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The Impact of Adult ADHD in the Quality of Life Profile

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Abstract

Objective: In this multicenter, cross-sectional study, we aimed to investigate the quality of life (QoL) and the neuropsychological and clinical characteristics of adults with ADHD with different developmental pathways. **Method:** Our study sample included 25 control (healthy) participants, 31 patients with newly diagnosed ADHD without comorbidities (ADHD-C-D), 31 with newly diagnosed ADHD with comorbidities (ADHD+C-D), and 29 with previously diagnosed ADHD with comorbidities (ADHD+C+D). **Results:** Compared with controls, ADHDs had little differences in the attentional performance but showed higher impulsivity, more severe symptoms of depression and anxiety, and lower QoL. The ADHD+C-D group showed more severe symptoms of depression and anxiety than the ADHD+C+D group (p = .037 and p = .008, respectively), and poorer QoL in the psychological health sphere (p = .003). **Conclusion:** Differences between ADHD and control subjects were particularly remarkable in mood symptoms and QoL. Previous diagnosis might have a positive impact on mood symptoms and QoL in ADHD adults. *(J. of Att. Dis. XXXX; XX(X) XX-XX)*

Keywords

ADHD, quality of life, adult ADD, comorbidity, developmental pathways

Introduction

ADHD has been thought to affect mainly during childhood and adolescence. However, there is increasing consensus in the fact that ADHD evolves throughout the patient's lifespan rather than ceasing in adulthood (Adler & Cohen, 2004; Biederman, 2005; Jadidian, Hurley, & Taber, 2015; Young & Gudjonsson, 2008). Overall, some ADHD core symptoms tend to decline over time, and they may manifest in different forms as patients adjust their social and personal environment to the symptomatology (Adler & Cohen, 2004; Biederman, Mick, & Faraone, 2000). In any case, ADHD will affect—to a greater or lesser extent—many aspects of the adult's life regardless of the degree of symptoms remission. Authors studying the impact of ADHD throughout the patient's lifespan observed a long-term persistence of the poor interpersonal skills, which resulted not only in fewer close friendships in the adulthood but also in a greater number of remarriages than control subjects (Bagwell, Molina, Pelham, & Hoza, 2001; Ingram, Hechtman, & Morgenstern, 1999; Murphy & Barkley, 1996; Wilson & Marcotte, 1996). Likewise, the reduced academic performance of ADHD patients, also characterized by increased disciplinary actions at school, results in a lower educational attainment (Ingram et al., 1999; Murphy & Barkley, 1996), limiting their access to qualified job positions. In the occupational area, ADHD patients have also shown greater chances to change jobs, either because they leave or they are dismissed (Barkley, 1998; Murphy & Barkley, 1996; Weiss, Hechtman, Milroy, & Perlman, 1985).

In addition to the multiple developmental pathways of ADHD patients, ADHD diagnosis and treatment during childhood influences the course of patients' life, leading to a broad diversity of clinical profiles in adult patients (Adler & Cohen, 2004; Biederman, 1998, 2005). In some cases, patients succeed in coping with ADHD core symptoms, mostly by developing alternative behaviors, which results in a compensated psychological and cognitive function. However, the most common scenario is ADHD core symptoms persisting—more or less pervasively—during adulthood. Some of these patients followed an adaptive pathway, having a high rate of syndromic and symptomatic remission and a partially restored functioning. By contrast, others have to deal with a remarkable number of severe ADHD symptoms, which in most cases result in the

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emergence of comorbidities related to mood, anxiety, bipolar disorders, personality disorders, antisocial behavior, and substance abuse disorders, particularly common in adult ADHD patients, with a prevalence that may reach up to 60% (Adler & Cohen, 2004; Fayyad et al., 2007). In these patients, comorbidities are more likely to be the actual therapeutic target, and the symptoms associated with the patient's comorbidity burden may even mask the inattention and hyperactivity symptoms, thus overlooking ADHD diagnosis and treatment (Ginsberg, Quintero, Anand, Casillas, & Upadhyaya, 2014).

