

Psychosocial risk factors in the development, maintenance and treatment outcome of eating disorders

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Psychosocial risk factors in the development, maintenance and treatment outcome of eating disorders

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Editorial: Psychosocial risk factors in the development, maintenance and treatment outcome of eating disorders

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Editorial on the Research Topic

Psychosocial risk factors in the development, maintenance and treatment outcome of eating disorders

Eating disorders (EDs) are psychiatric conditions characterized by pathological eating behaviors and attitudes toward food and body image (American Psychiatric Association, 2013). While genetic and biological factors play a significant role in the development of EDs (Huckins et al., 2024), psychosocial risk factors are considered crucial to understanding their onset and persistence (Aloi et al., 2022). These factors include a wide range of influences, such as familial dynamics, societal pressures, traumatic experiences, and individual psychological characteristics.

The family environment, including parental attitudes toward weight and diet, critical or controlling parenting styles, and a history of EDs in the family, can significantly impact an individual's relationship with food and body image (Gorrell et al., 2022). Societal and cultural pressures, particularly the pervasive idealization of thinness and appearance promoted by media and social platforms, further exacerbate body dissatisfaction and unhealthy eating behaviors (Holland and Tiggemann, 2016; Saiphoo and Vahedi, 2019).

Traumatic experiences, including physical, emotional, and sexual abuse, are also strongly linked to the development of EDs (Convertino and Mendoza, 2023). These experiences can lead to the development of maladaptive coping mechanisms, such as disordered eating, to regain a sense of control or numb emotional pain. Additionally, individual psychological factors, such as low self-esteem, perfectionism, interpersonal problems and difficulties with emotional regulation, play a pivotal role in both the development and maintenance of EDs (Robinson et al., 2024; Robinson and Wade, 2021; Lo Coco et al., 2012).

Therefore, the aim of this Research Topic is to enhance our understanding of how individual psychosocial factors can impact EDs, often exacerbating the clinical course and leading to less effective treatments.

In terms of social pressures factors, [Cerolini et al.](#) explore how body shaming and internalized weight bias contribute to the development of EDs among adolescents. They emphasize the pervasive nature of weight stigma and how societal pressures about body image can lead to harmful psychological effects. Adolescents internalize these negative attitudes, which can significantly impact their self-esteem and body satisfaction. The study highlights the strong association between internalized weight bias and the onset of disordered eating behaviors, suggesting that addressing these psychosocial factors is crucial for effective prevention and intervention strategies. Moreover, the study underscores the need for comprehensive programs targeting weight stigma and promoting body positivity to mitigate the risk of developing EDs in this vulnerable population.

In line with this topic, an interesting study by [Bogár et al.](#) investigates the prevalence and impact of EDs and body image issues within the fashion industry. The study employs content analysis to examine how the intense environmental pressures faced by fashion models contribute to the development and exacerbation of these disorders. It highlights the role of factors like industry standards, media portrayal, and occupational stress in shaping the mental health of models. The findings suggest that the high demands and unrealistic beauty standards perpetuated by the fashion industry significantly increase the risk of EDs and body image disturbances among models. The manuscript calls for heightened awareness and intervention strategies to address these psychosocial risk factors, aiming to foster a healthier and more supportive environment within the fashion industry. The research accentuates the need for systemic changes to protect the wellbeing of individuals in this high-pressure profession.

Two additional studies delve into the significant topic of overvaluation of weight, shape, and physical appearance in EDs. In the first study, [Escandón-Nagel et al.](#) aim to understand how overvaluation of weight and shape differs between individuals with overweight with and without binge eating disorder (BED). Through the Repertory Grid Technique, the research seeks to identify how self-construction and cognitive structures are associated with overevaluation in obesity, both with or without BED. The findings indicate that individuals with BED exhibit significantly higher levels of weight and shape overvaluation compared to those without BED. This overvaluation is associated with greater ED psychopathology and poorer mental health outcomes. The study highlights the importance of addressing self-construction and cognitive structure in treatment approaches for BED, suggesting that an approach based on Kelly's Personal Construct Theory focusing on weight and shape concerns may be particularly beneficial for this population. This research contributes to the nuanced understanding of the psychological factors underlying BED and obesity.

In this context, the second study by [Schönhals et al.](#) evaluates the psychometric properties of the German versions of the Upward and Downward Physical Appearance Comparison Scales (UPACS and DACS). The research involved both a clinical sample and a

control group, with a total of 2,114 participants. Structural equation modeling confirmed the one-factor structure of the DACS but not the UPACS. Both scales demonstrated good internal consistency and test-retest reliability. They also correlated as expected with related constructs such as appearance comparisons, eating disorder pathology, and self-esteem, indicating acceptable construct validity. However, some limitations of the UPACS were noted for women with EDs. Overall, this study suggests that both the UPACS and DACS are psychometrically suitable tools for assessing upward and downward physical appearance comparisons in both research and clinical settings, across genders and eating disorder statuses.

Regarding genetic risk factors, the systematic review by [Almaghrbi and Bawadi](#) explores the intricate relationship between gene polymorphisms and psychological/neurobiological factors in individuals with anorexia nervosa (AN). Drawing from 11 selected studies, the review highlights significant findings across various genetic markers and their impact on AN. Key insights include the consistent association of the 5-HTTLPR polymorphism with altered connectivity in brain networks, impaired inhibitory control, and heightened susceptibility to AN. Additionally, genes within the dopaminergic system (e.g., COMT, DRD2, DRD3, DAT1) influence reward processing, motivation, and decision-making processes implicated in AN pathology. The Val66Met polymorphism in the BDNF gene influences personality traits, eating behaviors, and emotional responses across different populations. Other genes, such as OXTR, TFAP2B, and KCTD15 are associated with social cognition, emotional processing, and body image concerns in AN. These findings underscore the genetic complexity underlying AN and advocate for further research to enhance therapeutic strategies tailored to genetic predispositions.

Furthermore, the systematic review of [Di Luzio et al.](#) explores the similarities and differences in clinical, genetic, and neurobiological aspects between Obsessive-Compulsive Disorder (OCD) and EDs, particularly during childhood and adolescence, which are crucial phases of neurodevelopment. Through a systematic review of 10 selected articles, OCD symptoms resulted more prevalent in individuals with EDs characterized by binge/purge behaviors compared to restrictive profiles. Both disorders exhibit obsessive-compulsive symptomatology, suggesting shared neurobiological alterations, particularly in the anterior cingulate cortex, which affects cognitive flexibility. Genetic overlaps between OCD and EDs were also identified. The study underscores the importance of integrating psychopathological and neurobiological perspectives for accurate diagnosis and tailored treatment strategies, potentially outperforming the outcome.

In the context of family environment, an interesting study by [Bevione et al.](#) investigates the impact of parental educational level (PEL) on EDs, focusing on treatment compliance and outcomes. The study highlights that patients with higher PEL, whether from mothers, fathers, or both, exhibit higher depressive symptoms but also lower levels of parental criticism. These patients tend to be younger, have an earlier onset of EDs, and shorter illness durations. Those with fathers or both parents with higher PEL are more likely to have AN, longer hospital stays, and higher personal standards, while those with mothers with higher PEL show lower rates of substance and alcohol addiction. The study also reveals that personal standards mediate the relationship between higher PEL

and lower dietary restraint. Overall, PEL emerges as a multifaceted risk factor influencing various aspects of EDs, suggesting nuanced pathways for intervention and support in clinical settings.

A stimulating study examines the role of perceived stress in relation to binge eating behavior in Chinese university students, focusing on the roles of life history strategy and distress tolerance. Li et al. found that perceived stress influences binge-eating behavior through its impact on life history strategy, suggesting a mediation effect. Additionally, distress tolerance was found to moderate both the direct relationship between perceived stress and binge-eating behavior, as well as the indirect relationship mediated by life history strategy. These findings imply that enhancing distress tolerance skills and implementing interventions based on life history theory could be effective to mitigate binge-eating triggered by perceived stress among university students in China. This study contributes to understanding the psychological mechanisms underlying binge eating in the context of stress, offering potential avenues for targeted interventions.

An important contribution regarding childhood adversities is the systematic review by Johnsen et al.. This systematic review synthesizes evidence on the prevalence of non-interpersonal traumatic events (NTE) in individuals with EDs. Conducted following the PRISMA guidelines, this review included 16 studies that identify five main types of NTE: accidents, illness, injury, natural disasters, and war. The findings suggest that illness and injury were more prevalent among patients with EDs compared to controls, particularly in those with the binge/purge subtype of AN. However, other types of NTE did not consistently show higher prevalence among patients with EDs. The review highlights a significant gap in research regarding the timing of trauma relative to EDs onset, which could influence associations. Overall, it emphasizes the need for more comprehensive studies to further understand the relationship between NTE and EDs, suggesting potential implications for treatment and intervention strategies.

Interestingly, two studies used the latent profile analysis (LPA) approach. LPA is a statistical method that identifies unobserved subgroups, or latent classes, within a heterogeneous population based on patterns of responses across multiple variables. Unlike traditional clustering methods, LPA assumes that individuals within each latent class share similar response patterns on several variables, but these classes are not directly observed or measured. By identifying these latent classes, LPA helps researchers understand underlying structures or typologies that exist within their data, revealing meaningful subgroups that may have distinct characteristics or behaviors. In the first study, Soodla et al. investigate the robustness of personality-based subtypes within patients with EDs through LPA, exploring various methodological approaches. Analyzing data from 221 individuals with EDs, the study conducted four LPAs, manipulating constraints on variances and covariances, and integrating state ED symptom measures as indicators. Results identified a stable four-profile model primarily defined by variations in impulsivity and perfectionism traits. Profiles with the most and least disturbances, both state and trait-related, were consistently replicated across different analytic conditions. Including ED symptoms enhanced subtype differentiation and alignment across profiles. In the second study, Aloi et al. examine metacognitive profiles among 395 individuals

diagnosed with various EDs using LPA. The research identified three distinct profiles: high functioning (HF), intermediate functioning (IF), and low functioning (LF), characterized by different levels of metacognitive impairments. Participants in the IF group tended to be older with higher BMI compared to those in the HF and LF groups. Individuals with bulimia nervosa (BN) predominantly fell into the HF and LF profiles, while those with BED were mainly categorized in the IF profile. The LF group exhibited significant psychological distress, including high levels of depression, emotional dysregulation, childhood adversity, and personality dysfunction. Multinomial logistic regression highlighted associations between metacognitive profiles and factors such as emotional abuse, emotional dysregulation, and detachment. These findings underscore the potential for metacognitive interpersonal therapy, a treatment focused on reducing impairments in metacognitive abilities, as a targeted intervention for EDs based on distinct metacognitive profiles identified in this study.

Finally, regarding the outcome variables involved in EDs treatment, the study of Muzi et al. explores the impact of Ryff's model of psychological wellbeing (PWB) and the early therapeutic alliance on treatment outcomes for 165 female-assigned patients with EDs in a residential program. The authors found that dimensions of PWB such as autonomy, positive relationships, and self-acceptance were associated with clinically significant and reliable symptom reduction. Additionally, the early therapeutic alliance plays a crucial role, directly influencing treatment outcomes and mediating the relationship between PWB dimensions and overall symptomatic improvement. These findings highlight the importance of both individual psychological strengths and the therapeutic relationship in EDs treatment. Authors suggest that understanding and fostering PWB dimensions and early alliance development could enhance therapeutic effectiveness, potentially aiding in predicting and addressing challenges in the therapeutic process to optimize patient outcomes.

The manuscripts included in this Research Topic represent a step forward in the comprehensive description and explanation of psychosocial risk factors in EDs, providing practical and useful information for their assessment and application in different treatment options and, most useful and desirable, in prevention. Identifying these risk factors remains a major challenge for health and mental health professionals.

Overall, this Research Topic aims to contribute to the advancement of the field by providing valuable insights to help practitioners and researchers understand the complexity of psychosocial risk factors in EDs. It is hoped that this Research Topic of studies will lead to improved prevention and treatment strategies, benefiting all those involved in the more effective management of EDs.

Author contributions

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Body shaming and internalized weight bias as potential precursors of eating disorders in adolescents

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Introduction: Body shaming (BS) is a growing phenomenon within the school context, especially among adolescents. Recently, it has been described as an unrepeatable act in which a person expresses unsolicited, mostly negative comments about an individual's body. The targeted person perceives these comments as negative, offensive or body shame-inducing. Empirical evidence also suggests that body weight is the most common reason that youths are teased and bullied. Indeed, weight stigma, described as bias or discriminatory behaviors, attitudes, feelings, and thinking about individuals, because of their weight, can lead to weight-based discrimination and victimization. Preliminary evidence suggests that BS and weight stigma have negative effects on psychological health both in the short and long term. In the delicate stage of adolescence development and pubertal maturation, BS experiences can be highly prevalent and it can lead to adverse outcomes such as eating disorders (ED). However, prevalence data in the Italian context are still lacking.

Methods: The study aims to estimate weight-related BS perceived by different sources (i.e., peers and family members) and their associations with public and internalized weight bias, body mass index (BMI), body dissatisfaction, and ED symptoms. A sample of 919 high school students ($M_{\text{age}} = 15.97$, $SD = 1.58$; 57.1% boys) completed a battery of self-report questionnaires assessing these variables.

