Athletes with eating disorders: clinical-psychopathological features and gender differences

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Abstract

Background Eating disorders (EDs) in the athlete population are often discussed in terms of comparing with non-athlete samples, however little is known regarding their gender clinical differences. Therefore, this study aimed to compare clinical and psychopathological features among athletes with an eating disorder (ED+A), non-athletes with an eating disorder (ED-A) and healthy controls (HCs), in addition to observing gender differences.

Methods The sample consisted of 192 participants, all were age and gender matched, ED+A $n = 64$, ED-A $n = 64$ and HCs $n = 64$, with each group consisting of 50 females and 14 males. And each participant completed a face-to-face interview and various self-report questionnaires regarding personality traits (Temperament and Character Inventory-Revised), eating (Eating Disorder Inventory – 2) and general psychopathology (Symptom Checklist 90 - Revised), as well as relevant clinical indexes (lifetime suicidal attempts/ideation and sport activities conducted).

Results In the ED+A group females had significantly higher eating and general psychopathology compared to males, especially body dissatisfaction (BD) and drive for thinness (DT) ($p <.001$). Overall, ED+A males had the lowest BD across the 3 groups. In terms of personality traits, ED+A females had significantly higher harm avoidance and lower self-directedness compared to their male counterparts. Lastly, suicidal ideation was significantly higher in ED+A females compared to males.

Conclusions These results suggest that it may be imperative to better understand the risk factors in the athletic realm which may lead to the development of EDs, and which factors may be protective as well. It may also be helpful to encourage trainers to include preventive and screening strategies for athletes.

Plain english summary

Eating disorders are mental illnesses which can affect anyone and may also be seen in athletes, where studies normally look at differences between athletes and non-athletes. However, there has been a lack of research comparing specific gender differences in athletes who have an eating disorder. This study looked at the differences not only between the groups, but also within the groups, in terms of eating disorder behaviors, psychological

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factors and personality. The findings were that in the athlete group, females had higher dissatisfaction with their body and had a higher desire to be thin. Female athletes were also more anxious and had more suicidal thoughts compared to male athletes.

Keywords Eating disorders, Athletes, Gender, Personality traits, Psychopathology

Eating disorder (ED) prevalence is globally estimated to be 8.4% for women and 2.2% for men, however, this number is constantly increasing [1]. Moreover, there are some subgroups that are more vulnerable to the onset of an eating disorder, one such being athletes [2]. Also, studies mostly focus on the question of whether EDs are more prevalent in athletes compared to the general population, with mixed results. For instance, in a study involving a population of 1,620 elite Norwegian athletes, they found that EDs were more prevalent in this group when compared to control subjects [3]. Another study demonstrated that there was a higher proportion of high school students with eating disorders from schools with talented athlete programs, than from regular high schools [4]. A meta-analysis involving 34 studies also found that athletes were at a higher risk of engaging in more disordered eating than non-athletes [5]. A more recent study also showed that either EDs or subthreshold EDs were more prevalent between athletes ($n = 3,509$; athletes were defined as community-based, self-identified competitive athletes) than controls ($n = 20,411$) [6]. However, other studies found that being involved in a sports activity is a protective factor against problematic eating behavior, as athletes would experience reduced performance if they had pathologic eating behavior [7]. Though, it is important to mention that in this referenced study, involvement in sports as a protective role was only found between "non-elite athletes" and not between those athletes who compete on the German national or junior national team [7]. While it is generally accepted that training regularly is associated with mental health benefits, it is also known that for the general population exercising as much as a professional athlete (i.e., more than 23 times per month) can have a harmful effect on one's mental health [8]. Additionally, studies have found that maladaptive exercise (e.g., a compulsive type of exercise that is largely seen as leading to a negative outcome or disrupting daily functioning) to lead to the development of an eating disorder [9–11].

Therefore, it is important to consider athletes as having a greater risk for developing an ED. There are several studies describing specific factors that make athletes more vulnerable for the onset of an ED. One of them being exercise itself, as there is a potential for the outgoing energy to be higher than what is incoming, which limits the amount of energy available for the body to engage in necessary functions such as bone or muscle growth [12]. Furthermore, it is also important to consider the pressure on athletes to lose weight [13, 14]. Athletes are motivated to start dieting in order to increase their performance [15] and improve their outcomes, and this initial weight loss can contribute to the continuation of calorie restriction [3, 16]. Apart from dietary requirements, the potential negative effect that pressure from the coaches/environment could have on an athletes' eating behaviors can also be a contributing factor to develop an ED [4]. Consequently, the way in which coaches interact with athletes can, by having a more positive role, be helpful in terms of prevention and remission of EDs [17].

Moreover, there are also some personality traits that are common in athletes which may make them more vulnerable to the onset of an ED, for instance, perfectionism [18], as well as determination, competitiveness and obsessiveness [19]. Studies have noted that the more compliant an athlete is, the more likely they are to have similar personality traits to patients with an ED (e.g., perfectionistic and harm avoidant [18, 20, 21]). Additionally, athletes are more likely not to listen to pain signals from their bodies, possibly to improve their performance and also due to the comments they receive from peers or coaches making light of the pain they are experiencing, which may contribute to their worsening psychological well-being [22]. Body dissatisfaction and low self-esteem are similarly predictive factors for EDs, not only in the general population, but also in athletes [23].

Another area often discussed is the prevalence of EDs in different subgroups of athletes. In sports where leanness plays a key factor (e.g., in aesthetic sports like rhythmic gymnastics), athletes are more at risk of developing an ED [2, 24]. Eating disorders are also more prevalent in endurance sports like swimming or skiing [4] and in sports with weight classes such as wrestling [19]. A study also found differences in general and eating psychopathology between athletes doing different kinds of sports: individual players tend to have more severe eating psychopathology symptoms (e.g., drive for thinness, body dissatisfaction, etc.) and are more dissatisfied with their own bodies than members of a sports team [21]. The personality of individual athletes with an ED also differs from team athletes, the former are more self-transcendent but less cooperative [21].

A question less frequently discussed in the literature is the comparison of female and male athletes suffering

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from EDs in terms of psychopathology and personality traits. Male athletes are often not included in studies [25], although they also tend to be under pressure to have an ideal body shape for their sport and therefore can have similar symptoms to females [26]. Studies show that eating disorders are just as prevalent in the case of male athletes as female non-athletes, which is surprising considering EDs tend to be viewed as a disease more prevalent among females [14]. Diagnosing male athletes with an ED, however, is challenging as their reasons for dieting may differ from females, as they would like to build muscle rather than lose weight [27].

Athletes who have EDs were found to have lower body dissatisfactions than non-athlete patients [5, 21]. Also, in the general population, male athletes presented less body dissatisfaction than male non-athletes [28]. In terms of gender differences, it was found that male athletes had a more positive body image than female athletes [29], as in the case of EDs [30, 31] and the general population [32]. It is also important to consider the potential higher perceived prevalence of EDs in female more so than male athletes [14]. As higher body dissatisfaction is an important risk factor for eating disorders in athletes [23], the higher prevalence of EDs in female athletes could be associated with their supposedly higher body dissatisfaction.

