

# Differences in emotion regulation along the eating disorder spectrum: cross sectional study in adolescents out patient care

## Abstract

**Background:** Emotion-regulation (ER) difficulties among individuals with eating disorders (EDs) are thought to contribute to the development and maintenance of eating disorders.

**Aims:** The present study explores the differences in ER difficulties along the eating disorders spectrum, to reveal the basing emotional mechanism in each subtype.

**Method:** In this case-control study, 91 girls, aged 11–18, diagnosed with eating disorders (EDs) according to DSM-V (35 ANRT, 29 ANBP, and 27 BN) were compared to 41 age-matched healthy controls (HC). Comparisons between the following ER dimensions were performed: alexithymia, anxiety, depression, DERS's components: Awareness and clarity of emotional states; acceptance of emotional distress; ability to engage in goal directed behavior and refrain from impulsive behavior as well as access to appropriate strategies that are perceived as effective to modulate the duration and/or intensity of emotional responses.

**Results:** The overall level of eating pathology was similar in BN and ANBP and higher than the ANRT group ( $p < 0.001$ ). The ANBP group reported significant higher level of alexithymia and depressive symptoms than the ANRT group and similar to the BN group ( $p < 0.001$ ). The anxiety levels of all patient groups were similar and higher in comparison to the HC ( $p < 0.001$ ). ANRT group presented significantly higher levels of alexithymia, depressive symptoms, anxiety and impulse control in comparison to HC ( $p < 0.001$ ) and significantly lower levels of alexithymia, depressive symptoms, and impulse control in comparison to ANBP ( $p < 0.001$ ). ANBP reported greater ER significant difficulties than ANRT ( $p < 0.001$ ) indicated by greater DERS total scores and DERS subscale scores non-acceptance, clarity and impulse control. ANBP and BN did not differ from each other on the DERS total score.

**Conclusion:** ANBP and BN seem to be originated from combination of defects in the emotional regulation as well as the impulse regulation system and both should be targeted during treatment.

**Keywords:** emotion regulation, eating disorder, adolescents

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Alina Segal,<sup>1,2</sup> Moria Golan<sup>1,3,4</sup>

<sup>1</sup>School of Nutritional Sciences, The Hebrew University of Jerusalem, Israel

<sup>2</sup>Maccabee Health Organization, Israel

<sup>3</sup>Shahaf Community Services for the Management of Weight-Related Problems, Israel

<sup>4</sup>Department of Nutrition, Tel Hai Academic College, Israel

**Correspondence:** Alina Segal, School of Nutritional Sciences, The Hebrew University of Jerusalem, Israel, Tel 972-544-887-621, Email segal-ah@netvision.net.il

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**Abbreviations:** ER, emotion regulation; ED, eating disorders; EMA, ecological momentary assessment; AN, anorexia nervosa; ANRT, anorexia nervosa restrictive type; ANBP, anorexia nervosa binge/purge; BN, bulimia nervosa; HC, healthy control; DSM-V, diagnostic and statistical manual of mental disorders, fifth edition; BMI, body mass index; SDS, standard deviation score; NS, not statistically significant; EAT-26, eating attitudes test; EDI-2, eating disorder inventory-2; DERS, difficulties in emotion regulation scale; TAS-20, toronto alexithymia scale; BDI, beck depression inventory; HAM-A, hamilton rating scale for anxiety; BSI, brief symptom inventory; SPSS, statistical package for social sciences; ANOVA, analysis of variance

## Introduction

Emotion-regulation (ER) difficulties among individuals with eating disorders (EDs) are thought to contribute to the development and maintenance of those disorders.<sup>1</sup> A key hypothesis in this context is that individuals with EDs display deficits in their ER and lack the skills required to adaptively and effectively cope with negative affective states.<sup>2</sup> The age of eating disorders onset is usually at early puberty. Developmentally, adolescence is characterized by significant biological and physical changes often accompanied by heightened emotional reactivity, instability, hypersensitivity to peer vulnerability to internalizing and externalizing psychopathologies associated with

poor emotion regulation, including depression, anxiety and antisocial behavior.<sup>3</sup> Evidence suggests that ongoing structural and functional brain development during adolescence, may contribute to adolescent-specific behaviors and that structural brain like sub cortical and limbic regions, that sub serve emotion generation and regulation show developmental change.<sup>4</sup> During the time lag in functional maturity between prefrontal and limbic regions, adolescents are less effective at regulating their own emotions and are more affected by emotional context.<sup>3</sup>