Regardless of the developmental pathway of ADHD patients, both the evolution of the core symptoms during adulthood and the clinical complexity of adult ADHD patients limit the functional assessment and often hamper the identification of adult subjects with difficulties caused by an underlying ADHD. In this regard, some authors have highlighted the need to clarify ADHD symptoms beyond inattention and hyperactivity and to consider the multiple developmental pathways and the neuropathological heterogeneity of ADHD in adults (Barkley & Murphy, 2010; Nigg, 2005; Seidman, 2006; Sonuga-Barke, 2005). Thus, the quality of life (QoL) assessment may be considered a measure of the ADHD long-term outcomes, which encompasses the impact of both executive and emotional dysfunctions associated with the disorder. Some authors reported a negative correlation between different QoL measures and the severity of ADHD symptoms (Adler et al., 2009; Mattos, Louzã, Palmini, de Oliveira, & Rocha, 2013). However, to our knowledge, QoL assessment in adult subjects with ADHD has been mainly focused on the outcomes of the various treatments (Adler et al., 2009; Mattos et al., 2013; Mick, Faraone, Spencer, Zhang, & Biederman, 2008). Also, as ADHD has been traditionally considered a cognitive disorder, most trials including adult patients with ADHD have focused on the study of the executive and neuropsychological dysfunctions of these patients (Barkley & Biederman, 1997; Seidman, 2006), while their emotional characteristics have been barely described.

Considering this background, the aim of this cross-sectional study was to assess the QoL and the neuropsychological, clinical, and emotional characteristics of adult patients with ADHD, including those without previous ADHD diagnosis. To better understand the different profiles of adult ADHD patients, we grouped them according to various developmental pathways and investigated the behavior of each variable in all groups. In our analysis, we included a control group without a history of ADHD, and with confirmed absence of ADHD diagnosis.

Materials and Methods

Study Design

In this multicenter, cross-sectional study, we assessed the neuropsychological performance, the clinical profile, and the QoL of adult ADHD patients and participants without ADHD diagnosis at the study start. We recruited control and ADHD adults from two different mental health units in Madrid (Spain), and two support associations for patients affected by ADHD; control subjects included relatives of our ADHD patients who voluntarily agreed to participate in the study. Data were collected between October 2013 and December 2014. In addition to the scales related to the study outcomes, participants' clinical history was reviewed for previous mental disorders. The diagnosis interview for adult ADHD (DIVA; Kooij, 2006) was used to confirm, rule out, or diagnose ADHD for the first time in the study subjects. This interview focuses on the 18 *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association [APA], 1994) symptoms of ADHD and uses concrete and realistic examples to thoroughly investigate whether a symptom is currently present or was present in childhood. The assessment of ADHD symptoms and impairment in childhood included additional information retrieved from patients' relatives, when possible. Accordingly, the Wender Utah Rating Scale (WURS; Ward, Wender, & Reimherr, 1993) allowed for a retrospective assessment of the ADHD symptoms during childhood.

Assessments were performed by trained professionals: two experienced psychologists (R.V. and I.M.). Before starting data collection, the investigators explained the methodology and the objectives of the study to eligible subjects, who were offered to freely participate in the study. All participants were native Spanish speakers and signed the informed consent approved by the research ethics committee of Gregorio Marañón Hospital (Madrid, Spain; Ref. 256/13) before entering the study. All data were managed in accordance with the local regulation on personal data protection (LOPD 13/1999).

Participants

Male and female participants aged between 18 and 65 years who were able to understand the instructions needed to carry out the proposed tests were included in the study. To minimize the bias associated with cognitive impairment, subjects with full-scale intelligence quotient below 70 on the Wechsler Adult Intelligence Scale (WAIS) were excluded from the study.

Participants were classified according to three characteristics: (a) current ADHD diagnosis (according to the DIVA assessment), (b) previous history of ADHD diagnosis in childhood or adolescence, and (c) presentation with comorbid psychiatric pathologies (according to the Structured Clinical Interview for *DSM-IV* Axis I Disorders [SCID-IV]; First, Spitzer, Gibbon, & Williams, 1999). Consequently, participants were divided into four groups as follows: (a) non-ADHD healthy adults (control group), (b) ADHD adults without comorbidity and undiagnosed in childhood

or adolescence (ADHD-C-D), (c) ADHD adults with comorbidity and undiagnosed in childhood or adolescence (ADHD+C-D), and (d) ADHD adults with comorbidity and previous ADHD diagnosis in their childhood or adolescence (ADHD+C+D). The putative group including patients without comorbidities and with previous ADHD diagnosis in their childhood or adolescence (ADHD-C+D) was discarded because all patients with previous ADHD diagnosis had at least one additional psychiatric comorbidity included in the SCID-IV.

