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ORIGINAL ARTICLE

Sexuality, embodiment and attachment style in anorexia nervosa

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Abstract

Purpose Recent studies hypothesized that sexual dysfunctions represent not just complications of eating disorders (EDs), rather they should be attributed to the core psychopathology of these disorders. Therefore, disorders of the embodiment and insecure attachment may play a role in maintaining an abnormal sexual functioning, given their known relations with core ED features. The aim of the study was to investigate the relationship between sexual dysfunctions and both disorders of the embodiment and attachment style in people with anorexia nervosa (AN).

Methods 111 adult women with AN and 120 healthy subjects completed the Symptom Checklist-90, Eating Disorder Examination Questionnaire, Identity and Eating Disorders, Attachment Style Questionnaire and the Childhood Trauma Questionnaire-Short Form.

Results Patients reported worse scores than controls in all areas assessed. In patients, low sexual desire was found to be associated with general and ED-specific psychopathology, and with disorders of embodiment and attachment style. Sexual dysfunctions had no associations with traumatic experiences. Dietary restriction showed an association with low sexual desire through embodiment disorder and Discomfort with Closeness, as confirmed by the serial mediation model.

Conclusion The present study suggests that disorders of embodiment maintained by pathological eating behaviours have a key role in the development of sexual dysfunctions in EDs, through the compromise of intimacy.

Level of evidence Level III, cross-sectional study with comparisons between cases and controls.

Keywords Embodiment · Anorexia nervosa · Attachment style · Sexual dysfunctions

Introduction

AN is a severe and often chronic disorder that mainly involves young women, [1]. General and specific aetiological factors such as insecure attachment style [2] and body image disturbances [1] have been widely demonstrated to be associated with onset and maintenance of AN. These two mentioned risk factors are connected, as adverse early life experiences seem to be associated with the development of body dissatisfaction, that is related to the core psychopathological nucleus of eating disorders (EDs) [3, 4]. Moreover, new approaches identified a disorder of the way in which people experience their own body (embodiment) as a core psychopathological dimension of AN [3–5]. In particular, embodiment seems to play a mediating role in the relationship between insecure attachment style and the specific psychopathology of EDs [6].

Recently, a growing body of literature has focused the attention on the role of sexual dysfunctions in AN, in which the most frequent appears to be the reduction of sexual desire [7], not just as a mere consequence of underweight, but as a specific problem deeply related with specific psychopathology such as body image disturbances [8, 9], body uneasiness [8], shape concerns [9] and dietary restraint [8]. Moreover, follow-up studies have demonstrated that the recovery of a normal sexual function represents an important predictor of outcome for patients affected by AN considering the fact that it is a marker of recovery of an healthy contact with one's own body [8]. Thus, it can be hypothesized that sexual

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dysfunctions represent not only a complication of EDs, but a more profound characteristic strictly connected with disorders of the embodiment. Furthermore, it is possible that sexuality of patients with AN may be also affected by insecure attachment, which has been also associated with sexual impairment [10]. In particular, it has been demonstrated that both anxious and avoidant attachment styles are associated with reduced sexual satisfaction [11] and that avoidant attachment style is more specifically related to a reduction in sexual desire than anxious attachment style [12].

To the best of our knowledge, no study has ever evaluated the relationship between abnormal sexual functioning and both disorders of the embodiment and attachment style in people with AN. According to the considerations discussed above, the aim of the present study was to investigate the following points: (1) the relationship between sexual dysfunctions and alterations of the embodiment; (2) the relationship between sexual dysfunctions and the presence of an insecure attachment style; (3) the role of embodiment as a mediator of the relationship between ED specific psychopathology and sexual desire impairment; (4) the role of insecure attachment style as a mediator in the relationship between ED specific psychopathology, alterations of the embodiment and low sexual desire.

Methods

The present observational study was conducted at the Outpatient Clinic for Eating Disorders of the Psychiatric Unit of the University of Florence, Italy. Patients were referred to the clinic by their general practitioner or other clinicians. All diagnostic procedures were performed in the context of the routine initial evaluation. All participants were adequately informed about the study and signed a consent form. The study protocol was approved by the ethics committee of the Institution.

Participants

Patients attending the Outpatient Clinic for Eating Disorders of the University of Florence between April 2016 and March 2019 were enrolled in this study, provided they met the following inclusion criteria: female gender, age between 18 and 40 years, current diagnosis of AN according to DSM-5 criteria. Exclusion criteria were as follows: comorbid schizophrenia, bipolar I disorder, acute psychotic disorder, illiteracy, intellectual disability, severe medical conditions precluding treatment in an outpatient context, current use of psychoactive medications, except for antidepressants (ADs) and benzodiazepines. Of the 123 AN patients referred, four subjects declined to participate and eight were excluded (one comorbid schizophrenia, one comorbid bipolar disorder, two severe medical conditions, four concurrent use of psychoactive medication).