From this perspective, ED behaviors (e.g., binge eating, purging, and restriction), may be viewed as efforts to avoid or reduce negative emotions, and in that regard, may be seen as functioning strategies to regulate emotions.<sup>5</sup> Binge attacks and/or purge behavior are then seen as attempts to cope with negative affect by providing short-term comfort or distraction.<sup>5</sup> Etiological models of EDs emphasize the role of difficulties in ER as trans-diagnostic factors across the ED spectrum.<sup>6</sup> The trans-diagnostic approach, proceeds from the notion, that all eating disorders have similar emotional dysregulation as the core characteristics and underlying psychopathology reflected in analogous attitudes and behaviors like restrictive, bingeing and purging that are understood as ineffective coping mechanism that attempts to influence, change, or control painful emotional states.<sup>6</sup> The presence of co-occurring psychopathology in ED is common. Self-regulation difficulties are expressed via anxiety and/or depression, which are

extremely frequent in subjects with ED.<sup>7</sup> Affective lability, heightened emotional arousal or the tendency to experience frequent fluctuations in affective states is common in adolescence and has been posited to increase one's vulnerability to engaging in maladaptive behaviors that may function as strategies to regulate aversive emotional states.<sup>3</sup>

Ecological momentary assessment (EMA) studies in AN samples have reported significant associations between affect lability and ED behaviors and higher daily levels of negative affect have been found to predict an increased likelihood of dietary restriction on subsequent days in AN group.<sup>8</sup> Negative affect was the only significant longitudinal predictor of purging following normal eating in ANBP.<sup>8</sup> Findings about the level of depression in different ED group are not consistent. Danner (2014) found higher depressive levels in ANRT and ANBP groups than in BN<sup>9</sup> and Brockmeyer<sup>10</sup> found higher depressive levels in ANBP group compared to ANRT and BN.<sup>10</sup> Rozenstein & colleagues<sup>11</sup> found that depression explained group differences 'scores in identifying feelings and difficulties in describing feelings for patients with ANRT but not for patients with BN and ANBP. Rozenstein and colleagues suggested that different mechanisms might underlie difficulties with identifying and communicating emotions (Alexitimia), for patients who restrict versus patients who engage in bingeing and purging behaviors. Specifically, while depression may directly contribute to difficulties with identifying and expressing emotions and greater use of suppression in patients who restrict, it may be that the increased impulsivity and affective instability is underlined behind the affective difficulties of patients with bingeing and purging behaviors.<sup>11,12</sup>

Several theoretical accounts have focused on anxiety, a specific facet of negative affect, as being particularly relevant to the etiology, maintenance, and treatment of ED. Comorbid anxiety disorders occur significantly more frequently in AN individual's than in controls, with lifetime prevalence rates of up to 50% and 41% to 75% in BN individuals.<sup>7</sup> EMA study in ANRT and ANBP groups, in the natural environment, support a strong association between varying patterns of daily anxiety patterns and the occurrence of ED behaviors such binge eating, self-induced vomiting and dietary restriction.<sup>8,13</sup> Although studies that measured anxiety level in ANRT, ANBP and BN groups report higher level compared to HC and no significant differences between them.<sup>7,9,10</sup>

In respect to the urge axis (impulse and desires), ED subtypes differ in terms of impulsivity.<sup>10</sup> Studies using neuropsychological tests repeatedly found exaggerated impulsive decision making and impaired inhibitory control in both BN and ANBP [14]. Danner<sup>9</sup> suggest that the binge/purge patients with AN differed in significant ways from patients with the restrictor form of AN and that fundamental psychological and neurobiological differences exist between the two subgroups.<sup>9,15</sup> The ANBP patients had less inhibitory control than ANRT patients and HCs, and this was linked to higher rates of impulsivity, more reports of stealing behavior, suicide attempts and self-injurious behavior and, it appears to be associated with a more negative outcome.<sup>5,15,16</sup> The characteristics of ER among adult patients with EDs have tended to focus on one or two patient groups, such as AN and BN.<sup>12,17</sup> Recently Lavender and colleagues<sup>18</sup> reviewed studies on ER and ED conducted within the two last decades and indicated a number of market limitation. Limitations include issues related to sampling, utilization of small or mixed ED samples. Moreover, relatively few studies include outpatient adolescents with eating psychopathology and measures of ER<sup>18</sup> which is the focus of our study. Only few studies have examined emotion dysregulation across various diagnostic groups.

These studies suggested the presence of greater ER difficulties in BN versus ANRT.<sup>5,10</sup> The degree to which emotion dysregulation dimensions are associated with ED symptoms within specific diagnostic groups, especially at the beginning of the illness course, remains unclear while not much is known about similarity and differences in emotion regulation between different types of ED. To overcome some of the limitations of previous studies studying only part of ED diagnosis and examining only partial ER dimensions as well as dealing with adult population, the present study explores the differences in ER functions along the spectrum of ED (i.e., ANRT, ANBP, BN) as compared to healthy control (HC) group to reveal the underline emotional mechanism of eating disorders in adolescents. In line with the theoretical models highlighting ER difficulties in the development and maintenance of EDs, we hypothesized that

