Research Article

Emotional Dysregulation and Quality of Life in Adolescents with Attention Deficit Hyperactivity Disorder: The Emotical Study

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Abbreviations

Attention Deficit Hyperactivity Disorder (ADHD); Child Behaviour Checklist (CBCL); Clinical Global Impression Scale (CGI); Clinical Global Impression Scale global improvement (CGI-C); Clinical Global Impression Scale of Severity (CGI-S); Emotional Dysregulation (ED); Health-Related Quality of Life (HRQoL); Strengths and Difficulties Questionnaire (SDQ); Strengths and Difficulties Questionnaire Spanish Version (SDQ-cas); Youth Self Report (YSR)

Abstract

Objective: Emotional disturbances in Attention Deficit Hyperactivity Disorder (ADHD) have been poorly explored. The lack of consensus in the definition of the patient with Emotional Dysregulation (ED), and the absence of a gold standard measure of the presence of emotional dysregulation contributes to this lack of knowledge

The aim of this study was to assess the presence of ED in ADHD adolescents and to measure its impact on patient quality of life.

Method: A cross-sectional observational study was designed. The ADHD severity was assessed using the Clinical Global Impression Scale of Severity (CGI-S). Patients with ED were those with scores 6-10 points in the emotional symptoms scale of the Strengths and Difficulties Questionnaire. Quality of life was assessed using the KIDSCREEN-10-INDEX.

Results: 270 adolescents were included. ED was present in 20.4% (95% CI 20.1-20.7). Psychiatric comorbidity was found in 48.9% (132). Methylphenidate was the treatment for 76.3% (184) and 20.7% (50) with lisdexamphetamine. Quality of life scores were worst as ADHD severity increased (p=0.005), if psychiatric comorbidity (p=0.008), and ED (p<0.0001) are present.

Conclusions: Adolescents suffering from ADHD with ED are at increased risk of psychiatric comorbidity and impairment of their quality of life.

Keywords: ADHD; Attention deficit hyperactivity disorder; Emotional dysregulation; Comorbidity; Adolescents

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a neurobiological disorder that begins in childhood and affects 3-7% of school-age children. In Spain, 6.8% of children and adolescents suffer from ADHD [1]. The disorder is characterized by a level of impulsivity, activity, and attention inappropriate to the age of development. Many of these children and adolescents have difficulty regulating their behaviour and adjusting to the expected norms for their age and, as a result, have difficulty adapting in their family,

school and relationships with their peers. They often perform below their abilities and may have emotional and behavioural disturbances [2].

Nuclear symptoms include inattention, hyperactivity and impulsivity, to which the symptoms secondary to psychiatric comorbidity that are very common in ADHD are added [3]. Children with ADHD have more oppositional defiant disorders, behavioural disorders and major depression. In the classroom, they have a higher rate of disruptive behaviours and hyperactivity. Girls with ADHD are less aggressive and impulsive than boys, have fewer symptoms of conduct disorder, but are at increased risk for anxiety disorders. In the school setting, girls show fewer behavioural problems and participate more in extracurricular activities [3,4]. These sex differences disappear after puberty [5].

Emotional disturbances in ADHD have hardly been explored compared with numerous studies assessing cognitive and behavioural symptoms. However, an increasing interest has emerged in recent years and the concept of Emotional Dysregulation (ED) has become part of the scientific interest in this entity. Children with ADHD have great difficulty modulating emotional responses, resulting in affective symptoms and impulsive and explosive behaviours, with unfavourable consequences in many areas of their life [6]. Assessing individual differences in emotion regulation is also a topic of special interest in ADHD, as children with ADHD and emotional dysregulation have been found to have more severe ADHD. It has also been reported that this group of children with ADHD and emotional dysregulation could be more homogeneous in their response to treatment than those without emotional dysregulation. However, there is a lack of consensus in both the definition of emotional dysregulation and the gold standard for its assessment [6-8].

The primary objective of the study was to assess the degree of emotional impairment in adolescents with ADHD, using a measurement method that can be compared to the healthy population. The secondary objectives were to assess the relationship between the presence of emotional dysregulation and impaired quality of life, the relationship between the presence of emotional dysregulation and age, sex, type of ADHD, and severity of the disease.