Healthy controls were recruited with local advertisements among students of this University, provided they met the following inclusion criteria: female gender, age between 18 and 40, absence of any mental disorder as assessed by a clinical evaluation and BMI (Body Mass Index) between 18.5 and 25.0 kg/m^2.

Assessment and measures

Two expert psychiatrists (G.C. and V.R.) performed the initial evaluation, collecting sociodemographic, pharmacological and clinical data through a face-to-face interview. Anthropometric measurements (weight and height) were made using standard calibrated instruments, BMI was calculated dividing body weight in kilogrammes by height in metres squared. Finally, all subjects were asked to complete a series of self-administered questionnaires.

Symptom Checklist-90 (SCL-90-R) [13] was used in order to evaluate general psychopathology. It is a multidimensional symptom self-report inventory comprised of 90 items, each measured on a 5-point scale of distress from "not at all" (0) to "extremely" (4). The SCL-90 quantifies psychopathology in terms of nine primary symptom constructs: Somatization (SOM), Obsessive–Compulsive (OC), Interpersonal Sensitivity (INT), Depression (DEP), Anxiety (ANX), Hostility (HOS), Phobic Anxiety (PHOB), Paranoid Ideation (PAR) and Psychoticism (PSY). In addition, three global measures reflect distinct aspects of overall psychological distress: general severity index (GSI), positive symptom distress index (PSDI) and positive symptom total (PST).

ED psychopathological features were investigated through the Eating Disorder Examination Questionnaire version 6.0 (EDE-Q 6.0) [14], a questionnaire assessing the behavioural and cognitive features of EDs divided in four subscales: Restraint, Eating Concern, Weight Concern and Shape Concern. A total score can be obtained by averaging the subscales.

The Identity and Eating Disorders (IDEA) Questionnaire [5] was used to evaluate embodiment and identity abnormalities in the present sample. It consists of 23 items divided into four subscales: feeling oneself only through the gaze of the other and defining oneself only through the evaluation of the other (GEO), feeling oneself only through objective measures (OM), feeling extraneous from one's own body (EB) and feeling oneself only through starvation (S). The average of all items represents the total score.

The Attachment Style Questionnaire (ASQ) [15], a 40-item self-administered questionnaire, was used to evaluate five dimensions of adult attachment: Confidence (eight items), reflecting a secure attachment style; Discomfort with Closeness (ten items) and Relationships as Secondary (seven

items), related to an avoidant attachment; Need for Approval (seven items) and Preoccupation with Relationships (eight items), related to an anxious-ambivalent attachment. Each item is rated on a 6-point scale, ranging from 1 (totally disagree) to 6 (totally agree). To avoid response bias, the items are listed in random order and three items are reverse-scored.

In order to evaluate traumatic experiences in the infancy the Childhood Trauma Questionnaire-Short Form (CTQ-SF) [16] was used, a retrospective self-reported questionnaire including 28 items with five subscales, three of which assessing abuse (emotional, physical and sexual) and two assessing neglect (emotional and physical). Higher scores indicate a greater childhood trauma.

Finally, sexual functioning was studied by means of the Female Sexual Functioning Index (FSFI) [17, 18], a multidimensional self-report instrument evaluating all dimensions of sexuality in women: desire, arousal, lubrication, orgasm, satisfaction and pain, as well as a total score. Higher scores indicate a better functioning for all subscales. The questions are referred to the 4 weeks prior to the assessment. All subscales except desire and satisfaction have a scoring of 0 in case of absence of sexual activity, that is defined as sexual intercourse, petting or masturbation.

Statistical analyses

Continuous variables were reported as mean ± standard deviation, whereas dichotomous variables were reported as absolute frequencies and percentages. Independent samples *t* test and chi-squared test were used for comparisons between groups (patients vs. controls, AN restricting type vs. AN binge-purging type and AN taking ADs vs. AN not taking ADs), while Analysis of Covariance (ANCOVA) was used to determine between-groups differences after adjusting for age and BMI.

Multiple linear regression models were performed using FSFI subscales as dependent variables and clinical/psychopathological variables as predictors, adjusting for age and BMI. Separate analyses were performed in patients and in controls in order to study the different correlates in the two groups.

Different mediation models were performed with FSFI Desire as a dependent variable, treating EDE-Q subscales as possible independent variables and all subscales of the IDEA and ASQ questionnaires as possible mediators. Percentile bootstrapping with 20,000 resamples and 95% confidence intervals was used in order to test mediation models. Bias-corrected bootstrapping was not used because of its elevated Type I error rates [19, 20].

All analyses were performed using IBM SPSS Statistics version 25 [21]; mediation analyses were performed using the PROCESS macro v.3.3 [22].