Rating Scales

The severity of the ADHD symptoms in adulthood was assessed using the Conners' Adult Attention Rating Scale (CAARS; Conners, 1999; La Malfa, Lassi, Bertelli, Pallanti, & Albertini, 2008). The presence of childhood symptoms was retrospectively assessed with the 61-item Spanish version of the WURS (Rodríguez-Jiménez et al., 2001). Participants' neuropsychological performance was assessed using three scales: the Conners' Continuous Performance Test (CPT), the Stroop Color-Word Interference Test (SCWT), and the WAIS. The CPT (Conners, 1993) included the computerized measure of the number of omissions (missed targets), commissions (incorrect responses to nontargets), and hit reaction times. The SCWT measures the subject's ability to avoid the semantic interference when naming printed colors not matching the name of the color. The version used in this study contained 100 items corresponding to three different colors, and subjects were asked to read as many items as possible for 45 s (Golden & Freshwater, 1978). The WAIS test was used in its fourth edition of 15 subtests grouped into four indexes: the verbal comprehension index, the perceptual reasoning index, the working memory index, and the processing speed index (Wechsler, 2014). For the purposes of this study, only the working memory index, the processing speed index, and the full-scale intelligence quotient index (based on the combined performance of the four indexes) were considered for the analysis.

In addition to the SCID-IV, the clinical and emotional profile of patients and controls was defined in terms of impulsivity, anxiety, and severity of depressive symptoms. Impulsivity was assessed using the Barratt Impulsiveness Scale (BIS-11), including the attentional, nonplanning, and motor subscales (Patton, Stanford, & Barratt, 1995). Anxiety was estimated as both anxiety trait and anxiety state using the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuchy, & Lushene, 2008). Finally, the severity of depressive symptoms was assessed using the Beck's Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

The patients' QoL was measured using the Adult ADHD Quality of Life (AAQoL) scale, a disease-specific tool for the assessment of QoL in adult ADHD patients (Brod et al., 2015). The AAQoL scale is based on a self-administered questionnaire of 29 items rated on a 5-point Likert-type scale. Items are grouped into four domains: (a) the life productivity subscore, regarding the ability to complete tasks and balance multiple projects; (b) the psychological health subscore, including feelings of being overwhelmed, anxious, or fatigued; (c) the relationships subscore, concerned to the feelings of tension, annoyance, and frustration in relationships; and (d) the life outlook subscale, regarding the overall perception of satisfaction and success in life management. Finally, a QoL total score is obtained from the four subscale scores. In this study, participants completed the AAQoL questionnaire at home and returned it on the following visit.

Statistical Analysis

Sociodemographic variables, as well as the scores of the various scales, were described for the study sample as a whole and for each individual group. Quantitative variables were described as means and standard deviations or medians, while categorical variables were described as frequencies and percentages for each group. The outcome variables were compared using ANOVA or ANCOVA tests when the individual values were normally distributed, whereas the Kruskal–Wallis test was utilized for variables that failed to show a normal distribution (assessed using the Shapiro–Wilk test). The post hoc pairwise analyses of variables showing significant differences in the ANOVA or the ANCOVA tests were carried out using either the Bonferroni correction or the Dunnett's test. Accordingly, variables showing significant differences in the Kruskal–Wallis analyses were compared with the Dunn's test. The chi-square or Fisher's exact tests were used to compare the proportions of categorical variables among groups. The significance level for general hypothesis testing was set at $\alpha = .05$, and the analyses were conducted using the SPSS software (Version 22.0 for Windows; IBM Corp., Armonk, NY) and MedCalc.

Results

Participants' Characteristics

A total of 119 participants were considered for eligibility, but three were excluded from the control group due to a positive diagnosis on at least one *DSM-IV* Axis I disorder, which provided a final study sample size of 116 subjects. After the initial assessment, 25 participants were included in the control group, 31 in the ADHD-C-D group, 31 in the ADHD+C-D group, and 29 in the ADHD+D+C group.

Table 1 shows the participants' main social and demographic characteristics in each group. Overall, our sample was balanced in sex but showed significant differences in

Table 1. Social and Demographic Characteristics of Subjects Included in Each Study Group.

