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ORIGINAL ARTICLE

Emotional intelligence, empathy and alexithymia in anorexia nervosa during adolescence

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Abstract

Purpose Socio-emotional difficulties have been observed on adult patients suffering from anorexia nervosa (AN). But researches with adolescents are scarce and non-congruent. The aim of this paper is to identify the socio-emotional difficulties that are encountered by AN during adolescence, and to isolate them from those encountered by control adolescents.

Method 41 AN and 38 control adolescents were assessed using the emotional quotient inventory by Bar-On, youth version (EQ-i: YV), the Toronto Alexithymia Questionnaire (TAS-20), the Interpersonal Reactivity Index (IRI), and anxiety and depression were controlled using the Hospital Anxiety and Depression Scale (HADS).

Results Personal distress remains the main difference between the two groups, even when depression and anxiety are controlled. Intrapersonal difficulties are observed in the AN group, as well as alexithymic traits.

Conclusion Research on AN has to focus on the socio-emotional difficulties during adolescence, to properly identify which difficulties are linked to that life period, and which are a trait of AN.

Level III Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one center or research group.

Keywords Anorexia nervosa · Emotional intelligence · Empathy · Alexithymia · Adolescence · EQ-i

Introduction

Emotions are at the centre of every human interaction. A deficit in emotional functioning can lead to many difficulties. For example, impairment in emotion recognition, identification, or regulation could make it difficult to keep a job, may lead to substance abuse, to the development of mental health issues, or to minor or major difficulties to cope with life's expectations and challenges [1].

Emotional intelligence (EI) is a concept developed in the 80s–90s by Mayer and Salovey [2] (for an ability model of EI), Goleman [3] and Bar-On [4, 5] (for a mixed model of abilities and trait Emotional and Social Intelligence), or a 'Trait' EI model [6, 7]. Mayer and Salovey revised model of EI understands EI as the "ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions" [2], excluding abilities of flexibility and motivation that could be found in their original model of EI [6], and is assessed via a performance based questionnaire (the Mayer–Salovey–Caruso-Emotional Intelligence Test—MSCEIT). The mixed model of abilities and trait Emotional Intelligence of Bar-On describes EI as an "array of emotional, personal, and social abilities that effect one's overall ability to effectively cope with daily demands and pressures" that is made possible by a "core capacity to be aware of, understand, control, and express emotions effectively" [5, 8]. The psychometric test developed by Bar-On (the Emotion Quotient Inventory: EQ-i) is a self-report questionnaire that assesses trait EI through 5 major dimensions: the intrapersonal intelligence, the interpersonal intelligence, adaptability, stress management, and general mood [8]. The Bar-On model, therefore, assesses one's cross-situational behavioural consistency in their ability to be emotionally and socially 'performant', whereas the ability model of Mayer

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and Salovey has a more cognitive approach of EI which is also closer to the core definition of EI [7].

During adolescence, the changes a person faces to find a place in society and among his or her peers and the modification of his/her body induced by puberty can lead to emotional difficulties. From flat affect to great emotional lability, the emotional life of a teenager can be challenging, and suicide or at-risk behaviours are the first mortality cause during adolescence [9]. On the other side, a well-developed emotional and social intelligence has proved to be linked with well-being [10, 11]. For adolescent in-patients, a good emotional intelligence (EI) protects patients against suicidal ideation, especially when they have a high perceived stress [12].

Emotional functioning in anorexia nervosa (AN) has been an increasing focus of interest during the last 10 years, PubMed entries growing from 35 in 2007 to 78 in 2016 for the research terms "Anorexia" and "Emotion". Indeed, the emergency to find a care that would significantly increase the patients' chances to overcome their disorder has led research teams to focus on genetics—with endophenotype-focus research for example [13]. Neurobiological teams have also been exploring the role of leptin in anorexia [14], or oxytocin [15] respectively, a hormone and a neuropeptide that could have a role in the development and treatment of AN. And last, for psychotherapeutic advances, teams have been interested in the socio-emotional aspects in AN, and emotional profiling in AN [16]. One type of therapy currently developed and perfected is emotion-focused therapy that shows some promise.