Results

General characteristics of the sample

Demographic and clinical characteristics of the sample are reported in Table 1. The final sample consisted of 111 AN patients (74 restrictive and 37 binge-purging subtype) and 120 controls. No significant difference was found between AN patients and controls in terms of age. As expected, AN patients showed higher levels of general and specific psychopathology, as measured by SCL-90 GSI and EDE-Q. Patients also reported higher scores in all IDEA subscales and in CTQ total score, Emotional Abuse and Emotional Neglect, as compared to controls. Moreover, patients reported worse ASQ scores. Regarding sexual function, AN patients reported greater levels of sexual impairment as compared to controls, with lower scores in all FSFI subscales.

When comparing the two subgroups of AN patients, no significant difference was found in terms of age. The binge-purging subtype showed a lower mean age of onset of the disease, a longer duration of illness and higher levels of general and specific psychopathology, as measured by SCL-90 GSI and EDE-Q. Moreover, binge-purging patients reported higher scores in ASQ Relationships as Secondary, in all IDEA subscales except S and in all CTQ subscales except Emotional Neglect as compared to restricting patients. Regarding sexual function, no statistical differences were found between the two subtypes in FSFI scoring.

No significant differences were found between patients assuming ADs and those who did not regarding sexual functioning.

Clinical and psychopathological correlates of sexual dysfunction

Age- and BMI-adjusted linear regression analysis for the associations between sexual dysfunction and variables related to clinical and psychopathological dimensions are reported in Tables 2 and 3, for patients and controls respectively.

While BMI did not show any association with FSFI in patients, a significant negative association was observed with total score, sexual arousal, orgasm and pain subscales in the control group.

Considering AN patients, both general and specific psychopathology, as measured by SCL-90 GSI and EDE-Q, respectively, were found to be negatively associated with sexual desire. A similar effect on sexual desire was observed for all IDEA subscales, with scores indicating

Table 1 General characteristics of the sample, reported as mean ± SD, together with the results of comparisons between groups (healthy subjects vs patients and restricting vs bingeing patients), performed by independent samples *t* tests and ANCOVAs (correcting for age and BMI)