Material and Methods

Study design and ethical standards

A cross-sectional observational study was designed. The patients were included between February and October 2017. Participating specialists were from 54 child and adolescent psychiatry or neuropaediatrics centres from 30 Spanish provinces in 15 autonomous regions. The investigators completed the case report form specifically designed for the study. The study was approved by the Clinical Research Ethics Committee of Hospital Universitario Fundación Alcorcón, Madrid. All patients and the parents or guardians of minor patients received information about the study and agreed to participate by signing the informed consent form. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Selection criteria

Patient selection was performed on a consecutive random basis,

selecting the first 5 patients visiting the clinic who met the screening criteria. The information sources were the case history and the data collected on the inclusion visit.

Patients of any race and sex, aged 12 to 18 years, with a confirmed diagnosis of ADHD according to DSM-5 criteria [2], with enough cognitive level to allow them to complete the study questionnaires, were included.

Sociodemographic and clinical variables

The date of birth, sex, weight, height, socioeconomic level (low: family income less than €15,000 per year; medium: family income between €15,000 and €45,000 per year, and high: family income greater than €45,000 per year) and alcohol use (more than 80 g of alcohol per day in men and 20 g/day in women), smoking and drugs intake were recorded. Information was collected on the presence of a history of psychiatric disease and ADHD in first-degree relatives.

The date of diagnosis of ADHD and the group in which the patient was classified according to the diagnosed ADHD subtype (DSM-5 criteria) were recorded: Predominantly inattentive ADHD, predominantly hyperactive-impulsive ADHD, or combined type ADHD, or the patient had not yet been classified. The presence of history of non-psychiatric or psychiatric disease was explored and if the patient has any suicide attempt.

Clinical assessment

The Strengths and Difficulties Questionnaire (SDQ) that was completed by the adolescents was used to determine the presence of emotional dysregulation (http://www.sdqinfo.com/). The questionnaire consists of 25 questions with three possible answers and assesses social, emotional, and behavioural functioning. Responses are grouped into five subscales: emotional symptoms, conduct problems, hyperactivity, peer problems, and prosocial scale [9, 10].

Scores for each of the five subscales can range from 0 to 10 points. The total score of the questionnaire (total difficulties score) is obtained by the sum of the scores of the four subscales, not including the prosocial scale, and ranges from 0 to 40 points. These results classify patients into three groups: normal, borderline, or abnormal (Table 1). In this regard, adolescents were classified such that 80% of adolescents in the population were within the normal range, 10% in borderline range, and the remaining 10% in the abnormal range [10]. The study classified adolescents with emotional problems or with emotional dysregulation if they obtained scores on the emotional scale of the SDQ-cas between 6 and 10 points.

To assess health-related quality of life, the adolescents completed the questionnaire KIDSCREEN-10 INDEX. This is a generic instrument consisting of 10 questions with five possible answers. The total score ranges from 10 to 50 points. For the comparison of the results obtained in the study with international quality of life data, scores were transformed to a 0 to 100 point scale based on data from an international sample of children from twelve European countries for the same age group, or T values where the mean is 50. Deviations of 10 points above indicate better quality of life and values below 10 indicate poorer quality of life. A low scale score means that the patient feels unhappy, maladaptive, and dissatisfied regarding their family life, peers, and school life. A high score on the scale means that the

Table 1: SDQ-cas questionnaire values defining normal, borderline and abnormal values in the total score and in the five dimensions of the questionnaire [10].

SDQ-cas questionnaire dimensions	Risk classification		
	Normal	Borderline	Abnormal
Emotional symptoms scale	0-5	6	7-10
Conduct problem scale	0-3	4	5-10
Hyperactivity scale	0-5	6	7-10
Peer problem scale	0-3	4-5	6-10
Prosocial scale	6-10	5	0-4
Total difficulties score	**0-15**	**16-19**	**20-40**

SDQ-cas: Strengths and Difficulties Questionnaire, Spanish version.

patient feels happy, adapted and satisfied with their family life, peers and school life. (http://www.kidscreen.org/cms/) [11].

The Clinical Global Impression (CGI) scale was used to assess the severity of illness (CGI-S) in seven categories, where 1 corresponds to a normal subject, and 7 to the most extremely ill patient. Global improvement is scored on a seven-point scale (CGI-C) where 1 is a patient who is much better and 7 is a patient who is much worse than the patient's pre-treatment status. Each score is analysed separately, there is no overall scale score [12].

