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High IQ May "Mask" the Diagnosis of ADHD by Compensating for Deficits in Executive Functions in Treatment-Naïve Adults With ADHD

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Abstract

Objective: To evaluate and compare the performance of adults with ADHD with high and standard IQ in executive functions (EF) tasks. **Method:** We investigated the neuropsychological performance of 51 adults with ADHD, compared with 33 healthy controls (HC) while performing a wide battery of neuropsychological tests that measure executive functioning. Adults with clinical diagnosis of ADHD were divided into two groups according to their IQ level (IQ ≥ 110—ADHD group with more elevated IQ, and IQ < 110—ADHD group with standard IQ). **Results:** The ADHD group with standard IQ presented a worse executive functioning compared with the HC group in the following measures: Stroop 2 (p = .000) and 3 (p = .000), Trail Making Test (TMT) B (p = .005), Wisconsin Card-Sorting Test (WCST)—perseverative errors (p = .022) and failures to maintain set (p = .020), Continuous Performance Test (CPT)—omission errors (p = .005) and commission errors (p = .000), and Frontal Assessment Battery (FAB)—conceptualization (p = .016). The ADHD group with more elevated IQ presented only impairments in the CPT—commission errors (p = .019) when compared with the control group. **Conclusion:** Adults with ADHD and more elevated IQ show less evidence of executive functioning deficits compared with those with ADHD and standard IQ, suggesting that a higher degree of intellectual efficiency may compensate deficits in executive functions, leading to problems in establishing a precise clinical diagnosis. *(J. of Att. Dis. 2017; 21(6) 455-464)*

Keywords

ADHD, IQ, executive functioning

Introduction

ADHD is a neurobehavioral disorder characterized by inattentiveness, impulsiveness, and hyperactivity, which involves significant impairments in multiple areas of daily life (Franke et al., 2012). It is usually diagnosed during childhood, but its persistence in adults is now recognized as highly prevalent. Studies estimate that the prevalence of ADHD in adults is between 2.5% and 4.9% (Simon, Czobor, Bálint, Mészáros, & Bitter, 2009). The adult ADHD is usually characterized by predominant inattentiveness symptoms, and hyperactive features are less observed (Franke et al., 2012). It is also more frequently associated with psychiatric comorbidities (A. Brown et al., 2012; Fischer et al., 2007; Haavik, Halmoy, Lundervold, & Fasmer, 2010).

Clinical symptoms in patients with ADHD are associated with prefrontal cortex (PFC) abnormalities and deficits in executive functions (EF; Alvarez & Emory, 2006). EF is a term that refers to self-regulatory behaviors used to guide the actions according to the context (Mahone, Cirino, et al., 2002). It involves focus and sustained attention, working memory, organization, planning, inhibitory control, flexibility, self-regulation, and behavioral control, which characterize the basic requirements for solving problems effectively (Lezak, Howieson, & Loring, 2004; Milioni, Rodrigues, & Cunha, 2013). Executive dysfunctions may

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explain difficulties with organization and planning typically observed in patients with ADHD. However, some studies have failed to detect alterations in tests of EF in patients with ADHD but there are few researches investigating this apparent contradictory information.

Previous studies demonstrate that ADHD occurs in people with all levels of intellectual functioning (Aylward, Gordon, & Verhulst, 1997). Jahangard, Haghighi, Bajoghli, Holsboer-Trachsler, and Brand (2013) found high rates of ADHD among young university students, suggesting that occurrence of ADHD and academic success/career do not exclude each other. The rates found in the study were larger than the worldwide estimated rates. However, it appears less commonly observed in participants with high intellectual levels. A meta-analysis investigation with 1,031 patients with ADHD and a healthy control (HC) group with 928 participants found that the ADHD individuals usually have a lower intellectual level when compared with the population in general (Bridgett & Walker, 2006).