	AN patients ($n=111$)	Healthy controls ($n=120$)	*t*	Age and BMI adjusted (ANCOVA)	AN restricting ($n=74$)	AN binge-purging ($n=37$)	*t*	Age and BMI adjusted (ANCOVA)
Age (years)	26.98 ± 10.63	27.29 ± 4.74	− 0.27	–	26.55 ± 10.70	27.81 ± 10.60	− 0.58	–
Onset of illness (years)	–	–	–	–	18.88 ± 4.90	16.21 ± 5.05	1.96	**5.58***
Duration of illness (years)	–	–	–	–	5.42 ± 8.33	9.28 ± 9.10	− 1.60	**6.77***
BMI	16.02 ± 1.43	21.43 ± 2.93	**− 17.12*****	–	15.84 ± 1.44	16.37 ± 1.35	− 1.82	–
FSFI total score	11.78 ± 11.28	19.35 ± 9.53	**− 5.36*****	**14.17*****	10.63 ± 10.88	14.12 ± 11.86	− 1.49	1.83
Sexual desire	2.70 ± 1.47	3.57 ± 1.19	**− 4.82*****	**5.53***	2.63 ± 1.43	2.84 ± 1.56	− 0.67	0.53
Sexual arousal	1.74 ± 2.04	2.74 ± 2.11	**− 3.53****	**5.95***	1.48 ± 1.91	2.27 ± 2.22	− 1.86	3.03
Lubrication	1.90 ± 2.38	3.33 ± 2.17	**− 4.60*****	**9.06****	1.64 ± 2.36	2.44 ± 2.38	− 1.60	2.11
Orgasm	1.57 ± 2.15	3.02 ± 2.00	**− 5.15*****	**12.37****	1.34 ± 2.07	2.04 ± 2.25	− 1.56	1.94
Satisfaction	2.10 ± 1.88	2.89 ± 1.91	**− 3.07****	**6.09***	1.91 ± 1.77	2.51 ± 2.06	− 1.53	1.53
Pain	1.76 ± 2.42	3.89 ± 2.56	**− 6.28*****	**24.45*****	1.62 ± 2.42	2.04 ± 2.42	− 0.81	0.60
IDEA total score	1.74 ± 0.97	0.51 ± 0.49	**12.13*****	**59.98*****	1.59 ± 0.96	2.03 ± 0.93	**− 2.24***	**4.95***
GEO	1.52 ± 1.15	0.58 ± 0.59	**7.77*****	**28.28*****	1.37 ± 1.10	1.81 ± 1.77	− 1.87	**3.23***
OM	2.10 ± 1.18	0.58 ± 0.71	**11.78*****	**63.46*****	1.93 ± 1.16	2.43 ± 1.16	**− 2.09***	**3.44***
EB	1.42 ± 1.08	0.23 ± 0.35	**11.30*****	**47.68*****	1.24 ± 1.04	1.78 ± 1.10	**− 2.44***	**7.08****
S	2.20 ± 1.11	0.63 ± 0.65	**13.13*****	**50.31*****	2.10 ± 1.13	2.40 ± 1.06	− 1.28	1.79
EDE− Q total score	3.00 ± 1.70	0.97 ± 0.95	**11.15*****	**78.65*****	2.71 ± 1.63	3.58 ± 1.72	**− 2.56***	**5.51***
Restraint	3.19 ± 2.03	1.01 ± 1.16	**10.01*****	**75.90*****	2.90 ± 1.98	3.77 ± 2.04	**− 2.13***	**3.66***
Eating concern	2.47 ± 1.64	0.50 ± 0.71	**11.83*****	**56.39*****	2.18 ± 1.59	3.05 ± 1.62	**− 2.66****	**6.46***
Weight concern	2.96 ± 1.79	1.11 ± 1.11	**9.47*****	**64.82*****	2.66 ± 1.72	3.57 ± 1.80	**− 2.53***	**5.73***
Shape concern	3.37 ± 1.85	1.26 ± 1.22	**10.19*****	**72.79*****	3.09 ± 1.76	3.93 ± 1.92	**− 2.51***	**3.40***
SCL− 90 GSI	1.46 ± 0.76	0.54 ± 0.49	**10.95*****	**47.34*****	1.29 ± 0.77	1.79 ± 0.62	**− 3.43****	**11.72****
ASQ confidence	27.00 ± 7.80	34.16 ± 4.04	**− 4.63*****	**5.78***	27.93 ± 8.64	25.61 ± 6.32	0.95	1.04
ASQ discomfort with closeness	40.66 ± 10.56	31.87 ± 7.61	**3.93*****	**8.19****	38.30 ± 11.17	44.22 ± 8.67	− 1.89	3.22
ASQ relationships as secondary	16.87 ± 7.01	11.77 ± 3.48	**3.69*****	**7.48****	15.11 ± 6.14	19.50 ± 7.58	**− 2.14***	**5.39***
ASQ need for approval	24.53 ± 8.20	18.20 ± 6.68	**3.52****	**7.16***	23.70 ± 8.52	25.78 ± 7.76	− 0.83	0.88
ASQ preoccupation with relationships	28.96 ± 8.50	24.90 ± 5.97	**2.26***	**8.41****	23.33 ± 8.37	31.39 ± 8.35	− 1.60	2.21
CTQ total score	38.57 ± 15.31	30.46 ± 6.37	**4.40*****	**5.23***	33.46 ± 6.08	46.50 ± 21.27	**− 3.07****	**11.47****
Emotional neglect	10.85 ± 4.83	8.05 ± 3.13	**4.11*****	**6.69***	9.93 ± 3.91	12.28 ± 5.82	− 1.64	3.13
Emotional abuse	8.20 ± 4.07	5.95 ± 1.84	**4.49*****	**9.18****	7.04 ± 2.52	10.00 ± 5.31	**− 2.55***	**7.46****
Sexual abuse	6.80 ± 4.19	5.40 ± 1.41	**2.93****	0.97	5.71 ± 1.98	8.50 ± 5.93	**− 2.31***	**6.35***
Physical neglect	6.67 ± 2.70	5.65 ± 1.61	**2.80****	0.67	5.71 ± 1.27	8.17 ± 3.59	**− 3.33****	**15.38*****
Physical abuse	6.04 ± 3.00	5.42 ± 1.09	1.79	0.27	5.07 ± 0.38	7.56 ± .42	**− 2.97****	**9.66****

t and *F* values are shown alongside their statistical significance

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

ASQ Attachment Style Questionnaire, *BMI* Body Mass Index, *CTQ* Childhood Trauma Questionnaire, *EB* feeling extraneous from one's own body, *EDE-Q* Eating Disorder Examination Questionnaire, *FSFI* Female Sexual Functioning Index, *GEO* feeling oneself only through the gaze of the other and defining oneself only through the evaluation of the other, *IDEA* Identity and Eating Disorders Questionnaire, *OM* feeling oneself only through objective measures, *SCL-90-R GSI* Symptom Checklist-90 Revised, *S* feeling oneself only through starvation, *SD* Standard Deviation

Table 2 Clinical and psychopathological correlates of sexual dysfunction in AN group