AN patients have been described as having an over-responsive fear and experiential avoidance of intense affects [17], and been associated with socio-emotional difficulties. From alexithymic tendencies [18], with higher scores at the Difficulty Identifying Feelings and Difficulty Describing Feelings scales and the total score of the Toronto Alexithymia Scale (TAS-20) than the general population [19, 20], to impaired emotion recognition [21], AN patients often present comorbid anxiety and/or depression. Anxiety and depression seems to be observed especially during the acute state of starvation, which probably exacerbates long-time non-identified emotional difficulties [22].

Difficulties in empathy have also emerged, with an impact on cognitive empathy [23], and AN difficulties on the 'Personal Distress' scale of the Interpersonal Reactivity Index (IRI) [24]. The heterogeneity of the results between studies show how much methodology, even when using the same test (IRI), and the same population (adult AN) has an impact.

But when research with adults on anorexia and emotional aspects exist, those with adolescents on emotional intelligence are, to our knowledge, nonexistent. Even when reasons can be found for methodological aspects, the importance of the issue still remains: most psychiatric disorders appear during adolescence and the sooner they are taken care of, the less chronic the disorders become, and the less impact they might have on ones' core personality.

The studies focusing on AN and EI have used the Mayer–Salovey–Caruso Emotional Intelligence Test (on an adult population) [17], or the Trait Meta Mood Scale (TMMS) [25] (Bourdier included them from 15 years old-onward without separating them from adults). Both research highlighted the role of depressive and anxious traits in the assessment of emotional intelligence, and both observed difficulties in emotional processing in the AN group compared to the healthy control group (HC), but those differences would mostly disappear once anxiety and depression were controlled. The EQ-i adult version has been used in a study on the link between bulimic symptomatology and trait EI, showing some difficulties in the bulimic group compared to the HC, but never on AN, nor has the EQ-i: YV [26].

The aim of this exploratory study is to assess the link between trait EI and AN during adolescence, using an inventory never used before on eating disordered adolescents, and after controlling for anxiety and depressive symptomatology. We expect adolescent AN patients to have more difficulties than adolescent HC in their ability to identify their emotions, and to have more difficulties in the management of their emotions, and the emotions of others.

Methods

Subjects

79 adolescent girls were included in this research:

- 41 girls, see Table 1 (mean age and std. dev 16.2 ± 1.4 years; range 13.1–18.9 years), suffering from anorexia according to the DSM-IV criteria (mean months of illness duration 23.68, Std. dev 18.18; min/max 5/74), using the Eating Disorder module of the DSM-IV, M.I.N.I Kid.6.0 [27] with a percentage of ideal body weight under 90 (%IBW) (mean 79.78; Sd 8.71), were recruited during their hospitalisation in the Psychiatric Department of the Institut Mutualiste Montsouris, in Paris, France (mean number of weeks of hospitalisation prior to inclusion 13.79, Sd 13.91; min/max 0/54). 29 with restricting subtype of AN, and 12 with the binge/purge subtype, according to the M.I.N.I Kid 6.0. Inclusion criteria were: the absence of psychotic symptoms according to the M.I.N.I Kid 6.0, to be fluent in French, and to consent, as well as their parents, to participate to the research.
- 38 healthy controls, all girls, (mean age std. dev 15.84 ± 1.83 years; range 13.1–18.8 years) with a %IBW > 90, where recruited through posters and adver-