Results: One in four students reported experiences of weight-related BS by peers or family members. A total of 37% reported having at least one BS experience in a lifetime. Higher scores of ED symptoms, body dissatisfaction, and weight bias were reported by adolescents who experienced BS, especially females. Among overweight participants, results showed that internalized weight bias partially mediated the relationship between BS by family members and ED symptoms and fully mediated the relationship between BS by peers and ED symptoms, after controlling for age, sex and BMI.

Discussion: These findings, despite their cross-sectional nature, add an important contribution to the creation of quantitative empirical evidence on the phenomenon of BS. Its role in explaining eating disorders, both alone and with the mediation of internalized weight stigma has been first proved and needs to be confirmed by longitudinal results.

KEYWORDS

body shaming, weight bias, eating disorders, weight stigma, adolescents

1 Introduction

Body shaming (BS) is a growing phenomenon within the school and social media context, especially among high-school students (Gam et al., 2020; Schlüter et al., 2023). However, there is still a lack of a clear scientific definition of BS, while various definitions have spread across non-scientific communities (i.e., magazines, internet sites, social networks, etc.). Recently, an exploratory study by Schlüter et al. (2023) has tempted to fill this gap generating a shared definition of BS as unrepeated acts in which a person expresses unsolicited, mostly negative opinions/comments about an individual's body, without necessarily intending to harm him/her. It can range from well-meant advice (e.g., medically-based advice from a family member: "You should lose some weight to prevent high blood pressure") to malevolent insults (e.g., an anonymous online comment such as "She looks too skinny, she's ugly!"). Essentially, the targeted person perceives these comments as negative, offensive or body shame-inducing. According to the authors (Schlüter et al., 2023), BS can occur online and offline, thus evolving into bullying or cyberbullying with repetition over time.

Individual's body or appearance is the focus of BS, targeting not only people with overweight or obesity but also thin or underweight individuals, thus leading to consider BS an umbrella term that includes different forms of victimization (Schlüter et al., 2023). Fauzia and Rahmijai (2019) categorized four forms of BS according to the targets of insulting: fat/thin shaming (i.e., negative comments directed to individuals with overweight/underweight), hair shaming (i.e., name-calling for excess hair on human bodies) and skin tone shaming (i.e., skin color discriminations). The most popular type of BS is fat shaming (Almas et al., 2021) since anti-fat attitudes, namely negative implicit prejudices toward individuals with overweight, are disconcertingly diffused in multiple life domains (e.g., schools, Pereda-Pereda et al., 2019; healthcare settings, Robinson, 2021). Empirical evidence suggests that according to students, parents, and teachers, body weight is the most common reason that youths are teased and bullied (Puhl et al., 2016). Indeed, weight stigma, described as bias or discriminatory behaviors, attitudes, feelings, and thinking about individuals, because of their weight, can lead to weight-based discrimination and victimization (Puhl and Lessard, 2020). Prejudices behind weight stigma are frequently encouraged by negative characteristics typically associated with obesity, such as laziness, lack of willpower or moral character, low intelligence, and attractiveness (Roberts and Polfuss, 2022; Tanas et al., 2022).

Weight-based teasing and bullying are reported as ordinary experiences among adolescents, especially for those with higher body weight (Bucchianeri et al., 2013; Puhl et al., 2013). Recent prevalence estimates indicate that around 25–50% of all teenagers report being discriminated against because of their weight (Puhl and Lessard, 2020). In particular, youngsters with overweight/obesity are 32% more likely to be verbally bullied by their peers, while secondary school students with obesity are 66% more likely to be victims of cyberbullying (Waasdorp et al., 2018; Puhl and Lessard, 2020). Consistently, further results show that BS victims in childhood have a higher body mass index (BMI) than their non-bullied peers and have a higher risk of developing obesity (Mamun et al., 2013; Takizawa et al., 2015). Longitudinal results documented that weight-based teasing is prevalent throughout adolescence (Haines et al., 2008), and may remain consistent during the transition into adulthood (Haines et al., 2013).

Considering this empirical evidence, we can certainly argue that weight stigma and body shaming can negatively impact the bio-psycho-social health of adolescents both in the short and long term. In support of this, cross-sectional findings documented links between weight-based victimization and negative health behaviors, disordered eating, and poorer emotional well-being (Puhl et al., 2017). A systematic review by Puhl and Lessard (2020) suggested long-lasting adverse effects of weight stigmatization by multiple interpersonal sources (i.e., peers, family members, and educators) on the psychological, social, academic, and physical well-being of youngsters. Consistently, meta-analytic results showed that weight stigma is positively associated with psychological distress (i.e., depression and anxiety, Alimoradi et al., 2020). Furthermore, little longitudinal evidence documented that weight-based teasing in adolescence predicted higher BMI and obesity 15 years later independently of gender (Puhl et al., 2017). Results from the same study (Puhl et al., 2017) also found a positive longitudinal association with eating disorder symptoms (i.e., binge eating, dieting, unhealthy weight control, eating to cope, poor body image, etc.) in female participants.

In the delicate stage of adolescence development and pubertal maturation, BS experiences can be highly prevalent, as previously suggested, and it can lead to adverse outcomes. Indeed, during this evolutive age physical changes often go in the direction of weight and shape gain that appear in contrast to the standards of beauty and thinness proposed by Western societies (Davison and McCabe, 2006; Wilhelm et al., 2020). However, prevalence data among the Italian context are still lacking. One previous study documented that 11.7% of adolescents with obesity report being verbally, relationally, and physically bullied because of their weight (Bacchini et al., 2015). Similarly, two studies by Guardabassi and Tomasetto (2020, 2022) in school-aged children documented the association of weight-based teasing with body dissatisfaction and eating restraint, and between weight stigma and impaired executive functions and low quality of life. Despite these early studies, evidence addressing BS and its potential role in explaining negative outcomes such as eating disorders in the Italian context is still scarce.

Our study aims to estimate BS experiences perceived by different sources (i.e., peers and family members) among Italian high-school students and their associations with eating disorder symptoms, BMI, and body dissatisfaction. Furthermore, we hypothesize that the effect of BS on psychological well-being may be mediated by the individual's *weight bias* (WB), defined as negative weight-related attitudes, beliefs, assumptions and judgments toward individuals who are overweight and obese (Washington, 2011). WB may also be distinguished into *public/explicit* WB (stereotypes, prejudices, and hostile attitudes toward individuals because of their weight) and *internalized* WB (self-stigma, applying these weight-based negative attitudes and stereotypes to themselves; Durso and Latner, 2008). Internalized WB can further increase the negative consequences of weight stigma and may be considered more important than the experience of stigma or weight status alone (Tanas et al., 2022). Recent results in adult samples showed that internalized WB may have an important role in explaining worse mental and physical health (Zagaria et al., 2023). Studies that deepen the relationships across these variables (BS, WB and EDs) in adolescence are still lacking, especially in the Italian context. For these reasons, we aim to test two mediation models among high-school students reporting overweight or obesity in which BS is inserted as the independent variable, eating disorders (ED) symptoms as the

dependent variable and weight bias (respectively public and internalized WB) as mediator, controlling for age, sex and BMI of participants.

2 Materials and methods

2.1 Participants and procedure

A sample of 919 high school students ($M_{age} = 15.97$, $SD = 1.58$; 57.1% boys) were enrolled in the study during the academic year 2022–2023, from 10 secondary schools (grades 9–11) in the urban area of Rome using a convenience sampling method. After an initial networking phase, 12 eligible schools were identified through the institutional contacts of the authors and partners involved in the study. The school leaders were contacted by email with the proposal to participate in the study. In addition, telephone contacts or meetings in person explained the objectives and procedure of the study. Those who agreed to participate (response rate > 80%) involved teachers in the distribution of informed consent 2 weeks before the start of the study. In most cases, the researchers went in person to explain the study in detail to teenage students and collect informed parental consent signed by both parents or legal guardians. In addition, when completing the questionnaires, they were also asked for their consent to participate and informed that they could withdraw from the study at any time they wished. In agreement with the teachers, and with the presence of the researchers in the classroom, the students completed a battery of tests during the timetable of the school lessons. The online battery of self-report questionnaires hosted by the Qualtrics platform¹ assessed BS, internalized and public WB, ED symptoms, body dissatisfaction and demographic information. This screening phase was the starting point of a project promoting an educational and experiential weight-related teasing/bullying prevention program, targeting the reduction of BS, weight stigma and associated negative outcomes. The protocol was approved by the Institutional Review Board of the Department of Psychology at Sapienza University of Rome (prot. Number 0001069).

2.2 Measures

2.2.1 Sociodemographic characteristics

Participants provided information related to their age, sex (as it appeared on their birth certificate), gender identity, school and class attended. They were also asked to report anthropometrics (i.e., height and weight) to calculate their BMI and to refer if they perceived themselves as overweight (yes/no).

2.2.2 Experiences of body shaming

Two yes/no questions were used to assess weight-related BS experiences from two sources: from peers (“Have you ever been teased or made fun because of your weight by peers?”) and from family members (“Have you ever been teased or made fun because of your weight by a family member?”) These questions were previously

employed by Puhl et al. (2017) and demonstrated good psychometric properties.

2.2.3 Weight bias

The Attitudes Toward Obese Persons Scale (ATOP, Allison et al., 1991), in the Italian version validated by Zagaria et al. (2022), was used to assess perceptions and attitudes about people with obesity. The Italian version of the scale consisted of 16 items rated on a six-point Likert scale, ranging from −3 (strongly disagree) to 3 (strongly agree). The scale measures explicit attitudes or stereotypes about obesity. Examples of proposed items are: “Obese workers cannot be as successful as other workers” or “One of the worst things that could happen to a person would be for him to become obese.” As stated by the original authors of the ATOP (Allison et al., 1991; see also Tsai et al., 2019), the scoring consisted of three steps: (1) reverse coding the negatively worded items, (2) summing the scores of the items, and (3) adding 60 to the summated score. This was done to avoid negative scores, as the scoring of the ATOP items ranged from −3 to 3. Finally, lower scores indicated more negative attitudes. Both original and Italian validation studies confirmed its validity and reliability. Cronbach’s alpha in the present sample was 0.765, indicating that the scale was internally consistent.

The Weight Bias Internalization Scale (WBIS, Durso and Latner, 2008) in the Italian version by Innamorati et al. (2017) was administered to assess the internalization of WB and negative stereotypes about overweight and obesity. For this purpose, the scale was electronically available only if participants previously responded “Yes” to the item assessing whether they perceived themselves as overweight. The 11 items were rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Once added together, higher scores indicated greater internalization of weight-related stigma. Examples of presented items are: “I do not feel that I deserve to have a fulfilling social life, as long as I’m overweight” and “My weight is a major way that I judge my value as a person.” This unidimensional scale demonstrated satisfactory convergent and criterion validity (Innamorati et al., 2017). Cronbach’s alpha in the present sample was 0.904, confirming excellent internal validity.

2.2.4 Eating disorders symptoms

The Disordered Eating Questionnaire (DEQ, Lombardo et al., 2004) was used to assess disordered eating-related behaviors and attitudes. This 24-item scale allows us to calculate a valid and reliable global score of ED symptomatology (e.g., restrictive eating, binge eating and purging behaviors, willingness to lose weight, ruminating, and worrying about weight and body shape, engaging in intense physical exercise to lose weight, etc.). A clinical cutoff score of 30 has been previously demonstrated as indicative of the presence of ED symptoms (Lombardo et al., 2011). In the present study, Cronbach’s alpha was 0.935, showing excellent internal validity.

2.2.5 Body size dissatisfaction

The Silhouette Rating Scale (SRS, Lombardo et al., 2022) is a pictorial tool depicting a series of nine female or male silhouettes varying in body dimensions (width of body parts) and shape. Images ranged from the thinnest (the first) to the larger (the ninth) silhouette. Two items assess current and ideal body size evaluation, allowing to estimate a score of body size dissatisfaction obtained from the discrepancy between them (ideal minus current body shape and size

¹ <https://www.qualtrics.com/>

TABLE 1 Descriptive statistics and bivariate correlations.

Variable	M (SD)	1	2	3	4	5
1. Internalized WB	42.80 (16.49)					
2. Public WB	64.01 (14.56)	−0.319**				
3. ED symptoms	28.40 (22.68)	0.736**	−0.015			
4. Body size dissatisfaction	−0.73 (1.88)	−0.519**	−0.066*	−0.587**		
5. BMI	21.93 (4.23)	0.145*	0.030	0.265**	−0.468**	

Calculations were based on the whole sample, except for internalized WB which was assessed only in a subsample of adolescents who perceived themselves in a condition of overweight.
* $p < 0.05$; ** $p < 0.001$.

TABLE 2 Independent sample *t*-tests across gender.

Variable	Females	Males	<i>t</i> (df)	<i>p</i> -value	Cohen's <i>d</i>
	Mean (SD)	Mean (SD)			
Internalized WB	47.80 (15.38)	37.46 (16.01)	5.461 (273)	<0.001	0.659
Public WB	65.80 (14.05)	62.64 (14.81)	3.418 (1003)	<0.001	0.218
ED symptoms	39.51 (24.60)	19.93 (16.75)	14.779 (976)	<0.001	0.954
Body size dissatisfaction	−1.61 (1.87)	−0.07 (1.59)	−13.817 (970)	<0.001	−0.895

Internalized WB was assessed only in a subsample of adolescents who perceived themselves in a condition of overweight.

ratings). Negative ratings indicate more body dissatisfaction. SRS showed good psychometric properties and it guaranteed the universality of use thanks to the absence of details related to ethnicity or culture and at the same time, maintaining the right level of realism.

