



Personality disorder traits, obsessive ideation and perfectionism 20 years after adolescent-onset anorexia nervosa: a recovered study

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Abstract

Purpose The many studies examining the relationship between anorexia nervosa (AN) and personality abnormalities have observed high comorbidity. However, no definitive studies to date have established whether there is a causal connection or whether it is a complication. The current study aimed to explore the nature of the relationship between personality disorder (PD) traits, obsessiveness and perfectionism, using a study design that allows the testing of some comorbidity models.

Methods Twenty-nine women were recruited from a group of former AN patients treated during their adolescence in a specialized unit around 20 years before the time of this study. They were divided into two groups according to the current presence of eating disorder (ED) symptoms (current-ED, $n = 11$; recovered, $n = 18$). Both groups were compared to a matched control group ($n = 29$) regarding current PD traits, obsessive beliefs and perfectionism.

Results Borderline PD traits, most cluster C PD traits and overestimation of threat were more common in the current-ED group than in the control and recovered groups. Obsessive–compulsive PD traits, intolerance of uncertainty, and perfectionism were also significantly more prevalent in the current-ED group compared to controls but did not reach significance when compared to the recovered group. No significant differences were found between the recovered and control groups.

Conclusion Our results mostly support the personality abnormalities observed as a transient effect related to the presence of ED psychopathology in patients with adolescent-onset AN.

Level of evidence Level III, case–control analytic studies.

Keywords Anorexia nervosa · Eating disorders · Personality disorders · Obsessiveness · Perfectionism

Introduction

Anorexia nervosa (AN) is an eating disorder (ED) that is characterized by food restriction leading to low weight, fear of gaining weight, and body image disturbances. It begins generally in adolescence and is associated with a high risk of morbidity and mortality [1].

Personality dysfunction is one of the factors that is hypothesized to play an important role in the etiology, course and outcome of AN [2]. Comorbid personality pathology is commonly encountered in the treatment of AN, and its influence on outcome has been noted in the literature for decades [3, 4]. Obsessional traits have been the most important personality pathology constructs linked to AN [5, 6]. Among these traits, perfectionism has been the focus of most of the debate and has been considered in most theoretical conceptualizations of AN [7, 8]. Regarding official classifications of personality disorders (PDs), cluster C PDs have

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been most frequently observed in AN, and among these disorders, obsessive–compulsive personality disorder (OCPD) has been the most frequently mentioned and investigated [2, 6]. Inside the range of obsessional constructs, obsessive cognitive beliefs represent a promising avenue because dysfunctional beliefs are a prominent target for psychological therapies [9, 10]. In addition to perfectionistic beliefs which have already proved their relevance for treatment development, some other beliefs such as intolerance of uncertainty have recently been proposed as possible novel targets for AN treatments [10–12].

The many cross-sectional studies in clinical populations have found high levels of comorbidities between AN and certain personality traits and PDs [2, 3]. Several personality traits such as negative affectivity, perfectionism, rigidity or obsessionality show elevated levels in AN patients [2, 12–15]. Likewise, anxious/fearful cluster C PDs are common in AN patients, notably avoidant personality disorder and OCPD, while dramatic/emotional cluster B PDs are more restricted to patients with either bingeing or purging behaviors [2, 16]. Regarding obsessive cognitive beliefs, two studies found most beliefs assessed to be elevated in AN patients, showing higher scores than patients with anxiety and similar scores to patients with obsessive–compulsive disorder [5, 17]. Among obsessive beliefs, intolerance of uncertainty has recently been the subject of a review and meta-analysis which demonstrated its presence in AN patients [11].

Cross-sectional studies are limited in their ability to explain an observed comorbidity as it might just be a by-product of a severe illness such as AN or starvation. The importance of understanding the comorbidity between AN and psychological characteristics such as PD and other personality-related traits is increasingly being recognized as a necessary pathway to broaden our knowledge of the causes, course and outcome of AN [18]. This focus is expected to help advance the identification of at-risk populations in whom prevention efforts should be maximized [19, 20]. A better integration of personality in the classification of ED will assist clinicians to select and adapt treatment strategies to concentrate efforts on relevant traits [16, 18, 19]. Moreover, a deeper understanding of the relationship between personality and AN might enrich the cognitive models of AN in which treatment protocols are rooted, helping patients achieve full and sustained recovery [5, 21]. Improving treatment models and strategies is especially important since meta-analyses of randomized control trials show that treatment outcomes for AN remain poor [22, 23].