Studies that have addressed the issue of absence of deficits in EF in patients with ADHD are based on analyses involving individuals with high IQ. Mahone, Hagelthorn, et al. (2002) tested children with ADHD and found that the measures of EF differed among the participants with ADHD and controls at average IQ level, but not among ADHD children and controls with high IQ. Thus, one possible explanation is that studies may have neglected an important variable characterized by the IQ of patients with ADHD. Although overlapping, IQ and EF are considered distinct cognitive domains (Ardila, Pineda, & Rosselli, 2000; Delis et al., 2007).

Some investigators (Jung, Yeo, Chiulli, Sibbitt, & Brooks, 2000; Russell, 2001) suggested that while low IQ levels are frequently correlated with a large number of neuropsychological impairments, the same does not apply to participants with average to above average IQ, perhaps because the usual neuropsychological tests are originally designed to measure deficits. Studies that evaluated patients with ADHD and high IQ found an average executive functioning, which apparently suggests that those participants do not have deficits on the EF, leading to the conclusion that neuropsychological tests would be irrelevant for an accurate ADHD diagnosis.

There are only four studies, in addition to Mahone, Hagelthorn, et al. (2002; previously mentioned), that assessed cognitive functions of individuals with ADHD divided by groups of high IQ and average or below average IQ. Katusic et al. (2011) and He, Qian, and Wang (2013) indicated that children with high IQ and ADHD perform worse than the high IQ control group, but better than their peers with ADHD and standard IQ. However, there is a lack of studies investigating the same in adults (Antshel et al., 2010). T. E. Brown, Reichel, and Quinlan (2009) evaluated the EF performance of 157 adults with ADHD and high IQ and found that the incidence of impairments among the participants was significantly higher than in the general population. However, they did not make comparisons with a control group or with adults with ADHD and standard IQ, which could provide even more conclusive data. Antshel et al. (2010) examined 64 adults with high IQ and ADHD. Comparing the results with a control group, they found that the high IQ healthy participants performed better in the majority of the psychological tests than the high IQ adults with ADHD; yet, the high IQ adults with ADHD had results within the average for all tests.

These information, when considered together, may indicate that, although there are plenty of individuals with high IQ and ADHD, many of them are underdiagnosed precisely because high IQ may act as an enhancer of cognitive abilities and possibly compensate some of the executive deficits associated with ADHD. However, all the studies cited above evaluated patients after a period of medication exposure and we know that even if the examiner asks the patient to not take the medication in the day of the neuropsychological assessment, a long-term exposure to stimulants could have altered brain functioning (Wang et al., 2013). A differential strategy to investigate different patterns of executive dysfunction depending on the IQ could be dividing the sample of patients with ADHD from those with high intellectual level and lower intellectual level, analyzing results from treatment-naïve patients, as stimulants may significantly interfere with executive functioning (Bueno, da Silva, Alves, Louzã, & Pompéia, 2014).

The aim of the present study was to verify the impact of different intellectual levels of medication-naïve adult ADHD individuals on EF presentation. We hypothesized that the presence of high IQ in adults with ADHD would be associated with a compensated performance on some EF tests, which would make the clinical diagnosis more difficult for these patients.

Method

Participants

A total of 51 treatment-naïve patients with ADHD aged 18 to 50 years were consecutively evaluated at the outpatient ADHD clinic of the Institute of Psychiatry, University of São Paulo, Brazil. We chose to evaluate medication-naïve patients to isolate the components of ADHD in its pure form and also to maintain a homogeneous group, without differences in individual responses to medication. Participants were interviewed with the Structured Clinical Interview for the *DSM-IV* (SCID; First, Spitzer, Gibbon, & Williams, 1995), and the Schedule for Affective Disorders and Schizophrenia for school-age children–present and lifetime version (K-SADS-PL; Kaufman et al., 1997) Adapted Module (version 6.0) to confirm the diagnosis of ADHD and also to access potential Axis I comorbidities. Patients with sluggish cognitive tempo (SCT), which is frequently found as comorbidity with ADHD (Barkley, 2012; Flannery, Becker, & Luebbe, 2014; Skirbekk, Hansen, Oerbeck, & Kristensen, 2011), were excluded from this study. For the assessment of symptom severity, we used the Adult ADHD Self-Report Scale (ASRS; Mattos et al., 2006).