Treatment

No treatment was administered as a result of the study. The selected patients were treated according to the clinical judgement of the specialist. Information was collected on the history of pharmacological and nonpharmacological treatments received up to the date of the study and about the current treatment of the patient.

Sample size

The primary study variable was the assessment of the proportion of adolescents with emotional dysregulation at the time of the study, if they had scores between 6 and 10 points on the emotional scale of the SDQ-cas questionnaire.

The proportion of children and adolescents with ADHD who have emotional dysregulation in the Spanish population is unknown. However, considering that 45.4% of Spanish adolescents with ADHD have emotional dysregulation, as measured by the Youth Self Report (YSR) [13], a proportion of emotional dysregulation in patients with ADHD of 45% was estimated for calculation of the sample in this study. A sample of 270 patients had 87% power to detect this proportion of patients with a precision of ±6 points, with a two-sided alpha error of 0.05 (Sample Power, SPSS).

Statistical analysis

A descriptive analysis was made of the variables included in the study, based on the distribution of frequencies and percentages for qualitative variables, and calculation of standard measures (mean, standard deviation, minimum and maximum) for quantitative variables. Comparisons between qualitative variables were made using the Fisher test or Chi-square test. A Student's t test was used to compare independent groups in the case of quantitative variables. When evaluating differences in the SDQ-cas and KIDSCREEN-10-INDEX according to the different characteristics, we performed factor analysis of variance applying Bonferroni or Games Howell correction according to the homogeneity of variances as a control for

Table 2: Anthropometric, sociodemographic, and family history of patients included in the study.

		N	%
Socioeconomic level	Low	15	5.8
	Medium	205	79.5
	High	38	14.7
	Missing	12	
Alcohol use	No	266	98.5
	Yes	0	0
	More than 6 months ago	4	1.5
	Missing	0	
Smoking	No	247	91.5
	Yes	20	7.4
	More than 6 months ago	3	1.1
	Missing	0	
Drug use	No	263	97.4
	Yes	3	1.1
	More than 6 months ago	4	1.5
	Missing	0	
History of first-degree relatives with psychiatric illness	No	203	76.3
	Yes	63	23.7
	Missing	4	
History of first-degree relatives with ADHD	No	186	71
	Yes	76	29
	Missing	8	

ADHD: Attention Deficit Hyperactivity Disorder

the error in multiple comparisons. An exploratory multivariate linear regression analysis was performed to assess the relationship of the variables age, sex, socioeconomic level, ADHD subtype, time since onset of ADHD, disease severity (CGI-S), presence of concomitant diseases in treatment, presence of psychiatric comorbidity and presence of emotional dysregulation (SDQ-cas emotional symptoms domain) on the total quality of life score (KIDSCREEN-10-INDEX). The significance level was set at 0.05. IBM-SPSS version 24.0 statistical package was used for the analysis.

Results

Sociodemographic data and medical history

A total of 270 adolescents were included in the study. Of total patients included in the study, 69.3% were boys (n=187) and 30.7% were girls (n=83) with a mean age of 14.8 years (95% CI 14.6-15). Girls were 0.8 years older (95% CI 0.3-1.2, p=0.002). The sociodemographic characteristics and clinical history of the patients by sex are described in Table 2. A total of 17.8% (n=48) of the adolescents had other concomitant diseases under treatment at the time of inclusion in the study.

A total of 48.9% (n=132) had psychiatric comorbidity at the time of inclusion in the study, with no differences between sexes or ADHD subtype. Behavioural and conduct disorders were observed in a greater proportion (p<0.001) in hyperactive (48.3%, n=14) and combined

Table 3: Presence of psychiatric comorbidity depending on the presence or absence of emotional dysregulation (DSM-IV classification).

	ADHD without emotional dysregulation N=215		ADHD with emotional dysregulation N=55		Total N=270		P
Psychiatric comorbidity disorders	**N**	**%**	**N**	**%**	**N**	**%**	
Anxiety disorders	16	7.4	11	20	27	10	0.006
Affective disorders	5	2.3	6	10.9	11	4.1	0.004
Behavioural and conduct disorders	49	22.8	15	27.3	64	23.7	0.486
Eating disorders	2	0.9	1	1.8	3	1.1	0.575
Personality disorders	3	1.4	3	5.5	6	2.2	0.068
Substance abuse disorders	7	3.3	0	0	7	2.6	0.175
Learning and communication disorders	38	17.7	12	21.8	50	18.5	0.48
Neurological disorders	9	4.2	2	3.6	11	4.1	0.854

ADHD: Attention deficit hyperactivity disorder.