Lilenfeld et al. [14] proposed several conceptual models of relevance to explain the relationship between EDs and personality traits: predispositional, complication, common cause and pathoplasty. The first two models are especially relevant for the purpose of the present study.

The predispositional model implies that personality variables increase the risk of developing an ED (risk factor). In the complication model, variation in personality traits is a consequence of the ED. These personality changes might be short-term (state effect) or long-term (scar effect).

Each conceptual model of Lilenfeld et al. can be ideally tested by different study designs. For the two models outlined, the ideal test is a longitudinal prospective study evaluating subjects before AN onset [14]. However, the low prevalence of AN requires enormous population samples for that purpose [24–26]. Thus, it has been difficult to conduct conclusive prospective studies with a significant minimum number of diagnosable AN patients [24, 27]. Moreover, there is some debate regarding the adequacy of establishing a PD diagnosis before adolescence, when AN often starts [28–30]. Therefore, prospective studies have focused on disordered eating rather than threshold diagnosis and personality traits rather than PDs [24, 31]. From these studies, we know that some personality traits (perfectionism and negative affectivity) precede anorexic attitudes and behaviors and seem to play a role in the development of AN [25, 31, 32]. However, few consistencies have been found regarding threshold AN cases, whether personality-related or not [24–26]. Some longitudinal prospective studies have followed up AN patients after the onset of the disorder and have investigated the ability of PDs and some personality traits, mainly perfectionism, obsessionality and negative affectivity, to predict outcome, with mixed results [33–38].

When prospective studies are not possible, recovered studies can be used to test the predispositional and complication models. These studies investigate differences between patients who have recovered from AN and those who are currently ill, sometimes also comparing them to paired control subjects. The presence of certain personality characteristics after long-term recovery gives some support to the possibility that these characteristics are premorbid. Interestingly, recovered studies are more rigorous for testing the complication model [14]. Personality elevations in currently ill patients with an ED compared to recovered patients support the state-effect model. Personality elevations in recovered patients compared to a matched control group give support to the scar-effect model or to the predispositional model, depending on the presence of these elevations prior to the onset of AN. Recovered studies have produced mixed results regarding the presence of elevations in PDs or personality traits such as perfectionism, negative affectivity or obsessionality in recovered AN patients when compared to currently ill patients or healthy controls [7, 38–40]. This variability is probably due to the length of recovery, the criteria for defining recovery, variability in AN subtype compositions and age of onset, or differences in personality assessments [27, 38, 39, 41, 42].

In summary, despite the vast literature on AN-personality relationships, ideal prospective longitudinal studies are difficult to conduct and, thus, are scarce and inconclusive. Recovered studies represent a good alternative to test certain relationship models. However, differences in methods among recovered design studies have yielded mixed results so far.

In the current study, a recovered study design was used to compare individuals with adolescent-onset AN who had been diagnosed and treated in our department about 20 years before the time of the current study. Differences in PD traits, obsessive cognitive beliefs and perfectionism were explored between currently ill patients and recovered individuals. Both groups were also compared to a matched control group. Our aim was to test the complication model and, to a lesser extent, the predispositional model.

We hypothesized that cluster C PD traits, some cluster B PD traits and perfectionism would be higher in currently ill patients than in recovered patients and healthy controls. We also hypothesized that OCPD traits and perfectionism would be higher in recovered patients than in control subjects. These hypotheses support a state effect for most PD traits that are elevated in currently ill patients (complication model), whereas OCPD and perfectionism would be risk factors for AN (predispositional model) or scars of the disease (complication model). Regarding obsessive beliefs, we expected elevations in currently ill patients compared to recovered patients and healthy controls but made no hypothesis regarding the comparison of the recovered and control groups.