2.3 Data analyses

Data were analyzed using [Jamovi 2.3 \(2022\)](#). Descriptive statistics and bivariate correlations among the main variables under investigation were calculated. To assess gender differences, independent sample *t*-tests were conducted along with Cohen's *d* to quantify the standardized mean difference. Similarly, independent sample *t*-tests were carried out to assess mean differences in key variables between individuals experiencing BS and those who were not. Eventually, two mediation models were computed, the first examining public WB, and the second examining internalized WB, as potential mediators of the relationship between BS and ED symptoms. Age, sex, and BMI were inserted as covariates in both models. Following [MacKinnon et al. \(2004\)](#), the significance of the indirect effects was formally tested by calculating 95% bias-corrected bootstrap confidence intervals (5,000 replications).

3 Results

3.1 Descriptive statistics

Descriptive statistics of the study variables are reported in [Table 1](#). The mean BMI was 21.93 (SD = 4.23) and based on it, 15.3% of the participants were classified in a condition of overweight according to the World Health Organization (BMI ≥ 25). Similarly, a slightly higher percentage of 16.6% indicated to perceive themselves in a condition of overweight (i.e., they answered “yes” to the single item “Do you perceive yourself as overweight?”). More specifically, 86 participants who were not classified as overweight within the BMI

range referred to perceived themselves as overweight, while 38 participants who described themselves as not overweight were classified as overweight according to their BMI.

Among all the adolescents, 25% reported having experienced BS by family members, while 25.1% experienced BS by peers. Moreover, 39.6% of the sample reported clinically significant ED symptoms (DEQ score ≥ 30).

As shown in [Table 1](#), bivariate correlations showed that most of the examined variables significantly correlated (ranging from small to large effects). As we expected, internalized WB in participants perceiving themselves as overweight was significantly associated with all the investigated variables, especially with ED symptoms ($r = 0.736$, $p < 0.001$) and body size dissatisfaction ($r = -0.519$, $p < 0.001$). Conversely, public WB did not correlate to ED symptoms, BMI and only weakly and negatively with body size dissatisfaction ($r = 0.066$, $p < 0.05$). Finally, as we expected, BMI, ED symptoms, and body size dissatisfaction significantly correlated with large effects.

3.2 Sex differences

As reported in [Tables 2, 3](#), independent sample *t*-tests revealed that females reported higher levels of internalized WB (Cohen's $d = 0.659$), ED symptoms (Cohen's $d = 0.954$), and body size dissatisfaction (Cohen's $d = -0.895$) compared to males. The only exception was public WB, which was significantly higher in males compared to females (lower scores indicating more negative attitudes, Cohen's $d = 0.218$).

Moreover, 51.5% of the female participants reported at least one experience of BS by family members or peers, compared to 26% of male participants. In total, 37% of participants reported at least one experience of BS by family or peers. The contingency table ([Table 3](#)) shows these distributions, and the chi-square test of independence confirmed that gender and BS experiences were significantly associated ($\chi^2 = 66.046$, $df = 1$, $p < 0.001$).

3.3 Differences between those who experienced BS and those who did not experience BS

Table 4 shows that adolescents who reported BS experiences showed higher levels of internalized WB (Cohen's $d = -1.128$), public stigma (Cohen's $d = 0.132$), ED symptoms (Cohen's $d = -1.116$), and body size dissatisfaction (Cohen's $d = 0.706$) compared to adolescents who did not report BS experiences.

3.4 Mediation models

In the first model, we examined the role of internalized WB as a mediator in the relationship between BS and ED symptoms (see Figure 1). Sex, age and BMI were included as covariates. Findings showed that BS by peers ($B = 7.364$, $p < 0.001$) and BS by family ($B = 5.904$, $p = 0.008$) were significantly associated with internalized WB, which in turn was positively associated with ED symptoms ($B = 0.859$, $p < 0.001$). Moreover, BS by family directly impacted ED symptoms ($B = 5.684$, $p = 0.013$), while the direct path from BS by peers was not significant ($B = 0.656$, $p = 0.768$). Importantly, internalized WB partially mediated the relationship between BS by family members and ED symptoms ($B = 5.074$, 95% BCI 1.467–9.031), and fully mediated the relationship between BS by peers and ED symptoms ($B = 6.329$, 95% BCI 3.051–10.132).

In the second model, we assessed the role of public WB as a mediator in the relationship between BS and ED symptoms (see

Figure 2). Sex, age and BMI were considered as covariates. Both BS by peers ($B = -1.790$, $p = 0.442$) and BS by family ($B = 1.525$, $p = 0.531$) did not predict public WB. Similarly, public WB was not significantly related to ED symptoms ($B = -0.130$, $p = 0.151$). Therefore, public WB did not mediate the relationship between BS by family and peers and ED symptoms ($B = -0.198$, 95% BCI -1.493 to 0.286 , and $B = 0.233$, 95% BCI -0.264 to 1.651 , respectively). Substantiating previous results, BS by peers ($B = 6.991$, $p = 0.013$) and BS by family ($B = 11.157$, $p < 0.001$) exerted direct effects on ED symptoms.

4 Discussion

This study primarily aimed to estimate the prevalence of weight-related body shaming experiences among a large sample of Italian high-school students and its associations with ED symptoms. Associations among these experiences and internalized and public weight bias, BMI, and body size dissatisfaction have been also established highlighting significant gender differences. Furthermore, we expanded previous research on the association between body shaming and ED symptoms in adolescents reporting overweight by evaluating the mediating role of internalized and public weight bias.

First, results showed that one in four high-school students reported experiencing weight-related BS by peers (25.1%) or by family members (25%), thus leading to a total percentage of 37% who reported having at least one BS experience in their lifetime. These numbers are consistent with previous synthesized results collected internationally (Puhl and Lessard, 2020) and constitute the first evidence in the Italian context that is still underrepresented through strong empirical evidence. Similarly, only Bacchini et al. (2015) estimated that 11.7% of adolescents with obesity reported being verbally, relationally, and physically bullied because of their weight, possibly underestimating these experiences. In addition, nearly 40% of participants reported clinically significant ED symptoms, which signaled an alarming growing prevalence rate, also compared to previous studies from the Italian context that documented a prevalence rate of 28.5% (e.g., Toselli et al., 2005), thus possibly reflecting a post-pandemic effect. Several studies, for instance, demonstrated that the COVID-19 pandemic has deeply disrupted daily life and has created a global context likely to increase ED risk and symptoms, decrease factors that protect against them, and exacerbate barriers to care (e.g., Rodgers et al., 2020). Indeed, this is also in line with recent systematic review data which documented a worsening of ED symptoms among patients with eating disorders (Gao et al., 2022). This data needs attention from the scientific community given the connection between disordered eating, poor psychosocial health, and lower overall health-related quality of life in adolescents (Wu et al., 2019).

TABLE 3 Distribution of female and male participants and experiences of body shaming.

BS experiences		Sex		Total
		Females	Males	
No BS	N	201	404	605
	% row	33.2%	66.8%	100%
	% column	48.4%	74%	63%
At least one BS	N	214	142	356
	% row	60.1%	39.9%	100%
	% column	51.6%	26%	37%
Total	N	415	546	961
	% row	43.2%	56.8%	100%
	% column	100%	100%	100%

TABLE 4 Independent sample t-tests across BS experiences.

Variable	Without BS experiences	With at least one BS experience	t (df)	p -value	Cohen's d
	Mean (SD)	Mean (SD)			
Internalized WB	33.21 (14.02)	49.49 (14.71)	−9.204 (273)	<0.001	−1.128
Public WB	64.69 (14.37)	62.78 (14.74)	1.969 (957)	0.049	0.132
ED symptoms	20.15 (17.65)	42.43 (23.34)	−16.710 (959)	<0.001	−1.116
Body size dissatisfaction	−0.28 (1.51)	−1.53 (2.17)	10.566 (959)	<0.001	0.706

Internalized WB was assessed only in a subsample of adolescents who perceived themselves in a condition of overweight. * $p < 0.05$; ** $p < 0.001$.

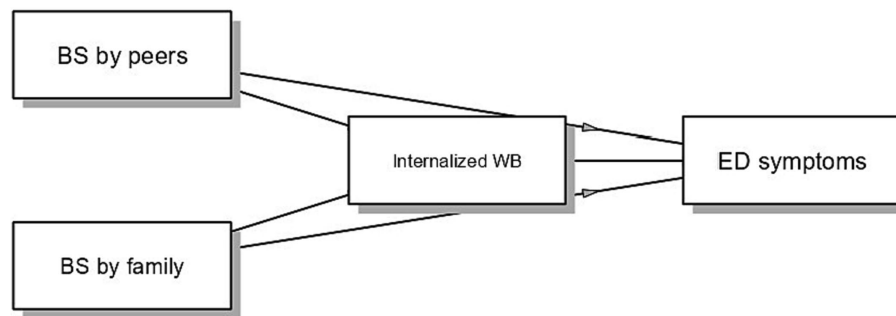


FIGURE 1

Mediation model examining the indirect relationship between BS and ED symptoms via internalized WB. The model was estimated on the subsample of adolescents who perceived themselves in a condition of overweight. BS by peers and BS by family were coded as 0 = not experienced and 1 = experienced.

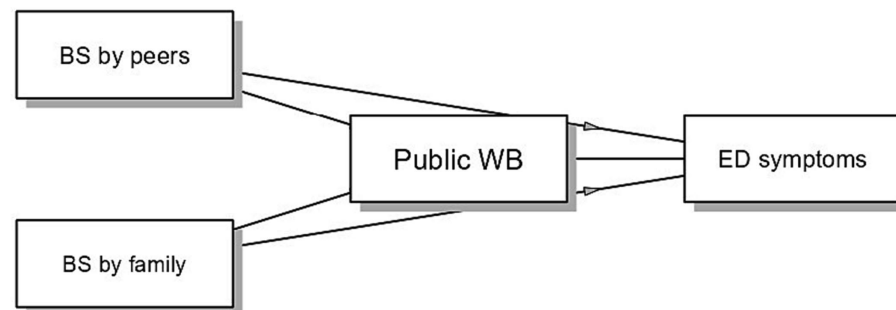


FIGURE 2

Mediation model examining the indirect relationship between BS and ED symptoms via public WB. The model was estimated on the subsample of adolescents who perceived themselves in a condition of overweight. BS by peers and BS by family were coded as 0 = not experienced and 1 = experienced.

Secondly, significant positive associations among the measured variables (i.e., internalized WB, body size dissatisfaction, ED symptoms) and BMI emerged, consistently with the literature supporting strong associations in adolescents (e.g., [Troncone et al., 2020](#)) and adults ([Innamorati et al., 2017](#)).

Furthermore, gender differences were detected in all the variables examined, highlighting higher scores of ED symptoms, body size dissatisfaction, and internalized WB in female participants coherently with existing literature (e.g., [Toselli et al., 2005](#); [Innamorati et al., 2017](#); [Lombardo et al., 2022](#)). The only exception was found in the public WB score, which was higher in males than in females, consistent with previous research using the same instrument among an Italian adult sample ([Zagaria et al., 2022](#)). Female students reported also twice the risk of having at least one lifetime weight-related BS experience compared to male students, which is probably related to sociocultural factors, such as the pervasive influence of the thin ideal in feminine beauty standards ([Emmer et al., 2020](#)).

Differences emerged also between participants who experienced weight-related BS and participants who did not report it, showing higher scores of public WB (small effect) and internalized WB, ED symptoms, and body size dissatisfaction (large effects) in the first group, thus signaling the importance of weight-related stigmatization in explaining worse psychological health outcomes ([Puhl et al., 2017](#); [Puhl and Lessard, 2020](#)). Consistently, this is supported by the results of the mediation model tested only on participants referring

overweight: internalized WB partially mediated the relationship between BS by family members and ED symptoms, and fully mediated the relationship between BS by peers and ED symptoms. This model shows that adolescents who perceive themselves as overweight may experience weight-related BS from peers and family members which is associated with higher levels of internalized WB and ED symptoms.

Lastly, as emerged in the second mediation model, public WB seems to have different effects compared to internalized WB, resulting in not being associated with the experience of BS and ED symptoms in adolescent participants with overweight. At first glance, it might seem controversial. However, this might make sense considering that this group (students who report overweight) may have internalized WB by applying negative stereotypes and attitudes to themselves, but have instead developed a greater sensitivity toward other people with impaired weight conditions (i.e., resulting in less negative attitudes toward obesity) and thus presenting a greater heterogeneity that does not support association with BS experiences and ED symptoms.