- All ED subtypes will report higher levels of alexithymia, anxiety, depression and all other assessed facets of ER than HCs (i.e., ANRT, ANBP, BN vs. control). Based on models describing ER difficulties as trans-diagnostic phenomena, we expected that
- ED subtypes would not differ in most of the ER components assessed. However, according to the specific phenotype of the ED subtypes (binge/purge vs. restricting), we expected that
- The ANRT and ANBP groups would report higher levels of depression and alexithymia than the BN, group. Regarding impulse control, we hypothesized that
- ANBP and BN groups would show heightened impulsive and impaired inhibitory controls compared to ANRT and HC. The fifth hypothesis was explorative and aimed to
- Clarify if additional ER differences between the ED adolescents groups vs. ED adult groups examined in the literature will be found, since the development of the emotion regulation is different in puberty and in adulthood.

## Materials and methods

### Participants

In this case-control study, 91 girls with eating disorders (ED), aged 11–18 from community-based outpatient care, at two public ED centers in the north and center of Israel, and 41 healthy controls (HC) were enrolled. The subsamples of the treated groups were composed of 35 diagnosed with ANRT, 29 with ANBP, 27 with BN. All applied for treatment for the first time. Diagnosis was performed according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V)<sup>19</sup> as assessed by specialist child and adolescent psychiatrists and pediatricians, highly experienced in the treatment of eating disorders including medical examinations, as well as diagnostic evaluations for eating disorder psychopathology and co morbid conditions. The control group included 41 age-matched healthy participants (HCs) recruited via advertisements in the local schools media. Participants and their parents (81.25% of those approached) signed a written consent form, approved by the Institutional Review Board of Maccabi Health Care Service for participants less than 18 years of age. They completed baseline assessments and then filled out the study questionnaires presented by two trained clinical dietitians. Another 21 patients (9 ANRT, 5 ANBP, 7 BN) refused to complete the baseline assessment and were excluded from the current study. No differences were observed in baseline characteristics between those who filled the questionnaire and those who refused (all *p* values > 0.5).

Study-inclusion criteria were ,

- i. Age 11-18years,
- ii. Medical stability at presentation for treatment,
- iii. No co morbid psychotic disorders, mental retardation, past ED hospitalization, gastrointestinal disease, diabetes or epilepsy.

Exclusion criteria for the HC group were any current diagnosis according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V)<sup>19</sup> and a lifetime diagnosis of any ED. Five HC adolescents, which completed the questionnaires, did not fit the criteria, and were excluded. Sociodemographic characteristics including personal and familial details were obtained from each participant at base line. Participants' height and weight were measured on electronic scale and BMI was calculated and presented in Table 1.

## Measurements

Eating Attitudes Test (EAT-26):<sup>20</sup> The EAT-26 has been particularly useful as screening tool to assess "eating disorder risk". Individuals who score 20 or more on the test should be interviewed by a qualified professional to determine if they meet the diagnostic criteria for an eating disorder. The tests are rated on a six-point scale in response to how often the individual engages in specific behaviors. The measure has demonstrated good validity and reliability in the past research including in studies with ED samples ( $\alpha = 0.83-0.9$ ). In this study, internal consistency was excellent for the total score ( $\alpha=0.943$ ). The Eating Disorder Inventory-2 (EDI-2)<sup>21</sup> is one of the most widely used instruments designed to measure psychological characteristics and behaviors describing the psychological functioning of individuals diagnosed with eating disorders. It includes 91 items divided into 11 subscales; Drive for thinness; Bulimia; Body dissatisfaction; Ineffectiveness; Perfectionism; Interpersonal distrust; Introspective awareness; Maturity fears; Asceticism; Impulse Regulation; Social Insecurity. High internal consistency values were reported for most of the scales of the inventory ( $\alpha = 0.9-0.82$ ). In our study except for Perfectionism which had lower internal validity ( $\alpha = 0.487$ ) all other subscales had good internal validity ( $\alpha = 0.676-0.90$ ). The total score had excellent internal validity ( $\alpha = 0.967$ ), which points to high reliability of the measurement instrument.

Difficulties in Emotion Regulation Scale (DERS):<sup>22</sup> The DERS is a 36-item self-report questionnaire that comprehensively assesses the multidimensional construct of emotion regulation. The measure provides a total score and six subscale scores: no acceptance (no acceptance of emotional states), strategies (limited access to adaptive emotion regulation skills), goals (difficulty with goal-directed behavior in the context of emotional distress), impulse (difficulty controlling behaviors when upset), clarity (lack of emotional clarity) and awareness (lack of emotional awareness). Items are rated on a 5-point Likert-type scale and are summed such that higher than 78 total score, indicates emotion dysregulation. Higher score than 12, 16, 14, 11, 11, and 14 on each subscale respectively, demonstrate difficulty in the specific emotion ability. The measure has demonstrated good validity and reliability in past research<sup>5</sup> including in studies with ED samples. Internal consistency in our study ( $\alpha=0.93$ ) for the total and ( $\alpha=0.92-0.872$ ) for subscales. The Hebrew version reliability and validity have been established by the researchers. Internal consistency in this sample was good for the total ( $\alpha=0.95$ ) and subscale ( $\alpha = 0.707-0.924$ ) scores. The Toronto Alexithymia Scale (TAS-20) self-reports was used to measure alexithymia.<sup>23</sup>