The ADHD patients were divided into two groups, with different intellectual levels—the IQ level was assessed by the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999): high IQ ADHD with IQ ≥ 110 (n = 20, IQ M = 118.9, SD = 6.528) and standard IQ ADHD with IQ < 110 (n = 31, IQ M = 96.24, SD = 8.089). A third group of 33 participants (IQ M = 110.94, SD = 14.989) was also formed to represent the HC group of the study.

In addition to the clinical instruments mentioned above, patients were screened for substance use with the Alcohol Use Disorders Identification Test (AUDIT; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) and the South Westminster Questionnaire (Menezes et al., 1996). Handedness was assessed using the Edinburgh inventory (Oldfield, 1971). Diagnostic criteria for substance abuse or dependence were assessed using the SCID (First et al., 1995). Moreover, a general medical history, including information about cerebrovascular risk factors, and data on the use of psychotropic and general medications, was obtained through interviews with patients and/or their family.

Exclusion criteria for the three groups were as follows: substance abuse or dependence (current and lifetime); the presence of medical conditions or neurological disorders, which could affect the central nervous system; mental retardation; past history of head trauma with loss of consciousness; learning disabilities; major depressive disorder, bipolar disorder, or any other major psychiatric disorder.

This study was approved by our local ethics committee (CAPPesq) from the board of the University of São Paulo Medical School. After complete description of the study to the participants, written informed consent was obtained.

Materials

The neuropsychological battery consisted of the following tests to assess EF.

Wisconsin Card-Sorting Test (WCST). It is a measure of abstraction ability and cognitive flexibility (Lezak et al., 2004). The participant is given a pack of 64 cards on which are printed one to four symbols (star, triangle, cross, and circle) in one of four colors (red, yellow, blue, and green). The participant is required to place each card under one of the four stimulus cards without being told the rule (match by number, color, or symbol). The participant must deduce the pattern based on the tester's comment of "right" or "wrong" to each response. Once the participant deduces the pattern (rule) and has 10 correct responses, the rule changes (categories). The number of categories (patterns) completed (5 are possible with 64 cards), the number of correctly laid cards, the perseverative errors, and the failures to maintain set were computed.

Stroop Color Word Test (SCWT). This test was designed to measure selective attention, cognitive flexibility, and inhibitory control (Lezak et al., 2004; Stroop, 1935). In this study, we used a version of the SCWT that was translated into Portuguese and adapted to Brazilian population (Cunha, Nicastri, Andrade, & Bolla, 2010). The SCWT we used has three parts: In Part I, the patient is invited to name different colors, printed in 20 small rectangles, as fast as he or she can; the randomly assigned colors used in the three parts of this version of the SCWT were as follows: green, blue, brown, and pink. In Part II, the participants have to name the color of the ink of non-color printed words, such as "each," "never," "today," and "everything"—in Portuguese: "cada," "nunca," "hoje," and "e tudo," respectively. In Part III, the patient has to name the color of the ink in which a color name is printed when the print ink is one of the colors above mentioned (Stroop, 1935). The score is measured by the time in seconds—until the patient has completed each part of the SCWT (I, II, and III).

Continuous Performance Test (CPT). It is basically a test of sustained attention and impulsivity (Conners & Staff, 2006). It requires the participant to press the appropriate key for any letter except the letter X. The measures include the number of errors of omission and errors of commission. Errors of omission occur when the participant fails to respond to the target stimulus. Errors of commission occur when the participant responds to a non-target stimulus. The omission errors are usually related to inattention, whereas commission errors are frequently reported as a measure of impulsivity (Riccio, Reynolds, Lowe, & Moore, 2002).