	FSFI total score	Sexual desire	Sexual Arousal	Lubrication	Orgasm	Satisfaction	Pain
BMI	0.08	− 0.01	0.10	0.12	0.07	0.14	0.02
IDEA total score	− 0.20	**− 0.32****	− 0.20	− 0.17	− 0.13	− 0.20	− 0.16
GEO	− 0.16	**− 0.24***	− 0.20	− 0.14	− 0.07	− 0.16	− 0.12
OM	− 0.21	**− 0.34****	− 0.18	− 0.16	− 0.13	− 0.19	− 0.17
EB	− 0.13	**− 0.21***	− 0.10	− 0.10	− 0.09	− 0.11	− 0.13
S	**− 0.21***	**− 0.30****	− 0.18	− 0.18	− 0.17	**− 0.23***	− 0.13
EDE-Q total score	− 0.14	**− 0.24***	− 0.10	− 0.11	− 0.12	− 0.11	− 0.13
Restraint	− 0.11	**− 0.21***	− 0.06	− 0.08	− 0.09	− 0.07	− 0.10
Eating concern	− 0.14	**− 0.25***	− 0.10	− 0.10	− 0.12	− 0.11	− 0.12
Weight concern	− 0.14	**− 0.22***	− 0.12	− 0.11	− 0.13	− 0.12	− 0.12
Shape concern	− 0.15	**− 0.24***	− 0.12	− 0.12	− 0.12	− 0.13	− 0.14
SCL-90 GSI	− 0.12	**− 0.25***	− 0.11	− 0.08	− 0.09	− 0.08	− 0.08
ASQ confidence	0.14	0.27	0.12	0.15	0.07	0.15	0.08
ASQ discomfort with Closeness	− 0.11	**− 0.36***	− 0.10	− 0.10	− 0.02	− 0.11	− 0.01
ASQ relationships as secondary	0.18	0.07	0.17	0.18	0.20	0.12	0.21
ASQ need for approval	− 0.20	**− 0.32***	− 0.18	− 0.18	− 0.12	− 0.22	− 0.13
ASQ preoccupation with relationships	− 0.05	− 0.17	− 0.05	− 0.01	− 0.08	− 0.04	0.02
CTQ total score	0.12	0.06	0.13	0.18	0.19	0.02	0.05
Emotional neglect	0.08	− 0.01	0.05	0.18	0.14	− 0.05	0.07
Emotional abuse	0.13	0.05	0.15	0.20	0.20	0.03	0.04
Sexual abuse	− 0.01	− 0.01	0.04	0.01	0.05	− 0.06	− 0.06
Physical neglect	0.15	0.12	0.16	0.19	0.23	0.07	0.03
Physical abuse	0.19	0.15	0.17	0.21	0.22	0.14	0.14

Multiple linear regression models were performed, with FSFI subscales as dependent variables. Age- and BMI-adjusted β values are shown alongside their statistical significance

(*$p<0.05$; **$p<0.01$; ***$p<0.001$)

ASQ Attachment Style Questionnaire, *BMI* Body Mass Index, *CTQ* Childhood Trauma Questionnaire, *EB* feeling extraneous from one's own body, *EDE-Q* Eating Disorder Examination Questionnaire, *FSFI* Female Sexual Functioning Index, *GEO* feeling oneself only through the gaze of the other and defining oneself only through the evaluation of the other, *IDEA* Identity and Eating Disorders Questionnaire, *OM* feeling oneself only through objective measures, *SCL-90-R GSI* Symptom Checklist-90 Revised, *S* feeling oneself only through starvation

a more pronounced disorder of embodiment predicting lower libido. In addition, IDEA S was significantly associated with lower sexual satisfaction and FSFI total score. Higher scores in ASQ Discomfort with Closeness and Need for Approval subscales predicted lower sexual desire; on the other hand, no significant associations were identified between any domain of sexual functioning and CTQ scores.

Similarly to AN patients, controls showed lower sexual desire scores associated with higher SCL-90 GSI and IDEA scores, except GEO; furthermore, IDEA S also negatively predicted FSFI total score and sexual arousal. Considering specific ED psychopathology in controls, only dietary restraint was significantly associated with an impaired sexual drive. Finally, among CTQ subscales, Emotional Abuse negatively predicted sexual desire, while higher scores in Physical Neglect were associated with lower lubrication and orgasmic function.