The measure consist of 20 items and 3 factors

- a. Difficulty in identification of emotions;

- b. Difficulty in description of emotions; and

- c. A cognitive component assessing externally oriented thinking. On a 5-point Likert scale, participants indicate how often these items apply to themselves. Individuals who score 61 or higher on the TAS-20 are identified as alexithymic. The reliability and validity ( $\alpha = 0.86$ ) have been demonstrated in previous studies.<sup>11</sup> Internal consistency in our sample was good for the total ( $\alpha=0.883$ ) and sub scale ( $\alpha =0.616-0.867$ ) scores.

The Beck Depression Inventory (BDI) was used to measure depression level. It is a 21-item self-report questionnaire widely used as self-report inventory for measuring symptoms of depression.<sup>24</sup> Each answer is being scored on a scale value of 0 to 3. Potential scores of the BDI range from 0 to 63, score between 0-9 is asymptomatic, 10 -18 indicate mild depression, 19-29 mild to severe and higher than 30 indicating severe depressive symptoms. The psychometric properties of the BDI have been well established ( $\alpha=0.91$ ). Internal consistency in this sample was good for the total ( $\alpha=0.943$ ). Hamilton Rating Scale for Anxiety (HAM-A) was used to measure the severity of anxiety symptoms<sup>25</sup> The scale consists of 14 items, each defined by a series of symptoms, and measures both psychic anxiety (mental agitation and psychological distress) and somatic anxiety (physical complaints related to anxiety). Each item is scored on a scale of 0 (not present) to 4 (severe), with a total score range of 0-56, where <17 indicates mild severity, 18-24 mild to moderate severity and 25-30 moderate to severe. ) Internal consistency is ( $\alpha = 0.74-0.96$ ) and in the present study was good ( $\alpha = 0.911$ ). The Brief Symptom Inventory (BSI) was used to measure the general psychopathology and psychological distress.<sup>26</sup> It is a 53-item self-report inventory in which participants rate the extent to which they have been bothered (0 = "not at all" to 4 = "extremely") by various symptoms; somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychotics. Total score higher than 63 indicates the presence of psychological distress. Internal consistency is ( $\alpha=0.71-0.85$ ) and in the present study internal consistency was good ( $\alpha=0.839$ ).

## Statistical analysis

All statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS) version 19 for Windows. The present study was powered to detect a significant difference between the different diagnosis groups at baseline required to DERS subscales questionnaire as reported in the literature.<sup>5</sup> According to the aims of the study, a significant difference of 4.5 points between the different groups required sample size of 22 subjects which is the bigger outcome, for a significance level of 5% ( $\alpha = 0.05$ ) and intensity of 80% ( $\beta = 0.2$ ).<sup>22</sup> Assuming a two-tail analysis,  $\alpha=0.05$ , SD of 4.4 and 20% drop-out – The minimum sample size was 27 in each group. Calculations were made with software version 11.12 winpepi. All variables included in the analyses were first examined for normality. To compare clinical characteristics (BMI and questionnaire scores) between the ED groups, one-way analyses of variance (ANOVA) and post hoc comparisons (Tukey) or nonparametric Kruskal-Wallis test were performed for variables with normal or skewed distribution, respectively. Several one-way ANOVAs and post hoc comparisons were conducted with participant group as the independent variable, and total DERS score as well as those of each DERS subscale as dependent variables. Analyses revealed significant differences between groups for all DERS subscales and total score. Pearson's or Spearman's correlation analyses were performed for variables with normal or skewed distribution, respectively, to examine the relations between emotion dysregulation, depressive symptoms and anxiety with BMI, and overall level of eating pathology, within each

subgroup. To reduce Type 1 errors stemming from multiple variables, we used the Bonferroni correction. According to the Bonferroni correction, differences were considered significant if  $p < 0.003$  (a total of 14 variables were tested). Stepwise linear regression analyses were performed to identify variables associate with severe symptoms (according to total EDI-2 scores) for each sub group separately. The following independent variables were included in the first step of each model: emotion regulation difficulties (DERS), alexithymia (TAS-20), depression (BDI), anxiety (HAM-A), psychological distress (BSI) and BMI.