Trail Making Test A and B. It is a timed psychomotor task requiring visuomotor tracking of a sequence (Part A) or two alternating sequences (Part B) to measure cognitive flexibility and sustained attention (Reitan, 1958). In Part A, the participant, as quickly as possible, connects the numbers 1 through 25 in numerical order that are printed on a page. In Part B, the participant has to connect the numbers 1 through 12 and the letters A through L in the following order: 1-A-2-B-3-C, and so on. The dependent measure for this study is the time taken, in seconds, to complete each part of the test.

Frontal Assessment Battery (FAB). It is a short instrument which consists of six subtests that explore different EFs: (a) conceptualization and abstract reasoning (similarities test), (b) mental flexibility (verbal fluency test), (c) motor programming and executive control of action (Luria motor

Table 1. Sociodemographic Variables and Intellectual Functioning in Patients With ADHD and Standard IQ (n = 31), ADHD and More Elevated IQ (n = 20), and HC (n = 33).

	ADHD IQ < 110	ADHD IQ ≥ 110	HC	
	M (±*SD*)	*M* (±*SD*)	*M* (±*SD*)	*p*
Age	27.84 (6.54)	28.00 (6.11)	26.82 (5.49)	.722
Gender (male/female)	29/5	12/8	22/11	.283
Handedness (right/left-handed)	30/1	20/0	32/1	.725
Education (years)	13.97 (2.20)	14.84 (3.07)	14.39 (2.34)	.483
Vocational position				
Exact sciences areas	8 (25.8%)	1 (5%)	—	.068
Humanities area	18 (58.1%)	10 (50%)	—	
Biological sciences areas	2 (6.5%)	3 (15%)	—	
High school students	3 (9.7%)	6 (30%)	—	
IQ	96.24 (8.08)	118.9 (6.52)	110.94 (14.98)	<.001
ADHD subtypes				
Inattentive (314.00)	13 (41.9%)	11 (55%)	—	.402
Hyperactive/impulsive (314.01)	—	—	—	
Combined (314.01)	18 (58.1%)	9 (45%)	—	
Severity of ADHD symptoms				
ASRS total score	52.37 (7.88)	54.16 (10.93)	—	.509

Note. HC = healthy controls; ASRS = Adult Self-Report Scale for ADHD Symptoms.

sequences), (d) resistance to interference (conflicting instructions), (e) inhibitory control (go–no go test), and (f) environmental autonomy (prehension behavior; Cunha et al., 2010; Slachevsky et al., 2004). Each subtest is scored from 3 to 0, for a maximum score of 18.

Controlled Oral Word Association Test (COWAT). It is a test of fluency of speech that is associated with EF (Benton & Hamsher, 1976). Participants are required to generate as many words as possible that begin with the letter F, for a time period of 1 min. Then, they are asked to do the same with the letter A and then the letter S. The total number of words generated for all three letters (F, A, S) serves as the score on this test for this study.

WASI. It is a short version of the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1999), including two subtests (Vocabulary and Matrix Reasoning) to provide a reliable brief measure of intelligence. It is based on the Vocabulary subtest, which requires the participant to orally define words, and the Matrix Reasoning subtest, based on incomplete grid patterns that require the participant to select the correct response from five possible choices.

Statistical Analysis

Statistical analyses were made using the ANOVA test for quantitative variables, and post hoc comparisons were performed using Tukey correction. The Fisher's Exact Test was used for categorical variables. The normality of observations was verified by the Kruskal–Wallis test, with post hoc comparisons by Bonferroni correction. We also performed correlation analysis between IQ and neuropsychological scores, using the Pearson correlation coefficient. In this case, we restricted the analyses to both groups of patients with ADHD (high and standard IQ). The level of statistical significance was $\alpha = .05$, and all the statistical tests were two-tailed. SPSS for Windows, version 14.0 was used to perform all statistical analyses.