Explicative mechanism of the relationship between eating disorder psychopathology and sexual dysfunction

Several mediation models were run, in order to test whether the association between specific ED psychopathology and sexual desire could be mediated by a disorder of embodiment. Among EDE-Q and IDEA questionnaires subscales, best fit for a mediation model was obtained with EDE-Q Dietary Restraint and IDEA Total Score: results are reported in Fig. 1a. The effect of the independent variable (EDE-Q restraint) on the dependent variable (FSFI desire) was no longer statistically significant when controlling for the mediating variable in a multivariate model ($\beta = -0.01$, $p = 0.99$), while IDEA total score maintained its significance ($\beta = -0.32$, $p = 0.012$). All the above results indicate that the variable IDEA total score functions as a mediator, according to Baron and Kenny [23]. A simple mediation

Table 3 Clinical and psychopathological correlates of sexual dysfunction in HC group. Multiple linear regression models were performed, with FSFI subscales as dependent variables

	FSFI total score	Sexual desire	Sexual arousal	Lubrication	Orgasm	Satisfaction	Pain
BMI	**− 0.25***	− 0.02	**− 0.22***	− 0.20	**− 0.22***	− 0.21	**− 0.25***
IDEA total score	− 0.13	**− 0.27***	− 0.10	− 0.08	− 0.09	− 0.01	− 0.11
GEO	− 0.05	− 0.16	− 0.01	0.01	0.01	0.06	− 0.14
OM	− 0.12	**− 0.28****	− 0.10	− 0.08	− 0.08	− 0.04	− 0.07
EB	− 0.14	**− 0.25***	− 0.11	− 0.11	− 0.16	− 0.04	− 0.08
S	**− 0.21***	**− 0.33****	**− 0.22***	− 0.20	− 0.20	− 0.11	− 0.03
EDE-Q total score	− 0.03	− 0.19	− 0.04	− 0.01	− 0.04	0.06	− 0.01
Restraint	− 0.05	**− 0.25***	− 0.11	− 0.06	− 0.09	0.04	0.10
Eating concern	− 0.05	− 0.20	− 0.06	− 0.02	− 0.07	0.04	0.01
Weight concern	0.03	− 0.17	0.04	0.07	0.04	0.12	− 0.01
Shape concern	− 0.05	− 0.11	− 0.03	− 0.01	− 0.04	0.02	− 0.10
SCL-90 GSI	− 0.16	**− 0.26***	− 0.11	− 0.07	− 0.13	− 0.10	− 0.12
ASQ confidence	0.23	0.13	0.22	0.20	0.30*	0.24	0.14
ASQ discomfort with Closeness	− 0.24	− 0.12	− 0.24	− 0.20	− 0.24	− 0.23	− 0.26
ASQ relationships as Secondary	0.02	− 0.04	0.11	0.11	0.07	− 0.05	− 0.10
ASQ need for Approval	− 0.03	− 0.04	0.09	0.11	− 0.06	− 0.13	− 0.12
ASQ preoccupation with relationships	0.09	− 0.34	0.18	0.12	− 0.01	0.17	0.12
CTQ total score	− 0.06	− 0.17	0.01	− 0.10	− 0.16	0.09	− 0.01
Emotional neglect	− 0.02	− 0.03	0.08	− 0.09	− 0.14	0.18	− 0.07
Emotional abuse	0.01	**− 0.26***	0.03	0.06	0.01	0.02	0.06
Sexual abuse	− 0.01	− 0.07	− 0.05	0.05	− 0.01	− 0.12	0.10
Physical neglect	− 0.16	− 0.20	− 0.10	**− 0.23***	**− 0.26***	0.09	− 0.07
Physical abuse	− 0.10	− 0.12	− 0.07	− 0.16	− 0.18	0.02	0.02

Age and BMI adjusted β values are shown alongside their statistical significance

(*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$)

ASQ Attachment Style Questionnaire, *BMI* Body Mass Index, *CTQ* Childhood Trauma Questionnaire, *EB* feeling extraneous from one's own body, *EDE-Q* Eating Disorder Examination Questionnaire, *FSFI* Female Sexual Functioning Index, *GEO* feeling oneself only through the gaze of the other and defining oneself only through the evaluation of the other, *IDEA* Identity and Eating Disorders Questionnaire, *OM* feeling oneself only through objective measures, *SCL-90-R GSI* Symptom Checklist-90 Revised, *S* feeling oneself only through starvation

analysis was performed using percentile bootstrapping with PROCESS [22]: as shown in Fig. 1a, the indirect effect was significantly different from zero, while the direct effect of dietary restraint on sexual desire was not significant, confirming the role of disordered embodiment as a mediator. The completely standardized indirect effect was − 0.19 (95% CI: − 0.36 to − 0.04).

Finally, a series of mediation analyses was performed to test the possible mediating role of the variables associated with insecure attachment, as measured by ASQ, for the association between embodiment alterations and low sexual desire: the best fit was found for the variable ASQ Discomfort with Closeness, as reported in Fig. 1b. This mediation model was statistically significant, with a completely standardized effect of − 0.17 (95% CI: − 0.48 to − 0.01). Given the above results all variables were included in a serial multiple mediation (SMM) model, evaluating whether the negative association of dietary restraint and sexual desire was mediated by IDEA total score and ASQ Discomfort with Closeness in sequence. The indirect effect of this path was statistically significant, with a completely standardized effect size of − 0.11 (95% CI: − 0.42 to − 0.01). Figure 1c illustrates the final SMM model.