(33.3%, n=45) than in predominantly inattentive (2.9%, n=3) ADHD. Learning disorders were observed in a greater proportion (p=0.007) of predominantly inattentive (28.8%, n=30) than combined (11.9%, n=16) ADHD.

Of the patients with comorbidity, 37.1% (n=49) had more than one psychiatric comorbidity at the time of study conduct. The mean number of comorbidities was 1.7 (95% CI 1.5-1.9), between 1 and 8 comorbidities with no gender or ADHD subtype differences.

A history of suicide attempts was recorded in two patients (1%), one boy and one girl with ADHD predominantly inattentive and indeterminate ADHD, respectively.

Diagnosis of ADHD

ADHD was classified as combined ADHD in 50% of patients (135), as predominantly inattentive ADHD in 38.5% (104), as predominantly hyperactive-impulsive ADHD in 10.7% (29), and in 0.7% (2) ADHD still was not classified.

Mean age at diagnosis was 10.7 years (95%CI 10.3-11.1), minimum of 3.2, and maximum of 17.9 years.

The time since onset of ADHD disease to the time of inclusion in the study was 4 years (95% CI 3.7-4.4), with a median of 3.4 years, ranging from 0 to 13.5 years.
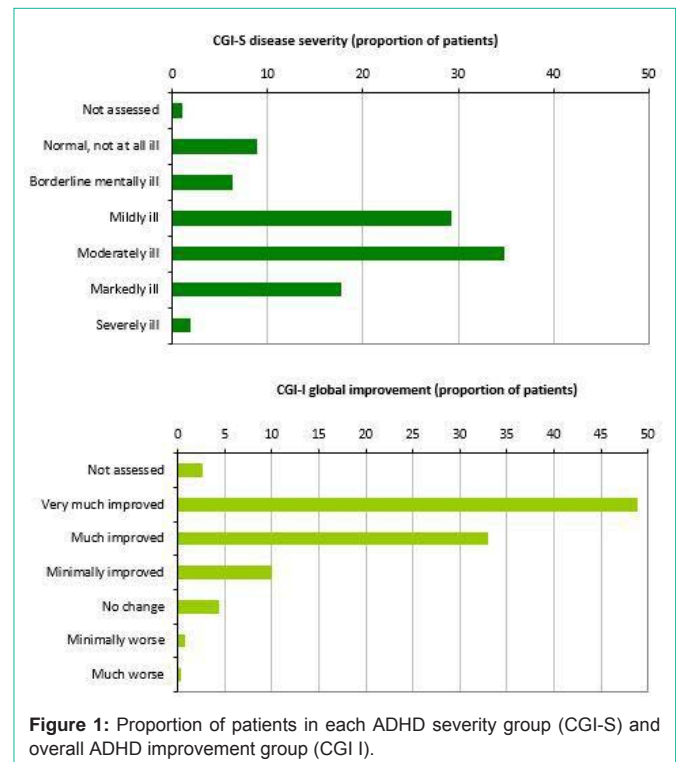
Figure 1 shows the proportion of adolescents in each category of the CGI scale, by which disease severity (CGI-S) and global improvement (CGI-I) were assessed. There were no significant differences by gender or ADHD subtype in any of the above variables.

SDQ-cas questionnaire

The total score of the SDQ-cas questionnaire in adolescents included in the study was 15.04 points (95% CI 14.27-15.81), with scores ranging from 1 to 33 points.

The mean score of the five subscales of the SDQ were: emotional symptoms scale 3.41 points (95% CI 3.13-3.69); conduct scale 3.35 points (95% CI 3.09-3.62); hyperactivity scale 5.89 points (95% CI 5.63-6.15); peer problems scale 2.39 points (95% CI 2.12-2.65); prosocial scale 7.72 points (95% CI 7.48-7.96). In this latter prosocial subscale, higher scores mean better prosocial behaviour.