Previous literature has also shown that female and male patients with an ED have different personality profiles, for example, women who suffer from an ED have higher reward dependence, cooperativeness [30, 31] and harm avoidance [31] than men. Suicidal ideation in the case of patients with an ED is also a significant aspect to consider, as suicide risk is higher for this vulnerable group than for controls [33]. Elite athletes however are considered to have lower suicidal ideation than controls [6], as participation in sport activities can serve as a protective factor against suicidal behavior [34, 35]. It is especially true for athletes who compete in team sports, as the supporting role of the teammates can contribute to the reduced likelihood of the onset of depression and suicidal ideation [34]. In a systematic review, six studies claimed that athletes have a reduced risk of suicidal behavior compared to non-athletes while three studies showed no significant difference and only one found athletes to have higher suicidal ideation. Also, within elite athletes, males were found to be at greater risk of suicidal behavior compared to females [36].

We can see that the topic of psychopathology, personality traits and suicidal ideation of athletes with eating disorders still has many unanswered questions, especially regarding gender differences. The general objective of this work was to explore the role of athletics on the ED profile, as well as the potential moderating role of gender. The specific objectives were to compare eating and general psychopathology, along with personality traits and prevalence of suicidal ideation, among athletes with an eating disorder (ED+A), non-athletes with an eating disorder (ED-A) and healthy controls (HCs), as well as look at gender differences between the groups.

We hypothesized there would be gender differences within the ED+A group for body dissatisfaction and drive for thinness. We also expected that males from the ED+A group would have lower body dissatisfaction than those in the ED-A and HC groups. Furthermore, we hypothesized there would be gender differences within the ED+A group in reward dependence and harm avoidance. Finally, we expected that there would be differences in suicidal ideation in the ED+A group compared to the ED-A and HC groups and also in the ED+A group in terms of gender.

Methods

Participants

The present study had a case–control design. The total sample was comprised of 192 cis-gender participants, 64 ($n = 50$ females) were athletes with an ED (ED+A), 64 ($n = 50$ females) non-athletes with an ED (ED-A) and 64 ($n = 50$ females) healthy controls (HCs) all age and gender matched. In this sample, being an athlete with an ED was defined as being at the professional level of a sport, this classification was determined by experienced clinical psychologists during an in-depth interview. In this group the athlete is able to live off their sport, receive payment for their performance via government grants or clubs as well as professionally compete in national or autonomic federations, regarded as a tier 2–4 level of performance [37]. The following sports were represented in this sample: soccer, basketball, korfball, volleyball, canoeing, swimming, fitness, cycling, running, martial arts, bodybuilding, climbing, figure skating, rhythmic gymnastics, triathlon, and snowboarding. Also, ballet was included in the sample, although it is not strictly considered a sport, due to its very particular characteristics in the literature, it has been likened to aesthetic sports [38].

The healthy controls were matched for age and sex and were recruited through several sources including word-of-mouth and advertisements at the local university and were from the same area as the patients with an ED. Prior to assessment, these individuals were interviewed regarding their lifetime history of health or mental illnesses (including EDs) and suicidal ideation and suicide attempts by having face-to-face interviews. Exclusion criteria for the HCs were having

current suicidal behavior or ideation, according to a semi-structured interview and following Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) diagnostic criteria, however lifetime suicidal ideation or behavior was not. In the general population, lifetime suicidal ideation shows similar prevalence in Spain, especially in this age range. The ED sample was from the Eating Disorders Unit at Bellvitge Hospital in Barcelona, Spain. Both groups (ED+A & ED-A) were matched for age, duration of the ED and sex ($n = 50$ women and $n = 14$ men), the ED-A group was taken from a larger pool of non-athlete ED cases using propensity scores. The participants included in this study were diagnosed according to the DSM-5 [39], by means of a semi-structured interview. Additionally, participation in this study was voluntary, where all individuals could cease participation at any time.

The social position index was obtained using the Hollingshead's algorithm [40]. Socio-demographic information including sex, civil status, education, employment, socioeconomic status as well as clinical data regarding eating disorder and psychopathological symptoms were assessed by experienced psychologists in the ED field using a semi-structured clinical interview based on the DSM-5 criteria [39].

Measures

Lifetime suicidal ideation and suicide attempts
Both prevalence of lifetime suicidal ideation and the history of suicide attempts were assessed during a face-to-face structured clinical interview in which participants were asked about past, recent, and present suicidal ideation and suicide attempts.

Temperament and Character Inventory-Revised (TCI-R) [41]. This questionnaire consists of 240 self-report items where there is a Likert scale from 1 to 5. It has 4 temperament scales (novelty seeking, harm avoidance, reward dependence, persistence) and 3 character scales (cooperativeness, self-directedness and self-transcendence) and has been validated in the adult Spanish general population [42]. For the current sample the Cronbach's alpha ranged from $\alpha = 0.748$ (novelty seeking) to $\alpha = 0.895$ (persistence).

Symptom Checklist-90 Items-Revised (SCL-90R) [43]. This is a self-report questionnaire consisting of 90 items which examine distress and psychopathology. This checklist has 9 primary dimensions: somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. Additionally, it has three global indices: Global Severity Index (GSI), Positive Symptom Total (PST), and Positive Symptom Distress Index (PSDI). Moreover, it has been validated in the

general adult Spanish population [44]. For this study the Cronbach's alpha ranged from $\alpha = 0.775$ (paranoia) to $\alpha = 0.981$ (global indexes).

Eating Disorder Inventory – 2 (EDI-2) [45]. It consists of 91 self-report questions, looking at psychological and behavioral characteristics on a 6-point Likert scale in relation to eating disorders. The inventory has 11 subscales: drive for thinness, body dissatisfaction, bulimia, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation, and social insecurity. It has been validated in the Spanish population [46]. When looking at Cronbach's alpha in this study, it ranges from $\alpha = 0.709$ (ascetic) to $\alpha = 0.961$ (total scale).

Ethics
According to the Declaration of Helsinki, the present study was approved by the Clinical Research Ethics Committee (CEIC) of the University Hospital of Bellvitge. Furthermore, written and informed consent was obtained from all participants in this study.

Statistical analysis
Stata18 for Windows was used to analyze the data [47]. The comparison between the groups was based on chi-square (χ^2) tests for categorical variables and analysis of variance (ANOVA) for quantitative measures. The effect size of the global tests was valued with Cramer's-V (C-V) for the χ^2 and eta-squared (η^2) for the ANOVA. The effect size of the differences was based on the standardized Cohen's-*h* for proportions and Cohen's-*d* for means, considering mild-moderate effect size for values over 0.50 and high-large for values over 0.80 [48]. In this work, because of the small sample size for some comparisons (concretely those carried out on a gender-differentiated basis), relevant differences/associations were considered for any statistical significance ($p \leq .05$) or an effect size at least in the mild range [49].

The control in the increase of the Type-I error due to the multiple statistical significance tests was based on the Finner's method [50], a family-wise error rate procedure more powerful than the classical Bonferroni's correction.

Results
Descriptive variables for the sample
Table 1 displays the frequency distribution of the sociodemographic variables, the ED subtype and the age of onset and duration of the problematic eating. Most participants were single, with primary or secondary education levels, employed or students, and were in mean-low to low social position indexes. No differences between the groups were obtained.