Table 1 Results at the EQ-i: YV, TAS-20, IRI and HADS, for the HC and AN group

	HC ($n=38$)		AN ($N=41$)		t score
	M	SD	*M*	SD	
Age	16.4	1.73	16.2	1.44	−0.42
*Studies	5.7	1.44	5.4	1.40	−0.85
% IBW	100.5	11.71	79.8	8.71	**−8.88*****
Intrapersonnal intelligence	96.1	14.12	88.0	16.34	**2.34****
Interpersonal intelligence	101.5	10.06	101.7	10.99	−0.06
Stress management	94.6	13.34	97.4	15.48	−0.85
Adaptability	101.6	14.20	99.2	15.09	0.72
General mood	94.9	12.01	72.3	11.03	**8.69*****
TOT EQ−i	97.4	11.22	94.0	12.14	1.28
Difficulty identifying feelings	17.6	5.51	22.0	5.44	**−3.59*****
Difficulty describing feelings	13.9	4.96	16.4	4.72	**−2.27****
Externally oriented thinking	17.5	5.60	18.6	5.10	−0.90
TOT TAS-20	49.0	11.51	57.0	9.95	**−3.30*****
Perspective taking	17.5	4.49	17.4	4.11	0.09
Fantasy	20.0	4.81	18.0	5.05	1.80
Empathic concern	21.0	3.30	21.1	3.93	−0.15
Personal distress	14.6	3.61	17.9	4.00	**−3.84*****
Cognitive empathy	37.6	7.18	35.5	6.99	1.31
Affective empathy	35.6	5.21	39.0	6.45	**−2.58****
HADS-anxiety	7.6	3.43	10.5	3.59	**−3.65*****
HADS-depression	3.1	2.95	7.2	4.11	**−5.05*****

*Number of years since the 6th grade; % IBW: % of Ideal Body Weight

** p values significant at .05

***p value significant at .01

tisements, inclusion criteria were the absence of past or actual psychological and eating disorder explored with the M.I.N.I Kid 6.0, to be fluent in French, and to consent, as well as their parents, to participate to the research.

Measures

Emotional assessment

The Bar-On Emotional Quotient Inventory: Youth Version (EQ-i: YV) [28] French translation, was used to evaluate the emotional intelligence. The adolescent version was created by Bar-On and Parker using items from the EQ-i, and the formulation was modified to suit the understanding level of a child. Factor analyses were conducted and confirmed the four-factor model, and the one-factor general mood scale, as well as the positive impression scale [28].

This self-report questionnaire consists of 60 items with a total Emotional Intelligence Score, 4 sub-scales that generated a general EQ score:

- the Intrapersonal Intelligence—(INTRA) that evaluates one's ability to understand and express his feelings and needs;
- the interpersonal intelligence—(INTER) that evaluates one's empathy towards others, his understanding of others' emotions and the quality of his relation and interaction with others;
- adaptability—(AD) that evaluates one's ability to adapt and regulate his emotions in different settings, and is a combination of the EQ-i' flexibility reality testing and problem-solving scales
- stress management—(SM) that evaluates stress tolerance and impulse control [28].

Additional scales help to the interpretation of the results: General Mood scale, and a positive Impression scale, and an Inconsistency Index—that we use to verify if the subject has answered authentically and coherently. The BarOn EQ-i:YV uses a 4-point Likert-style format, with response options ranging from "very Seldom True of Me" to "Very often True of Me". Standard scores have a mean of 100 and a standard deviation of 15. Scores below 90 are indicative of problematic levels of emotional intelligence, and the greater the number of scores below 90, the greater the likelihood that the results indicate a moderate to severe problem or deficiency [28].

The EQ-i: YV is one of the most used test of EI for children and adolescents, along with the TEIque. It has so far been used on general population to assess the effectiveness of specific psychological interventions [29], as well as Attention Deficit Hyperactivity Disorder [30], or depressive adolescents [31] for example. This test presents good internal reliability (Cronbach's α for each subscales for females are between 0.82 and 0.90) [28].

The Interpersonal Reactivity Index (IRI) [32]—French version [33], used on adolescents [34], is a self-report questionnaire of 28 items assessing empathy, with two subscales for Cognitive Empathy (CE) [Perspective Taking (PT)—which reflected a tendency or ability of the subject to adopt the perspective, or point of view, of other people ; Fantasy (FS)—which denoted a tendency of the respondent to identify strongly with fictitious characters in books, movies, or plays]; and two subscales for Affective Empathy (AE) [Empathic Concern (EC)—tendency for the respondent to experience feelings of warmth, compassion and concern for others undergoing negative experiences; and personal distress (PD)—which indicated that the respondent experienced feelings of discomfort and anxiety when witnessing the negative experiences of others]. Answers are reported

on a 5-point scale (ranging from 0—does not describe me at all, to 4—describes me very well). Cronbach's α of observed mean scores showed acceptable values, ranging from 0.67 to 0.87 [34].