Method

Procedure and participants

A sample of women who had been diagnosed and treated for AN at the Department of Child and Adolescent Psychiatry and Psychology of the Hospital Clinic of Barcelona between 1987 and 1993 were located and assessed. We attempted to locate all women treated for an ED during that period and invite them to participate. In all, 82 female patients were treated for an ED at our department during those years. We were able to locate 62 of these patients by telephone (76%). Of these 62 patients, 29 (46.8%) agreed to complete questionnaires about their personality, obsessive beliefs and perfectionism. The mean number of years since the first assessment at the department was 22 years (range, 17–29 years) [43].

Information on clinical characteristics during the adolescent episode of AN was obtained from their clinical records. At follow-up, the assessment was carried out using a structured interview and questionnaires. The sample was divided

into two groups depending on their current eating disorder status: one group of former AN patients currently showing an absence of any eating disorders (recovered group) and another group of patients currently suffering from an eating disorder (current-ED group). A recovery status was assigned on the basis of full recovery. All the participants in our recovered group met the full recovery criteria of Barone-Cone [41]: (1) no longer meeting the criteria for an eating disorder, (2) abstinence from bingeing, purging and fasting for 3 months, (3) body mass index > 18.5, and (4) EDE subscale scores all within 1 SD of healthy, age-matched population norms.

A comparison group of 29 women of similar age and from the same geographical area (control group) was also studied. The exclusion criteria for this group were any current psychiatric disorders, a history of eating disturbances or severe somatic illnesses.

Demographic information on the three groups of the study is provided in Table 1.

Informed consent was obtained from all the participants in the study. Participants were told that the study was designed to improve our knowledge of AN and its long-term consequences. Data collection and procedures were approved by the Ethics Committee of our institution. For more details about the methods, see Andrés et al. [43].

Measures

Clinical records of the women who agreed to participate in the study were thoroughly reviewed to obtain information on onset, clinical characteristics, treatment, course and outcome during the adolescent episode of AN.

The Structured Clinical Interview for Axis I Disorders (SCID-I) instrument [44] was used to determine all past and current diagnoses. DSM-5 criteria were used for all diagnoses [45]. All interviews were conducted by the same experienced interviewers and were analyzed by a group of psychiatrists and clinical psychologists.

The Personality Diagnostic Questionnaire-4+ (PDQ-4+) [46] is a 99-item true–false self-report whose items closely reflect the DSM criteria for PDs. It assesses the ten official DSM-IV and DSM-5 PDs (see Table 3). The questionnaire can be used in two ways. From a categorical viewpoint, a specific personality disorder is diagnosed when its criteria threshold is reached. It can also be used dimensionally, counting the number of criteria without assigning a categorical diagnosis. When used dimensionally, it can also produce scores for cluster A, B and C PDs, as well as a PDQ total score, which may be interpreted as an index of general personality pathology. In this study, dimensional scores were used. The Spanish version of the PDQ-4+ has shown suitable psychometric properties [47].

Table 1 Demographic characteristics

	Current-ED <i>n</i> = 11	Recovered <i>n</i> = 18	Control <i>n</i> = 29	Test statistic	<i>p</i> value
	M (SD)	M (SD)	M (SD)		
Age	37.73 (5.75)	35.89 (2.76)	36.55 (2.55)	<i>H</i> = 1.39	0.499*
BMI at follow-up	19.12 (4.42)	21.01 (2.00)	22.31 (2.14)	<i>H</i> = 5.56	0.062*
	<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)		
Marital status					
Single	6 (66.66)	4 (25.00)	10 (38.50)		
Relationship	3 (33.33)	11 (68.75)	13 (50.00)	$\chi^2 = 4.58$	0.333 [†]
Separated	0	1 (6.25)	2 (11.50)		
Education					
Primary	3 (27.50)	1 (5.50)	3 (10.50)		
High school	2 (18.00)	2 (11.00)	8 (27.50)	$\chi^2 = 5.38$	0.250 [†]
University	6 (54.50)	15 (83.50)	18 (62.00)		

*Significance values from Kruskal–Wallis test

[†]Significance values from Chi-squared test

The Obsessive Beliefs Spanish Inventory-Revised (OBSI-R) [48] is a 50-item self-report instrument based on the work carried out by the Obsessive–Compulsive Cognitions Working Group (OCCWG) [49]. It was designed to assess eight domains that are hypothesized to be characteristic of clinical samples with OCD: excessive responsibility, over-importance of thoughts, the importance of thought control, likelihood thought-action fusion, moral thought-action fusion, overestimation of threat, intolerance of uncertainty, and perfectionism. The psychometric properties of the OBSI-R are adequate [48].