Discussion

This study attempted for the first time to clarify the already demonstrated association between sexual dysfunctions and ED specific psychopathology in patients affected by AN [7], considering the role of embodiment and attachment style as potential mediators of this relationship.

Sexual dysfunctions in AN patients: the role of experiential factors vs weight status and trauma

Overall, according to previous observations [7], the results of the present study confirmed that patients affected by AN

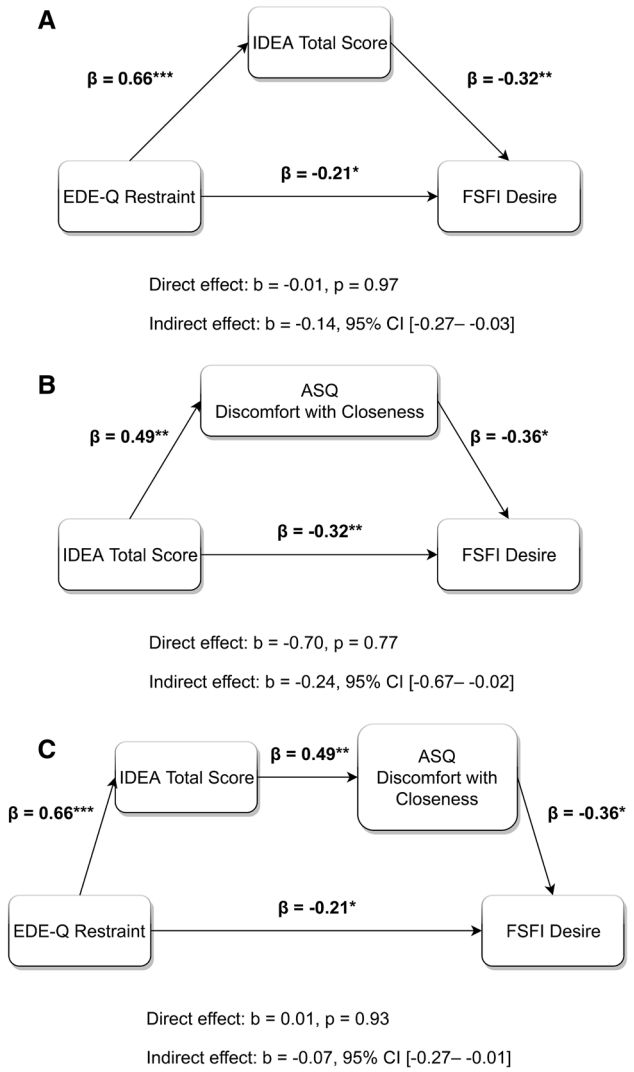

Fig. 1 Simple (**a**), (**b**) and serial (**c**) mediation models illustrating the association between dietary restraint and lower sexual desire, with disordered embodiment and intimacy problems as mediators. Standardized beta coefficients are presented alongside unstandardized direct and indirect effects for every model. *ASQ* Attachment Style Questionnaire, *EDE-Q* Eating Disorder Examination Questionnaire, *FSFI* Female Sexual Functioning Index, *IDEA* Identity and Eating Disorders Questionnaire

report a worse sexual functioning as compared to a group of age matched healthy controls.

In particular, experiential factors have proved to have a fundamental role in determining a reduction in sexual functioning, especially with regard to the reduction of sexual desire, a cognitive dimension of sexuality.

As previously demonstrated, both aspects of general and ED specific psychopathology have been associated with a reduction in sexual desire [7]. Moreover, this is the first study on AN to report a positive association between sexual dysfunction and aspects related to insecure attachment, in particular Discomfort with Closeness and Need for Approval, and between sexual dysfunctions and disorders of embodiment, as assessed by all subscales of IDEA.

Conversely, the role of weight status in determining a reduction in sexual function was not found to be significant in this group of patients. These data seem to confirm the hypothesis that sexual dysfunctions in patients with AN are not just a generic consequence of emaciation or general psychopathology, but a problem correlated with the specific psychopathological nucleus.

Previous studies showed controversial data on this issue: some studies [24–27], consistent with our results, show that experiential factors, such as dissatisfaction about one's own body, may cause intense emotional reactions of fear and shame preventing AN patients to engage in sexual relations, whereas others consider biological and endocrine factors to be more important and decisive in sexual dysfunctions, neglecting the aspects related to corporeality and emotions [28]. Additionally, no significant correlations between child trauma (CTQ) and sexual functioning (FSFI) were found. This could suggest that the mechanism underlying sexual dysfunction in AN patients is not associated with the presence of traumatic experiences, which are known to be frequent among these patients [29], but rather with ED specific psychopathology and with embodiment disorder. Alternatively, traumatic experiences may be associated with sexual dysfunction through the total mediation of variables not assessed in the present study that are highly connected with early adverse experiences, i.e. ineffectiveness feelings [30].