Table 1 Descriptive of the sample

		HC (*n* = 64)		ED-A (*n* = 64)		ED+A (*n* = 64)		*p*
		n	%	*n*	%	*n*	%	
Sex	Women	50	78.13%	50	78.13%	50	78.13%	1.000
	Men	14	21.88%	14	21.88%	14	21.88%	
Civil status	Single	49	76.56%	50	78.13%	55	85.94%	0.398
	Married	12	18.75%	8	12.50%	6	9.38%	
	Divorced	3	4.69%	6	9.38%	3	4.69%	
Education	Primary	28	43.75%	17	26.56%	16	25.00%	0.134
	Secondary	25	39.06%	34	53.13%	37	57.81%	
	University	11	17.19%	13	20.31%	11	17.19%	
Employment	Employed/student	43	67.19%	44	68.75%	52	81.25%	0.149
	Unemployed	21	32.81%	20	31.25%	12	18.75%	
Social index	High	0	0.00%	0	0.00%	1	1.56%	0.323
	Mean-high	7	10.94%	3	4.69%	1	1.56%	
	Mean	7	10.94%	6	9.38%	7	10.94%	
	Mean-low	16	25.00%	19	29.69%	24	37.50%	
	Low	34	53.13%	36	56.25%	31	48.44%	
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*
Age (yrs)		27.95	7.07	25.58	6.73	25.41	8.09	0.092
Age of onset of ED(yrs)		---	---	19.97	5.97	18.55	7.77	0.248
Duration of ED (yrs)		---	---	5.74	5.40	6.89	5.66	0.243
		n	%	*n*	%	*n*	%	*p*
ED subtype	AN	---	---	25.00	39.06%	22.00	34.38%	0.773
	BN	---	---	21.00	32.81%	20.00	31.25%	
	BED	---	---	4.00	6.25%	3.00	4.69%	
	OSFED	---	---	14.00	21.88%	19.00	29.69%	

Note. SD: standard deviation. HC: healthy control. ED-A: non-athlete with an eating disorder. ED+A: athlete with eating disorder

AN: anorexia nervosa. BN: bulimia nervosa. BED: binge eating disorder. OSFED: other specified feeding and eating disorder

Comparison between the groups at baseline

tk 4Table 2 shows the comparison between the three groups considered in the study (HC, ED-A and ED+A), for the ED symptom severity (EDI-2), the psychopathology state (SCL-90R), the personality profile (TCI-R) and the suicidal behaviors risk. As expected, differences between the HC and the clinical conditions (ED-A and ED+A) were obtained for most EDI-2 scales (except for interpersonal distrust), and the SCL-90R scales (except for somatization and phobic anxiety in the pairwise comparisons HC *versus* ED+A). HC also achieved lower mean in the TCI-R persistence scale for the comparison versus ED+A, and higher mean in the TCI-R self-directedness in the comparisons with both ED-A and ED+A. The comparison between ED-A *versus* ED+A only reported a statistical difference in the EDI-2 body dissatisfaction scale (lower mean associated to athletes).

Table 3 shows the comparison in the clinical profile among the female subsamples. The comparison between the HC and the clinical conditions (ED-A and ED+A) reported differences for most EDI-2 scales (except for interpersonal distrust scale) and the SCL-90R factors (except for somatization and phobic anxiety). Regarding the personality profile, HC achieved lower persistence in the comparison versus ED+A,

higher mean in self-directedness in the comparisons versus both ED-A and ED+A, and higher mean in cooperativeness in the comparison versus ED+A. The comparison between ED-A versus ED+A achieved a statistically significant difference in the persistence level (higher mean associated to athletes).

Table 4 shows the comparison in the clinical profile among the male subsamples. Comparing the HC versus the ED-A group, differences were obtained in most EDI-2 scales (except for body dissatisfaction, interpersonal distrust and social insecurity), in all the SCL-90R scales, some personality domains (harm avoidance, reward dependence, persistence and self-transcendence), and the risk of suicidal attempts. The comparison between HC versus ED+A obtained differences in some EDI-2 scales (drive for thinness, body dissatisfaction, interoceptive awareness and maturity fears), the SCL-90R depression scale, some TCI-R factors (novelty seeking, persistence, self-directedness and cooperativeness), and the risk of suicidal attempts. Finally, compared with ED+A, ED-A men also reported higher ED severity levels (except for the interpersonal distrust, maturity fears and social insecurity scales), worse psychopathology state, more dysfunctional personality profile (except in the novelty