4.1 Strengths and limitations

These findings shed new light not only on the importance of BS experience but also on the role of internalization of WB, which is

associated with the worst mental health-related quality of life (as already documented in a sample of women referring overweight and obesity by Zagaria et al., 2023) and may be considered more important than the experience of stigma or weight status alone (Tanas et al., 2022). Of course, since the cross-sectional nature of the study, constitutes one of its main limits, it is difficult to estimate the directionality of the effects, taking into account that they could be bidirectional. However, previous longitudinal results (Puhl et al., 2017) added strong support to the evidence that weight-based teasing in adolescence (and therefore we supposed also WB internalization) can predict higher BMI and obesity in adulthood and ED symptoms in female participants. Consistent with this, clinical reports and excerpts from the life stories of patients seeking help with weight or ED in adulthood support this hypothesis and underscore the importance of longitudinal studies addressing these issues at the national and international levels. A major limitation of the study is related to the self-reported nature of the assessment, especially self-reported height and weight used to calculate BMI, which may be subjected to social desirability and recall biases. Moreover, we used BMI and not BMI-for-age percentile, which can be considered more accurate for the weight classification of children and adolescents, especially when comparing their perception with “standard weight classifications.” However, we were interested in the subjective perception of overweight compared to real nutritional status or weight classification. Therefore, we used this self-reported classification (overweight/not overweight) in both mediation models and not BMI cut-off points to divide our sample. Future studies including both subjective and objectively measured anthropometric parameters, as well as longitudinal designs are needed to further support these preliminary results. Another limitation that should be mentioned, is related to the collection of demographic information among students. For reasons related to time restrictions and the choice not to overload students with a too-long battery of tests, personal data such as socio-demographic conditions related to family income, living conditions, neighborhood or environmental and relational context, as well as sexual orientation were not measured. Indeed, a recent publication suggests that sexual orientation may have an important role in association with weight-related bias (Meneguzzo et al., 2022). Concerning the class/school context, general experiences of bullying and victimization (both actions taken and suffered) have been collected and have been the subject of a recent publication (see Vacca et al., 2023).

4.2 Conclusions and future directions

These findings, despite their cross-sectional nature, add an important contribution to the creation of quantitative empirical evidence on the phenomenon of body shaming among adolescent students. A quarter of teenagers reported experiencing body shaming by family members and peers. Its role in explaining eating disorders, both directly and indirectly through the mediation of internalized weight bias, has been first proved and needs to be confirmed by longitudinal results.

These findings underscore the importance of addressing weight-related educational programs and health initiatives, including weight-based anti-bullying interventions, especially among adolescents. There is an urgent need to draw the attention of the scientific and non-scientific community (health professionals, researchers, clinicians, educators, coaches, teachers and parents) to the harmful effect of any form of

weight-related prejudice and discrimination. In fact, instead of stimulating healthy and beneficial effects in reducing overweight, obesity or even underweight, they can rather lead to harm and suffering in stigmatized youths (Tanas et al., 2022).

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Institutional Review Board of the Department of Psychology at Sapienza University of Rome. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants’ legal guardians/next of kin.

Author contributions

SC: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. MV: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing. AZe: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing – review & editing. AZa: Data curation, Formal analysis, Software, Visualization, Writing – review & editing. CL: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The effect of perceived stress on binge eating behavior among Chinese university students: a moderated mediation model

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Introduction: Previous studies have demonstrated a strong link between perceived stress and binge eating behavior, but the psychological mechanisms underlying such phenomenon are not fully understood. The present study further addressed this issue in a life history framework, focusing on life history strategy and distress tolerance.

Methods: Firstly, we investigated the mediation role of life history strategy on the relationship between perceived stress and binge eating behavior. Secondly, we examined the moderation role of distress tolerance on the effect of perceived stress on life history strategy, as well as on the direct effect of perceived stress on binge eating behavior. We analyzed data from 1342 Chinese university students.

Results: Results indicated that life history strategy mediates the relationship between perceived stress and binge eating behavior; distress tolerance has significant moderating effects on the direct effect of perceived stress on binge eating behavior and their indirect effect via life history strategy.

Discussion: Therefore, distress tolerance skills training and life history-based interventions might be potentially effective ways to reduce binge eating behavior triggered by perceived stress.

KEYWORDS

perceived stress, life history strategy, binge eating behavior, distress tolerance, Chinese university students

Introduction

Binge eating is characterized by rapid and excessive food consumption, often accompanied by a feeling of loss of control (1). From 2018 to 2020, the global prevalence of binge eating is estimated to be 0.6–1.8% among adult women and 0.3–0.7% among adult men (2). A study in China found 85 cases of binge eating behavior among 1,103 college students based on the scores of the binge eating scale (3). Binge eating often leads to poor personal quality of life, work, family (4), because of its negative consequences including non-suicidal self-injury (4), gastric perforation and acute gastric dilatation (5). Given its pervasiveness and serious negative consequences, binge eating has become a significant public health concern.

Laboratory, descriptive, and ecological momentary assessment studies have demonstrated that binge eating is preceded by negative affect accompanying perceived stress (6), and that perceived stress positively predicts binge eating behavior (7, 8). Further, individuals with binge eating behavior have higher level of perceived stress and negative emotional experience than healthy controls under the same stressful laboratory situation (9). However, the psychological mechanisms by which perceived stress leads to binge eating are still not fully understood.

Existing researches have mainly addressed this issue from the perspective of self-regulation or coping strategies. For example, higher level of psychological distress (including stress) and emotional eating was observed in individuals with emotional dysregulation, an important aspect of self-regulation (10). Meanwhile, more coping strategies (including both positive and negative coping strategies) to relieve stress and more catastrophizing were reported by individuals with binge eating in stressful tasks (11). The risk of binge eating was increased by distraction coping increases, while decreased by social support (7). More directly, the relationship between perceived stress and binge eating/emotional eating is mediated by eating self-regulation (12) and emotion-focused coping (13) and moderated by resilience (14), cognitive reappraisal, but not response inhibition (15). In this research perspective, binge eating behavior is regarded as maladaptive behavior because of its negative consequences in the long run.

On the other hand, binge eating also is proposed to be motivated by a desire to escape from self-awareness, it might be an emotion regulation strategy to avoid unpleasant emotional distress accompanying aversive self-perceptions (16). Specifically, binge eating is a concrete and palatable way to distract from concerns about emotional distress. It seems that the expectation that binge eating will help to alleviate negative affect leads to the occurrence of this behavior (17–19). Therefore, binge eating appears to be a proactive adaptation strategy effective at the moment. In this context, it may be an adaptive behavior for binge eaters under special circumstances where due to excessive pressure, they have to focus on the present and cannot take into consideration the future. That is a fast life history strategy according to life history theory in evolutionary psychology.

Life history theory has been developed as an explanation for differences in energy and time allocation patterns between and

within species (20). Resources are limited for all living organisms. How to allocate their limited resources is critical to the survival and continued existence of the species. The strategies for allocating resources often change based on their assessment of environmental stress. In predictable environments, planning and working for higher future rewards is cost effective. Therefore, cognition and behavior of humans and animals tend to be more future oriented than present oriented. That is to say, they prefer to behave in ways that are likely to be rewarded in the future but little or no immediate benefit. This strategy is called the slow life history strategy. Conversely, when the future is uncertain and hard to be predicted, it is unlikely that investing will pay off in the future. Therefore, a fast strategy is more adaptive, with organisms focusing more on the present and discounting the future (21).

Environmental stress is key to inducing a fast life history strategy (22). In the human life history strategy, more emphasis is placed on individual's subjective perception in term of environmental stress (23, 24). That is to say, perceived stress, rather than objective environmental stress, more accurately reflects an individual's stress state and more effectively triggers a fast life history strategy. Individuals with binge eating behavior suffer from high standards and expectations, particularly an acute sensitivity to the difficult (perceived) demands of others (16); This psychological trait exacerbates the state of imbalance between environmental demands and the individual's capacity to cope with these demands, resulting in more perceived stress. In fact, they have higher levels of perceived stress under the same stressful situation (9). Therefore, they are expected to have a faster life history strategy. Further, a number of reviews or studies have examined a variety of psychopathological symptoms within a life history strategy perspective (17, 25), including eating disorders (26, 27). In contrast, slow life history strategy has a function in protecting against disordered eating behaviors (28). Based on these evidences, it is reasonable to assume that fast life history strategy may mediate the relationship between perceived stress and binge eating (H1).

Distress tolerance (DT) refers to the perceived and actual capability to withstand aversive physical and psychological states (29, 30), including uncertainty, ambiguity, frustration, negative emotion, physical discomfort (31). Individuals with lower DT are thought to be more reactive to distress, more likely to experience stress overload (32) and more attempt to avoid these aversive states (29). That is to say, under the same perceived stressful situation, individuals with low distress tolerance are more likely to experience psychological overload followed by a stronger motivation to alleviate negative experiences, finally results in the initiation of the fast life history strategy and occurrence of binge eating behavior. Therefore, it seems reasonable to hypothesize that distress tolerance moderates the relationship between perceived stress and fast life history strategy (H2) and that distress tolerance moderates the relationship between perceived stress and binge eating (H3).

Together, the present study aimed to investigate the psychological mechanism underling the role of perceived stress in the occurrence of binge eating behavior in Chinese culture. First, we tested whether life history strategy independently mediates their relationship. Then, we investigated whether distress tolerance

moderates the direct effect of perceived stress on binge eating behavior and/the life history strategies. The hypothetical model was shown in Figure 1.

Materials and methods

Participants

This research was approved by the ethics committee of Guizhou Medical University. Chinese undergraduate students from a university in Guizhou province were recruited. Prior to participation, all students were asked to sign informed consent forms and informed that their responses would be anonymous with the option of withdrawal at any time. Data of the subjects who chose the same answer for more than half of the total scale were excluded (33). Finally, 1342 students (519 males and 823 females) aged 18–24 ($M = 19.03$, $SD = 1.02$) were included in data analysis.

Measures

Binge eating behavior

To measure binge eating behavior, the Chinese version of Binge Eating Scale (BES) adapted by Wu Siyao, et al. (34) was adopted. The scale consists of 16 items, each with 3 to 4 options. The total score of the scale ranges from 0 to 46 points, higher total score indicates a more severe level of binge eating behavior. In this study, the Cronbach's alpha was 0.79.

Perceived stress

To measure perceived Stress, the Chinese version of Perceived Stress Scale (PSS) revised by Tingzhong Yang (35) was adopted. PSS is developed by Cohen et al. (36) and includes two dimensions: tension (e.g., Can't cope with all the tasks on your own.) and sense of loss of control (e.g., Things are going as hoped.). Each dimension contains 7 items, using a 5-Likert point scale. Items belonging to the sense of loss of control dimension were scored in reverse. The total

score is from 0 to 56, with higher score indicating higher perceived stress. In this study, the Cronbach's alpha was 0.77.

Life history strategy

To measure life history strategies, the life history strategy Scale revised by Sai Xueying et al. (37) was adopted. There are 20 items in the original scale and using a 7-Likert point scale. It's important to mention that item 20 "I believe in religion and regularly participate in religious activities" has been removed in the Chinese version of the Life History Strategy Scale (37). The total score is derived from the summation of individual scores. Higher score suggests propensity towards slow life history strategy, whereas lower score indicates preference for fast life history strategy. In this study, the Cronbach's alpha was 0.88.

Distress tolerance

To measure Distress tolerance, the Distress Tolerance Scale (DTS) the revised by You Jianing et al. (38) was adopted. The scale consists of 16 items, which was scored on a 5-Likert point scale. The scale has a total score range of 15–75, where higher DTS score indicates lower distress tolerance. In this study, the Cronbach's alpha was 0.83.

Statistical analysis

The data gathered in this study were analyzed as outlined by Hayes (39) in his book. SPSS 26.0 was used to conduct common method bias test, descriptive statistical analysis and correlation analysis of the data. Then, the mediation effect of life history strategies was examined by PROCESS macro model 4 and the moderation role of distress tolerance was examined by model 1. Finally, all the study hypotheses were tested simultaneously by model 8. Data were calculated based on standardized scores. Bootstrapped confidence interval (CI; 5,000 bootstrap samples) for the indirect effect was obtained. If zero is not included in the confidence interval, effects are significant.

Results

Common method biases tests

To exclude common method bias, the Harman single factor method was used in this study (40). The results showed that there were 14 factors with feature roots greater than 1, among which the cumulative variance explained by the first factor was only 16.918%, less than the critical value of 40% (41). Therefore, common method biases are unlikely to confuse the interpretation of the data analysis.

Describe statistics and correlation analysis

Table 1 shows the descriptive statistics and correlations of the variables in this study. Perceived stress was negatively correlated with life history strategy ($r = -0.432$, $p < 0.001$) and positively correlated

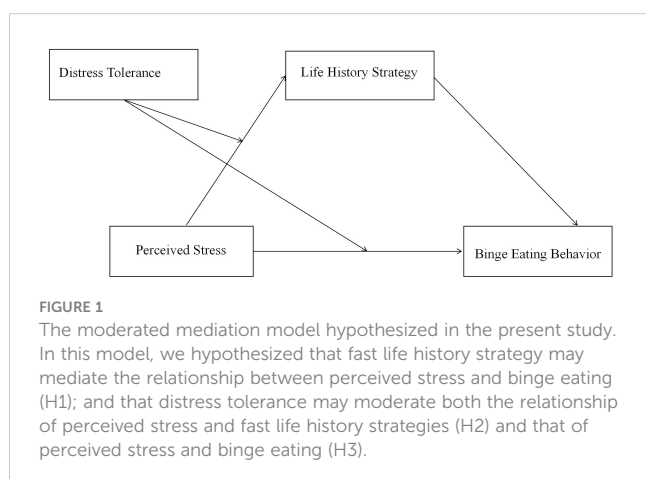


TABLE 1 Descriptive statistics and correlation of variables.