Sexual dysfunction and disorders of embodiment in patients with AN

The present data show a negative correlation between all EDE-Q and IDEA subscales and sexual desire, and the mediation model suggests that the relation between eating symptomatology, specifically abnormal dietary restraint, and reduced sexual desire is maintained by the presence of disorders of embodiment.

As previously demonstrated, patients with EDs show severe disorders of embodiment, that is, the pre-reflexive experience of one's own body as the most primitive form of self-awareness [5]. Indeed, they score higher in IDEA questionnaire as compared to control subjects, and there is a significant association between IDEA total score and eating symptomatology [5, 31]. This suggests that disorders of embodiment and eating symptomatology are closely related in EDs. In these past years, the hypothesis that disorders of embodiment are key features in EDs is increasingly supported [6, 32–34]. As a consequence of this impairment in feeling one's own body, the constitution of an identity based on one's own bodily sensations is affected, considering also that subjects with EDs live their own emotions as

disturbing [33, 35]. Other anomalies of embodiment, including feeling deprived of one's own vitality and capacity to desire, may isolate these persons from the others and from the world [31, 33, 34]. These anomalies of lived corporeality may also cause these subjects to adopt a third-person perspective in relation to their own body that consequently becomes for them a semi-extraneous object [5, 31, 33, 34], possibly leading to the phenomenon known as *spectatoring* already theorized by Masters and Johnson [36], which as a manifestation of cognitive distraction has shown to mediate the association between bodily dissatisfaction and sexual dysfunction [37, 38].

Sexual dysfunction, disorders of intimacy and disorders of embodiment in patients with AN

The present results show significant correlations between disordered intimacy and sexual desire. Intimacy is a complex psychological concept including a drive for closeness tenderness, personal affiliation, trust and sexual desire. High scores in ASQ, in particular in "Discomfort with Closeness" (evaluating feeling uncomfortable in intimate relationships) and "Need for Approval" subscales, correlate with a reduction of sexual desire. Moreover, the present results showed that the relationship between alterations of the embodiment and reduction of desire appears to be totally mediated by an increase in discomfort in situations of intimacy. The subscale "Discomfort with closeness" is a significant factor related to avoidant attachment and associated with fear of intimacy and low incidence of positive experiences in relating with others [15]. In a preceding study subjects with EDs displaying an avoidant attachment style reported a stronger tendency to experience their own body from a third-person perspective, with a decreased capacity to feel one's own body from first-person perspective [6] and that disorders of embodiment mediate between insecure avoidant attachment and ED symptomatology. This suggests that in AN disorders of embodiment influence interpersonal relationships both in terms of relating to others and of sexuality.

Finally, the serial mediation model showed that the relationship between dietary restraint and sexual dysfunction is not direct. Rather, persevering in aberrant eating behaviours maintains the disorders of embodiment by preventing AN patients from feeling their body, except through the aberrant behaviours themselves. This in turn compromises the patients' ability to be comfortable in intimacy situations, which results in a long-term reduction in sexual desire. These results seem to be in line with what was reported in a recent study by Dunkley et al. [39] carried out on female undergraduate students: in their sample the relationship between specific ED psychopathology and sexual dysfunction was totally mediated by an index of psychological maladjustment measuring, among other things, interoceptive deficits, interpersonal insecurity and alienation.

Conclusions

In summary: (1) disorders of embodiment mediate between eating symptomatology and the reduction of sexual desire; (2) disorders of embodiment together with disorders in intimate relationship mediate the sequence connecting eating symptomatology and reduction of sexual desire; (3) disorders in intimate relationships mediates the relation between disorders of embodiment and sexual desire.

These findings can have relevant clinical implications. Underlying the key-role of disorders of embodiment in the development of sexual dysfunctions in EDs can promote an embodiment-focused therapeutic approach helping patients to feel and recognize their bodily feelings, including emotions and desire.

Considering the limited sample size, the results of the present study should be considered as preliminary. Furthermore, some methodological limitations must be addressed.

First of all, the inability to draw causation between variables, due to the observational nature of the study. All psychopathological measures are derived from self-administered questionnaires. Finally, considering that the study was performed in a clinical sample, the conclusions cannot be extended to the general population.

Author contributions All authors contributed to the study conception and design, material preparation, data collection and analysis, and to drafting and revising the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

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

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

Ethical approval All procedures were in accordance with the ethical standards of the institutional research committee (Ethical Committee Area Vasta Centro, reference number OSS.14.162) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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