Table 2 Comparison at baseline: ANOVA

	HC (n=64)		ED-A (n=64)		ED+A (n=64)		HC versus ED-A		HC versus ED+A		ED-A versus ED+A		η^2
	Mean	SD	Mean	SD	Mean	SD	p	|d|	p	|d|	p	|d|	
EDI-2 Drive thinness	3.89	4.70	14.02	5.88	12.66	7.37	**0.001***	**1.90**†	**0.001***	**1.42**†	0.451	0.20	0.356
EDI-2 Body dissatisfaction	9.33	7.81	17.00	8.49	13.16	9.42	**0.001***	**0.94**†	**0.044***	0.44	**0.043***	0.43	0.119
EDI-2 Interoc. awareness	2.58	2.56	9.72	7.21	9.30	7.18	**0.001***	**1.32**†	**0.001***	**1.25**†	0.925	0.06	0.229
EDI-2 Bulimia	1.27	1.90	5.66	5.34	5.08	4.96	**0.001***	**1.10**†	**0.001***	**1.02**†	0.754	0.11	0.169
EDI-2 Interpers. distrust	4.03	3.58	4.95	4.20	4.89	4.45	0.446	0.24	0.495	0.21	0.996	0.01	0.011
EDI-2 Ineffectiveness	3.39	3.11	9.13	6.85	8.94	7.40	**0.001***	**1.08**†	**0.001***	**0.98**†	0.985	0.03	0.162
EDI-2 Maturity fears	4.27	3.32	7.45	5.88	7.44	5.83	**0.003***	**0.67**†	**0.003***	**0.67**†	1.000	0.00	0.079
EDI-2 Perfectionism	2.89	2.78	5.61	4.57	6.45	5.37	**0.003***	**0.72**†	**0.001***	**0.83**†	0.552	0.17	0.109
EDI-2 Impulse regulation	1.77	3.35	6.05	5.80	5.17	5.84	**0.001***	**0.90**†	**0.001***	**0.72**†	0.629	0.15	0.116
EDI-2 Ascetic	2.47	1.94	7.20	4.26	7.17	5.06	**0.001***	**1.43**†	**0.001***	**1.23**†	0.999	0.01	0.241
EDI-2 Social Insecurity	3.78	3.60	6.44	4.74	6.38	5.56	**0.007***	**0.63**†	**0.009***	**0.55**†	0.997	0.01	0.066
EDI-2 Total scale	39.66	15.03	93.22	41.26	86.64	52.07	**0.001***	**1.73**†	**0.001***	**1.23**†	0.640	0.14	0.272
SCL-90R Somatization	1.18	0.84	1.70	0.85	1.43	0.97	**0.005***	**0.61**†	0.291	0.27	0.238	0.29	0.054
SCL-90R Obses.-compul.	1.07	0.78	1.75	0.80	1.63	0.99	**0.001***	**0.86**†	**0.001***	**0.63**†	0.723	0.14	0.108
SCL-90R Int.sensitivity	0.98	0.73	1.99	0.92	1.71	1.09	**0.001***	**1.21**†	**0.001***	**0.78**†	0.238	0.28	0.175
SCL-90R Depression	1.10	0.80	2.13	0.81	1.92	1.05	**0.001***	**1.29**†	**0.001***	**0.89**†	0.425	0.22	0.202
SCL-90R Anxiety	0.87	0.75	1.61	0.84	1.45	0.93	**0.001***	**0.94**†	**0.001***	**0.69**†	0.556	0.18	0.127
SCL-90R Hostility	0.58	0.64	1.47	1.10	1.17	0.84	**0.001***	**0.99**†	**0.001***	**0.79**†	0.163	0.30	0.151
SCL-90R Phobic anxiety	0.56	0.72	1.00	0.83	0.89	1.03	**0.018***	**0.57**†	0.105	0.37†	0.770	0.12	0.045
SCL-90R Paranoia	0.80	0.68	1.40	0.81	1.27	0.90	**0.001***	**0.81**†	**0.004***	**0.60**†	0.664	0.15	0.096
SCL-90R Psychotic	0.56	0.50	1.36	0.77	1.22	0.80	**0.001***	**1.23**†	**0.001***	**0.99**†	0.510	0.18	0.200
SCL-90R GSI	0.91	0.61	1.70	0.68	1.50	0.84	**0.001***	**1.22**†	**0.001***	**0.81**†	0.312	0.25	0.182
SCL-90R PST	43.64	22.71	63.86	15.02	56.80	22.62	**0.001***	**1.05**†	**0.002**	**0.58**†	0.151	0.37	0.146
SCL-90R PSDI	1.74	0.56	2.32	0.57	2.17	0.68	**0.001***	**1.03**†	**0.001***	**0.69**†	0.360	0.25	0.144
TCI-R Novelty seeking	98.41	11.87	101.89	15.04	98.84	15.77	0.390	0.26	0.985	0.03	0.486	0.20	0.012
TCI-R Harm avoidance	104.98	17.49	111.89	20.18	107.80	23.53	0.167	0.37	0.741	0.14	0.531	0.19	0.019
TCI-R Reward depend.	103.14	15.76	100.41	14.51	100.33	15.76	0.603	0.18	0.586	0.18	1.000	0.01	0.007
TCI-R Persistence	108.67	16.54	113.66	22.49	120.83	19.75	0.363	0.25	**0.003***	**0.67**†	0.124	0.34	0.061
TCI-R Self-directedness	138.17	22.66	120.41	20.60	124.67	24.05	**0.001***	**0.82**†	**0.004***	**0.58**†	0.563	0.19	0.103
TCI-R Cooperativeness	136.66	15.38	133.28	15.77	132.08	18.66	0.520	0.22	0.301	0.27	0.920	0.07	0.014
TCI-R Self-transcend.	61.58	14.45	63.33	16.72	64.94	15.78	0.819	0.11	0.481	0.22	0.845	0.10	0.008
Suicidal behavior	n	%	n	%	n	%	p	|h|	p	|h|	p	|h|	C-V
Suicidal ideation	13	20.31%	20	31.25%	20	31.25%	0.157	0.25	0.157	0.25	1.000	0.00	0.115
Suicidal attempts	3	4.69%	7	10.94%	6	9.38%	0.188	0.24	0.300	0.19	0.770	0.05	0.096

Note. SD: standard deviation. HC: healthy control. ED-A: non-athlete with an eating disorder. ED+A: athlete with eating disorder

η^2: Eta-squared. C-V: Cramer's-V

*Bold: significant comparison (0.05). †Bold: effect size into the ranges mild-moderate to the high-large

seeking and persistence domains), and higher risk of suicidal behavior.

Table 5 shows the comparison between men and women, within each group condition. Among the HC participants, men obtained higher mean in the EDI-2 bulimia and ascetic scales, lower mean in the SCL-90R somatization, anxiety and phobic anxiety, lower mean in the TCI-R reward dependence, self-directedness and cooperativeness, and lower risk of suicidal attempts.

Among the ED-A patients, men reported lower mean in the EDI-2 body dissatisfaction scale, lower cooperativeness, and higher self-transcendence.

Within the ED+A patients, compared to women, men obtained a more functional clinical profile. The only exceptions were for the EDI-2 interpersonal distrust and maturity fears, the TCI-R cooperativeness, and the risk of suicidal attempts.

Finally, we have obtained two multinomial regression analyses, to identify the variables with the highest discriminative capacity study on the ED diagnostic status (ED+A / ED-A / HC). Multinomial models are a generalization of logistic regression to multiclass problems (categorical criteria with more than 2 levels) and allow to assess the relationships between a set of independent variables on the probabilities of the different levels of a categorically distributed dependent variable (the parameters of the model are interpreted close to log-odds achieved in logistic regression with two levels of the outcome variable). In this work two separate models were obtained, stratified by the participants' sex (female and male subsamples). The list of variables defined as the independent variables included age, social economic position, ED severity level (EDI-2 total), global psychopathology distress (SCL-90R GSI), personality factors (TCI-R scores) and suicidal behaviors. The complete results of this analysis are displayed in Table S1 (supplementary material). Within the women subsample, the variables with significant capacity to discriminate between ED-A versus HC were ED symptom (Wald-χ^2 = 17.20, p <.001), harm avoidance (Wald-χ^2 = 4.56, p =.033), self-directedness (Wald-χ^2 = 4.28, p =.038) and self-transcendence (Wald-χ^2 = 3.97, p =.050); for women, the variables with significant capacity to discriminate between ED+A versus HC were age (Wald-χ^2 = 6.12, p =.013), ED symptom severity (Wald-χ^2 = 19.6, p <.001), and persistence (Wald-χ^2 = 6.42, p =.011). No statistically significant results were identified within the multinomial model adjusted for the male subsample, but these results must be interpreted with caution due the low number of men included in the study and the consequence underpowered analysis.

Discussion

This study compared three groups of individuals, athletes with an eating disorder (ED+A), non-athletes with an eating disorder (ED-A) and healthy controls (HC), looking at eating and general psychopathology, personality traits and suicidal ideation while taking gender into account.

Psychopathology and personality traits

When comparing gender in the ED+A group, overall women had higher eating and general psychopathology compared to men. In relation to the hypotheses, body dissatisfaction (BD) and drive for thinness (DT) were significantly higher in females compared to males in this group. A previous study has highlighted this disparity in athletes who do not have an ED, males had lower BD compared to females [51]. However, according to a recent meta-analysis, many studies have had mixed results concerning ED psychopathology (e.g., BD) and female athletes, where some have stated that BD is lower while others that BD is higher in athlete samples with or without ED [52]. Moreover, when looking at males across the groups, the lowest BD was found in the ED+A compared to the ED-A and HC groups. In this case, lower BD could correspond to being closer to the societal male body ideal and have a higher drive for muscularity in this group [53, 54], which may be a driving factor in their ED development. Also, this study has shown that males with an ED who are athletes show less eating psychopathology than non-athletes with an ED, this could be a sign that the screening scales frequently used in EDs (such as the EDI), do not capture the peculiarities of these specific populations (males and athletes). Also, as with female athletes, previous studies have presented various results, where in a recent review, it was found that male athletes tended to either have lower BD than healthy controls or there was no significant difference between the groups [28]. Also, when looking at DT, the results showed that females in the ED+A group had higher DT compared to males. In line with this, a recent study in a sample of athletes found that DT oriented behaviors and attitudes were present in 8.27% of the participants, which was 9.15% of women and 6.67% of men [53]. It has been suggested that perfectionism interacts with BD to predict higher DT in adolescent females [55, 56], which could be a reason as to the higher BD and DT levels in females. Also, these results correspond with research in non-athletic ED samples, in females who have anorexia nervosa and bulimia nervosa [31]. However, further research is required to better understand the influence of BD and DT on athletes with an ED.