Variable	$M \pm SD$	1	2	3	4
1. Perceived Stress	24.33 \pm 6.29	1			
2. Life History Strategy	102.21 \pm 14.43	-0.432***	1		
3. Binge Eating Behavior	7.91 \pm 5.87	0.362***	-0.253***	1	
4. Distress Tolerance	37.94 \pm 8.77	0.565***	-0.28***	0.368***	1

N=1342, *** $p < 0.001$.

with binge eating behavior ($r = 0.362, p < 0.001$). Life history strategy was negatively correlated with binge eating behavior ($r = -0.253, p < 0.001$). Distress tolerance was positively correlated with perceived stress ($r = 0.565, p < 0.001$) and negatively correlated with life history strategy ($r = -0.28, p < 0.001$), while positively correlated with binge eating behavior ($r = 0.368, p < 0.001$).

Testing for mediation effect

To test hypothesis 1, PROCESS macro-Model 4 was used. The specifications of this model can be seen in Table 2. Since Gender and BMI are important variables that affect eating behavior and may confound the interpretation of our results (42–44), they were selected as covariates in the present study. After controlling for gender and BMI, the mediator and dependent variable models showed that perceived stress was negatively correlated with life history strategy ($\beta = -0.73, p < 0.001$, see Model 1 of Table 2), and life history strategy was negatively correlated with binge eating behavior ($\beta = -0.06, p < 0.001$, see Model 2 of Table 2). While, perceived stress was also positively associated with binge eating behavior ($\beta = 0.25, p < 0.001$, see Model 2 of Table 2). Therefore, life history strategy partly mediated the relationship between perceived stress and binge eating behavior, supporting Hypothesis 1.

Testing for the moderation effect

To examine the moderation effect of distress tolerance on the relationship between perceived stress and life history strategy, the PROCESS macro model 1 was used. Results was shown in Table 3.

The interaction between perceived stress and distress tolerance on life history strategy was significant ($\beta = 0.14, p < 0.05$; see Model 3 of Table 3). Thus, distress tolerance had a moderating role between perceived stress and life history strategy, supporting Hypothesis 2. Similarly, PROCESS macro model 1 was also ran to test the moderation effect of distress tolerance on the relationship between perceived stress and binge eating behavior. Results was also shown in Table 3. The interaction between perceived stress and distress tolerance on binge eating behavior was also significant ($\beta = 0.06, p < 0.05$, see Model 4 of Table 3), supporting Hypothesis 3.

To describe it more directly, figure of predicted perceived stress against life history strategy was plotted in Figure 2. Low and high level of distress tolerance score (1- SD below the mean and 1+ SD above the mean, respectively) were showed in the figure separately. The results showed that when perceived stress is high, both individuals with higher distress tolerance and those with lower distress tolerance tend to use the fast life history strategy; while perceived stress was low, individuals with low distress tolerance were more inclined to use faster life history strategy than those with high distress tolerance.

Similarly, figure of predicted perceived stress against binge eating behavior was plotted. As shown in Figure 3, the higher distress tolerance score, the more prone to binge eating behavior score, regardless of the perceived stress. That is to say, individuals with lower distress tolerance are more likely to engage in binge eating behavior than those with higher distress tolerance.

Testing for the whole research model

Finally, all the study hypotheses were tested simultaneously using PROCESS macro model 8. The results showed that binge

TABLE 2 Testing the mediation effect of Life History Strategy on binge eating behavior.

Model 1 (Life History Strategy)					Model 2 (Binge Eating Behavior)			
Constant	β	t	SE	95% CI	β	t	SE	95% CI
Gender	0.16	4.06***	0.04	0.08 ~ 0.23	0.17	8.80***	0.02	0.13 ~ 0.20
BMI	0.00	0.24	0.01	-0.01 ~ 0.01	0.01	3.71***	0.00	0.01 ~ 0.02
PS	-0.73	-17.50***	0.04	-0.81 ~ -0.65	0.25	11.09***	0.02	0.20 ~ 0.29
LHS					-0.06	-4.22***	0.00	-0.08 ~ -0.03
R ²	0.19				0.19			
F	106.27				77.62			

N=1342, the Beta value are standardized coefficients, thus they can be compared to determine the relative strength of different variables in the model. Each column is a regression model that predicts the criterion at the top of the column. PS, perceived stress, LHS, life history strategy. * $p < 0.05$, *** $p < 0.001$.

TABLE 3 Testing the moderation effect of distress tolerance.

Model 3 (Life History Strategy)					Model 4 (Binge Eating Behavior)			
Constant	β	t	SE	95%CI	β	t	SE	95%CI
Gender	0.17	4.26***	0.04	0.09 ~ 0.24	0.14	7.68***	0.02	0.11 ~ 0.18
BMI	0.00	0.16	0.01	-0.01 ~ 0.01	0.01	3.99***	0.00	0.01 ~ 0.02
PS	-1.01	-6.51***	0.16	-1.32 ~ -0.71	0.18	7.68***	0.02	0.14 ~ 0.23
DT	-0.31	-2.75*	0.11	-0.54 ~ -0.09	0.14	7.73***	0.02	0.11 ~ 0.18
PS×DT	0.14	2.28*	0.06	0.02 ~ 0.25	0.06	2.16*	0.03	0.01 ~ 0.12
R ²	0.20				0.22			
F	65.73				74.17			

N=1342, The Beta value are standardized coefficients, thus they can be compared to determine the relative strength of different variables in the model. Each column is a regression model that predicts the criterion at the top of the column.PS, perceived stress, DT, distress tolerance. *p<0.05, ***p<0.001.

eating behavior was predicted by both perceived stress and life history strategy in Model 6, and life history strategy was predicted by perceived stress in Model 5. Therefore, the relationship between perceived stress and binge eating behavior was partly mediated by life history strategy. In addition, the indirect effect of perceived stress on binge eating behavior via life history strategies was also moderated by distress tolerance ($\beta = 0.01, p < 0.05$. see Model 5 of Table 4); meanwhile, the direct effect of perceived stress on binge eating behavior was also moderated by distress tolerance ($\beta = 0.01, p < 0.05$. see Model 6 of Table 4). The index of moderated mediation was -0.0006 with a 95% confidence interval (CI) of [-0.0012, -0.0001] (see Model 7 of Table 4), the zero value was not included. Therefore, the whole research model was supported.

Discussion

Numerous studies have demonstrated perceived stress is an important trigger of binge eating behavior (6, 15, 45). However, the psychological mechanisms by which perceived stress triggers binge eating behavior are not fully understood. In the present study, we

further addressed this issue from the perspective of evolutionary psychology, focusing on life history strategy and distress tolerance. Firstly, we found a mediating role of life history strategy on the relationship between perceived stress and binge eating behavior. Secondly, when distress tolerance is introduced as a moderator for the perceived stress-life history strategy and perceived stress-binge eating in the model, main interactional effects were also been observed.

There are a number literatures have attempted to explain a variety of psychopathological symptoms within a life history strategy framework (17, 25, 28, 46), including eating disorders (26, 27). However, the evolutionary origin and function of binge eating remains unexplored, and binge eating may have adaptive implications from a life history strategy perspective, especially in situations of high perceived stress.

The term perceived stress refers to a perceived imbalance state between environmental demands and the individual's capacity to cope with these demands (47). When a person perceives that his abilities are sufficient to cope with the demands of the environment, the perceived stress is low. On the contrary, when he perceives that his abilities are insufficient to cope with the demands of the environment, the perceived stress is high. It has been shown that individuals with binge eating behavior suffer from high standards

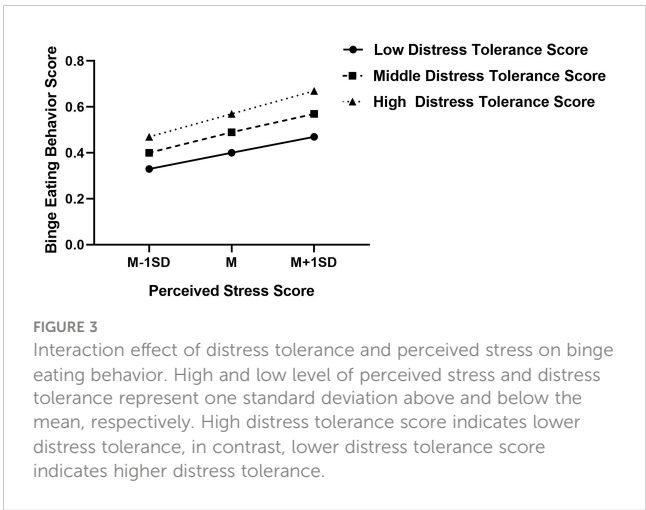
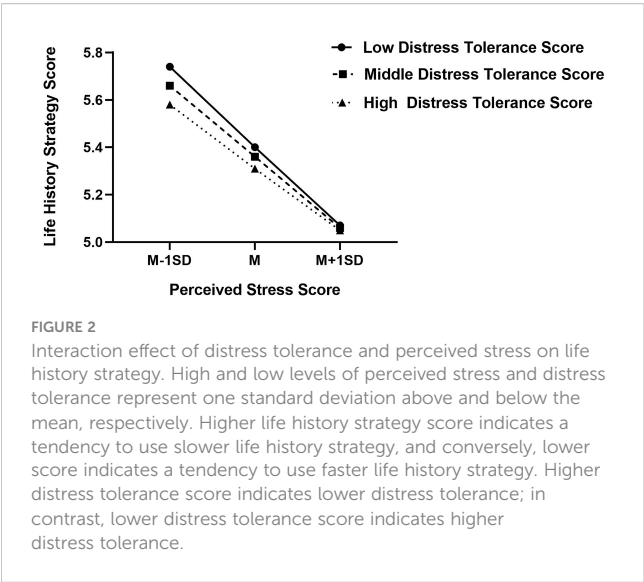


TABLE 4 Testing for the whole research model.

Model 5 (Life History Strategy)					Model 6 (Binge Eating Behavior)			
Constant	β	<i>st</i>	<i>SE</i>	95%CI	β	<i>t</i>	<i>SE</i>	95%CI
Gender	3.14	4.26***	0.74	1.69 ~ 4.59	2.42	8.14***	0.30	1.83 ~ 3.00
BMI	0.02	0.16	0.12	-0.22 ~ 0.26	0.19	4.03***	0.05	0.10 ~ 0.29
PS	-0.91	-13.25***	0.07	-1.04 ~ -0.77	0.17	5.87***	0.03	0.11 ~ 0.23
DT	-0.10	-1.95	0.15	-0.20 ~ -0.00	0.15	7.55***	0.02	0.11 ~ 0.19
PS×DT	0.01	2.28*	0.01	0.00 ~ 0.02	0.01	2.42*	0.00	0.00 ~ 0.01
LHS					-0.04	-4.08***	0.01	-0.07~-0.02
R ²	0.20				0.23			
F	65.73				65.31			
Model 7								
Index of moderated moderated mediation	β	<i>SE</i>	95%CI					
	-0.0006	0.0003	-0.0012~-0.0001					

N=1342, The Beta value are standardized coefficients, thus they can be compared to determine the relative strength of different variables in the model. Each column is a regression model that predicts the criterion at the top of the column. PS, perceived stress, LHS, life history strategy, DT, distress tolerance. *p<0.05, ***p<0.001.

and expectations, particularly an acute sensitivity to the difficult (perceived) demands of others (16). Therefore, the binge eater is expected to have higher perceived disparity between environmental demands and his capacity to cope with these demands. That is to say, they perceive that they are unable to cope with the demands of their environment and are more likely experience stress overload. In this context, the future is uncertain and hard to predict, it is unlikely that investing will pay off in the future. It is crucial for individuals with binge eating disorder to promptly address excessive psychological stress. Therefore, a fast strategy, focusing more on the present and discounting the future, is more adaptive, where binge eating was used to escape from such emotional distress, particularly when there is no alternative, adaptive emotion-regulation skills (48). The results of the present study supported this hypothesis, finding that life history strategy mediated the relationship between perceived stress and binge eating behavior.

Distress tolerance is another important psychological variable related to coping with stressors. It reflects the perceived and actual capability to withstand aversive physical and psychological states (29, 30). Individuals with low distress tolerance not only have a low threshold for experiencing negative emotions, but also lack emotion regulation skills (49). Previous researchers have found that distress tolerance alone negatively predicted binge eating behavior (50–52), although there are also studies that do not support this view (9, 53). This inconsistency might suggest that distress tolerance may interact with other factors in binge eating. In the present study, we expanded the mechanism of distress tolerance in binge eating. We found that distress tolerance regulates binge eating behavior by interacting with perceived stress through two pathways: (1) the direct effect of perceived stress on the binge eating; (2) the indirect effect of perceived stress on the binge eating through the life history

strategy. Therefore, distress tolerance may be an important potential intervention target for binge eating. This was supported by the fact that Dialectical Behavior Therapy (DBT) skills training which include distress tolerance skills reduces binge eating (54).

At the theoretical level, the present study improves our understanding about how perceived stress leads to binge eating behavior in a life history framework. Perceived stress may affect binge eating by fast life history strategy; Distress tolerance moderates both the direct effect of perceived stress on binge eating and its indirect effect through life history strategy.