		Subgroups				
	Overall (*n* = 116)	Control (*n* = 25)	ADHD-C-D (*n* = 31)	ADHD+C-D (*n* = 31)	ADHD+C+D (*n* = 29)	*p* value[a]
Age (years), *M* (*SD*)	38.3 (11.5)	43.6 (9.5)	41.7 (9.6)	37.8 (11.5)	30.5 (11.0)	**<.001**
Sex, *n* (%) of females	65 (56)	14 (56)	17 (55)	19 (61)	15 (52)	.900
Relationship status, *n* (%)						
Never lived with a partner	19 (16)	2 (8)	4 (13)	5 (16)	8 (28)	**.009**
Currently with a partner	86 (74)	21 (84)	27 (87)	23 (74)	15 (52)	
Undetermined	11 (9)	2 (8)	0	3 (10)	6 (21)	
Independence level, *n* (%)						
Dependent of parents	23 (20)	1 (4)	2 (7)	8 (26)	12 (41)	**<.001**
Partially independent	9 (8)	0	1 (3)	1 (3)	7 (24)	
Independent, living alone	16 (14)	1 (4)	5 (16)	7 (23)	3 (10)	
Living with a partner and/or children	66 (57)	22 (88)	23 (74)	15 (48)	6 (21)	
Other	2 (2)	1 (4)	0	0	1 (3)	
Educational level, *n* (%)						
Postgraduate studies	13 (11)	4 (16)	3 (10)	2 (6)	4 (14)	.372
Bachelor's degree	25 (22)	9 (36)	4 (13)	6 (19)	6 (21)	
Graduated/university studies of 1-3 years	30 (26)	5 (20)	10 (33)	6 (19)	9 (31)	
≤12 academic years	37 (32)	5 (20)	12 (40)	14 (45)	6 (21)	
No primary education	10 (9)	2 (8)	1 (3)	3 (10)	4 (14)	
School performance (median)						
Score in secondary school	6	7	6	6	6	**<.001**
Grade retentions	1	0	1	1	1	**.008**
School events, *n* (%)						
School failure	38 (33)	2 (8)	13 (42)	11 (36)	12 (43)	**.023**
School absenteeism/escape	15 (13)	0	1 (3)	8 (26)	6 (25)	**.006**
Disruptive behavior						
Nonviolent	20 (17)	0	5 (16)	5 (16)	11 (35)	**.010**
Violent	7 (6)	0	0	1 (3)	6 (21)	**.001**
Working status, *n* (%)						
Stable employment	39 (34)	12 (48)	14 (45)	10 (32)	3 (10)	**<.01**
Unstable employment	32 (28)	9 (36)	7 (23)	10 (32)	6 (21)	
Unemployed	21 (18)	2 (8)	4 (13)	8 (26)	7 (24)	
Retired	24 (21)	2 (8)	6 (20)	3 (10)	13 (45)	
Working events (median)						
Job changes	3	3	3	4	3	.338[b]
Layoffs	0	0	0	1	0	**.047**[b]

Note. Percentages were calculated for each group. ADHD-C-D = patients without comorbidities and without previous ADHD diagnosis; ADHD+C-D = patients with comorbidities and without previous ADAH diagnosis; ADHD-C+D = patients without comorbidities and with previous ADHD diagnosis.

[a]Significant *p* values (<.05) are in bold.

[b]Calculated considering only subjects with previous working experience.

most of the sociodemographic characteristics. The post hoc analysis of the mean age in the study groups revealed that subjects in the ADHD+C+D group were significantly younger than those included in other ADHD groups ($p < .05$ for both pairwise comparisons). Therefore, age was included as a covariate in the ANCOVA analyses when required.

Significant differences were also found regarding the level of independence and the relationship status. The proportion of patients engaged in a relationship was significantly higher in the control group and lower among patients in the ADHD+C-D group. To further investigate the relationship between each group and the level of independence, patients were grouped into two main categories: independent and nonindependent. The chi-square test revealed significant differences between study groups ($p < .001$), with a greater proportion of independent subjects in the control group, and a greater proportion of nonindependent subjects in the ADHD+C-D group.

Table 2. Neuropsychological and Clinical Characteristics of the Study Subjects.