Table 3 Comparison at baseline among the female subsample: ANOVA

	HC (n=50)		ED-A (n=50)		ED+A (n=50)		HC versus ED-A		HC versus ED+A		ED-A versus ED+A		η^2
	Mean	SD	Mean	SD	Mean	SD	p	|d|	p	|d|	p	|d|	
EDI-2 Drive thinness	3.42	4.36	14.36	5.99	13.72	7.50	**0.001***	**2.09†**	**0.001***	**1.68†**	0.871	0.09	0.409
EDI-2 Body dissatisfaction	9.40	7.63	18.12	8.00	15.36	9.31	**0.001***	**1.11†**	**0.002**	**0.70†**	0.258	0.32	0.162
EDI-2 Interoc. awareness	2.82	2.69	9.72	7.26	10.52	7.42	**0.001***	**1.26†**	**0.001***	**1.38†**	0.812	0.11	0.241
EDI-2 Bulimia	1.00	1.37	5.98	5.47	5.88	5.18	**0.001***	**1.25†**	**0.001***	**1.29†**	0.994	0.02	0.220
EDI-2 Interpers. distrust	3.98	3.60	5.34	4.15	5.16	4.74	0.271	0.35	0.373	0.28	0.977	0.04	0.021
EDI-2 Ineffectiveness	3.44	3.23	9.74	6.43	10.38	7.60	**0.001***	**1.24†**	**0.001***	**1.19†**	0.869	0.09	0.215
EDI-2 Maturity fears	4.20	3.46	7.32	5.61	7.68	6.12	**0.013***	**0.67†**	**0.004***	**0.70†**	0.942	0.06	0.085
EDI-2 Perfectionism	2.98	2.93	5.22	4.38	7.32	5.31	**0.037***	**0.60†**	**0.001***	**1.01†**	0.055	0.43	0.146
EDI-2 Impulse regulation	1.62	3.29	5.58	5.69	6.04	6.17	**0.001***	**0.85†**	**0.001***	**0.89†**	0.907	0.08	0.129
EDI-2 Ascetic	2.16	1.69	7.20	4.24	7.88	5.23	**0.001***	**1.56†**	**0.001***	**1.47†**	0.698	0.14	0.292
EDI-2 Social Insecurity	3.50	3.55	6.72	4.28	7.14	5.83	**0.003***	**0.82†**	**0.001***	**0.75†**	0.903	0.08	0.111
EDI-2 Total scale	38.52	15.72	95.30	38.71	97.10	53.32	**0.001***	**1.92†**	**0.001***	**1.49†**	0.974	0.04	0.330
SCL-90R Somatization	1.32	0.86	1.76	0.87	1.60	0.98	0.059	0.50†	0.301	0.31	0.699	0.17	0.039
SCL-90R Obses.-compul.	1.05	0.74	1.73	0.78	1.80	0.95	**0.001***	**0.90†**	**0.001***	**0.89†**	0.903	0.09	0.148
SCL-90R Int.sensitivity	0.96	0.73	2.07	0.89	1.91	1.05	**0.001***	**1.36†**	**0.001***	**1.04†**	0.656	0.17	0.231
SCL-90R Depression	1.16	0.80	2.20	0.76	2.07	1.03	**0.001***	**1.33†**	**0.001***	**0.99†**	0.761	0.14	0.225
SCL-90R Anxiety	0.97	0.75	1.65	0.79	1.62	0.90	**0.001***	**0.88†**	**0.001***	**0.78†**	0.983	0.04	0.130
SCL-90R Hostility	0.55	0.65	1.40	1.07	1.27	0.89	**0.001***	**0.95†**	**0.001***	**0.92†**	0.770	0.13	0.152
SCL-90R Phobic anxiety	0.63	0.79	0.99	0.76	0.99	1.08	0.129	0.47	0.128	0.38	1.000	0.00	0.036
SCL-90R Paranoia	0.77	0.67	1.38	0.80	1.40	0.92	**0.001***	**0.82†**	**0.001***	**0.78†**	0.993	0.02	0.118
SCL-90R Psychotic	0.57	0.50	1.39	0.75	1.33	0.80	**0.001***	**1.29†**	**0.001***	**1.15†**	0.925	0.07	0.228
SCL-90R GSI	0.95	0.63	1.72	0.65	1.65	0.83	**0.001***	**1.22†**	**0.001***	**0.95†**	0.872	0.10	0.199
SCL-90R PST	45.42	23.44	64.64	14.68	60.28	21.42	**0.001***	**0.98†**	**0.002***	**0.66†**	0.560	0.24	0.145
SCL-90R PSDI	1.71	0.54	2.35	0.54	2.29	0.63	**0.001***	**1.19†**	**0.001***	**1.00†**	0.878	0.10	0.208
TCI-R Novelty seeking	97.82	12.02	102.24	13.80	100.56	14.93	0.272	0.34	0.605	0.20	0.827	0.12	0.018
TCI-R Harm avoidance	106.72	16.68	112.12	19.07	110.96	22.87	0.393	0.30	0.562	0.21	0.958	0.06	0.014
TCI-R Reward depend.	105.54	15.68	99.82	14.77	101.90	16.75	0.196	0.38	0.515	0.22	0.804	0.13	0.022
TCI-R Persistence	109.70	15.94	112.42	22.48	122.74	21.28	0.796	0.14	**0.006***	**0.69†**	**0.040***	0.47	0.074
TCI-R Self-directedness	141.08	21.34	119.32	18.19	120.52	24.00	**0.001***	**1.10†**	**0.001***	**0.91†**	0.961	0.06	0.183
TCI-R Cooperativeness	139.88	13.22	134.94	16.51	130.80	19.86	0.340	0.33	**0.028***	**0.54†**	0.468	0.23	0.048
TCI-R Self-transcend.	61.86	14.61	61.24	15.09	66.48	16.19	0.980	0.04	0.323	0.30	0.235	0.33	0.023
Suicidal behavior	n	%	n	%	n	%	p	|h|	p	|h|	p	|h|	C-V
Suicidal ideation	11	22.00%	16	32.00%	19	38.00%	0.260	0.23	0.081	0.35	0.529	0.13	0.143
Suicidal attempts	3	6.00%	4	8.00%	5	10.00%	0.695	0.08	0.461	0.15	0.727	0.07	0.060

Note. SD: standard deviation. HC: healthy control. ED-A: non-athlete with an eating disorder. ED+A: athlete with an eating disorder

η^2: Eta-squared. C-V: Cramer's-V

*Bold: significant comparison (0.05). †Bold: effect size into the ranges mild-moderate to the high-large

Another factor where there were significant differences between genders in the ED+A group was personality traits, specifically significantly higher harm avoidance (HA) and lower self-directedness (SD) in females compared to males. These two traits are seen to be prominent in patients with an ED, where athletes with an ED have lower HA and SD compared to non-athletes with an ED [57] and seem to be gender specific. However, to the best of our knowledge, previous studies have not examined the differences within the ED+A group between male and female participants, in terms of these traits. Nevertheless, these traits do coincide with previous research in non-athlete females who have anorexia nervosa and bulimia nervosa [31]. Some possibilities for this difference could be related to a gender bias in this scale or that there are some questions which lean more towards societal expectations of female behavior, such as emotional expression considered to be more feminine (e.g., crying when sad) versus those associated with a societal masculine expression of emotions (e.g., yelling when angry) [31, 58].