The Toronto Alexithymia Scale 20-items (TAS-20) French version [35, 36], is a self-report questionnaire of alexithymia that assesses alexithymia with a total score composed of three factors: the difficulty to identify feelings and to distinguish them from body sensations (DIF), the difficulty to describe feelings of others (DDF), and externally oriented thinking (EOT), and a threshold value at the total score of: alexithymic 56. The test presents a good internal consistency for both the DIF ($\alpha > 60$) and DDF ($\alpha > 70$) but not for EOT ($\alpha = 0.43$), the last being a frequent observation in the translations of the TAS-20 on an adolescent population [37].

Clinical assessment

Age, age of onset, duration of the eating disorder, number years at school since the 6eme (French equivalent of the 6th grade in the USA system) was asked to participants.

- The DSM-IV Mini International Neuropsychiatric Interview, French version for children and adolescents (M.I.N.I Kid 6.0) was used to confirm diagnosis of AN, and asses the presence of mood disorder.
- The %IBW—the percentage of the ideal body weight, with the Peck formula, for girls < 18 years. The formula for the IBW is:

$$\begin{aligned} \text{IBW} &= 77.55796 + (6.93728 \times h) \\ &\quad - (0.171703 \times h2) + (0.001726 \times h3). \end{aligned}$$

  The height (h) here is in inch.
- The Hospital Anxiety and Depression Scale: HADS [38] French version, validated in adolescent populations [39, 40], is a 14 item self-report assessment. The HADS is used to diagnose anxiety and depression without somatic aspects of both mood and anxiety disorders. Response are reported on a 4-point (0–3) scales, the higher the score is the more severe is the symptomatology with threshold for each scale at > 8 points: suspicion of disorder, > 11: confirmation of disorder.

Procedures

Referent psychiatrists of patients did a first screening to verify with all entering patients if they met inclusion criteria, before a trained research psychologist, a PhD student trained with clinical interview and standardized assessment, approached them and their parents to ask for written consent. All addressed patients were asked to participate in the research protocol. Patients and controls were assessed individually. Patients were interviewed as soon as consent was obtained from both parents and patients, and only three patients refused to participate. For HC who had accepted to participate to the research, a first screening process happened on the phone, to verify if they understood all inclusion criteria, HC were then interviewed by the same research psychologist, after school at home.

Written informed consent and assent were obtained from all participants and their caregivers and the study was approved by the local ethics committee (the Comité de Protection des Personnes Ile-de-France III the 11/10/2015, no. Am6844-1-3256, EudraCT no. 2015-A00210-49).

Statistical analysis

Analysis were made using the IBM SPSS Statistics Version 19, level of significance was adjusted two-tailed at $p = 0.05$. We first compared the HC group with the AN on all variables using a parametric method: the Student's t test for independent groups (Table 1), we then conducted a Pearson correlation analysis between the variables that showed significant differences at the t test, and the depression and anxiety variables evaluated with the HADS (Table 2) to assess for possible association between the variables. To evaluate how depression and anxiety would predict the link between anorexia (group variable transformed with anorexia coded 1 if present, and 0 if not) and observed emotional difficulties at the comparison test, we conducted a linear regression (Table 3) using the emotional assessment scales as the outcome dependent variable, and for predictors the independent variables: group variable and the variable depression and anxiety (one or both depending on the previously observed correlation, as is requested for this statistical analysis).