## Results and Discussion

### Results

**Age and BMI:** There was a main effect of age, with the ANRT group being younger than the BN group ( $p < 0.001$ ) (Table 1). As expected, groups differed with respect to their mean BMI, with ANRT and ANBP having the lowest BMI values compared to both BN and HCs. BN did not differ from HC but differed significantly from ANRT and ANBP ( $p < 0.001$ ). All groups except the ANRT group (18.1 in Table 1) presented a mean BMI within the healthy range (18–25 kg/m<sup>2</sup>).

**Length of illness:** ANBP and BN groups had a longer pretreatment period of ED symptoms' compared to the ANRT group ( $p < 0.005$ ).

**Eating pathology:** As expected, groups differed in self-reported levels of clinical characteristics (Table 2).

### Self regulation scales

The ANBP group reported significantly higher levels of alexithymia and depressive symptoms than the ANRT group and levels similar to the BN group. ANBP and BN reported the highest levels of alexithymia and depressive symptoms, followed by the ANRT and HC groups, in descending order ( $p < 0.001$ ). The anxiety levels of all patient groups were similar and higher than those of the HCs ( $p < 0.001$ ). Psychological distress in the ANBP group was

reported to be significantly higher than in the ANRT group, and non significantly higher than in the BN group. All three patient groups had significantly higher psychological distress than the HC group ( $p < 0.001$ ). The post hoc pair wise comparisons revealed that ANRT, ANBP and BN patients reported greater overall ER difficulties than HCs, as indicated by greater DERS total scores ( $p < 0.001$ ) (Table 2). There were some differences between the groups on specific subscales. The subscales 'lack of emotional awareness' and "clarity" were higher only in the ANBP group compared to the HCs ( $p = 0.006$ ). ANRT and BN were similar to the HC ( $p < 0.001$ ) in these factors. The ANBP group reported higher difficulty in ER in comparison to ANRT group, as indicated by greater DERS total score and 3 subscale scores: non acceptance, clarity and impulse control ( $p < 0.001$ ). ANRT and BN were similar on the DERs total score ( $p < 0.001$ ) and on all subscales scores except "No acceptance of emotional response".

The ED subtypes groups did not differ with respect to the DERS subscales 'goal-directed behavior', 'emotional awareness' or 'access to ER strategies' ( $p < 0.001$ ). ANBP reported greater problems than ANRT with respect to impulse control, and did not differ from BN ( $p < 0.001$ ). All three ED groups had significantly higher scores on the impulse control scale, than the HC group. No significant correlations were found between BMI and ER difficulties (DERS), alexithymia (the Toronto Alexithymia Scale-TAS-20), depression (the Beck Depression Inventory—BDI), anxiety (the Hamilton Rating Scale for Anxiety-HAM-A) or psychological distress (the Brief Symptom Inventory—BSI), in either the research or control participants. Significant positive correlations were found for all groups between ED symptomatology (the Eating Disorder Inventory-2-EDI-2) and difficulties in ER (DERS), alexithymia (TAS-20), depression (BDI) and psychological distress (BSI). The strongest correlation was found in the ANBP group (Table 3). Significant correlations were also found between ED pathology and higher anxiety levels (HAM-A) in all groups except the ANBP and HC groups. However, the anxiety subscale of psychological distress (BSI) was correlated with ED pathology in all groups.

**Table 1** Sample and clinical characteristics of the final sample

	ANRT	ANBP	BN	HC	p
	n=35	n =29	n=27	n=41	
Age	15.6±2.0a	16.4±1.5ab	16.9±1.4b	16.3±2.0ab	<0.001
BMI-SDS	-1.01±1.21a	-0.56±0.85ab	0.37±0.73c	0.05±0.84bc	<0.001
BMI	18.1±2.2	19.4±1.8	22.8±3.7	22.8±2.7	<0.001
Country of birth					
Israel	34	27	27	37	
Other	1	2	—	4	NS
Marital status (married number)	28	26	22	33	NS
Father education					
Academic degree (n)	11	8	7	14	
Vocational (n)	13	11	12	17	NS
High school (n)	11	10	8	10	
Mother education					
Academic degree (n)	16	10	13	21	
Vocational (n)	10	14	10	15	NS
High school (n)	9	5	4	5	
Length of illness/symptoms (months)	5.1±2.0a	6.9 ±2.7b	6.5±2.1b	0	0.005

ANRT, Anorexia Nervosa Restrictive Subtype; ANBP, Anorexia Nervosa Binge-Purge Subtype; BN, Bulimia Nervosa; HC, Healthy Control; BMI, Body Mass Index; SDS Standard Deviation Score Ns, not statistically significant. Different superscripts denote significant group differences after post hoc Tukey comparison. There were no differences between groups (NS) in sociodemographic characteristics, country of birth and parents' education ( $p < 0.05$ ).