Suicidal ideation
In the ED+A group suicidal ideation was found to be significantly higher in females than males. Previous studies have noted that participating in sports may be a protective factor in terms of suicide, and when comparing ED+A and ED-A groups, there appears to be less suicidal ideation in the former [35, 59]. However, some factors which may contribute to the risk of suicide in the ED+A group could be related to the pressure to compete, injury, etc [60]. According to a systematic review regarding athletes compared to the general population, various studies found that male athletes were at an increased risk of suicide, whereas only one found females to be at an increased risk [36]. Additionally, a study found that in the general European population, lifetime prevalence of suicidal ideas was 7.8%, and 1.8% for suicidal attempts [61]. Moreover, in Spain specifically, lifetime prevalence of suicidal ideation was 3.67% and attempts were 1.46% in in the general population [62]. Therefore, further research is needed regarding the potential risk factors and level of suicidal ideation and suicide attempts regarding gender, athletes and ED diagnosis, over the lifespan.

Clinical implications
As we have observed in this study, there are significant psychopathological differences in females and males with ED+A compared to ED-A and HC. This highlights the importance of implementing specific interventions for this group, especially in terms of gender.

Preventive interventions are crucial, as it has been widely demonstrated that understanding risk and protective factors reduces the likelihood of developing an ED [63]. In this context, factors such as dieting, personality traits, pressure to lose weight, frequent weight fluctuations, early start of sport-specific training, overtraining, injuries and unfortunate coaching behavior are important risk factors to be considered [4]. Hence, prevention programs where athletes focus on healthy weight interventions could curtail the development of an ED in this subgroup [64] potentially leading to improved athletic performance. A notable characteristic according to Naylor and colleagues [65] is the tendency towards perfectionism and to display obsessive thoughts and/or behaviors related to both sports practice and routines or activities, as well as to food and the body. Thus, this tendency towards perfection and high expectations of oneself lead to a feeling of failure or frustration if it is not achieved, which can lead to a search for solutions that can sometimes occur through weight reduction, with the belief that being thinner will improve performance. Potentially, this can be seen via the significantly higher perfectionism in ED+A females, compared to males, in the present study, potentially demonstrating a form of rigidity in thought processes related to their sport or other activities. This is particularly important in the phase when they stop playing sport at a professional level, when prioritization of life goals becomes necessary. Preventive strategies and preparation for this phase, when they are no longer professional athletes and must pursue other goals in life, will help them to avoid easily resorting to inappropriate eating strategies as a coping method.

Another particularly important aspect, as mentioned by Hernández-Mulero and Berengüí [66], is to prevent athletes from developing maladaptive levels of athletic identity (AI), thereby reducing the risk of developing an ED. These authors argue that higher AI increases the likelihood of developing an ED. Therefore, it is necessary to encourage athletes to find other interests and pursuits outside of the sports realm.

Limitations and strengths
Some limitations of this study are regarding the measures which were used. First of all, the participants may experience questionnaire fatigue as these are self-report tests with a large amount of questions. Also, those that are typically used in ED research tend to be more female oriented, such as the EDI-2, especially the factors of drive for thinness and body dissatisfaction [67], and not male nor athlete oriented, it may be more beneficial to not only observe drive for thinness but also a drive for muscularity [68]. This study could have

Table 4 Comparison at baseline among the male subsample: ANOVA

	HC (n = 14)		ED-A (n = 14)		ED+A (n = 14)		HC versus ED-A		HC versus ED+A		ED-A versus ED+A		η²
	Mean	SD	Mean	SD	Mean	SD	p	|d|	p	|d|	p	|d|	
EDI-2 Drive thinness	5.57	5.61	12.79	5.49	8.86	5.57	**0.006***	**1.30†**	0.306	**0.59†**	0.188	**0.71†**	0.233
EDI-2 Body dissatisfaction	9.07	8.69	13.00	9.27	5.29	4.18	0.413	0.44	0.439	**0.56†**	**0.040***	**1.07†**	0.152
EDI-2 Interoc. awareness	1.71	1.82	9.71	7.30	4.93	3.93	**0.001***	**1.50†**	0.234	**1.05†**	**0.046***	**0.82†**	0.326
EDI-2 Bulimia	2.21	3.04	4.50	4.83	2.21	2.61	0.261	**0.57†**	1.000	0.00	0.261	**0.59†**	0.087
EDI-2 Interpers. distrust	4.21	3.64	3.57	4.22	3.93	3.17	0.900	0.16	0.979	0.08	0.968	0.10	0.005
EDI-2 Ineffectiveness	3.21	2.78	6.93	8.07	3.79	3.33	0.191	**0.62†**	0.960	0.19	0.302	**0.51†**	0.093
EDI-2 Maturity fears	4.50	2.88	7.93	6.96	6.57	4.78	0.225	**0.64†**	0.572	**0.52†**	0.785	0.23	0.075
EDI-2 Perfectionism	2.57	2.21	7.00	5.11	3.36	4.47	**0.025***	**1.12†**	0.881	0.22	0.077	**0.76†**	0.191
EDI-2 Impulse regulation	2.29	3.60	7.71	6.09	2.07	2.97	**0.010***	**1.08†**	0.992	0.06	**0.007***	**1.18†**	0.272
EDI-2 Ascetic	3.57	2.41	7.21	4.49	4.64	3.50	**0.035***	**1.01†**	0.731	0.36	0.176	**0.64†**	0.165
EDI-2 Social Insecurity	4.79	3.75	5.43	6.21	3.64	3.34	0.934	0.13	0.807	0.32	0.596	0.36	0.027
EDI-2 Total scale	43.71	11.82	85.79	50.26	49.29	22.31	**0.006***	**1.15†**	0.902	0.31	**0.019***	**0.94†**	0.262
SCL-90R Somatization	0.69	0.53	1.49	0.77	0.82	0.64	**0.010***	**1.21†**	0.880	0.21	**0.033***	**0.95†**	0.237
SCL-90R Obses.-compul.	1.14	0.95	1.84	0.92	1.01	0.91	0.156	**0.74†**	0.928	0.15	0.074	**0.91†**	0.141
SCL-90R Int.sensitivity	1.06	0.77	1.70	0.99	1.02	0.97	0.200	**0.72†**	0.990	0.05	0.157	**0.69†**	0.110
SCL-90R Depression	0.89	0.78	1.88	0.93	1.40	0.98	**0.022***	**1.15†**	0.342	**0.57†**	0.373	**0.51†**	0.178
SCL-90R Anxiety	0.53	0.62	1.49	0.99	0.86	0.81	**0.014***	**1.16†**	0.563	0.47	0.143	**0.69†**	0.203
SCL-90R Hostility	0.67	0.65	1.71	1.18	0.81	0.55	**0.008***	**1.10†**	0.905	0.24	**0.026***	**0.98†**	0.246
SCL-90R Phobic anxiety	0.31	0.33	1.02	1.07	0.51	0.73	0.060	**0.91†**	0.783	0.36	0.227	**0.56†**	0.141
SCL-90R Paranoia	0.88	0.74	1.48	0.87	0.82	0.70	0.139	**0.74†**	0.980	0.08	0.094	**0.83†**	0.136
SCL-90R Psychotic	0.54	0.54	1.29	0.88	0.82	0.66	**0.029***	**1.02†**	0.585	0.46	0.233	**0.60†**	0.168
SCL-90R GSI	0.77	0.52	1.60	0.82	0.98	0.69	**0.010***	**1.22†**	0.710	0.35	0.069	**0.82†**	0.224
SCL-90R PST	37.29	19.33	61.07	16.45	44.36	23.17	**0.011***	**1.33†**	0.644	0.33	0.097	**0.83†**	0.214
SCL-90R PSDI	1.88	0.63	2.24	0.66	1.74	0.70	0.366	**0.56†**	0.871	0.20	0.159	**0.73†**	0.096
TCI-R Novelty seeking	100.50	11.46	100.64	19.39	92.71	17.69	1.000	0.01	0.467	**0.52†**	0.455	0.43	0.051
TCI-R Harm avoidance	98.79	19.52	111.07	24.55	96.50	23.14	0.362	**0.55†**	0.965	0.11	0.243	**0.61†**	0.080
TCI-R Reward depend.	94.57	13.24	102.50	13.87	94.71	10.17	0.259	**0.58†**	1.000	0.01	0.271	**0.64†**	0.086
TCI-R Persistence	105.00	18.68	118.07	22.79	114.00	10.93	0.176	**0.63†**	0.431	**0.59†**	0.839	0.23	0.089
TCI-R Self-directedness	127.79	24.95	124.29	28.07	139.50	18.14	0.929	0.13	0.444	**0.54†**	0.259	**0.64†**	0.073
TCI-R Cooperativeness	125.14	17.47	127.36	11.41	136.64	13.11	0.919	0.15	0.115	**0.74†**	0.238	**0.76†**	0.117
TCI-R Self-transcend.	60.57	14.34	70.79	20.51	59.43	13.33	0.268	**0.58†**	0.983	0.08	0.199	**0.66†**	0.095
Suicidal behavior	n	%	n	%	n	%	p	|h|	p	|h|	p	|h|	C-V
Suicidal ideation	2	14.29%	4	28.57%	1	7.14%	0.357	0.35	0.541	0.23	0.139	**0.59†**	0.239
Suicidal attempts	0	0.00%	3	21.43%	1	7.14%	**0.034***	**0.96†**	0.309	**0.54†**	0.280	**0.51†**	0.303