Statistically significant differences (p=0.01) in emotional

Figure 1: Proportion of patients in each ADHD severity group (CGI-S) and overall ADHD improvement group (CGI I).

symptoms subscale score were observed between sexes, with higher scores for adolescent females with a mean difference of 0.8 (95% CI 0.2-1.4). No statistically significant differences were seen in the total score and the other scales, when compared by gender.

Statistically significant differences were observed in the SDQ conduct problems subscale score between the three ADHD subtypes. The highest score was found in adolescents with predominantly hyperactive-impulsive ADHD, followed by combined and predominantly inattentive ADHD. The difference in predominantly inattentive ADHD versus predominantly hyperactive ADHD was 2.7 points (95% CI 1.7-3.7), p<0.0001. The difference in predominantly inattentive versus combined ADHD was 1.5 points (95% CI 0.9-2.2), p<0.0001. The difference between combined ADHD and predominantly hyperactive-impulsive ADHD was 1.2 points (95% CI

Table 4: KIDSCREEN-10-index quality of life scale scores according to risk classification in the total score and dimensions of the SDQ-cas questionnaire. Comparison with data from healthy children and adolescents (ENSE 2011/2012), scores from 0 to 100 points [11,14].

SDQ-cas classification by dimension and by total score	EMOTICAL Study N=270			Children aged 8-14 years healthy Spanish [11, 14] N=2571		
	N	Mean KIDSCREEN-10	95% CI		Mean KIDSCREEN-10	95% CI	
EMOTIONAL SYMPTOMS SCALE							
Normal	215	46.13	44.98	47.28	89.22	88.78	89.67
Borderline	22	41.07	38.68	43.45	85.29	86.57	87.01
Abnormal	33	38.93	35.91	41.94	77.95	75.87	80.02
CONDUCT PROBLEMS SCALE							
Normal	147	47.29	45.89	48.68	89.22	88.78	89.67
Borderline	44	43.8	40.97	46.63	85.29	83.57	87.01
Abnormal	79	40.86	39.28	42.45	77.95	75.87	80.02
HYPERACTIVITY SCALE							
Normal	120	47.67	45.88	49.46	88.86	88.35	89.37
Borderline	45	44.04	41.94	46.13	86.53	84.71	88.34
Abnormal	105	41.95	40.64	43.26	84.27	83.04	85.5
PEER PROBLEMS SCALE							
Normal	201	46.86	45.69	48.03	88.89	88.43	89.35
Borderline	40	41.08	39.35	42.81	84.35	81.94	86.76
Abnormal	29	36.04	33.24	38.83	78.43	76.2	80.66
PROSOCIAL SCALE							
Normal	233	45.53	44.41	46.64	88.12	87.65	88.59
Borderline	18	40.61	36.59	44.63	81.51	77.7	85.31
Abnormal	19	40.41	36.3	44.51	80.64	75.95	85.33
SDQ TOTAL DIFFICULTIES SCORE							
Normal	148	48.29	46.96	49.62	89.26	88.8	89.71
Borderline	61	42.34	40.5	44.18	83.77	81.65	85.89
Abnormal	61	38.96	37.07	40.85	78.04	76.02	80.06

SDQ-cas: Strengths and Difficulties Questionnaire, Spanish version.

0.2-2.2), p=0.14.

Statistically significant differences were observed in the hyperactivity subscale scores of the SDQ between adolescents with predominantly inattentive ADHD and those with the other two types of ADHD. The difference between predominantly inattentive and predominantly hyperactive-impulsive ADHD was 1.8 points (95% CI 0.8-2.8), p<0.0001. The difference between predominantly inattentive ADHD and combined ADHD was 1.1 points (95% CI 0.5-1.8), p<0.0001. There were no differences in scores between children with predominantly hyperactive and combined ADHD.

Statistically significant differences were seen in the total score of the SDQ questionnaire between children with inattentive ADHD as compared to patients with hyperactive-impulsive ADHD (p= 0.003), with a mean difference of 4.4 points (95% CI 1.3-7.6), with a higher score in adolescents with predominantly hyperactive-impulsive ADHD. Total SDQ scores were also higher in patients with combined ADHD as compared to predominantly inattentive ADHD (p<0.001), with a difference of 3.2 points (95% CI 1.3-5.2), with a higher score in combined ADHD.