The Eating Disorder Inventory-2 (EDI-2) [50] is a 91-item self-report questionnaire that evaluates behavioral and cognitive traits associated with eating disorders. For the purpose of this study, the perfectionism subscale was selected. EDI-2 has shown adequate psychometric properties in the Spanish population [51].

Statistical analysis

Kruskal–Wallis and Chi-squared tests were used to compare demographic characteristics between the groups (current-ED group, recovered group, and control group; see Table 1).

Adolescent clinical characteristics and the lifetime prevalence of binge-purging symptoms were compared between the two groups of former AN patients (current-ED and recovered). Fisher's exact test was used to compare frequencies between the groups, while Student's *t* test or Mann–Whitney *U* tests were used to compare the means of continuous variables depending on parametric assumption fulfillment. In both cases, significance was set at $p < 0.05$.

To explore mean differences in PD traits (PDQ4+), obsessive beliefs (OBSI-R) and perfectionism (EDI-II) between the groups (current-ED group, recovered group, and control group), different tests were used based on the distribution of the variables. One-way ANOVA and Tukey post-hoc tests or the Kruskal–Wallis test and Dunn post-hoc method were used to compare groups depending on parametric assumption fulfillment.

For ANOVA and Kruskal–Wallis tests, the significance of three group comparisons was set at $p < 0.05$. For post-hoc comparisons between pairs, significance was set at $p < 0.005$ to correct for multiple comparisons.

SPSS version 25 was used for the statistical analyses.

Results

Adolescent and lifetime clinical characteristics of current-ED and recovered patients

The recovered and current-ED groups were comparable in terms of their clinical characteristics during their index adolescent episode (Table 2). The prevalence of lifetime binge-purging symptoms was also similar between the two groups ($p = 1.000$): three out of 11 (27.8%) in the current-ED group and five out of 18 (27.3%) in the recovered group.

Differences in current personality characteristics between current-ED patients recovered patients and controls

The mean differences between the current-ED, recovered and control groups in PDQ-4+ DSM PD traits, OBSI-R

Table 2 Clinical variables in adolescence

	Currently-ED <i>n</i> = 11 M (SD)	Recovered <i>n</i> = 18 M (SD)	Test statistic	<i>p</i> value*
Age of onset	13.18 (1.83)	13.61 (1.24)	<i>t</i> = 0.753	0.458
Age at admission	14.60 (2.01) ^a	14.28 (1.53)	<i>t</i> = -0.478	0.637
Treatment delay (months)	16.80 (3.67)	8.00 (2.17)	<i>U</i> = 51	0.068
Premorbid BMI	20.63 (4.58) ^a	20.29 (1.98) ^b	<i>t</i> = 0.223	0.827
BMI at admission	15.41 (4.05) ^a	16.06 (2.04)	<i>t</i> = 0.572	0.572
Treatment during adolescence (months)	22.90 (21.57)	34.83 (23.93)	<i>t</i> = 1.307	0.203
Inpatient treatment (days)	85.91 (122.80)	77.11 (86.84)	<i>U</i> = 84	0.521
	<i>N</i> (%)	<i>N</i> (%)		<i>p</i> value ⁺
Hospitalization (Y/N)	5 (45.45)	14 (77.78)	$\chi^2 = 3.16$	0.114
Comorbidity (Y/N)	7 (63.64)	5 (27.78)	$\chi^2 = 3.62$	0.119
Psychopharmacological treatment (Y/N)	8 (80.00) ^a	11 (68.75) ^c	$\chi^2 = 0.40$	0.668
Suicide attempt (Y/N)	5 (50.00) ^a	4 (25.00) ^c	$\chi^2 = 1.70$	0.234
Discharge against medical advice (Y/N)	2 (18.18)	2 (11.11)	$\chi^2 = 0.29$	0.622

*Student's *T* test or Mann–Whitney *U* test (as appropriate), ⁺ Fisher exact test

^a*n* = 10, ^b*n* = 17, ^c*n* = 16

obsessive beliefs and EDI perfectionism (EDI-P) scores are shown in Table 3.