Note. SD: standard deviation. HC: healthy control. ED-A: non-athlete with an eating disorder. ED+A: athlete with eating disorder

η²: Eta-squared. C-V: Cramer's-V

*Bold: significant comparison (0.05). †Bold: effect size into the ranges mild-moderate to the high-large

Table 5 Assessment of gender as a potential interaction factor within the clinical subsamples

	HC						ED-A						ED+A					
	Female (n=50)		Male (n=14)				Female (n=50)		Male (n=14)				Female (n=50)		Male (n=14)			
	Mean	SD	Mean	SD	p	|d|	Mean	SD	Mean	SD	p	|d|	Mean	SD	Mean	SD	p	|d|
EDI-2 Drive thinness	3.42	4.36	5.57	5.61	0.131	0.43	14.36	5.99	12.79	5.49	0.380	0.27	13.72	7.50	8.86	5.57	0.028*	0.74†
EDI-2 Body dissatisfaction	9.40	7.63	9.07	8.69	0.891	0.04	18.12	8.00	13.00	9.27	0.045*	0.59†	15.36	9.31	5.29	4.18	0.001*	1.40†
EDI-2 Interoceptive awareness	2.82	2.69	1.71	1.82	0.154	0.48	9.72	7.26	9.71	7.30	0.998	0.00	10.52	7.42	4.93	3.93	0.009*	0.94†
EDI-2 Bulimia	1.00	1.37	2.21	3.04	0.034*	0.51†	5.98	5.47	4.50	4.83	0.363	0.29	5.88	5.18	2.21	2.61	0.013*	0.89†
EDI-2 Interpersonal distrust	3.98	3.60	4.21	3.64	0.831	0.06	5.34	4.15	3.57	4.22	0.165	0.42	5.16	4.74	3.93	3.17	0.364	0.31
EDI-2 Ineffectiveness	3.44	3.23	3.21	2.78	0.813	0.07	9.74	6.43	6.93	8.07	0.177	0.39	10.38	7.60	3.79	3.33	0.003*	1.12†
EDI-2 Maturity fears	4.20	3.46	4.50	2.88	0.768	0.09	7.32	5.61	7.93	6.96	0.735	0.10	7.68	6.12	6.57	4.78	0.534	0.20
EDI-2 Perfectionism	2.98	2.93	2.57	2.21	0.631	0.16	5.22	4.38	7.00	5.11	0.200	0.37	7.32	5.31	3.36	4.47	0.013*	0.81†
EDI-2 Impulse regulation	1.62	3.29	2.29	3.60	0.515	0.19	5.58	5.69	7.71	6.09	0.227	0.36	6.04	6.17	2.07	2.97	0.023*	0.82†
EDI-2 Ascetic	2.16	1.69	3.57	2.41	0.015*	0.68†	7.20	4.24	7.21	4.49	0.991	0.00	7.88	5.23	4.64	3.50	0.033*	0.73†
EDI-2 Social Insecurity	3.50	3.55	4.79	3.75	0.241	0.35	6.72	4.28	5.43	6.21	0.372	0.24	7.14	5.83	3.64	3.34	0.036*	0.74†
EDI-2 Total scale	38.52	15.72	43.71	11.82	0.256	0.37	95.30	38.71	85.79	50.26	0.450	0.21	97.10	53.32	49.29	22.31	0.002*	1.17†
SCL-90R Somatization	1.32	0.86	0.69	0.53	0.011*	0.89†	1.76	0.87	1.49	0.77	0.300	0.33	1.60	0.98	0.82	0.64	0.006*	0.95†
SCL-90R Obsessive-compul.	1.05	0.74	1.14	0.95	0.685	0.11	1.73	0.78	1.84	0.92	0.662	0.13	1.80	0.95	1.01	0.91	0.007*	0.86†
SCL-90R Interp.sensitivity	0.96	0.73	1.06	0.77	0.644	0.14	2.07	0.89	1.70	0.99	0.183	0.39	1.91	1.05	1.02	0.97	0.006*	0.88†
SCL-90R Depression	1.16	0.80	0.89	0.78	0.270	0.34	2.20	0.76	1.88	0.93	0.187	0.38	2.07	1.03	1.40	0.98	0.031*	0.68†
SCL-90R Anxiety	0.97	0.75	0.53	0.62	0.052	0.63†	1.65	0.79	1.49	0.99	0.548	0.17	1.62	0.90	0.86	0.81	0.007*	0.88†
SCL-90R Hostility	0.55	0.65	0.67	0.65	0.554	0.18	1.40	1.07	1.71	1.18	0.341	0.28	1.27	0.89	0.81	0.55	0.073	0.62†
SCL-90R Phobic anxiety	0.63	0.79	0.31	0.33	0.142	0.53†	0.99	0.76	1.02	1.07	0.909	0.03	0.99	1.08	0.51	0.73	0.123	0.52†
SCL-90R Paranoia	0.77	0.67	0.88	0.74	0.605	0.15	1.38	0.80	1.48	0.87	0.707	0.11	1.40	0.92	0.82	0.70	0.033*	0.71†
SCL-90R Psychotic	0.57	0.50	0.54	0.54	0.881	0.04	1.39	0.75	1.29	0.88	0.670	0.12	1.33	0.80	0.82	0.66	0.033*	0.70†
SCL-90R GSI	0.95	0.63	0.77	0.52	0.324	0.32	1.72	0.65	1.60	0.82	0.570	0.16	1.65	0.83	0.98	0.69	0.008*	0.87†
SCL-90R PST	45.42	23.44	37.29	19.33	0.239	0.38	64.64	14.68	61.07	16.45	0.436	0.23	60.28	21.42	44.36	23.17	0.019*	0.71†
SCL-90R PSDI	1.71	0.54	1.88	0.63	0.321	0.29	2.35	0.54	2.24	0.66	0.511	0.19	2.29	0.63	1.74	0.70	0.007*	0.82†
TCI-R Novelty seeking	97.82	12.02	100.50	11.46	0.460	0.23	102.24	13.80	100.64	19.39	0.728	0.09	100.56	14.93	92.71	17.69	0.100	0.52†
TCI-R Harm avoidance	106.72	16.68	98.79	19.52	0.135	0.44	112.12	19.07	111.07	24.55	0.865	0.05	110.96	22.87	96.50	23.14	0.041*	0.63†
TCI-R Reward depend.	105.54	15.68	94.57	13.24	0.020*	0.76†	99.82	14.77	102.50	13.87	0.546	0.19	101.90	16.75	94.71	10.17	0.133	0.52†
TCI-R Persistence	109.70	15.94	105.00	18.68	0.351	0.27	112.42	22.48	118.07	22.79	0.410	0.25	122.74	21.28	114.00	10.93	0.145	0.52†
TCI-R Self-directedness	141.08	21.34	127.79	24.95	0.052	0.57†	119.32	18.19	124.29	28.07	0.430	0.21	120.52	24.00	139.50	18.14	0.008*	0.89†
TCI-R Cooperativeness	139.88	13.22	125.14	17.47	0.001*	0.95†	134.94	16.51	127.36	11.41	0.112	0.53†	130.80	19.86	136.64	13.11	0.304	0.35
TCI-R Self-transcend.	61.86	14.61	60.57	14.34	0.771	0.09	61.24	15.09	70.79	20.51	0.058	0.53†	66.48	16.19	59.43	13.33	0.141	0.51†
Suicidal behavior	n	%	n	%	p	|h|	n	%	n	%	p	|h|	n	%	n	%	p	|h|
Suicidal ideation	11	22.00%	2	14.29%	0.526	0.20	16	32.00%	4	28.57%	0.807	0.07	19	38.00%	1	7.14%	0.028*	0.79†
Suicidal attempts	3	6.00%	0	0.00%	0.348	0.51†	4	8.00%	3	21.43%	0.155	0.39	5	10.00%	1	7.14%	0.746	0.10