		Study groups				
	Overall (n = 116)	Control (n = 25)	ADHD-C-D (n = 31)	ADHD+C-D (n = 31)	ADHD+C+D (n = 29)	p value[a]
Neuropsychological variables						
Conners' continuous performance test						
Omissions	48.9 (27.1)	49.3 (28.6)	42.1 (24.1)	51.0 (27.7)	51.6 (27.8)	.444
Commissions	54.8 (31.6)	39.6 (29.1)	52.6 (32.8)	63.4 (27.8)	59.6 (33.0)	**<.049**
Hit reaction time	62.2 (28.1)	65.0 (27.2)	61.8 (30.2)	64.2 (31.2)	59.8 (24.0)	.945
Stroop interference						
Word	1	1	1	1	1	.154
Color	1	1	1	2	1	.137
Word-Color	1	0	1	1	1	**.086**
Wechsler Adult Intelligence Scale						
Working memory index	98.6 (16.1)	102.3 (11.1)	100.0 (16.2)	93.4 (17.4)	97.7 (17.7)	.089
Processing speed index	102.9 (13.4)	108.2 (14.7)	104.5 (11.8)	99.9 (13.0)	98.6 (12.6)	.110
Full-scale intelligence quotient	101.8 (16.5)	107.2 (13.0)	106.4 (13.2)	93.3 (20.4)	99.6 (14.5)	**.002**
Clinical and emotional variables						
Barratt impulsiveness scales						
Attentional	20.2 (8.3)	12.7 (3.8)	21.5 (4.7)	23.4 (8.7)	21.9 (9.6)	**<.001**
Nonplanning	19.9 (8.6)	12.4 (5.0)	19.0 (7.7)	24.3 (8.6)	22.7 (7.7)	**<.001**
Motor	20.3 (8.1)	12.1 (5.6)	21.4 (6.8)	23.6 (7.4)	22.5 (7.4)	**<.001**
Total	56.5 (19.4)	35.8 (13.1)	59.8 (15.1)	66.2 (16.5)	60.3 (18.7)	**<.001**
State-Trait Anxiety Inventory						
Trait	59.7 (28.7)	34.6 (25.3)	52.9 (25.4)	79.8 (16.1)	65.4 (27.9)	**<.001**
State	59.3 (27.5)	38.4 (24.4)	55.4 (25.3)	75.2 (18.7)	64.6 (27.5)	**<.001**
Beck's Depression Inventory	10.6 (8.5)	3.9 (2.9)	8.7 (6.3)	17.0 (8.5)	11.5 (9.0)	**<.001**
Intensity of ADHD symptoms						
Wender Utah Rating Scale	40.2 (19.5)	16.1 (11.3)	44.0 (12.5)	43.1 (15.5)	53.7 (17.1)	**<.001**
Conners' Adult Attention Rating Scale	13.8 (7.3)	5.4 (4.5)	15.4 (6.7)	15.8 (6.3)	17.2 (5.3)	**<.001**

Note. Results are presented as the mean score (standard deviation) or median of each scale. ADHD-C-D = patients without comorbidities and without previous ADHD diagnosis; ADHD+C-D = patients with comorbidities and without previous ADAH diagnosis; ADHD-C+D = patients without comorbidities and with previous ADHD diagnosis.

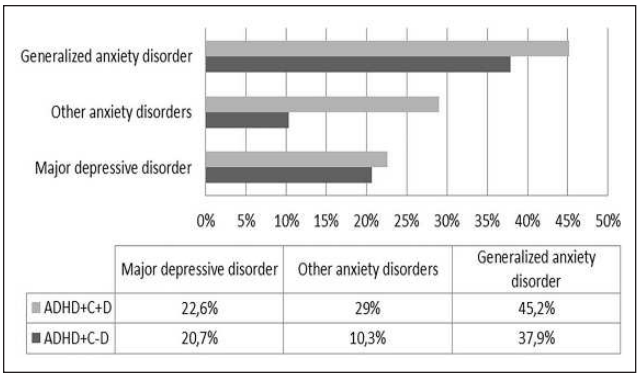
[a]p value corresponding to given test statistic. Significant p values (<.05) are in bold.

Regarding the educational attainment, the control group had a greater proportion of subjects with higher education than the ADHD groups. Control subjects were also less likely to interrupt education before graduation and reported a lower incidence of signal events related to school history, such as absenteeism and disruptive behavior. The control group showed higher scores at secondary school and a lesser number of grade retentions than ADHD groups ($p < .001$ and $p < .05$ for all pairwise comparisons of scores and number of grade retentions, respectively), but no significant differences were observed between ADHD groups. Only subjects with comorbidities reported episodes of disruptive behavior during the school period, with a higher incidence in subjects with a previously diagnosed ADHD (ADHD+C+D).

The proportion of patients in each level of occupational attainment significantly differed among the study groups. To further investigate the relationship between study groups and working status, we regrouped the four initial categories into two main categories: employed and unemployed. The chi-square test for this new set of groups revealed a significantly greater proportion of employed subjects in the control group ($p < .01$) than in any ADHD group. Overall, study subjects reported a low number of job changes and layoffs, which were remarkably greater in the ADHD+C-D group.