Table 2 Correlations between 'mood' variables—anxiety and depression, and the observed emotional difficulties

	Pearson's correlation r	
	Anxiety	Depression
Intrapersonnal (EQ-i:YV)	−0.095	−0.348**
General mood (EQ-i:YV)	−0.499**	−0.622**
Difficulty identifying feelings (TAS-20)	−0.478**	−0.445**
Difficulty describing feelings (TAS-20)	−0.192	−0.326**
Total TAS-20	−0.364**	−0.410**
Personal distress (IRI)	−0.228*	−0.185
Affective empathy (EA)	−0.232*	−0.195

*p significant a 0.05; **p significant at 0.01

Table 3 Linear regression results between the predicted values 'emotional difficulties' and the mood and AN

	Model β; *p* value			Overall fit
	Anxiety	Depression	Group	R^2
INTRA	–	−0.293; 0.02	−0.111; 0.371	0.121
GM	−0.162; 0.059	−0.294; 0.002	−0.495; 0.000	0.612
DIF	0.314; 0.007	0.212; 0.084	0.152; 182	0.302
DDF	–	0.268; 0.035	0.117; 0.352	0.116
TAS-20	0.269; 0.019	0.236; 0.068	0.249; 0.029	0.186
PD	0.087; 0.088	–	0.401; 0.000	0.161
AE	0.145; 0.14	–	0.282; 0.012	0.08

Results

No difference was observed between the two groups for age or level of education.

On the HADS

Differences were observed for the HADS-A scale [$t(77) = -3{,}84$; $p = 0.000$] and the HADS-D scale [$t(77) = -5.05$, $p = 0.000$], with AN scoring significantly higher than HC.

On the EQ-i:YV

For the EQ-i:YV, what we can say by looking at the means of the two groups for each scale, is that when both groups have a total EQ-i:YV score in the average, the AN group has a much more heterogeneous trait emotional intelligence profile than the HC. They have scores that are under the 90 thresholds for INTRA (mean 88.0), and as expected at the general mood (mean 72.3).

Differences were observed on the INTRA subscale [$t(77) = 2.34$, $p = 0.022$], with AN group ($\bar{x} = 88.02$) having more difficulties than HC ($\bar{x} = 96.08$). Significant difference was also observed between the two groups on the General Mood Scale [$t(77) = 8.69$, $p = 0.000$].

INTRA is significantly correlated to depression evaluated with the HADS-D ($r = -0.348$, $p = 0.002$), but not with anxiety ($r = -0.95$, $p = 0.407$).

GM is significantly correlated with both depression ($r = -0.622$, $p = 0.000$) and anxiety ($r = -0.499$, $p = 0.000$), with a stronger correlation with depression.

When INTRA was predicted, it was found that depression ($\beta = -0.293$; p value = 0.02) was a better predictor of emotional difficulties on this sub-scale than the diagnosis of anorexia ($\beta = -0.111$; p value: non-significant n.s), the overall model fit was $R^2 = 0.121$.

When General Mood was predicted, it was found that depression ($\beta = -0.360$, p value = 0.000) and the diagnosis of anorexia ($\beta = -0.524$, p value = 0.000) were significant predictors with on overall fit model of $R^2 = 0.612$, but not anxiety ($\beta = 0.162$, p value = n.s).

On the IRI

Overall, we observe that HC and AN patients have very similar means on the Perspective Taking scale (mean 17.5 vs. 17.4), as well as the Empathic Concern (mean 21.0 vs. 21.1), The Fantasy scale mean results in the AN group are lower than the HC group (mean 20.0 vs. 18.0), while for Personal Distress, the mean scores of the AN group is higher than the HC's (mean 17.9 vs. 14.6).

While conducting a Student t-Test, significant differences were observed for the Personal Distress scale [$t(77)$=-3.84; $p = 0.000$]. A significant difference was also observed in the main scale Affective Empathy ($r = -2.58$, p value = 0.012). No significance was observed for the Fantasy scale.

Comparison between the Personal Distress scale and mood variables showed a significant correlation with anxiety ($r = .228$, $p = 0.043$), but not with depression ($r = 0.185$, $p = 0.10$).

Comparison between the Affective Empathy scale and mood variables showed a significant correlation with anxiety ($r = 0.232$, p value = 0.04), but not with depression.

Linear regressions to understand the mediation of anxiety on Personal Distress ($\beta = 0.087$, p value = n.s) showed that it did not explain the differences between the groups better than the relation between anorexia and personal distress itself ($\beta = 0.401$, p value = 0.000), with an overall fit model of $R^2 = 0.167$. When predicting for the Affective Empathy score with anxiety and the group variable, we observe that anxiety is none significant, and that the Affective Empathy score could be explained by the diagnosis of anorexia ($\beta = 0.282$, p value = 0.012), with an overall fit of $R^2 = 0.08$.