**Table 2** Mean (and SD) scores of the ANRT, ANBP, BN and HC groups for eating disorder symptomatology (EDI-2), alexithymia (TAS-20), depression (BDI), anxiety (HAM-A), psychological distress (BSI) and emotion regulation difficulties (DERS)

	ANRT	ANBP	BN	HC	Scoring Pathology	p
EDI-2 total score	101.2±36.3 <sup>b</sup>	141.2±47.7 <sup>c</sup>	133.2±44.7 <sup>c</sup>	54.2±25.6 <sup>a</sup>	>78	<0.001
TAS-20 total score	58.3±13.7 <sup>b</sup>	67.1±10.5 <sup>c</sup>	60.8±10.5 <sup>bc</sup>	45.0±10.5 <sup>a</sup>	61 < 0-9 non	<0.001 <0.001
BDI	21.3±11.6 <sup>b</sup>	30.5±12.4 <sup>c</sup>	24.3±12.4 <sup>bc</sup>	7.1±8.3 <sup>a</sup>	10-18 mild 19-29 moderate 30 < severe	<0.001
HAM-A	21.9±11.0 <sup>b</sup>	26.0±10.7 <sup>b</sup>	23.5±13.4 <sup>b</sup>	8.9±6.0 <sup>a</sup>	0-17 mild 18-24 moderate 25-30 severe	<0.001
BSI	89.5±40.6 <sup>b</sup>	121.1±39.7 <sup>c</sup>	100.8±34.1 <sup>bc</sup>	43.2±23.2 <sup>a</sup>	63 <	<0.001
DERS: No acceptance of emotional responses	12.9±4.5 <sup>a</sup>	18.6±5.8 <sup>b</sup>	19.7±6.2 <sup>b</sup>	10.9±4.5 <sup>a</sup>	12 <	<0.001
DERS: Lack of emotional awareness	16.8±4.6 <sup>ab</sup>	19.3±5.2 <sup>b</sup>	17.6±3.9 <sup>ab</sup>	15.4±4.0 <sup>a</sup>	14 <	0.006
DERS: Lack of emotion clarity	13.2±4.7 <sup>a</sup>	17.3±3.9 <sup>b</sup>	14.1±4.8 <sup>a</sup>	11.6±4.8 <sup>a</sup>	11 <	<0.001
DERS: goal-directed behavior	19.8±4.7 <sup>b</sup>	20.2±3.9 <sup>b</sup>	19.1±3.5 <sup>b</sup>	13.5±5.2 <sup>a</sup>	14 <	<0.001*
DERS: impulse-control difficulties	15.8±6.4 <sup>b</sup>	21.0±5.6 <sup>c</sup>	19.3±6.3 <sup>bc</sup>	10.7±4.6 <sup>a</sup>	11 <	<0.001*
DERS: strategies	26.2±8.3 <sup>b</sup>	30.0±6.6 <sup>b</sup>	28.5±5.6 <sup>b</sup>	15.5±7.0 <sup>a</sup>	16 <	<0.001
DERS total score	104.8±24.6 <sup>b</sup>	126.3±21.9 <sup>c</sup>	118.3±21.5 <sup>bc</sup>	77.7±18.2 <sup>a</sup>	79 <	<0.001

ANRT, anorexia nervosa restriction type; ANBP, anorexia nervosa binge-purge; BN, bulimia nervosa; HC, healthy control; EDI-2, Eating Disorders Inventory; TAS-20, Toronto Alexithymia Scale; BDI, Beck Depression Inventory; HAM-A, Hamilton Rating Scale for Anxiety; BSI, Brief Symptom Inventory; DERS, Difficulties in Emotion Regulation Scale; \*Kruskal-Wallis test. Different superscripts denote significant group differences after post hoc Tukey comparison. The overall level of eating pathology differed between the groups; the HCs differed, as expected, from all groups ( $p < 0.001$ ). The overall level of eating pathology was similar in BN and ANBP groups and higher than the ANRT group ( $p < 0.001$ ).

**Table 3** Pearson and Spearman correlations between eating disorder symptomatology (EDI-2) and emotion regulation difficulties (DERS), alexithymia (TAS-20), depression (BDI), anxiety (HAM-A), psychological distress (BSI) and BMI

EDI-2	DERS	TAS-20	BDI	Depression	HAM-A	Anxiety BSI	BSI	BMI	p
ANRT	r=0.587	r=0.484	r=0.638	r=0.679*	r=0.483	r=0.721	r=0.664	NS	<0.001
ANBP	r=0.856	r=0.781	r=0.674	r=0.726	NS	r=0.647	r=0.79	NS	<0.001
BN	r=0.729	r=0.587	r=0.840	r=0.756*	r=0.549	r=0.747	r=0.82	NS	<0.001
HC	r=0.566	r=0.310	r=0.721	r=0.547	NS	r=0.436	r=0.5	NS	<0.001

ANRT, anorexia nervosa restriction type; ANBP, anorexia nervosa binge-purge; BN, bulimia nervosa; HC, healthy control; EDI-2, Eating Disorders Inventory; DERS, Difficulties in Emotion Regulation Scale; TAS-20, Toronto Alexithymia Scale; BDI, Beck Depression Inventory; HAM-A, Hamilton Rating Scale for Anxiety; BSI, Brief Symptom Inventory; BMI, body mass index; NS, not significant; \*Spearman correlations.