Neuropsychological and Clinical Characteristics

Table 2 summarizes the neuropsychological mean scores and the subject clinical characteristics in each group. When assessing the neuropsychological performance, only the number of commissions in the CPT test and the full-scale intelligence quotient in the WAIS test were significantly different among study groups. For CPT commission score, significant differences between the control group and the ADHD+C-D and ADHD+C+D groups emerged in the Dunnett test post hoc analysis ($p = .011$ and $p = .039$,



	Major depressive disorder	Other anxiety disorders	Generalized anxiety disorder
ADHD+C+D	22,6%	29%	45,2%
ADHD+C-D	20,7%	10,3%	37,9%

Figure 1. Main comorbidities in ADHD comorbid groups.

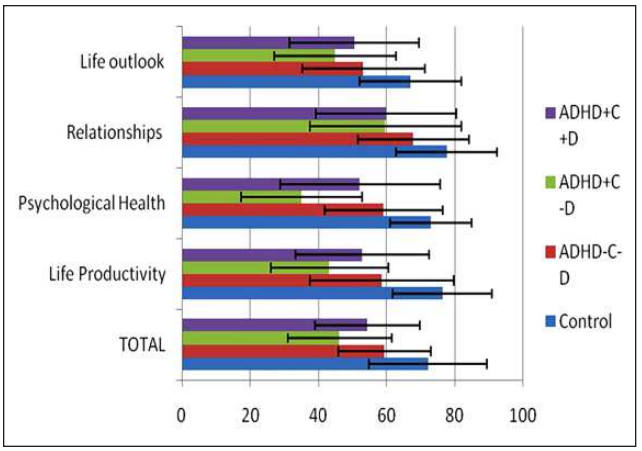


Figure 2. The self-perceived QoL, assessed by the AAQoL scale.
Note. QoL = quality of life; AAQoL = Adult ADHD Quality of Life.

respectively). For the full-scale intelligence quotient, the post hoc analysis revealed significant differences only between control subjects and those in the ADHD+C-D group ($p = .003$). Finally, the overall comparison of the word-color index mean scores in the SCWT scale was close to the significance level ($p = .086$), suggesting a trend to lower scores in control subjects as compared with all ADHD patients.

Study groups showed significant differences in the scores of all scales related to the clinical and emotional profile (Table 2). In the post hoc analysis of the BIS-11 scores, control subjects showed significantly lower scores than ADHD subjects in all subscales ($p < .001$ for all pairwise comparisons); however, no significant differences were found among groups including ADHD patients. The corresponding analysis of STAI also revealed significantly lower trait and state anxiety scores in control subjects than in ADHD subjects ($p < .01$ for all pairwise comparisons). For ADHD subjects, STAI mean scores were significantly higher in the ADHD+C-D group than in the ADHD+C+D group ($p = .008$). Similarly, the severity of the depressive symptoms, assessed by the BDI scale, was significantly lower in control subjects than in ADHD subjects with comorbidities ($p < .01$ for pairwise comparisons with both ADHD+C-D and ADHD+C+D groups). When comparing ADHD groups, the BDI mean scores were significantly higher in the ADHD+C-D group than in the ADHD-C-D ($p < .001$) and ADHD+C+D ($p = .037$) groups. The SCID-IV allowed identifying the presence of eight different comorbidities in the ADHD+C-D group, and 10 in the ADHD+C+D group (Figure 1). However, the differences in the SCID outcomes between these two groups including patients with comorbidities were not significant.

Significant differences were seen in the severity of ADHD symptoms in the overall comparison (Table 2). The post hoc analysis of symptoms severity during adulthood, measured by the CAARS, showed significantly lower scores in the control group than in each of the ADHD groups ($p < .001$ for all pairwise comparisons), but no significant differences between ADHD groups (pairwise comparisons). Similarly, the severity of symptoms during childhood, measured by the WURS, was significantly milder in control subjects than in ADHD subjects ($p < .001$ for all pairwise comparisons). In this scale, subjects in the ADHD+C+D group showed a higher mean score than those in the ADHD+C-D group ($p = .029$).