On the TAS-20

Differences were observed on the DIF scale [$t(77) = -3.59$; p value = 0.001], the AN having more difficulties identifying their emotions than HC (means 22.02 vs. 17.6). We have also observed difference at the DDF [$t(77) = -2.27$; p value = 0.26), AN having more difficulties describing their feelings than HC (mean 16.41 vs.13.95). The two groups also scored significantly differently at the total score of the TAS-20 [$t(77) = -3.30$; p value = 0.001).

Correlation between the two sub-scales of the TAS-20 and the 2 sub-scales of the HADS show a strong correlation between the difficulty identifying feelings and anxiety ($r = .478$, p value = 0.000) as well as with depression ($r = 0.445$, p value = 0.000). Difficulty describing feelings only showed a significant correlation with depression ($r = 0.326$, p value = 0.003), and not with anxiety ($r = 0.192$,

p value = n.s). The total score of the TAS-20 appears to be highly correlated to both anxiety ($r = 0.364$, p value = 0.001) and depression ($r = 0.410$, p value < 0.001).

When predicting for the level of difficulty identifying feelings with both anxiety and depression as well as the group variable, we observe anxiety ($\beta = 0.314$, p value = 0.003) is a significant predictor, above depression ($\beta = 0.212$, p value = 0.084) and the anorexia diagnosis ($\beta = 0.152$, p value = n.s), with an overall fit of $R^2 = 0.302$.

When predicting for difficulty describing feelings with depression and the group variable we observe that depression ($\beta = 0.268$, p value = 0.035) is a significant predictor over the diagnosis of anorexia ($\beta = 0.117$, p value = 0.352), with and overall fit of $R^2 = 0.116$.

When predicting for the total score at the TAS-20 with depression and anxiety and the group variable we observe that depression is not significant, and that the total score could be explained by the level of anxiety ($\beta = 0.269$, p value = 0.019) and the diagnosis of anorexia ($\beta = 0.249$, p value = 0.029), with an overall fit of $R^2 = 0.186$.

Discussion

By conducting this research we wanted to explore the difference between trait emotional intelligence, empathy, and alexithymia in a sample of adolescent girls suffering from an anorexia nervosa and a control sample of healthy adolescents. We wanted to do so using an evaluation never used before on this clinical population, the emotional intelligence inventory of Reuven BarOn for children and adolescent, the EQ-i: YV.

Regarding anxiety and depression, the AN group had significantly higher score than the HC at the HADS-D and HADS-A scales, even though the HC's group mean score at the HADS-A was more elevated than the HADS-D. But the tendency for a healthy adult population to present higher anxiety than depression was previously observed in the MSCEIT and AN research [17].

With this research, we were able to highlight the difference in intra-personal trait emotional intelligence between our clinical group and the HC, but that difference could be explained by the high depression traits assessed in the AN group, as shown with the linear regression. Indeed, the difference between the two groups is better explained by depression than the group variable. The results of the groups in the General Mood Scale is explained by depression, which is expected, and the diagnosis of anorexia.

In prior researches focusing on anorexia nervosa and emotional intelligence during adulthood, even if there was a significant difference between patients and healthy controls at the MSCEIT (Mayer–Caruso–Salovey Emotional Intelligence Test), score of the patients were still in the norm. Indeed, their 'worst' score would be in the managing emotion branch of the MSCEIT, and their mean score is 95.35 (scores are similar to IQ standard score : a mean of standard score of 100, and a standard deviation of 15) which is 'normal', and does not reflect high emotional difficulties [17]. Only the HADS-A had a significant negative correlation with the MSCEIT total score. We controlled the difference between HC and AN adolescents, and observed that indeed some of the difference at the trait Intrapersonal emotional intelligence, as well as stress management, and the total score of trait emotional intelligence, could be explained by anxiety or depression.