**Table 4** Variables associate with higher ED severity (total EDI-2) for each group

Group	Variables in the final model	B (SE)	P	R2
ANRT	BSI-anxiety	28.0 (4.6)	<0.001	0.578
	BMI-Z	7.3 (3.5)	0.043	
	constant	56.1 (10.3)	<0.001	
ANBP	DERS-total	1.3 (0.3)	<0.001	0.84
	BSI-total	0.6 (0.1)	0.001	
	Hamilton-total	-1.1 (0.4)	0.015	
	constant	-68.5 (23.3)	0.007	
BN	BSI-total	1.1 (0.1)	<0.001	0.675
	constant	24.9 (15.8)	0.129	
HC	DERS-total	0.5 (0.2)	0.026	0.415
	BSI-depression	17.1 (6.9)	0.018	
	constant	2.9 (14.6)	0.846	

ANRT, anorexia nervosa restriction type; ANBP, anorexia nervosa binge-purge; BN, bulimia nervosa; HC, healthy control; EDI-2, Eating Disorders Inventory; DERS, Difficulties in Emotion Regulation Scale; TAS-20, Toronto Alexithymia Scale; BDI, Beck Depression Inventory; HAM-A, Hamilton Rating Scale for Anxiety; BSI, Brief Symptom Inventory; BMI, body mass index.

The variables associated with higher ED severity differed between groups. In the ANRT higher ED severity was associated with higher anxiety, and higher BMI. In the ANBP group, higher ED severity was positively associated with DERS and total BSI and negatively with HAM-A. In the BN group, similar to the ANBP group, higher ED severity was associated total BSI score (Table 4).

## Discussion

This is the first time that potential differences in self-reported ER difficulties have been investigated between the restricting and binge/purge subtypes of AN and, BN in an adolescent outpatient population. The length of illness of the ANBP and BN groups had a longer pretreatment period of ED symptoms' compared to the ANRT group ( $p < 0.005$ ). This could be attributable to BMI within the healthy range, secrecy and denial of eating problems by adolescents, and a sense of shame or guilt that are a part of the illness.<sup>27</sup> In line with our first hypothesis, all ED subtypes reported significantly higher ER difficulties than HCs in both experiencing and differentiating emotions, as well as in the attenuation and modulation of emotions. These findings replicate and extend results from previous adult ED population studies,<sup>5,12</sup> thereby supporting the relevance of ER difficulties in ED.<sup>6</sup> Most previous studies examined relationships between ER difficulties and emotional problems in ED as a whole group<sup>5,12</sup> whereas the results of the present study highlight the importance of distinguishing between ED subtypes. In partial support of our second hypothesis, in addition to impulse-control difficulties, ANRT, ANBP, and BN differed with respect to DERS subscales. The ANBP group had higher scores than the ANRT group on ED pathology, total ER difficulties as well as on three DERS subscales: nonacceptance of emotional responses, lack of emotional clarity and impulse-control difficulties.

The BN group presented intermediate scores with respect to ER difficulties. These findings contraindicate the view of eating disorders as trans-diagnostic syndrome across the ED spectrum.<sup>6,12</sup> Contrary to our third hypothesis, the ANBP group showed significantly higher levels of depression (severe depression) compared to the ANRT group but not significantly different from the BN group. Anxiety levels were similar in all ED groups. Our fourth hypothesis (impulse control difficulties: BN = ANBP > ANRT) received partial support as the ANBP-but not BN-group reported more difficulties than ANRT regarding impulse control in an ER framework. These impulse-control difficulties have been linked to binge eating and purging behaviors.<sup>17</sup> Previous study on adolescents ED groups,<sup>28</sup> supports the hypothesis that differences in neural function can be identified between ANRT and the binge/purge groups (ANBP/ BN), during a task requiring inhibitory control, and reported that the ANBP/ BN showed increased activation in the right dorsolateral prefrontal cortex, suggesting inefficient or possibly compensatory activation. The finding of increased hypothalamic activation suggests aberrant responses in a region associated with emotional function that might also indicate that the binge-purge group is experiencing greater stress during response inhibition.<sup>29</sup> No evidence of comparable correlates of increased inhibitory control was found in the ANRT.<sup>28</sup> This finding differs from adults findings with BN<sup>30</sup> who found decreased activation in the fronto-striatal region. These differences could result from developmental differences, clinical severity chronicity, diagnosis (ANBP versus BN) and co-morbidity.