QoL

The self-perceived QoL, assessed by the AAQoL scale, was significantly different among the study groups (Figure 2). The post hoc analyses revealed significant differences between control subjects and those with ADHD diagnosis in all subscales, including the total AAQoL score ($p < .05$ for all pairwise comparisons). Regarding the differences in the pairwise comparisons between ADHD groups, the ADHD+C-D group had significantly lower scores than the ADHD-C-D group in the productivity subscale ($p = .01$), the psychological health subscale ($p = .001$), and the total AAQoL scale ($p = .006$). Subjects in the ADHD+C-D group also exhibited a lower mean score in the psychological health subscale than those in the ADHD+C+D group ($p = .003$).

Discussion

We investigated the QoL and the neuropsychological and clinical characteristics in different adult ADHD profiles and found that the developmental pathway of these patients exerts greater influence on the emotional manifestations than on the ADHD core symptoms. Among the different developmental pathways of ADHD subjects, we found that the diagnosis at an early age (childhood or adolescence) might have a positive impact on some QoL dimensions later on life.

In the last decades, only the most dysfunctional ADHD cases were properly identified, whereas subjects with less dysfunctional symptoms or with partially adaptive developmental pathways remained underdiagnosed (Barkley, Fischer, Smallish, & Fletcher, 2002; Barkley, Murphy, & Fischer, 2008; Setyawan et al., 2015). Moreover, the presence of comorbidities and their severity might increase the likelihood of receiving a specialized attention, thus favoring an increase in the diagnosis rate (Sayal, Mills, White, Merrell, & Tymms, 2015). In line with this retrospective scenario, our study subjects previously diagnosed with ADHD were significantly younger, showed more severe childhood symptoms in the retrospective interview, and reported more episodes of disruptive behavior during the school period than other ADHD subjects. In other indicators of school performance, such as school dropout rate, final grades, and the number of grade retentions, the comparisons between ADHD groups did not reveal significant differences. However, compared with control subjects, ADHD patients had lower grades and higher chances of early leaving school than control subjects. This observation is consistent with the temperament profile and the greater likelihood of school dropout observed in previous studies with young ADHD patients (Flood et al., 2016; Fried et al., 2016; Willoughby, Gottfredson, & Stifter, 2016).

In addition to the time lapse in the diagnosis of ADHD, our results reflect an important risk of underdiagnosis in adults (Ginsberg et al., 2014). The modulation of the core symptoms (inattention, hyperactivity, and impulsivity) during adulthood has been pointed out as a major obstacle for ADHD diagnosis in adults. Indeed, whereas inattentiveness was central to ADHD diagnosis in the *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed.; *DSM-III*; APA, 1980), various authors have reported a low sensitivity of scales assessing attention in adults, particularly the CPT scale (Dulcan, 1997; Mcgee, Clark, & Symons, 2000). Likewise, the discrepancies observed when comparing the SCWT and WAIS scores between healthy and ADHD adult subjects (although being significant in most cases) led some authors to highlight the need for clarifying the executive dysfunctions associated with ADHD in adulthood (Boonstra, Oosterlaan, Sergeant, & Buitelaar, 2005; Ginsberg et al., 2014; Hervey, Epstein, & Curry, 2004; Seidman, 2006; Sergeant et al., 2002). In line with the observed modulation of attentional symptoms in adulthood, we found little differences between controls and ADHD subjects in the neuropsychological scales, with no significant results among study groups in the CPT omissions and hit reaction time subscales. We also failed to find significant differences in the WAIS working memory and processing speed indexes. These results suggest that even though neuropsychological tests are helpful tools for understanding the cognitive processes underlying ADHD, they do not fully describe the individual variability and might, therefore, be insufficient for ADHD diagnosis.

Symptoms related to impulsivity, rather than inattention, seem to have a greater influence on the difficulties that adult ADHD patients suffer in their working and relational spheres (Ogg, Bateman, Dedrick, & Suldo, 2016). However, there is no agreement on the extent of impulsivity persistence during adulthood, with some authors suggesting a faster decline in impulsivity than in inattentive symptoms (Faraone et al., 2000), and others suggesting an intermediate persistence (up to 60%; Young & Gudjonsson, 2008). In our study, healthy subjects displayed lower impulsivity scores in all BIS-11 subdomains. Accordingly, the CPT commission subscale, which is also considered a measure of impulsivity, was the only domain of the CPT scale that yielded significant differences among the study groups.