A statistically significant relationship was observed between the severity of ADHD and the total scores of the SDQ questionnaire (p=0.001) and the subscales: conduct problems (p=0.002), hyperactivity (p=0.001) and peer problems scale (p=0.049).
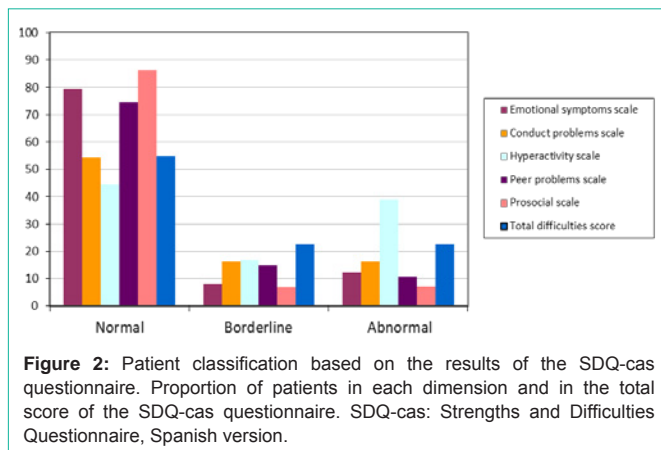
Figure 2 shows the proportion of patients classified as normal, borderline, or abnormal according to the reference values shown in Table 1.

Presence of emotional dysregulation

According to the definition of emotional dysregulation described in the methods section, 20.4% (95% CI 20.1-20.7) of the patients included in the study (55 of the total) had emotional dysregulation.

A statistically significant relationship (p=0.032) was seen between the presence of psychiatric comorbidity and the presence of emotional dysregulation. Children with psychiatric comorbidity had a higher proportion of emotional dysregulation (25.8%, n=34) than children without psychiatric comorbidity (15.2%, n=21).

Table 3 shows the proportion of children with each type of comorbidity according to whether or not they had emotional

Figure 2: Patient classification based on the results of the SDQ-cas questionnaire. Proportion of patients in each dimension and in the total score of the SDQ-cas questionnaire. SDQ-cas: Strengths and Difficulties Questionnaire, Spanish version.

dysregulation. DSM-IV classification was shown to allow comparison with previous studies. A significantly higher proportion of anxiety disorders (p=0.006) and affective disorders (p=0.004) were found in patients with emotional dysregulation.

It was found that the proportion of children with emotional dysregulation increased as a function of the severity of ADHD and decreased as a function of the longer duration of ADHD, although this was not statistically significant. Emotional dysregulation was present in 19% of patients treated with methylphenidate, 42.9% of patients treated with atomoxetine, 20% of patients treated with lisdexamphetamine and 24.1% of patients not treated with pharmacological treatment until the time of the study. The differences between the treatments were not statistically significant.

No statistically significant differences were seen in the presence of dysregulation based on age, gender, or ADHD type, or on the sociodemographic and clinical variables previously defined in the univariate analysis.

Quality of life assessment

The mean KIDSCREEN score was 31.1 points (95% CI 35.4-36.9), with a minimum of 15 and a maximum of 50. The score over 100 points (where the mean is 50 and the standard deviation 10, T values calculated over the healthy European population) was 44.8 (95% CI 43.8-45.9), ranging between 20.6 and 83.8 [11].

There were no differences in quality of life scale scores between sexes, by age or by ADHD subtype.

A worse quality of life score was seen in the presence of emotional dysregulation (p<0.0001), with a difference of 5.2 points (95% CI 3.1-7.2) as compared to patients with no emotional dysregulation.

A multivariate analysis was performed to assess factors related to better or worse quality of life and to control for confounding factors. The analysis was performed on 244 patients with all data available for the variables included in the equation (r = 0.435). Worse quality of life scores was seen in the presence of greater severity of ADHD (CGI-S, p=0.005), in the presence of psychiatric comorbidity (p=0.008), and in the presence of emotional dysregulation (p<0.0001). Patients with emotional dysregulation had a 2.1 point lower score on the quality of life scale (95% CI 0.6-3.7) after adjusting for the clinical and demographic variables, which is equivalent to 4.98% less (95% CI 2.4-

7.6) in the T-scores than in the healthy population, where the mean is 50 and the standard deviation is 10 [11]. No relationship was seen with age, sex, socio economic level, presence of associated diseases, ADHD subtype, or time since onset of ADHD.