At the practical level, the present study results suggested that life history-based interventions might effectively relieve stress-induced binge eating behavior. Specifically, developing slow life history strategy could help individuals to reduce their binge eating behavior when encountering similar stressful situations in the future. This is consistent with the idea that understanding eating interventions through an evolutionary lens (55). Further, our results also suggested that distress tolerance skills training might be a potentially effective way to reduce binge eating behavior triggered by perceived stress directly or indirectly by developing slow life history strategy. In fact, previous researches have confirmed that DBT, which includes distress tolerance skills training, significantly reduces binge eating behavior (54, 56). Whether distress tolerance skills training alone also have a similar effect requires further studies in the future.

On the other hand, the present study cannot draw causal conclusions because of its cross-sectional design. Longitudinal studies are still needed to further confirm these conclusions in the future. In addition, although our sample size is relatively large, it is all from one university, which limits the representativeness of the sample. Future research should increase the sampling locations.

Conclusion

Perceived stress induced binge eating behavior may be mediated by fast life history strategy; Distress tolerance moderates both the direct effect of perceived stress on binge eating and its indirect effect through life history strategy. Therefore, distress tolerance skills training and life history-based interventions might be potentially effective ways to reduce binge eating behavior triggered by perceived stress.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding authors.

Ethics statement

The studies involving humans were approved by the ethics committee of Guizhou Medical University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

XM: Conceptualization, Funding acquisition, Writing – review & editing. JG: Conceptualization, Formal analysis, Investigation, Writing – original draft. YL: Writing – review & editing. BX: Writing – review & editing. CL: Writing – review & editing, Conceptualization, Funding acquisition, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Increased eating disorder frequency and body image disturbance among fashion models due to intense environmental pressure: a content analysis

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Introduction: Female fashion models are under intense occupational pressure. The present study focuses on assessing the lived experience of fashion models with regards to their dieting and exercising habits, body image perception, eating disorder-like symptoms, and experience of abuse via self-narrated reports.

Methods: Series of open questions were distributed among international fashion models (N=84, mean age=23.2 years; mean BMI=16.9) selected by convenience and snowball sampling. Models from 17 countries participated. The questions targeted models' eating, exercising, dieting habits, body image perception, and eating disorder symptoms. The average word count of the transcripts was 2473.9 (SD = 2791.6). Thematic content analysis was performed on the transcripts. A total of 31 codes were created to address disordered eating and body image concerns.

Results: Negative body-related claims appeared in 89.3%, and positive claims in 64.3% of the models' transcripts. Negative remarks about eating were made by 45.2% of the participants, and 23.8% positively. Control over their food intake was exercised by 78.6% of the participants and 40.5% used extreme calorie restriction. Models who talked more positively about their bodies expressed significantly more frequently extreme calorie restriction. Extreme sports habits occurred in 23.8% of the transcripts, obsessive sports habits were claimed by 11.9% of participants. Self-induced vomiting was prominent in 14.3% of the answers. Criticism from other industry members was experienced by 83.3% of the participants while 44.0% received body appreciation. Body image disorder-like symptoms were expressed by 63.1% of models. Such models mentioned significantly more often content about eating disorders and talked significantly more negatively about eating. Psychological problems were mentioned by 48.8%, whereas 16.7% took part in psychotherapy. Those who partake in therapy mentioned significantly more eating disorder content in their narratives. Abuse was mentioned by 25.0% of the models.

Conclusion: Fashion models are experiencing increased environmental pressure to conform to the extreme slimness ideal. There is a heightened prevalence of

disordered eating and other weight-controlling behaviours among fashion models to succeed in their careers. Qualitative research is crucial in understanding the more subtle dynamics in conforming to and maintaining the thin beauty ideal.

KEYWORDS

anorexia nervosa, appearance pressure, body image disorder, content analysis, eating disorders, fashion industry, fashion models

1 Introduction

Data on the prevalence of disturbed eating habits and body image concerns among fashion models is scarce. This can be due to the closed structure of the unique profession and the concern over potential repercussions stemming from disclosure of confidentialities (1, 2). However, with the rise of unrealistic beauty standards (3) and the increasing rates of eating disorders (EDs) (4) it is more important than ever to investigate this specific group.

Professions that necessitate a low body weight and are associated with appearance, such as ballet dancers, marathon runners, and flight attendants, are more prone to an increased risk of developing EDs (5). Models are facing intense pressure to reach and to maintain the size requirements dictated by the fashion industry (6). Contrary to the pursuit of bigger size representations, the beauty standards remained similar in the past decade: height of at least 175 cm, waist circumference around 60 cm and hip circumference preferably not bigger than 90 cm (7, 8). Even though regulations have been implemented on several international fashion markets (9), the majority of models appearing on the runways, e.g. on New York Fashion Week, still has a BMI under 18.5 (10), which is considered underweight (11). These unrealistic measurement requirements put sociocultural pressure on young women, both models and non-models, to conform to the thin beauty ideal (12). According to Rodgers et al. (13), 62.4% of female fashion models have been asked to lose weight or to change their body shape and/or size. Presumably due to the intense appearance pressure, models are at significantly greater risk for developing subclinical anorexia nervosa (AN) compared to non-models (14).

Peer-pressure, the abundantly displayed strong emphasis on thin body ideals, appearance related criticism are risk factors for body image concerns and EDs (15). Body dissatisfaction foresees the emergence of EDs of clinical severity (16). In the fashion industry, models are often encouraged by their agents to lose weight, even though they are already thin (17). In a study, 63.1% of models reported that they would receive more job offers providing that they were slimmer (13). Weight loss remains a pivotal element and a major accomplishment in the fashion industry (18). Such criticism can highly influence body perception, self-

esteem, and cause the feeling of shame which is correlated with disordered eating habits (19).

Besides the considerable mental health consequences, the lack of proper nutrition can cause several somatic symptoms, such as osteoporosis, cardiac complications, brain shrinkage or amenorrhoea (20–22).

The difficulties of partaking in modelling extend beyond eating and body image disturbances. The presence of abusive or traumatic experience is not unusual (18). This might further enhance the risk for the development of EDs, as both traumatic events and the lack of psychosocial resources are associated with higher ED frequency (23).

The present study aimed to explore the nuanced relationship between fashion models and their dietary habits, exercise routines, body image perception, ED-like symptoms, experience of abusive nature amongst other factors relevant in the scope of ED development in the sociocultural context of the fashion industry via self-narrated reports. We trust that this qualitative research adds great value to the limited number of existent quantitative findings, and to better understand lived experience of models. There exists a significant gap in the literature in the assessment of subjective experiences influencing ED risk factors. To our knowledge, amongst all the research conducted about fashion models, only one study has previously applied qualitative evaluation, specifically interpretative phenomenological analysis (18). Our research aims to fill this gap, enriching the understanding of the sociocultural dynamics at play and providing a grounded perspective on the personal and professional challenges models face, and contributing to targeted interventions and policy recommendations within the industry.

2 Materials and methods

2.1 Measures

A series of open questions were distributed among fashion models, aiming to gather information about their careers, their view on the fashion industry, their relationship with their agents, and their attitudes towards their body image, eating, exercising and dieting habits. The list of questions contained 23 open questions concerning their health, diets, the requirements enforced by the industry, and it also touched on their self-perception including

Abbreviations: AN, Anorexia nervosa; BN, Bulimia nervosa; DSM-5-TR, Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision; ED, Eating disorder; EDI, Eating Disorder Inventory.

insecurities about their looks, and all questions were registered at one occasion. Data was collected about their age, their experience in the fashion industry, their nationality, height and weight. The answers to the series of open questions were gathered via e-mail ($N = 73$, in a Microsoft Word format) and online video calls ($N = 14$). Participants were provided the possibility to answer all questions in free text or free speech, enabling them to fully elaborate on their experience (see [Supplementary Material 1](#)). All participants received the same questions. The online calls were recorded, and their transcripts were created within 24 hours to be analyzed in the same format as the written answers.

2.2 Sample

Data was collected from 87 participants who were recruited with convenience and snowball sampling method (the first author worked in the fashion industry as a model for five years). The data collection took part between 2016 June and 2021 May. Three participants were omitted from the analysis, since one of them was not an active fashion model, while two participants' interviews were not recorded in their entirety. In total, 84 transcripts were analyzed. The mean age of the participants was 23.23 years ($SD = 4.4$, range 16 – 34 years). Their average experience in the fashion industry was 6.56 years ($SD = 3.67$, range 1 – 15 years), and their average BMI was 16.9 ($SD = 1.60$, range 14 – 23.7). It is remarkable that 36.4% of the models reported BMI of between 17.0 and 18.5, and a further 52.3% under 17.0 (moderately or severely underweight). Mean height of the fashion models was 177.8 cm ($SD = 3.6$, range 171–186 cm). Models of various nationalities participated in the study, from 17 countries, including American, Canadian, Dutch, English, French, Hungarian, Polish, Russian, and Spanish subjects, amongst others. The average wordcount of the transcripts was 2473.9 ($SD = 2791.6$).

2.3 Thematic content analysis

Before starting the coding procedure, all transcripts were fully anonymized, and identifiers were omitted. The collected data was analyzed by performing a thematic content analysis (24). After the data collection phase, the video call interviews were read and transcribed. After the critical reading of the transcripts a coding booklet was developed containing coding instructions on 31 codes. This coding booklet was developed by the authors of the present paper. The codes were in alignment with our research questions such as attitudes towards one's body, weight and exercise. Other codes referred to symptoms of EDs according to DSM-5-TR, since the goal of our research was to connect attitudes to various ED-like symptoms. The codes used in the current analysis are presented in [Table 1](#). Before manually starting the coding procedure, all transcripts were fully anonymized, and identifiers were omitted. Only explicit mentioning of each content category was coded, possible latent contents were ignored in this analysis for better reliability. One testimony could receive multiple of the same codes, even contradictory ones (e.g., positive and negative attitudes towards their bodies within one testimony). The level of analysis was semi-sentences.

Coders were recruited from Pázmány Péter Catholic University, Budapest, Hungary who attended a content analysis course during their psychology MSc programs. They received no benefits for their work, and they volunteered to join the coding process. They had knowledge that they participate in research focusing on fashion models' lived experiences, however they were not introduced to the research goals. This means that while they were aware of the codes they were supposed to locate, they had no information as to what kind of statistical analyses were to be performed after their work. The Coders were trained to use the coding booklet. A sample was sent out to the coders for training purposes. The texts were broken into semi-sentences and sent to the coders in a spreadsheet where each line of the first column contained one semi-sentence, and every column corresponded to one code. Coders needed to mark line by line whether it contained the specific code. The coding was later evaluated by the second author who is an experienced researcher in content analysis. Coding inaccuracies were assessed, discussed, corrected and coders were re-trained before receiving more transcripts. The testimonies were assigned randomly to the coders, and they were hand-coded by at least two people. Krippendorff's alphas were calculated using Hayes and Krippendorff's (25) KALPHA algorithm (see [Table 1](#)). Every coding difference was sorted with the involvement of a third judge with experiences in eating and body image disorders, who only coded the parts where the two judges' interpretation differed. Due to the large fluctuations in the wordcounts, the analyses were conducted using relative frequencies. The absolute frequency of the codes was divided by the wordcount corresponding to the transcripts.

2.4 Data analysis

The coding process' resulted in a table containing the frequency of the codes per transcript. Data analysis was performed on two levels. Firstly, frequencies of each code were calculated and transformed into percentages to determine what rate each code appears in all of the transcripts. Secondly, relative frequencies were calculated: each code's frequency divided by the corresponding transcript's wordcount. These relative frequencies allowed for the comparison of the transcripts. Mann-Whitney U tests were performed using the relative frequencies of the codes as dependent variables, while grouping the transcripts along various codes for ex. transcripts with or without signs of overeating.

2.5 Ethical approval

The research is in accordance with the Helsinki Declaration and was approved by the Regional Research Ethical Board of the Semmelweis University Budapest (No. 3/2020). Written informed consent was obtained from all participants included in this study.

3 Results

[Table 1](#) contains the number of models and the percentage of the prevalence of each code. The distribution of the codes was

TABLE 1 Content analysis codes with their brief description, the Krippendorff's alpha values of the two independent judges' coding and their occurrence amongst fashion model subjects (N=84).