On a research assessing Emotional Intelligence with the Trait meta mood scale [25], in an AN population composed of adolescents and adults, negative correlations were observed between the HADS-A/HADS-D and the 'Clarity' scale (to be able to discriminate our emotions), and the 'Attention' scale (the ability to focus and pay attention on our emotions), which are close concepts to the INTRA scale of the EQ-i:YV. This corroborates what we have found on the low INTRA score of the AN group, and their high score on the HADS-A and HADS-D compared to HC.

What we have observed in our research on the difference at the INTRA emotional intelligence dimension of the EQ-i: YV reflects more what we see in our daily practice. Indeed, the standard mean score of the anorexic sample is lower than the control sample. And, unlike the control sample which has a mean score that does not show any specific emotional difficulties, the anorexic one is in a 80–89 range, which indicate that their ability to properly identify and express their feelings and needs is underdeveloped, and has room for improvement.

This difficulty for our sample of anorexic adolescents to properly identify their emotions in the INTRA dimension of the EQ-i : YV is also found in the Difficulty Identifying Feelings (DIF) of the TAS-20, where patients show greater difficulties than healthy controls. That result is coherent with what is observed in literature [20] on alexithymia on the same kind of population, and we have showed that this difference can partly be explained by anxiety rather than the diagnosis of anorexia or depression. We also observe that our patients have difficulties in describing their feelings (DDF), and that depression predicts those difficulties of expression of emotions better than the sole diagnosis of anorexia, so much so that the link between anorexia and the DDF disappears when depression is taken into account. Last, global alexithymia traits have shown to be highly influenced by anxiety, as well as the presence of anorexic traits.

On the IRI, one of the main findings is that when conducting a linear regression with anxiety and anorexia as predictor variables, the score at the personal distress subscale is best predicted by the diagnosis of anorexia, over anxiety difficulties, as is the global Affective Empathy scale which

comprises the personal distress score. It is the sole emotional difficulty for which the link with anorexia is not better explained by one of our mood variables (anxiety and depression). A high score in that dimension means that the person might be overwhelmed by anxiety or feel some discomfort when facing someone else's distress. This score is coherent with those observed by Gramaglia [24] on an adult anorexic population. We have also found a significant difference on the main affective empathy, which is not what Calderoni [23] observed on an only restrictive population. This might be explained by our own population which is composed of binge/purge type as well as restrictive type, as well as the high level of personal distress of our AN sample compared to HCs. No significant difference was observed on the cognitive empathy scales between our samples, even if the Fantasy Scale scores of the AN group is lower than the HC group.

Our sample has also shown difficulties in the INTRA scale of the EQ-i: YV, but not at the INTER. This result linked to those found on the IRI scales, put in light the investment of adolescents in their relationships during this period of time, when making friends and being part of a group is important. It is maybe felt as being more valuable by teens than an introspective work on knowing oneself. But this investment is emotionally costly for AN patients, and could be source of distress.

Even if our results are promising, our research do present some limitations. First the size of our population is small, and even if we have used the appropriate statistical tests to counter it, our results should be taken with caution. Second, using a self-report on a population that is known to have difficulties knowing well themselves (healthy adolescents or clinical population) for obvious practical reasons, is limiting, and we intend to use other evaluations in a close future. Last, having no other research on that same population using the same evaluation, makes the interpretation of our results much more delicate. We hope that new researches will make up for those methodological limits, and our research team will continue exploring the emotional difficulties in place during adolescence, with or without a psychological disorder.

Perfect knowledge of all the subtleties of emotional difficulties during adolescence, and especially in this case when presenting an eating disorder, should help us develop specific patient care, tailor made for each emotional profile encountered in eating disorders, and avoid systemizing generalizations on alexithymia traits, or emotional inhibition in those patients for example.

In conclusion, we have observed that patients with anorexia during adolescence present emotional difficulties that are heightened by anxiety and depression, except for their difficulty to cope with others' distress. This might put patients in difficulty and should be taken into account during long-term hospitalizations. The almost systematic psychotherapeutic or medical prescription for anxiety and depression in our institutions seems, in light of what we observed in our research, absolutely justified.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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