Table 4 shows the T-score results of the KIDSCREEN-10-INDEX questionnaire in the study sample compared to the healthy Spanish population in each risk group of the SDQ questionnaire, by total score and by dimension [14].

Treatment for ADHD and psychiatric comorbidities

Behavioural therapy, psychological support, or both had been received by 60.7% of patients (164) at the time of the study visit. In the past, 98.5% (266 patients) had received some type of drug treatment.

At the time of inclusion in the study, 89.3% (241 cases) were receiving drug treatment for ADHD, the most common treatment being methylphenidate in 76.3% of patients (184 cases), followed by lisdexamphetamine in 20.7% (50 cases), and atomoxetine in 2.9% (7 cases).

Drug treatment for psychiatric comorbidities was received by 50 patients (18.5%) of the total patients included.

Discussion

This study found that 20.4% of patients with ADHD had emotional dysregulation as measured by the emotional dimension score of the SDQ-cas questionnaire. Biederman et al [15] reported a 19% rate of severe dysregulation in adolescents with ADHD. This patient profile was obtained using the Child Behaviour Checklist (CBCL), based on reports from parents of adolescents. In addition, Gomez-Simón et al [13] found that 45.4% of Spanish adolescents with ADHD suffered emotional dysregulation, as measured by the Youth Self Report, a validated self-report instrument that provides the same information as the CBCL [16].

Adolescents with psychiatric comorbidity showed in our study a greater proportion of emotional dysregulation, up to 10.6% more than patients with no emotional dysregulation. On the other hand, it is known that behavioural disorders persist longer in patients with emotional dysregulation (up to 10 more years) than in those who without this disorder [17]. There has been observed too, a correlation between the presence of depressive symptoms and emotional dysregulation and subsequent development of depression [18,19]. In our study, these adolescents with emotional dysregulation had a higher proportion of anxiety disorders (p=0.006) and affective disorders (p=0.004) than adolescents without emotional dysregulation (Table 3). This finding suggests a greater risk for this group of patients to develop depression, anxiety, and bipolarity in the future, and the need for increased monitoring [3-5].

The relationship between the presence of emotional dysregulation and the severity of ADHD was not significant in our study, but a positive trend was seen. No differences were found either by age, sex, or ADHD type. Studies evaluating emotional dysregulation in relation to ADHD subtype are limited and the results are conflicting. According to Maedgen (2000), the expression of emotions is more intense in children with combined ADHD than in cases of inattentive ADHD or in children without ADHD [20]. Similarly, Anastopoulos (2011) determined that children with combined ADHD show greater

emotional lability than children with inattentive or predominantly hyperactive ADHD [21].

The total SDQ score for adolescents in the study was 15.04 points, which was significantly worse than in the healthy Spanish population of the same age, which was 8.29 points (95% CI 7.96-8.62). Hence, adolescents with ADHD have a much lower quality of life score than adolescents in the general population, suggesting that they have an increased risk of mental health problems [14].

Compared to the healthy Spanish pediatric population [14], the quality of life of adolescents with ADHD included in the study was significantly worse, regardless of whether children were classified as normal, borderline, or abnormal in the total scores of the SDQ questionnaire, and in all its dimensions (Table 4). We found no studies relating the quality of life of adolescents with ADHD to the presence of emotional dysregulation, so the data found in our study could serve as a reference for future studies.

The presence of emotional dysregulation was related to worse quality of life, regardless of age, sex, socioeconomic level, comorbidity, ADHD subtype, and time since onset of ADHD. When patients with ADHD with emotional dysregulation are compared to those without emotional dysregulation, the quality of life of the former is 5% lower (95% CI 2.4-7.6) than in the latter, who, due to the mere fact of suffering ADHD, already have a worse quality of life.

Unfortunately, it has not yet been shown that a given treatment is superior to another in its effect on emotional symptoms of patients, an aspect that the cross-sectional design of our study does not allow us to analyse, but that should be addressed in future studies [6-8].

Emotional dysregulation is becoming increasingly recognized as a new dimension of ADHD [6], and in fact emotional dysregulation, such as low frustration tolerance and explosive behaviours, were described from the first definitions of the disorder, particularly since the onset of DSM-II [22]. However, they have not become part of the core description of ADHD, as shown in DSM-5, a classification that considers low tolerance to frustration, irritability and mood lability as features merely associated with the disorder [2].