Notwithstanding the persistence of some cognitive symptoms and executive dysfunctions in adulthood, there is growing concern on the limitations of the executive and neuropsychological assessment in the diagnosis and management of adult ADHD patients (Barkley & Murphy, 2010; Ginsberg et al., 2014; Nigg, 2005; Seidman, 2006). Some authors suggested that, along with the traditional ADHD symptoms, anxiety and depressive symptoms mediate the decline of QoL during adulthood (Yang, Tai, Yang, & Gau, 2013). Comorbidities increase with age (Barkley et al., 2002; Murphy & Barkley, 1996) and often arise when the subject leaves the controlled, familial environment (Barkley et al., 2002). It seems reasonable that the core symptoms of ADHD progress through an internalizing pattern as patients adapt themselves to the social environment, increasing the risk of developing anxiety. In our study, the differences between healthy and ADHD subjects were more remarkable in the scales assessing anxiety and depression than in those assessing the neuropsychological performance. Interestingly, among subjects with comorbidities (ADHD+C-D and ADHD+C+D groups), those without a previous ADHD diagnosis showed the highest anxiety scores. Likewise, patients in the ADHD+C-D group showed a significantly greater severity of depressive symptoms than other ADHD groups. Furthermore, depression has been related to the number and severity of conflicts and adverse events during life (Yang et al., 2013), but also to low school performance in adolescents with nondiagnosed cognitive dysfunctions (Schulte-Koerne, 2016). Considering these observations, it is not surprising that the ADHD+C-D group exhibited more frequent job chances and layoffs, and a higher severity of depressive symptoms than other ADHD groups. Hence, in our sample, the absence of a previous ADHD diagnosis seemed to exert more influence on mood symptoms and adverse life events than the intensity of ADHD symptoms itself, as similar CAARS scores were observed in all ADHD groups. This observation is consistent with that of other authors who showed how the failure to diagnose ADHD prevents children and their parents from seeking the assistance they need to achieve their full potential in academic and psychosocial settings (Fredriksen et al., 2014; Fried et al., 2016).

Due to the psychological dysfunction and disability, ADHD has a strong impact on multiple dimensions of patients' life, including school performance, job success, friendship, and partner relationships. Therefore, a negative correlation between ADHD and the patients' QoL may be expectable (Adler et al., 2009; Mattos et al., 2013; Yang et al., 2013). For the assessment of the QoL, we used an ADHD specifically designed scale, which provides separate information about four dimensions of the patients' life. As expected, control subjects exhibited better QoL than those with ADHD. Among ADHD subjects, the presence of comorbidities influenced QoL in most of the AAQoL domains. Interestingly, subjects in the ADHD+C-D group showed the lowest scores in all AAQoL subscales. These differences were statistically significant when compared with subjects without comorbidities in the total AAQoL score, and in the productivity and psychological health subscores. In the psychological health subscale, subjects with comorbidities and newly diagnosed ADHD (ADHD+C-D) also showed a significantly lower score than those with previous ADHD diagnosis. The psychological health subscale contains six items including feeling anxious, overwhelmed, and fatigued. Hence, the differences observed in the AAQoL scores between these two ADHD groups with comorbidities are consistent with the trend observed in the state and trait anxiety scores, which were also higher among newly diagnosed subjects than among those with a previous ADHD diagnosis.

The representativeness of our results might be limited by a selection bias potentially associated with the recruitment process. Considering the difficulties of recruiting nondiagnosed ADHD subjects, we screened subjects from two different settings: mental health units and support associations for ADHD patients. Thus, ADHD subjects who have followed an adaptive pathway and have compensated their difficulties could be more likely to be included in our study, whereas those with greater dysfunctionality may be underrepresented. Nonetheless, our study is innovative in the comprehensive description of different adult ADHD profiles, particularly those without a previous diagnosis. Finally, it would have been of great interest to include retrospective data about treatment in previously diagnosed ADHD subjects. However, we considered that retrospectively retrieving such information might have led to inaccurate records and a subsequent increase in the risk of bias.

In conclusion, our results show that despite the heterogeneity of adult ADHD subjects, the different developmental pathways—and most particularly the presence/absence of comorbidities and a previous diagnosis during childhood—display some consistent characteristics. The various profiles of adult ADHD subjects, rather than the neuropsychological scales, seem to differ in the emotional symptoms and the QoL. We also found that regardless of the limitations of ADHD management in the previous decades, the presence of a previous ADHD diagnosis might result in a better outcome, particularly in the emotional domain, which in turn has a relevant impact on the QoL of adult ADHDs. In this regard, future investigations should explore the individual influence of the various symptoms, dysfunctions, and comorbidities on the QoL of adult ADHD patients.

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