Results

When comparing the participants of the three groups, there were no statistically significant differences in age, education, handedness, and gender (see Table 1). The participants from ADHD groups ($n = 51$) were male ($n = 40$) and female ($n = 11$), as well as the participants from HC group (total = 33; male = 22, female = 11). They were all Brazilians, native speakers of Portuguese. The ADHD groups did not differ in terms of vocational position, ADHD subtypes, and severity of ADHD symptoms. The estimated IQ (WASI) ranged from 78 to 138 in the ADHD groups and from 77 to 139 in the HC group (see Table 1), and the groups showed statistically significant differences: ADHD IQ < 110 × ADHD IQ ≥ 110 ($p < .001$), ADHD IQ < 110 × HC ($p < .001$), ADHD IQ ≥ 110 × HC ($p = .006$).

Table 2. Performance of ADHD Group With Standard IQ, ADHD Group With More Elevated IQ, and Control Participants in Neuropsychological Tests.

	ADHD	ADHD			p	p	p
	IQ < 110	IQ ≥ 110	HC	p	ADHD < 110	ADHD ≥ 110	ADHD < 110
Neuropsychological tests	*M* (±*SD*)	*M* (± *SD*)	*M* (± *SD*)	Total	× HC	× HC	× ADHD ≥ 110
WCST							
Correct	44.27 (9.96)	47.10 (10.08)	48.94 (9.44)	.171	.147	.785	.577
Perseverative errors	9.30 (4.59)	8.20 (5.70)	6.36 (2.77)	.028*	.022*	.292	.650
Failure maintain set	0.63 (0.89)	0.40 (0.60)	0.12 (0.33)	.021*	.020*	.130	1.000
Categories	2.83 (1.46)	3.15 (1.50)	3.70 (1.55)	.077	.066	.410	.748
SCWT							
Stroop 1	15.87 (3.26)	14.80 (3.62)	14.12 (2.55)	.082	.067	.720	.453
Stroop 2	20.10 (5.22)	17.40 (4.22)	15.52 (2.45)	.000*	.000*	.239	.061
Stroop 3	28.13 (10.40)	23.15 (9.03)	19.97 (5.13)	.001*	.000*	.271	.308
CPT							
Omission errors	4.77 (7.20)	2.80 (4.25)	1.15 (2.85)	.004*	.005*	.076	1.000
Commission errors	19.93 (7.72)	16.25 (7.95)	10.70 (5.81)	.000**	.000*	.019*	.175
TMT							
Part A	37.48 (10.53)	32.35 (14.88)	33.67 (13.86)	.324	.472	.932	.357
Part B	78.42 (34.80)	65.00 (18.96)	57.64 (17.92)	.007*	.005*	.572	.169
FAB							
Conceptualization	2.26 (0.68)	2.50 (0.61)	2.70 (0.53)	.019*	.016	.584	.623
Mental flexibility	2.81 (0.40)	2.89 (0.32)	2.76 (0.56)	.687	1.000	1.000	1.000
Motor programming	2.42 (0.89)	2.20 (1.01)	2.73 (0.63)	.063	.317	.064	1.000
Sensitivity to interference	2.77 (0.62)	2.90 (0.31)	2.91 (0.58)	.716	1.000	1.000	1.000
Inhibitory control	2.68 (0.65)	2.60 (0.82)	2.91 (0.29)	.161	.222	.304	1.000
Environmental autonomy	3.00 (0.0)	3.00 (0.0)	3.00 (0.0)	1.000	1.000	1.000	1.000
Total score	15.94 (2.13)	15.95 (1.57)	16.91 (1.26)	.044	.063	.120	1.000
COWAT							
Total score	34.87 (10.30)	39.00 (8.55)	35.42 (10.74)	.329	.974	.428	.333

Note. HC = healthy controls; WCST = Wisconsin Card-Sorting Test; SCWT = Stroop Color Word Test; CPT = Continuous Performance Test; TMT = Trail Making Test; FAB = Frontal Assessment Battery; COWAT = Controlled Oral Word Association Test.
*When the p value refers to statistically significant difference between ADHD group with standard IQ and control group. **When the p value refers to statistically significant difference between ADHD with more elevated IQ and control groups.