Note. SD: standard deviation. HC: healthy control. ED-A: non-athlete with an eating disorder. ED+A: athlete with an eating disorder. AN: anorexia nervosa. BN: bulimia nervosa. BED: binge eating disorder. OSFED: other specified feeding and eating disorder. *Significant comparison (0.05). †Bold: effect size into the ranges mild-moderate to the high-large

included other questionnaires (e.g., EDE-Q), or more specific ones, to be able to capture dissatisfaction with one's body. Especially as a drive for muscularity has been shown to be a risk factor in males regarding ED-related psychopathology in anorexia nervosa [69]. Although, when looking across genders, a systematic review by Kling et al. [70] found that some body image scales remain unaltered across genders. Some of them being, the Body Appreciation Scale (original and second version) which is helpful when examining gender differences, as well as the Body Esteem Scale for Adolescents and Adults, the Centre for Appearance Research Valence Scale, two subscales of the Multidimensional Body Relations Questionnaire (i.e., Appearance Evaluation and Body Areas Satisfaction). Additionally, future studies should consider related aspects taking into account the characteristics of this population, more so related to body shape and muscularity than losing weight. Also, the TCI-R has been shown in the general population to have differences regarding gender for each of the scales, this could be due to biological or availability factors of the participants. Additionally, a factor which was not taken into account in this study was the amount of exercise and potential maladaptive exercise in the three groups, which could be a confounding factor in the results of this study. Moreover, another factor is sexual orientation in relation to sports and EDs. Previous studies found that there is a higher prevalence of EDs among homosexual males compared to heterosexual males [71, 72], however research is limited in terms of EDs and homosexual athletes [73]. Additionally, in the healthy control group, their participation in sports or physical activity was not collected, which could be an interesting factor to note in future studies. Finally, the comparisons including the participants' sex are underpowered due the small sample size of the male groups (it was possible to miss a real effect, since the lack of statistical significance is not evidence in favor of the null hypothesis). It should be kept in mind that in this study we have considered relevant any statistically significant result or with an effect size at least in the medium-moderate range. In any case, it is important that future studies with larger samples provide evidence that confirms or refutes the results of our research.

However, this study also had strengths, such as, having a clinical sample of patients who were athletes diagnosed with an eating disorder, a heterogeneity of female and male patients, and being able to compare two clinical samples with healthy controls. Also, as there are not many studies comparing gender in the ED athlete groups, this was also a novel aspect of this study.

Conclusions

This study looked at athletes in an eating disorder population and compared them to non-athletes with an eating disorder and healthy controls. It provides pertinent information regarding the eating and psychopathology of female and male athletes compared to the other two groups. While also looking within the athletic population and assessing personality traits and suicidal ideation. This study could provide beneficial information in terms of risk and protective factors for athletes in relation to eating disorder development as well as aid in better understanding when athletes are in treatment. Lastly, in the athletic realm this study could be beneficial for coaches and other personnel to incorporate some screening and preventative tools.

Abbreviations

ED	Eating disorder
ED-A	Athletes with an eating disorder
ED-NA	Non-athletes with an eating disorder
HC	Healthy Controls
BD	Body Dissatisfaction
DT	Drive for thinness
GHQ-28	General Health Questionnaire-28
TCI-R	Temperament and Character Inventory-Revised
SCL-90R	Symptom Checklist-90 Items-Revised
GSI	Global Severity Index
PST	Positive Symptom Total
PSDI	Positive Symptom Distress Index
EDI-2	Eating Disorder Inventory-2
CEIC	Clinical Research Ethics Committee
ANOVA	Analysis of Variance

Supplementary Information

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Supplementary Material 1
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Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the Declaration of Helsinki, signed informed consent (document version 19/10/2021) was obtained from all participants before completing the psychometric assessments and initiating outpatient treatment; this document legally legitimizes the use of patient data, and was approved by the Clinical Research Ethics Committee of Bellvitge University Hospital (Record 19/21).

Consent for publication
Not applicable.

Competing interests
F.F.-A. and S.J.-M. received consultancy honoraria from Novo Nordisk.

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