Current-ED patients scored higher in all the PD dimensions evaluated through the PDQ-4+ when compared to the recovered and control groups, although all cluster A and some cluster B PD comparisons did not reach significance. In post-hoc comparisons, borderline PD, cluster B, and all cluster C dimensional traits were more prevalent in the current-ED group than in the recovered and control groups. However, after correcting for multiple group comparisons, the difference in the prevalence of obsessive PD traits between the current-ED and recovered groups lost significance (*p* = 0.010).

Group comparisons for the obsessive belief dimensions of OBSI-R reached significance for intolerance of uncertainty, overestimation of threat and perfectionism. The current-ED patients scored significantly higher than controls for these three variables. Differences between the current-ED and recovered groups failed to reach significance for intolerance of uncertainty (*p* = 0.057) and perfectionism (*p* = 0.078).

For perfectionism from EDI-II, significant differences were observed between the current-ED and control groups, the latter scoring lower. The differences between the current-ED and recovered groups (*p* = 0.022) and between the recovered and control groups (*p* = 0.020) lost significance after correcting for multiple comparisons.

Discussion

Overall, there were differences in the prevalence of Cluster C and some cluster B PD traits between adolescent-onset AN patients who still have an ED around 22 years after the onset of the disorder (current-ED) and matched controls as well as recovered individuals. Personality differences between current-ED patients and healthy controls support our hypothesis and are in line with the results of many different studies and meta-analyses that have reported elevations in similar personality traits and the presence of PDs in ED patients [2, 3, 16]. Although important, these comparisons offer little information to explain the relationship between EDs and personality pathology [14, 42].

Therefore, the main interest of the present study was to explore the differences between current-ED and recovered patients, and between recovered individuals and controls. These comparisons enable the testing of the complication model of comorbidity (state vs. scar effects) and, with some more uncertainty, the predispositional model. Great similarity in PD traits was found between the recovered and control participants, with both groups showing significant differences from current-ED patients, suggesting that for fully recovered patients, most increases in PD traits commonly found during the illness are a state-effect of the disorder (complication model).

Table 3 Mean differences in current personality characteristics

	Current-ED <i>n</i> = 11 M (SD)	Recovered <i>n</i> = 18 M (SD)	Control <i>n</i> = 29 M (SD)	<i>p</i> value	Post hoc
PDQ-4+					
Cluster A [†]	5.91 (4.41)	2.44 (2.36)	2.52 (2.08)	ns	
Paranoid PD [†]	2.09 (1.76)	1.11 (1.28)	0.83 (1.14)	ns	
Schizoid PD [†]	1.55 (1.37)	0.56 (0.62)	0.79 (0.82)	ns	
Schizotypal PD [†]	2.36 (2.33)	0.78 (0.88)	0.90 (1.08)	ns	
Cluster B*	9.09 (5.01)	3.89 (3.25)	3.28 (2.40)	<0.001	ED > R ^a , C ^a
Histrionic PD [†]	2.09 (1.22)	1.61 (1.46)	1.55 (1.15)	ns	
Narcissistic PD [†]	2.36 (1.75)	0.94 (1.11)	0.69 (1.07)	0.013	
Borderline PD [†]	4.00 (2.19)	1.11 (0.96)	0.86 (0.79)	<0.001	ED > R ^a , C ^a
Antisocial PD [†]	0.64 (1.29)	0.22 (0.42)	0.17 (0.60)	ns	
Cluster C*	12.91 (5.99)	5.06 (3.49)	3.97 (3.33)	<0.001	ED > R ^a , C ^a
Avoidant PD*	4.91 (2.30)	1.83 (2.73)	1.24 (1.62)	<0.001	ED > R ^a , C ^a
Dependent PD [†]	3.73 (2.45)	0.78 (1.26)	0.66 (0.90)	<0.001	ED > R ^a , C ^a
Obsessive PD*	4.27 (2.10)	2.44 (1.25)	2.07 (1.51)	0.001	ED > C ^b
PDQ total score [†]	35.36 (15.29)	14.61 (9.16)	12.48 (8.51)	<0.001	ED > R ^b , C ^a
OBSI-R					
Inflated responsibility*	27.30 (6.91)	21.82 (5.83)	20.48 (8.45)	ns	
Over-importance of thoughts [†]	9.60 (4.53)	9.65 (4.90)	9.14 (4.06)	ns	
Importance of thought control [†]	17.70 (6.57)	15.53 (6.77)	13.76 (5.61)	ns	
Thought-action fusion Likelihood [†]	11.30 (8.04)	8.06 (4.60)	7.38 (3.29)	ns	
Thought-action fusion Morality [†]	25.10 (11.51)	20.47 (10.49)	18.86 (7.81)	ns	
Overestimation of threat [†]	30 (12.64)	16.41 (8.40)	14.72 (8.12)	0.001	ED > R ^b , C ^b
Intolerance of uncertainty*	25.30 (7.38)	19.06 (5.65)	16.76 (6.92)	0.004	ED > C ^b
Perfectionism*	29.00 (14.37)	20.59 (8.82)	17.17 (7.80)	0.006	ED > C ^b
EDI-II					
Perfectionism [†]	7.55 (5.50)	3.28 (3.21)	1.48 (1.92)	<0.001	ED > C ^a