We did not find any significant differences among the groups in COWAT (p = .329), Trail Making Test (TMT)—Part A (p = .324), Stroop 1 (p = .082) and FAB—mental flexibility (p = .687), motor programming (p = .063), sensitivity to interference (p = .716), inhibitory control (p = .161), and environmental autonomy (p = 1.00). However, the ADHD group with standard IQ presented a lower executive functioning compared with the HC group in the following measures (Table 2): Stroop 2 (p = .000) and Stroop 3 (p = .000), TMT B (p = .005), WCST—perseverative errors (p = .022) and failure to maintain set (p = .020), CPT—omission errors (p = .005) and commission errors (p = .000), and FAB—conceptualization (p = .019). The ADHD group with high IQ presented a lower executive performance in the CPT—commission errors (p = .019) when compared with the control group. To investigate whether these neuropsychological findings could be biased by some sociodemographic factors, a complementary ANCOVA including gender and age as covariates did not show any distinct results.

Finally, within diagnostic groups (ADHD, standard, and high IQ), we found significant negative correlations among time spent to complete both TMT—Part A (r = −.305, p = .030) and Part B (r = −.343, p = .014)—suggesting that higher IQ is associated with less time to complete both tasks (Figure 1).

Discussion

In our study, the ADHD group with standard IQ differed in almost all measures of executive functioning when directly compared with the HC group, suggesting the presence of executive deficits in inhibitory control, sustained attention, cognitive flexibility, abstraction ability, and impulsivity. On