Code name (Krippendorff's alpha)	Code description	Occurring statements (Number of models; %)
Weight (Positive: .545; Negative: .551; Neutral: .499)	Every mention of the participant's weight.	Positive: 17; 20.2% Negative: 46; 54.8% Neutral: 66; 78.6%
Exercise, training, sport (Positive: .549; Negative: .732; Neutral: .746)	Every mention of the participant's exercise, training, or sports habits.	Positive: 34; 40.5% Negative: 12; 14.3% Neutral: 77; 91.7%
Body (Positive: .547; Negative: .541; Neutral: .517)	Every mention of the participant's body perception.	Positive: 54; 64.3% Negative: 75; 89.3% Neutral: 80; 95.2%
Eating (Positive: .635; Negative: .618; Neutral: .391)	Every mention of the participant's experiences, habits with eating.	Positive: 20; 23.8% Negative: 38; 45.2% Neutral: 81; 96.4%
Body appreciation (.664)	Every mention where the participant expresses receiving appreciation toward their body from other industry members.	37; 44.0%
Body critique (.634)	Every mention where the participant expresses receiving criticism toward their body from other industry members.	70; 83.3%
Abuse (.259)	Every explicit mention of abuse (verbal, physical, emotional, or other) suffered by the participant.	21; 25.0%
Monotrophic diet (.391)	Every explicit mention of a type of diet that involves eating only one food item.	23; 27.4%
Extreme calorie restriction (.487)	Every explicit mention of extreme calorie restriction.	34; 40.5%
Dietary control (.618)	Every explicit mention of the participant's will to greatly control their eating habits.	66; 78.6%
Loss of dietary control (.667)	Every explicit mention where the participant admits they lost control of their eating habits.	19; 22.6%
Liquid diet (.75)	Every explicit mention of the participant's liquid diet.	3; 3.6%
Overeating and binge eating episodes (.628)	Every explicit mention that the participant has significantly	14; 16.7%

(Continued)

TABLE 1 Continued

Code name (Krippendorff's alpha)	Code description	Occurring statements (Number of models; %)
	overeaten or had a binge eating episode.	
Self-induced vomiting, purging (.731)	Every explicit mention that the participant has purged themselves by self-induced vomiting after eating.	12; 14.3%
Extreme sports habits (.532)	Every explicit mention that the participant has got extreme sporting habits.	20; 23.8%
Obsessive and/or compulsive sporting habits (.456)	Every explicit mention that the participant has got obsessive and/or compulsive sports habits.	10; 11.9%
Consumption of laxatives (.896)	Every explicit mention that the participant consumes laxatives without a specific medical reason.	6; 7.1%
Fear of gaining weight (.343)	Every explicit mention that the participant has got heightened fear from gaining weight.	18; 21.4%
Lack of or irregular menstruation cycle (.749)	Every explicit mention that the participant experiences lack of or irregular menstruation cycle.	16; 19.0%
Body image disorder (.375)	Explicit signs of body image disorder.	53; 63.1%
Eating disorder (.567)	Explicit signs of eating disorder.	31; 36.9%
Psychological disorders (.42)	Every explicit sign of psychological disorders.	41; 48.8%
Therapy (.698)	Every explicit mention that the participant underwent or is currently treated in psychotherapy.	14; 16.7%

Positive or negative valence was added to a code if the participant's attitude toward the subject is clearly stated. Neutral code was added if the attitude is not clearly mentioned. The valence is added to each individual occurrence.

analyzed, and non-parametric Mann-Whitney U tests were performed using the relative frequencies for each code for a more in-depth analysis. Due to the extensive number of possible relations between each codes, only the significant relations will be demonstrated.

3.1 Body related statements

The mostly referenced code in the current study was statements about the subjects' body. Negative claims appeared in 89.3% of the models ('I felt fat and hated it') while 64.3% mentioned positive remarks about their bodies ('I think that my body is perfect'). Models who talk positively about their bodies also mention significantly more frequently extreme calorie restriction ($U(N_{\text{posbody}}=14, N_{\text{negbody}}=70) = 661, z = 2.310, p = .021$) and

monotrophic eating ($U(N_{\text{posbody}}=14, N_{\text{negbody}}=70) = 613, z = 1.879, p = .041$). These individuals talked significantly more about body image disorder-like symptoms ($U(N_{\text{posbody}}=14, N_{\text{negbody}}=70) = 715, z = 2.771, p = .006$) and psychological disturbances ($U(N_{\text{posbody}}=14, N_{\text{negbody}}=70) = 673, z = 2.360, p = .018$). Participants who talked positively about their bodies made significantly more negative statements about their weight ($U(N_{\text{posbody}}=14, N_{\text{negbody}}=70) = 682.5, z = 2.425, p = .015$). Neutral statements were made by 95.2% of the models, such as ‘Hmmm, my measurements. I’m 184 cm tall and 48-49 kg’. Those participants mentioned significantly more positive statements about their bodies who did not talk about body image disorder-like symptoms ($U(N_{\text{nobodyimagedisorder}}=31, N_{\text{bodyimagedisorder}}=53) = 611.5, z = -1.992, p = .001$).

More than half of the participants, 54.8% had negative opinion about their weight (‘I was desperate to lose weight’), while only 20.2% of the models said positive affirmations in the same regard (‘I’m feeling so comfortable, with my body, with my weight’). Neutral statements of their weight (‘I’m 54 kg.’) were made by 78.6% of the models – most likely due to the nature of the questions. Negative weight related statements were significantly more frequent among models who show body image disorder-like symptoms ($U(N_{\text{nobodyimagedisorder}}=31, N_{\text{bodyimagedisorder}}=53) = 1151, z = 3.206, p = .001$).

3.2 Eating related statements

Nearly half of the participants (45.2%) said something negative about eating habits or their attitudes towards eating, e.g., ‘I couldn’t enjoy food anymore in a normal way’. Positive opinion about eating (‘I love food and I love cooking.’) were given in 23.8% of the transcripts. The models who talked negatively about eating mentioned significantly more body image disorder-like symptoms ($U(N_{\text{nobodyimagedisorder}}=31, N_{\text{bodyimagedisorder}}=53) = 1071, z = 2.530, p = .011$). Those who talked more negatively about eating, talked significantly more often about overeating ($U(N_{\text{noovereating}}=70, N_{\text{overeating}}=14) = 710, z = 2.888, p = .004$). More than two thirds, 78.6% of the participants, have mentioned that they control their food intake, e.g., ‘[...] skipping lunch at school, skipping breakfast, or eat a few slices of apple or crackers’. Monotrophic eating (‘I started to lose weight by eating 3 apples a day’) occurred in 27.4% of the answers, and 40.5% claimed to have used extreme calorie restriction (‘I completely started starving myself. I was like on one apple a day pretty much.’) through their modeling career. Juice fasting was occurrent amongst 3.6% of the participants. According to the answers, 22.6% of participants have lost control over their food intake. These individuals portrayed significantly more frequent binge eating ($U(N_{\text{lossofcontrol}}=19, N_{\text{noslossofcontrol}}=65) = 1033, z = 6.844, p < .000$), self-induced vomiting ($U = 874, z = 4.507, p < .000$), extreme caloric restriction ($U(N_{\text{lossofcontrol}}=19, N_{\text{noslossofcontrol}}=65) = 888, z = 3.256, p = .001$), and obsessive sports habits ($U(N_{\text{lossofcontrol}}=19, N_{\text{noslossofcontrol}}=65) = 770.5, z = 2.908, p = .004$). They made significantly less positive remarks about their bodies ($U(N_{\text{lossofcontrol}}=19, N_{\text{noslossofcontrol}}=65) = 435.5, z = -1.992, p = .046$), more negative remarks about eating ($U(N_{\text{lossofcontrol}}=19,$

$N_{\text{noslossofcontrol}}=65) = 983, z = 4.274, p < .000$), more frequent controlling of food intake ($U(N_{\text{lossofcontrol}}=19, N_{\text{noslossofcontrol}}=65) = 865.5, z = 2.665, p = .008$) and monotrophic eating ($U(N_{\text{lossofcontrol}}=19, N_{\text{noslossofcontrol}}=65) = 857, z = 3.260, p = .001$). Moreover, ED related statements are also significantly more frequent amongst these models ($U(N_{\text{lossofcontrol}}=19, N_{\text{noslossofcontrol}}=65) = 1018, z = 4.948, p < .000$) and they engaged more frequently in psychotherapy ($U(N_{\text{lossofcontrol}}=19, N_{\text{noslossofcontrol}}=65) = 856, z = 3.928, p < .000$). Binge eating was prominent amongst 16.7% of the models. Models who stated binge eating talked significantly more frequently about extreme caloric restriction ($U(N_{\text{noovereating}}=70, N_{\text{overeating}}=14) = 674.5, z = 2.493, p = .013$), self-induced vomiting ($U(N_{\text{noovereating}}=70, N_{\text{overeating}}=14) = 739, z = 4.911, p < .000$), obsessive exercising ($U(N_{\text{noovereating}}=70, N_{\text{overeating}}=14) = 626.5, z = 2.913, p = .004$), weight gain ($U(N_{\text{noovereating}}=70, N_{\text{overeating}}=14) = 692, z = 3.378, p = .001$) and ED symptoms ($U(N_{\text{noovereating}}=70, N_{\text{overeating}}=14) = 751, z = 3.620, p < .000$).

3.3 Sports habits related statements

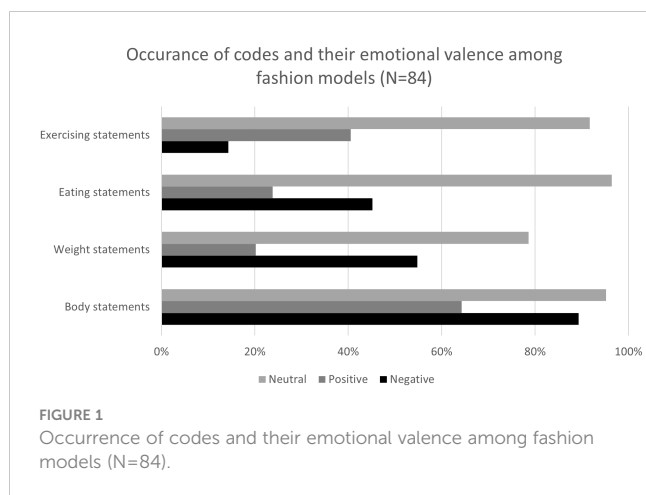
Statements about exercising were predominantly positive (‘I love doing Pilates’) or neutral (‘I work out 6 times a week’) (40.5% and 91.7%, respectively), and negative in only 14.3% of the cases (‘I didn’t feel motivated to workout’). Extreme sports habits (‘I worked out every day for 2 hours’) were portrayed by 23.8% of the participants. Obsessive sports habits (‘I wouldn’t leave until I would burn a specific number of calories’) were claimed by 11.9% of the participants. The occurrence of codes and their emotional valence is presented in Figure 1.

3.4 Purging related statements

Self-induced vomiting was prominent in 14.3% of the transcripts and it appeared significantly more frequently among models who experienced body image disorder-like symptoms ($U(N_{\text{nobodyimagedisorder}}=31, N_{\text{bodyimagedisorder}}=53) = 1007.5, z = 2.833, p = .005$). Laxative abuse was reported by 7.1% of the models and was mentioned significantly more by those individuals who talked about body image disorder-like symptoms ($U(N_{\text{nobodyimagedisorder}}=31, N_{\text{bodyimagedisorder}}=53) = 914.5, z = 1.931, p = .050$). None of the respondents who made positive statements about their bodies mentioned the usage of laxative substances.

3.5 Statements about external feedback on body

Our analysis shows that 83.3% of the participants were criticized by other industry members (‘My agent told me that I’m ugly’), while 44.0% received body appreciating affirmations (‘The sicker I was the more approval I was getting’). Models who talked more frequently about external criticism mentioned more body image disordered-like



symptoms ($U(N_{\text{noappr}}=47, N_{\text{appr}}=37) = 1033, z = 2.099, p = .036$). However, those individuals also talk more about self-induced vomiting ($U(N_{\text{noappr}}=47, N_{\text{appr}}=37) = 1059.5, z = 2.813, p = .05$), laxative use ($U(N_{\text{noappr}}=47, N_{\text{appr}}=37) = 966, z = 1.947, p = .049$), and engagement in psychotherapy ($U(N_{\text{noappr}}=47, N_{\text{appr}}=37) = 1025.5, z = 2.165, p = .030$).

3.6 Psychological disturbances related statements

Body image disorder-like symptoms ('Even when I lost the weight to 45 kgs [I'm 5'11"] I still thought that I was fat') were expressed by 63.1% of the participants. Significantly more negative remarks about one's body were observed among participants who reported body image disorder-like symptoms ($U(N_{\text{bodyimagedisorder}}=31, N_{\text{no bodyimagedisorder}}=53) = 1165.5, z = 3.186, p = .001$). Models who reported body image disorder-like symptoms talked significantly more often about extreme caloric restriction ($U(N_{\text{bodyimagedisorder}}=31, N_{\text{no bodyimagedisorder}}=53) = 1091, z = 2.812, p = .005$), monotrophic eating ($U(N_{\text{bodyimagedisorder}}=31, N_{\text{no bodyimagedisorder}}=53) = 1083, z = 3.086, p = .002$), and losing control ($U(N_{\text{bodyimagedisorder}}=31, N_{\text{no bodyimagedisorder}}=53) = 978, z = 1.980, p = .048$). Previous, or active EDs were mentioned by 36.9% of the models. Those models who mentioned body image disorder-like symptoms mentioned significantly more often content about EDs as well ($U(N_{\text{bodyimagedisorder}}=31, N_{\text{no bodyimagedisorder}}=53) = 1117, z = 3.165, p = .002$). Psychological problems of different sorts (e.g., anxiety, depression, panic attacks, suicidal attempts) were mentioned by 48.8% of the models, while 16.7% confessed to taking part in psychotherapy. Those who engage in psychotherapy make significantly more remarks about losing control in eating ($U(N_{\text{nother}}=70, N_{\text{ther}}=14) = 723, z = 3.817, p < .001$), and talk significantly more about overeating ($U(N_{\text{nother}}=70, N_{\text{ther}}=14) = 734, z = 4.512, p < .001$) and self-induced vomiting ($U(N_{\text{nother}}=70, N_{\text{ther}}=14) = 779, z = 5.710, p < .001$). Furthermore, those who mentioned taking part in therapy talk significantly more

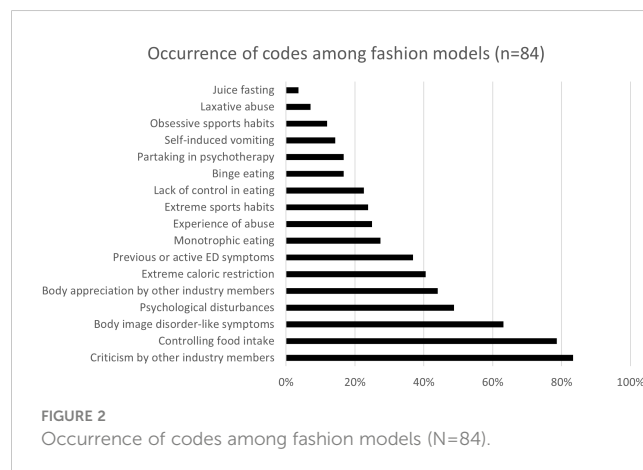
about weight gain ($U(N_{\text{nother}}=70, N_{\text{ther}}=14) = 694, z = 3.412, p < .001$) and mention significantly more ED content ($U(N_{\text{nother}}=70, N_{\text{ther}}=14) = 699, z = 2.899, p = .004$) in their narratives. Those who do not engage in psychotherapy make significantly more negative remarks about their bodies ($U(N_{\text{nother}}=70, N_{\text{ther}}=14) = 229, z = -3.135, p = .002$). One quarter of the models (25%) mentioned statements referring to abuse (every content which refers to being subjected to physical or psychological violence). The occurrence of codes is presented in Figure 2.