In the present study the adolescent groups, were not severely malnourished and with relatively short duration of ED symptoms, suggesting that these neural processes occur prior to, or early in the evolution of the disorder, and may not be the result of chronic disease

or state dependent starvation. The results highlights that adolescent subjects with binge-purge behaviors (ANBP, BN) likely differ from ANRT on clinical and neural level of the inhibition response, and therefore risks and effective interventions may differ between these two groups. This finding is in agreement with a previous study and the phenotypical differences between ANRT and ANBP.<sup>28</sup> Nevertheless, in the present study the BN group did not differ from the ANRT group in impulse control, which replicated mixed findings.<sup>5,10,31</sup> Our fifth, explorative hypothesis concerned the comparison of ED adolescents and ED adult population subtypes (ANRT ANBP, BN). Previous studies on ER of adult population, found greater emotional clarity and awareness deficits in AN versus controls but AN diagnostic subtypes have not been found to differ.<sup>10,32</sup>

In the present study, the "awareness" subscale did not differ between the ED groups, except the ANBP compared to the HC. One possible explanation for the absence of differences in emotional awareness between the ED groups may be that being aware of one's emotions is well known in ED, but not sufficient condition for adaptive emotion regulation or healthy response especially in adolescent population. In respect to the "clarity" sub scale only the ANBP group showed difficulties in understanding and distinguishing between emotional states. That could be explained by the immature ability at this age, as well as discriminate of emotional states, mainly due to severe depression which was found in the ANBP. Additional, the ANBP and BN but not ANRT displayed reduced emotional expression enhance avoidance and suppression. Larsen et al.,<sup>33</sup> suggest reciprocal relationship between suppression and depressive symptoms during early-to-mid adolescence and that depressive symptoms may lead to greater use of suppression. The emotional acceptance of ANRT group can be explained by the shorter illness duration, and the lower depression level. Longer illness can increase the affective axis and reduce the capacity of negative emotional arousal.

In all three ED groups, a consistent positive correlation was found between the severity of the ED symptoms (EDI-2) and ER (DERS). This finding is consistent with the study hypothesis and in accordance with the literature.<sup>4,5,12,27,34,35</sup> In the ANRT group, high levels of anxiety, and higher BMI were found to be associated with higher ED pathology. Conversely concomitant weight loss seems to positively reinforce by feelings of control and achievement and in turn reduce anxiety level. Similar correlation has been found in former study.<sup>36</sup> In ANBP and BN group, the anxiety axis and the affective axis were found to be associated with severe ED pathology. Similar results were reported in previous study.<sup>35</sup> This may indicate that during the ED course along with high levels of depression and anxiety states, more maladaptive strategies are used in attempt to allow a momentary relief.

Additional in the ANBP group, emotion regulation difficulties (DERS) including impulse axis, was found in association with the severity of ED symptoms. Although no significant differences were found between the ANBP and BN for the impulse control difficulties, it is possible that the severe level of depression of the ANBP group may feature greater difficulties in controlling their behavior in response to affective states than patients with ANRT and BN. This findings support past research where impulsivity is shown to be both a risk factor for disordered eating behaviors such as binge eating, purging, and restricting.<sup>17</sup> There was no association between initial weight, in any of the groups, and ER (DERS), alexithymia (TAS-20), level of depression (BDI, BSI), level of anxiety (HAM-A, BSI) and level of psychological distress (BSI). This may be explained by the study outpatient populations. The ANBP and BN groups were at nearly the fiftieth percentile while the ANRT group was one percentile below the fiftieth percentile, reflecting the point of arrival for the treatment

of adolescent populations with ED, without prolonged illness. Thus, it may be concluded that the difficulties in ER, the anxiety and the depressive symptoms are not a result of the underweight situation, but a platform infrastructure for the ED.

## Conclusion

The current findings further demonstrate the need to differentiate between the two AN subtypes and the similarity between the ANBP and the BN group for impulse, affective and anxiety axis. We suggest that there are differences in the ER process at the beginning of ED in the puberty age. Moreover, we first report on differences in “non acceptance of emotional responses” and ‘lack of emotional clarity” among ED subtypes. This suggests that is specific co relational relationships within each separate AN group that might no longer be noticeable when analyzing adult population or a mixed ED group. Incorrect conclusions may have been drawn from previous studies, as they assumed an association that does not hold true for all AN subtypes. Although the current study is important in terms of ER and associated negative emotions, its limitations should be acknowledged. First, the sample size of the ED groups was still relatively small, approximately 30 patients per patient group. The sample was restricted to female patients only, restricting any generalizations to male ED patients. Considering the number of correlation analyses conducted in this study, it is important that future studies replicate the present findings using larger sample sizes.

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## Conflicts of interest

Author declares there are no conflicts of interest.

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