*Significance values from ANOVA and Tukey post-hoc tests

[†]Significance values from Kruskal–Wallis test and Dunn post-hoc method^a*p* < 0.001, ^b*p* < 0.005

Our results are in line with those of the longitudinal study of Herperzt-Dahlman et al. [52]. They assessed the presence of PDs with a semi-structured interview and did not find differences between long-term recovered adolescent-onset AN patients and matched controls, whereas recovered and current-ED patients were significantly different. A recovered condition might not be a good reflection of a premorbid personality (predispositional model) since there might be complications during illness (scar effects) that were not present before. However, when fully recovered patients do not show certain pathological patterns, it seems more difficult to hypothesize the presence of these patterns premorbidly in them. Nonetheless, it might be the case that patients with more prominent PD traits during adolescence do not recover or that successful treatment ameliorates the condition in this group. Indeed, Wentz et al. [34], performing a longitudinal study following adolescent AN patients over 18 years, found that the obsessive–compulsive PD (OCPD) was a predictor

of poor outcome. Their assessment of PDs was made retrospectively at baseline on the basis of premorbid history, thus indicating the possibility of OCPD being a risk factor for adolescent-onset AN. One possible explanation is that adolescent AN patients with premorbid OCPD are less likely to recover over time. However, prospective studies assessing PDs at baseline in adult samples or with short follow-up periods have failed to predict AN outcome from this variable [35, 36, 53]. Another explanation could be that successful treatment improves OCPD in recovered patients.

In contrast to the many cross-sectional studies evaluating comorbid DSM PDs in current-ED patients, there are only a few longitudinal prospective and recovered design studies that have assessed official PD diagnoses or traits, either premorbidly, at baseline or at follow-up. The reason for not evaluating PD diagnoses and traits before AN onset in population-based prospective studies might be the early age of onset of this disorder [29, 30]. One probable reason

not to evaluate PD diagnoses at baseline or at follow-up in recovered studies is that the gold standard clinical interviews required for formal diagnoses are time-consuming (e.g., SCID-II or IPDE). We used a questionnaire for a dimensional assessment of DSM PD traits. Dimensional assessments of personality pathology are becoming increasingly popular as current categorical diagnoses are under question [54, 55]. Dimensional scores have been proposed to be more informative from a therapeutic point of view [56], as well as more valid and reliable from a statistical one [57]. Moreover, relying on categorical dichotomous scores for evaluating PD constructs in recovered AN patients and controls with low PD base rates might render it impossible to obtain enough information to conduct analyses [58].

