgroup of patients and in the design of differential intervention strategies.

Regarding the neuropsychological evaluation of these patients, it is expected that patients with high functioning ADHD present a good performance in tests that evaluate sustained attention and distracting interference. Likewise, it is possible that patients in this subgroup have better working memory and attention control domains.

Regarding the treatment of these patients, the findings of this study should be considered when planning intervention strategies. It could be assumed that, beyond the characteristic lack of adherence of these patients, the high functioning of this subgroup would require a focused treatment in the deficit aspects in order to sustain the motivation in the task. In this sense, it would be advisable to work specifically on speed of processing and abstract and fluid reasoning, domains that have shown a deficient performance.

It is essential to bear in mind that the design of the study cannot speak of any type of causal relationship between cognitive profile and high academic-occupational performance. The present investigation gives an account and describes the neuropsychological differences between a sample of adults with ADHD with high academic performance and low functioning ADHD.

The study presents a series of limitations. The samples are small, which is why the results have limited power and the probability of committing a type II error is high. It is important to clarify at this point that a large part of the differences was registered between both subtypes of ADHD studied, but not between them and the control group, except for the subtest of matrixes. This could be explained by statistical issues owing to the fact that small sample sizes increase the probability of not rejecting a null hypothesis when in fact, it is false. It is possible that by increasing the size of the samples, some of the differences that were not statistically significant before, may become significant now. In addition to the above, due to the shortage of validated behavioral instruments in the country, it has not been possible to include any instrument that evaluates behavioral aspects of patients with ADD /ADHD. Additionally, as a consequence of the aforementioned limitation; it has only been possible to control for depressive symptomatology and not for other psychiatric variables. It is possible that these aspects generate unpredictable variations in the results and function as fortuitous sources of variation.

Regarding future directions, due to the fact that authors, such as Stearns et al. (2004) minimizes the power of WAIS in the differentiation of diagnosis and argue that the WAIS profile is not a reliable indicator for diagnosis because not all people with ADHD have a significantly lower performance in working memory, it is important in this point to think about the use of alternative and ecological instruments in future studies. A previous study (Torralva, Gleichgerrcht, Lischinsky, Roca & Manes, 2012) has compared the diagnostic precision of standard cognitive assessment and a more ecological battery of instruments. The authors divided patients with a diagnosis of ADHD in high and low functioning according to their performance in the standard cognitive assessment. What they observed was that the ecological tests (Hotel Test and computerized tests of inhibitory control and working memory) were more sensitive to differentiate between adults with high functioning ADHD and healthy control group. In the future, it could be relevant to apply this type of tools to differentiate between the subgroup of patients with ADHD high and low academic-occupational functioning.

On the other hand, it is important to clarify that- although the present work has focused on the differential neuropsychological characteristics among adult adults with ADHD and high academic performance- it is essential for future studies to correlate these findings with the evaluation of environmental, behavioral and psychiatric aspects.

A favorable and enriched environment is probably a modulating factor in the performance of adults with ADHD. There are numerous studies in various pathologies that indicate the positive role of environments with greater stimulation and containment as protectors or shock absorbers of the impact of mental disorders in everyday life (Curtis & Patel, 2008). In fact, cognitive models of diathesis-stress emphasize this issue (Lange et al., 2005).

Finally, subsequent studies could more accurately describe the job performance since the occupational ranking does not fully envisage the quality of employment. In this sense, it is necessary to include variables such as salary, duration of each job and reasons for leaving work, which have not been studied in depth until now.

Conclusions

The originality of the present study resides in the fact of being the first to try to find some neuropsychological correlate that may be related to the academic-occupational functioning of adults diagnosed with ADHD, without pretending to establish hypotheses of a causal type, given the characteristics observed at work.

Little is known so far about the characteristics of adults with high functioning ADHD and this study is a first step towards this knowledge.

From this study it can be thought that working memory could contribute to the academic-occupational performance of adults with ADHD. Adults with high functioning ADHD would have a higher level of conservation of this cognitive domain. They would also present a better functioning at the attention-executive level and in terms of sustained attention.

Of course, like all work in which the target population is reduced, this work presents limitations that hinder its generalization capacity.

Anyway, from this study it is expected that new lines of research related to this topic can be established, including the evaluation of environmental and psychological/psychiatric aspects, either to correlate these findings with psychiatric symptoms, as well as to compare them with stable features of personality. In addition, it is necessary to carry out ecological studies to consolidate the current findings regarding executive functions and their role in the differentiation of adults with ADHD with high academic-occupational performance and low-functioning ADHD.

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