Emotional lability, which affects nearly 50% of patients with ADHD, is associated with aggressive behaviour, depressed mood, difficulties regulating emotions and increased risk of comorbidity [18,19,21]. Children with ADHD more often experience negative emotions such as anger, depression, and guilt than those without ADHD and have greater difficulty regulating and controlling these emotional states [23]). Those with high emotional lability show alterations of the circuits connecting the cortex to the amygdala, which are fundamental structures for regulating emotions [24]. A review of the relationship between ADHD and emotional dysregulation [7] identifies three possible conceptual models: the first considers emotional dysregulation as one of the core features of the disorder that should, therefore, be part of its description and diagnostic criteria [25-27]; the second suggests that the association of ADHD and emotional dysregulation is a gnosological entity other than ADHD without emotional difficulties [28,29]; and the third suggests that they are distinct but strongly correlated symptom clusters [30,31].

The fact that there is no consensus on the definition of emotional

dysregulation, nor is there a predominant conceptual model [32], means that a gold standard for assessment is also lacking. This has led to the development of different assessment proposals, the majority developed from existing scales that include an emotional dimension in the assessment of disorders. There are numerous questionnaires that include measurement of the emotional dimension. Among these, the so-called CBCL, has been considered a useful tool in the identification of patients with ADHD and difficulties in emotional regulation [16]. Biederman et al [33] and Spencer et al [34] evaluated the dysregulation of emotions in people with and without ADHD by using three CBCL subscales: attention problems, anxiety-depression symptoms, and aggressive behaviour. They found that between 36% and 44% of children and adolescents diagnosed with ADHD had scores of 180 or greater, as a result of the sum of the T-scores in these three subscales versus 2% in adolescents without ADHD, and related it to the presence of emotional dysregulation. This group of patients is defined as either A-A-A profile or emotional dysregulation profile [33]. However, the CBCL is too lengthy a questionnaire for the epidemiological evaluation of the disease in clinical studies and does not apply to the general population, and therefore does not allow for comparison of the results at the population level.

Other short instruments such as the SDQ, which also assess the emotional dimension, have been used in numerous studies in the healthy population and allow for comparison of the results [9,10]. This was the questionnaire selected by the Spanish Ministry of Health to conduct the National Health Survey in 2006 and 2012 [14] and is the questionnaire used in our study to classify patients with ADHD according to whether or not they had emotional alterations.

It is also of great interest to know whether there are differences in Health-Related Quality Of Life (HRQoL) in adolescents with ADHD depending on whether or not they have emotional dysregulation. Specifically, the KIDSCREEN-10 questionnaire was used for its measurement [11]. It is an instrument that has been developed in Europe, with known reliability and validity coefficients, which allows for obtaining a summary measure of HRQoL to compare subsets of the paediatric and adolescent population. This questionnaire has also been used in the latest Spanish National Health Surveys and allowed for comparison of the results with those of the general Spanish and European paediatric population [14].

One of the weaknesses of this study is that the instrument used to identify emotional dysregulation, the SDQ questionnaire, may not detect dysregulation with sufficient precision, because it has not been not validated for it, and there are no comparative studies with other scales, so we do not know its sensitivity and specificity for this measurement. The questionnaire was chosen because it was validated in Spanish and used in Spain in the National Health Survey in the healthy population, which allowed for comparing the results with this population group.

Conclusion

In conclusion, we have observed that adolescents suffering from ADHD with emotional dysregulation have a greater risk of developing psychiatric comorbidity, and besides have a negative impact on their quality of life, regardless of the ADHD subtype. A unanimous concept of emotional dysregulation by the scientific

community needs to be agreed and validated and consensus-based tools developed for the identification of patients with emotional dysregulation. These instruments should be sensitive to change, allowing for adequate assessment of patient outcomes and treatment effect on the emotional dimension.

Contributors' Statement

Mardomingo Sanz MJ and Montañés Rada F contributed to the design and coordination of the study.

Soler López B contributed to the design, monitoring, statistical analysis and drafted the first manuscript.

The EMOTICAL study group contributed to the inclusion of patients in the study.

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