Regarding obsessive beliefs, all three groups scored similarly for OBSI-R traits that might be linked more to OCD, such as, for example, over-importance of thoughts or thought-action fusion-likelihood [48, 59]. We expected to observe differences between current-ED and control groups in those obsessive beliefs. Previous studies in ED samples have found similar levels of most obsessive beliefs to those recorded in OCD samples, and higher levels than in anxiety and community samples [5, 17]. Differences between the current-ED and control groups were found for intolerance of uncertainty, overestimation of threat and perfectionism. These traits are also present in theoretical models of anxiety, depression and eating disorders, and can be regarded as transdiagnostic [12, 13, 48, 59, 60]. We could barely differentiate between the recovered and current-ED groups on the basis of the OBSI-R scores. Likewise, we did not find differences between the recovered and control groups either, with the scores of the recovered group being much closer to those of the control group than the current-ED group (see Table 3). EDI perfectionism scores followed a similar significance pattern as the OBSI-R scores, although approaching significance not just for the comparison of the current-ED vs. recovered groups, but also for the comparison between the recovered vs. control groups ($p=0.020$). However, the perfectionism scores of the recovered group in our study were closer to those of the control group than of the current-ED group. Hence, we cannot conclude state effects for obsessiveness and perfectionism, which were not different between the recovered group and the other two groups.

In contrast to PD diagnoses and dimensions, various obsessional and perfectionism measures have been used more frequently across different study designs. Results from recovered studies on AN show mixed results. When looking at fully recovered AN patients, some studies have reported greater similarity to current-ED or partially recovered patients than to controls [7, 13], whereas other studies have found profiles that are much closer to those of controls than of not fully recovered patients [38, 39]. These mixed results could be due to differences in recovery criteria and

length [13, 39, 40]. When patients have been recovered for a very long time or when studies include cognitive criteria for recovery, the recovered patients tend to be more similar to controls than to partially recovered or current-ED patients [38–40]. Thus, it seems that at least for a group of AN patients who have achieved full recovery, increased perfectionism and obsessiveness are state effects of the disease.

However, for current-ED and partially recovered patients, perfectionism and obsessiveness could be risk factors or predictors of a negative outcome. Results from prospective longitudinal studies are far from definitive [25, 26, 37]. One study found perfectionism to be a risk factor for AN [61], but this finding has not been replicated in other studies [26, 32, 62]. Some studies have predicted outcome in AN patients using baseline perfectionism scores [33, 36, 38]. However, when the recovery criteria include cognitive symptoms and the length of recovery or follow-up is increased, perfectionism and obsessiveness do not predict outcome [35, 38, 63].

Residual cognitive symptoms represent a significant risk for relapse and their reduction has been considered a necessary step to attain and maintain full recovery [21, 23, 64]. If obsessional traits are elevated only during acute or residual AN, they might well represent symptomatic expressions of AN; if they are also present before AN they could be considered risk factors influencing poor prognosis [8, 18, 21]. In both cases, obsessive cognitive beliefs such as perfectionism, intolerance of uncertainty or overestimation of threat represent interesting processes as they are transdiagnostic constructs which are already included in different cognitive models of treatment [5, 10, 65, 66]. Perfectionism has been included in treatment models for EDs, which will hopefully contribute to reduce ED symptoms and improve ED course and outcome [8, 10]. As the presence of intolerance of uncertainty in EDs has recently been demonstrated, its inclusion in treatment models is beginning to be tested [11, 12]. According to our results and other previous studies, the overestimation of threat may be of relevance in AN [5, 17]; it is one of the most relevant constructs in cognitive models of anxiety, helping to develop transdiagnostic treatments for these disorders [66], and might be a good candidate for further exploration in EDs as well.

Notwithstanding the absence of elevations in all the traits assessed in our recovered group, we found some trends worth mentioning. Despite different scores, the current-ED and recovered groups could not be differentiated on the basis of OCPD traits when correcting for multiple comparisons. In addition, differences between the recovered and control groups approached significance for the perfectionism scores. Taken together, these results suggest that there are slight differences in some obsessional traits between recovered and healthy controls, which might become significant in larger similar samples. We hypothesize that when these traits are elevated in recovered AN patients they may increase the

risk of relapse [8, 64]. Given the relevance of these traits during acute phases of the illness they may represent targets for interventions aimed at preventing relapses in partially or fully-recovered participants [64].