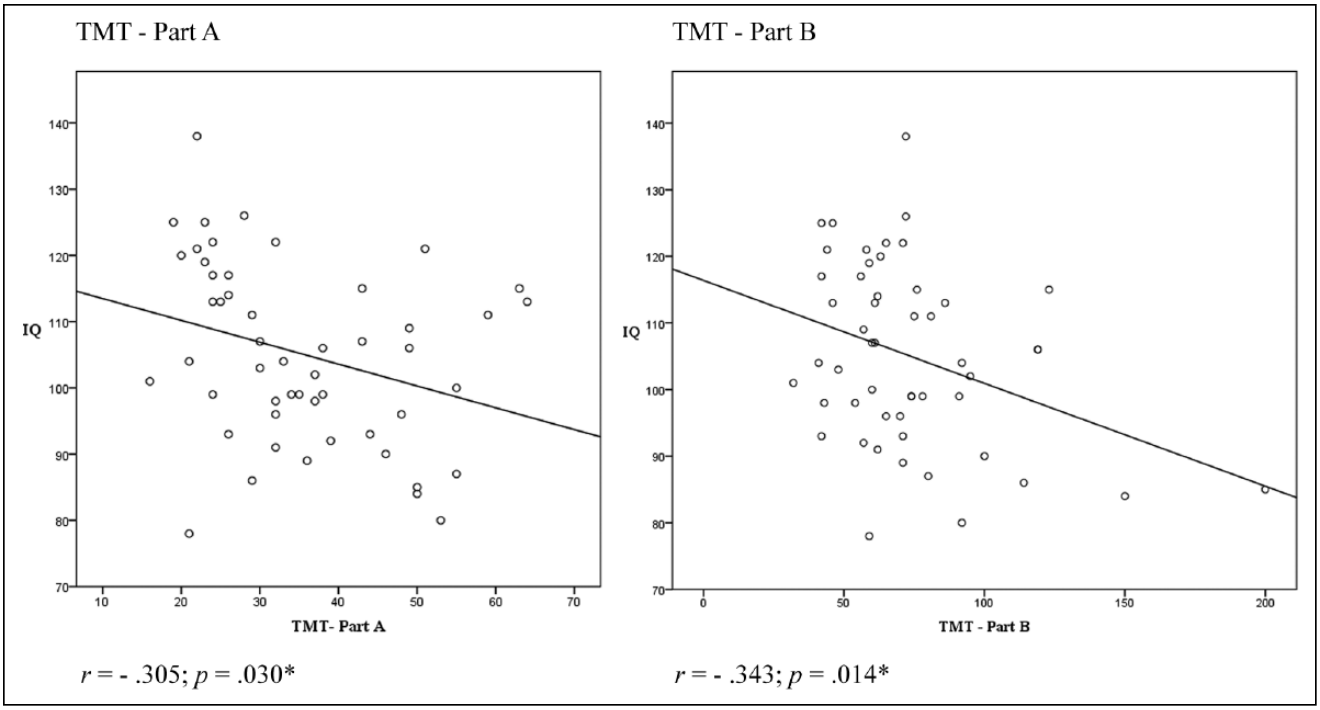

Figure 1. Significant correlations between IQ and executive functioning as measured by the TMT among patients with ADHD.
Note. r = Pearson's correlation coefficient; TMT = Trail Making Test.
$^*p < .05$.

the other side, the ADHD group with high IQ underperformed the control group only in an impulsivity score (commission errors). We also found significant negative correlations between IQ and neuropsychological measures, suggesting that greater IQ is associated with less time to complete tasks measuring speed processing and cognitive flexibility, thus indicating that adults with ADHD and more elevated IQ are more likely to demonstrate better executive performance in some executive tasks. Our data have some important clinical implications because they indicate that the presence of a higher IQ may compensate deficits in EFs in adults. It helps to explain why highly intelligent patients are usually underdiagnosed when they are still children, therefore the high IQ coul be "masking" their disorder.

In fact, it is expected that individuals with ADHD show deficits in EF once those cognitive functions are severely affected by this disorder (T. E. Brown et al., 2009). From our point of view, however, it is not different with high IQ individuals. Studies with ADHD and high IQ adults show that these individuals do have EF impairments (Antshel et al., 2009; T. E. Brown et al., 2009). T. E. Brown et al. (2009) tested 157 individuals with ADHD and IQ ≥ 120. Their data showed that these participants had significantly more EF impairments than in general population. Antshel et al. (2009) tested 53 adults with high IQ who did not have ADHD and 64 adults who had ADHD and high IQ, and found that the participants with ADHD and high IQ had more functional impairments, lower quality of life, and poorer occupational functioning than the ones with high IQ who did not have ADHD.

Our data show that, although ADHD adults with more elevated IQ may have EF impairments, these deficits arise more discreetly in EF tasks data than the ones presented by individuals with the disorder and standard IQ. It means that the impairment is present, but the ADHD individuals with more elevated IQ may have a wider range of intellectual strategies to compensate the deficits. Our data provide support for the hypothesis that high IQ in adults with ADHD improves the performance on EF activities, which may lead to problems in establishing a precise diagnosis from objective neuropsychological measures. It is possible that high IQ individuals have their performance increased by an interesting factor, the "creative compensation." In this context, Healey and Rucklidge (2006) evaluated 89 children and observed that the creative group with ADHD symptoms had better results on measures of IQ, working memory, and EF than the ADHD group, and they performed similarly to the creative group without ADHD symptoms. ADHD symptoms appear to be usual in the presence of creative skills, probably because creativity itself is associated with *latent inhibition* (a difficulty in inhibiting irrelevant stimuli and, therefore, a deficit in selective attention; Carson, Peterson, & Higgins, 2003). However, studies indicate that creative achievement is associated with high IQ (Carson et al., 2003). Considering all these factors together, we understand that the presence of creative skills is associated with both high IQ and ADHD symptoms. Therefore, one of the factors that may improve the performance of ADHD and high IQ individuals is the presence of a kind of "creative compensation," as mentioned above. Thus, creativity as an additional tool may help in "masking" their disorder. In our study, we did not use creativity tests to corroborate this hypothesis, but we suggest that future studies take it into account.