This study had several limitations. First, a significant proportion of the AN patients seen in our department during the period under study were not located or refused to participate. At the time patients were treated at our department as adolescents, all of them lived with their families and mobile phones were not common in Spain. Thus, most patients were contacted through the landline phone numbers that their parents had at the time of treatment. In some cases, parents refused to inform their daughters, usually on the grounds that “they did not want their daughter to remember the illness”. It is possible that the patients who agreed to participate, or whose parents agreed to inform them of the study, presented different characteristics from the patients who declined to participate or who were not informed by their parents. For example, patients or families dealing with more severe and enduring EDs or with other psychiatric or psychosocial problems may well have refused to take part. Although current-ED and recovered groups had comparable adolescent clinical characteristics they may have differed in terms of other variables that were not measured and that may have introduced bias. In addition, the single 20-year-long follow-up period made it difficult to locate or to obtain collaboration from an important group of patients. Nonetheless, the collaboration rates in our study are comparable to those of other similar studies with shorter follow-up periods [40]. A second limitation of the study was the small sample size, decreasing the statistical power and restricting the generalizability to males and community samples. A third shortcoming was that personality and obsessive traits and most of the current clinical symptoms were self-reported, thereby being susceptible to self-report biases such as social desirability. However, the former patients and controls were evaluated through a two-day assessment process that included interviews, questionnaires and physical examinations. Clinical records from adolescence were thoroughly examined and objective clinical data from adolescence were available.

One of the strengths of our study was that it included only girls with an early onset of adolescent AN who had undergone treatment in a specialized setting around twenty years before the current assessment. Furthermore, the study included a healthy matched control group.

Our data add to those from other recovered studies in the field, demonstrating that a relatively high percentage of patients fulfill the strict criteria for recovery a very long time after the onset of AN in adolescence. These fully recovered patients show a profile of PD traits, obsessive beliefs and perfectionism that is much closer to that of healthy matched controls than to that of patients who still have an eating disorder. At least in these patients, personality disorders as

well as obsessional and perfectionistic traits are probably not among the causes of the disorder (predispositional model) and would not be among the consequences of AN (complication/scar effect model).

The conclusions of our study support the idea that complete recovery is possible and occurs at a significant rate. As qualitative work has shown, it is important to instill hope even in the adverse case of severe and enduring AN [21]. To improve treatments and achieve full recovery in most patients, it is important to individualize treatment according to selected variables that are relevant to different groups of patients [67]. It has been proposed that treatment should probably proceed in phases [23, 68]. After the weight has been restored in initial phases of AN, and after ED behaviors and cognitions have been addressed, other novel psychological targets may be necessary to improve current outcomes in AN [23]. PD traits and obsessional traits are good candidates as they are related to the presence of illness or partial recovery in AN. Obsessive-cognitive beliefs may represent cognitive processes at an adequate level to be included in treatment models and be targeted as therapeutic goals. Indeed, perfectionism has been found to be a predictor of poor outcome across different disorders and has been included in several different models, notably AN [10, 65]. Future research should help improve these models and should determine whether these models and targets add benefits for some groups of AN patients.

What is already known on this subject?

A wealth of studies demonstrates significant relationships between the presence of AN and elevations in personality traits such as negative affectivity, perfectionism or obsessionalism. However, prospective studies are still scarce and the results from current literature regarding causal connections between AN and personality are unavailable. Moreover, results from studies exploring different comorbidity models are mixed.

What this study adds?

A recovered study design allows us to test some comorbidity models between adolescent-onset AN and personality that a conventional cross-sectional study does not allow to test. This way the results of this study might help to advance the knowledge about the personality characteristics of long-term eating disorder patients and fully-recovered patients when compared to a matched control group. This study adds to a few other studies in the field that also evaluated adolescent-onset AN patients a very long time after the onset using a recovered study design. Interestingly this study finds that fully-recovered adolescent-onset AN patients display

personality characteristics that are much closer to controls than to currently ill patients.

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Data availability The datasets generated and/or analyzed in the current study are available from the corresponding author upon reasonable request.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This research study was approved by the Clinical Research Ethics Committee of the Hospital Clínic de Barcelona (CEIC Hospital Clínic). The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, revised in 2008.

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

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