The present results may explain why the impairments in EF in adults are not noticed until the beginning of the academic life at the university or in jobs in which these participants were challenged by increasing demands (T. E. Brown et al., 2009). This study also provides evidence that individuals with high IQ and suspected ADHD should be assessed in detail, with greater attention to clinical criteria for ADHD and to the nuances of neuropsychological performance. Only quantitative performance analyses are very limited for the ADHD diagnosis, especially if we take into account the comparison between participants with more elevated IQ and less elevated IQ, and qualitative assessment may fill essential gaps. The present data also suggest that the participant's intellectual performance should be compared with what would be expected of an improved executive functioning (Lezak et al., 2004). The disparity between executive functioning and IQ (i.e., high IQ and low executive functioning) is an indicator of the presence of executive deficits that interfere with the practical performance of the individual. From this point of view, our data support the idea that neuropsychological tests can potentially help and provide greater accuracy in diagnosis, especially in some situations when it is hard to clinically detect the symptoms, but they are still rarely used for these purposes (Coutinho, Mattos, Araújo, & Duchesne, 2007). Once the presence of executive deficits may be compensated in individuals with high IQ, it is easy to comprehend the reason why many adults with high IQ and ADHD are at high risk for delayed recognition and treatment of their symptoms, as their behavior may be confused with laziness, especially by parents and teachers, who note their intellectual potential in academic or work situations above all. The chronic difficulties shown by these participants during adulthood illustrate how individuals with ADHD can be very talented, but still have significant impairments in their ability to manage their skills to specific tasks, as self-management skills, which clearly shows the impairment in EF (T. E. Brown et al., 2009).

This study has some limitations that must be taken into consideration. First, the data are based on a relatively small sample of patients with ADHD. Most recent studies have similar (Antshel et al., 2009) or larger samples (T. E. Brown et al., 2009), but the total number of participants in these studies is not much larger than ours. However, we have divided our patients with ADHD into two different groups, which reduced the size of each group. Second, we did not use any evaluation instrument for other conditions that might influence the results (e.g., depression, anxiety). However, patients were selected with detailed clinical assessment by the SCID, which enabled the exclusion of cases with comorbid psychiatric disorders. Moreover, the ADHD groups were similar in terms of vocational position, symptoms severity, and distribution of ADHD subtypes. Third, there was a statistically significant difference between the average IQ of the HC group and the ADHD with standard IQ group; however, the HC individuals were randomly chosen and reflect the reality of our population. Fourth, it would be more common to use a cutoff of 120 to differentiate individuals with high IQ of those with average IQ, but we chose to divide the group of adults with ADHD into IQ $\geq$ 110 (more elevated) and $<$110 (standard), because even individuals with high average IQ (between 110 and 120) could have their EF deficits compensated by a subtle superiority in the IQ. Maybe, if we had divided the groups into above or below 120, the findings in EFs could be even more evident. Thus, we believe that future studies should consider the most appropriate "cutoff" to confirm our hypothesis. Finally, we used a short version of the scale of intelligence (WASI), which seemed more appropriate because it is less subject to the effects of fatigue, considering that our participants were also evaluated in other neuropsychological domains. Although the validation study of the WASI has shown good results, its use still raises contradictions. Axelrod (2002) recommended caution when using any short version of intelligence scales. The author and his team tested the WASI in a heterogeneous clinical sample and found lower correlations between WASI and WAIS. Therefore, future studies should investigate the clinical correlation of our findings with more complete measures of intelligence (e.g., WAIS–Fourth Edition).

In conclusion, the present study may serve to alert clinicians and investigators that a more elevated IQ may compensate impairments in the EF in individuals with ADHD, so a comprehensive neuropsychological battery including IQ tests is necessary to establish a more precise evaluation and better contribute to the clinical diagnosis. More than using standard norms, it is relevant to the neuropsychologist to compare the participant with high IQ with himself, in different cognitive measures. Further studies with larger sample sizes, prospective monitoring, and with other variables should be conducted to further investigate our hypothesis.

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