4 Discussion

This study was designed with the intention to better understand the lived experience of fashion models with special regards to their eating and exercising habits, self-perception, potentially prevailing psychological disturbances, abuse, and other strongly related factors. The present study greatly adds to the scarce quantitative data about fashion models.

Fashion models encounter elevated levels of appearance and sociocultural pressure linked to symptoms of disordered eating. This pressure emanates from the prevailing extremely thin aesthetic in the fashion industry and is exerted by fellow members of the field (13, 26). The pressure to maintain an extremely slender physique, driven by professional standards and industry expectations, coupled with unrealistic ideals perpetuated by women seeking success as fashion models, is proposed to contribute to a more negative body image within this group (17). Up to this day, fashion runways are still overpowered by extremely slender models (27, 28). Among the fashion superpowers, France has been particularly affected by the cult of thinness: 'Paris thin' has become a concept among models and agents and refers to the excessive thinness required by the shows of the *haute couture* fashion houses (29).

The excessive emphasis on appearance and body weight, intense competition, and the prevalent use of clinically underweight models in the fashion industry may exacerbate appearance concerns among fashion models (7, 20, 30). The need to do well, to conform to industry standards, to be financially independent and to succeed at a young age can even be anxiety-forming (18).



4.1 Discussion of results of eating and body concerns

4.1.1 BMI values

The average BMI of fashion models was 16.9 (SD= 1.60, range 14.0 – 23.7) which is classified as moderately underweight (11). Even though previous findings also confirm models being underweight, this is a considerably lower result. Previous data shows self-reported BMI values of 17.7 (26), 17.4 (13) and 17.0 (31). However, it was suggested that professional models' perceived BMI is significantly lower than the experimenter-measured BMI (i.e., 17.0 vs. 18.6) (31). According to fashion industry standards, the bodyweight of models is insignificant, as they are judged by the measurements of their height, bust, waist and hips (17). This proposes that fashion models might be uncertain about their actual bodyweight resulting in biased BMI results (31). Models proved better at accurately estimating their body measurements and overall size compared to non-models using a three-dimensional avatar (32). Another explanation for the low BMI value could be that our study group consists of internationally recognised high fashion models, mostly working at fashion shows where size requirements are stricter than in the commercial sector, thus they might feel a stronger influence to obtain an extremely thin physique (2).

4.1.2 Full or partial eating disorder symptoms

We found that 36.9% of the participants portrayed to experience EDs either manifested before their modelling career or during the modelling years, or showed very severe ED-like symptomatology, including both clinical or subclinical AN and BN. The existing data on the prevalence of EDs among fashion models is inconsistent and presents contradictory results (6). Seemingly, professional models are more prone to develop partial syndrome EDs, rather than their full-blown forms. The occurrence of subclinical AN is significantly greater among models, 14.6% ($p < 0.001$) compared to 2.7% of control subjects (14). Similar results were published in 2002, 12.7% of fashion models had partial AN, and an additional 7.9% had partial BN symptoms (26). In 2008, strictly similar results were found: 12.7% of professional models fulfilled partial syndrome criteria of AN, but no significant difference was shown between fashion models and control group in full-blown ED symptoms (7). Further research states that the prevalence of EDs is not higher among professional fashion models (1). The current result is notably higher. The difference could stem from the nature of questionnaire-based and interview-based evaluations. While fashion models showed no significant distinctions from their peers on self-compiled inventories, they were more inclined to acknowledge symptoms within the spectrum of EDs during face-to-face interviews (7). We must acknowledge that models were not examined by medical professionals, and self-reported diagnosis might not be accurate. It has also been suggested that women predisposed to disordered eating symptoms might gravitate towards the fashion industry (7).

4.1.3 Body satisfaction

Statements about one's body becomes very dominant amongst models. Negative body remarks were the most prominent (89.3%) in the study group. These results are in alignment with previous findings of professional models portraying higher drive for thinness and

dysfunctional investment in appearance (30). Interestingly, extended time period in the modelling profession correlated with enhanced body appreciation but concurrently showed stronger drive for thinness, indicating that already underweight models have a strong desire to maintain their low body weight or become thinner (30). It is noteworthy that almost two thirds of the models (64.3%) had positive claims about their physiques in our study, but it was not correlated with the amount of time spent with modelling.

Such negative body image concerns can lead to manifesting symptoms of disordered eating (33) and diminished mental health (34). The current study shed light to some very interesting relations between certain body controlling behavior in the modelling industry, providing evidence to previous assumptions. Negative body perception was in relation with negative claims about eating, more frequent excessive calorie restriction, laxative abuse and body image disorder-like symptoms. Thus, the fashion industry has been criticized that it creates a 'toxic' environment being the foundation of increasing body image disorders and EDs (18, 20). This statement could be accurate, as models' higher self-reported BMI is significantly associated with poorer body appreciation and greater body dissatisfaction (30).

However, contradicting data can also be found in the literature. No significant differences were found between models and non-models regarding body dissatisfaction (7) and body satisfaction (35). It has been proposed that fashion models may possess personality profiles enabling them to cope better with the pressures of maintaining a thin figure. Alternatively, certain aspects of the job, such as the boost to self-esteem derived from conforming to societal or industry ideals, may serve as a defense against negative body image (1). Models may recognize that their adherence to societal standards of appearance, particularly the thin ideal, could serve as a protective factor mitigating negative body image (30).

4.1.4 Weight manipulating behaviors

Due to the intense pressure to maintain the size requirements of the fashion industry, a considerable number of models use weight manipulating behaviours like restricting food intake, exercising excessively, using laxatives and even self-induced vomiting (8, 13).

4.1.4.1 Dieting

The current study's participants showed some type of dietary control in 78.6% of the cases, which aligns with the previous quantitative findings. It has been previously reported that several dieting methods are at practice amongst professional models, including skipping meals (56.5%), dieting (70.5%), fasting (51.7%), or using weight loss pills (23.6%) (13). Extreme calorie restriction was used in 40.5% of the cases. In our study, 27.4% of the models portrayed monotrophic eating, and only 3.6% of the models juice fasted in order to lose weight, which is much lower than published by Rodgers et al. (13). Our finding should be understood on a general level as we did not conduct the study at specific period in the fashion industry (e.g., Fashion Weeks), but 46% of models were found to specifically lose weight for New York Fashion Week Fall'18 (10). Clean eating is also a form of dietary restrictions (36). Social standards impede the identification of orthorexia nervosa, potentially resulting in the escalation of more severe EDs as symptoms advance (37).

4.1.4.2 Self-induced vomiting, laxative abuse

Besides restricting one's calorie intake, self-induced vomiting is also applied for weight controlling purposes. Twelve participants (14.3%) used such method. Former studies show both lower (8.2%, 13; 7.5%, 8) and higher (25%, 10) frequencies for temporary self-induced vomiting. Models are more likely to experience higher levels of professional pressure during specific periods, e.g., New York Fashion Week, thus the higher results. Our examination was not conducted during such period. This further reinforces the assumption to the ED-forming nature of the fashion industry.

However, after better understanding the answers, the transcripts revealed that making oneself sick is due to previous food restriction or intentional starvation. This method usually leads to yoyo dieting and weight fluctuation (38). We believe that this result underscores the validity of our hypothesis that many of the fashion models use weight controlling methods due to external pressure, which leads to rebound effects and yoyo dieting on the long term. Weight gain was experienced in 21.4% of the participants. Severe calorie restriction results in increased urge for binge eating and additionally, in weight gain, called binge priming (39).

"[...] but after a while we still gain weight and so in fact I especially imagine when you have not eaten for a very long time, when you eat, you eat again 10 times more. That's sure yoyo. So that's why diets are very bad but at first it works. [...]" (Excerpt from transcript #87)

Laxative abuse is also a form of purging, occurrent amongst 7.4% of the participants, compared to an almost double rate found by Rodgers et al. (13%; 2017). Losing control over food intake resulted in significantly more frequent binge eating, self-induced vomiting, weight gain and ED related statements.

4.1.4.3 Exercising

Exercising was favoured by models, 40.5% of the participants gave positive statements about sports activities, while only 14.3% of the models had any negative relation to exercising. For weight controlling purposes, it was found that 81.2% of the models engage in physical activities regularly and 69.4% of those models were told to "tone up" in order to book more modelling jobs (13). However, such habits can become extreme (23.8%) or even obsessive (11.9%) due to the intense pressure of the agents and designers.

The restrictive diets, excessive exercising habits, purging, consumption of laxatives, especially at younger age can cause serious health consequences. Digestive problems, hair loss, amenorrhoea, cardiac complications, hormonal imbalances, osteoporosis are all serious implications of an insufficient food intake and mannequins are at risk of such outcomes (14). Federal law was adopted in France, implying that models must obtain a health certificate from a doctor declaring that they are in good health (40), however, eating and exercising behaviours are poorly assessed hindering the intervention for EDs (10).

4.1.5 External remarks about physical appearance

Our study reveals that 83.3% of the models have experienced criticism related to their appearance in the fashion environment. These negative remarks mostly target body measurements, especially hip circumference, but also extends to skin and hair condition, facial

features, teeth and even clothing style. These types of negative remarks, that can potentially be considered bullying, are very dangerous during adolescence (most fashion models are still minors) as personality development hasn't finished yet and such sentences can lead to low self-esteem, distorted self-perception, body-image disorders and potential development of EDs (41), moreover, negative weight-related remarks can be remembered for years, maintaining negative body associations (42). Such negative remarks concerning losing weight and changing body size directed to already underweight models are very frequent among fashion models (13).

Conversely, the occurrence of body appreciation from industry participants is roughly half of the frequency of body criticism, namely 44.0%. If we investigate those positive feedbacks in detail, it becomes clear they mostly appraise models' weight loss. Models confessed that those appreciative words are usually followed by criticism or that they seem dishonest.

"[...] they would praise you if it looked like you lost some weight, and they would quickly remark if by any reason you had 92 cm hips. [...]" (Excerpt from transcript #56)

"[...] Oh, you lost weight, you look really good, but you know, for Fashion Week you need to lose a bit more weight! [...]" (Excerpt from transcript #16)

Models being negatively criticized by other industry members talked significantly more often about eating in an unfavorable manner, however, unpleasant remarks about exercising were less frequent. This finding is in alignment with the intense drive for thinness and pressure to use unhealthy weight controlling behaviors to conform to the extremely thin industry standards. Models might find comforting exercising to achieve their desired body shape and to fulfill their drive for thinness, hence the negative relation.

4.2 Discussion of results of other psychological aspects in fashion models

According to our findings, not only the occurrence of EDs and body image disorders seemed heightened among professional models, but also other psychological disturbances and abuse of different sources are existent in this population. The mental well-being of models is at great risk and should be better protected.

4.2.1 Psychological disturbances

Due to the intense pressure models must face, the uncertain working environment, loneliness, and the continuous rejections brings a mental burden on these young women (43), that potentially manifest in different kinds of psychological disturbances. Almost half of the participants (48.8%) reported psychological difficulties throughout their modelling days. The participants mentioned in their rapport depression, severe anxiety, insecurities, low self-esteem, sudden mood swings, excessive crying, insomnia, obsessive-compulsive tendencies, body dysmorphia, and even suicidal thoughts. It is important to highlight that the participants only submitted self-narrated reports; thus, the diagnosis might not be entirely accurate. Uncertainty and the unpredictable nature of the modelling profession can play a factor in controlling one's physical appearance, food consumption, or exercise

habits (44, 45). Each fashion season is unique, and models can be replaced at any moment (17) and the frequent rejection is described as “soul-destroying” and even traumatic (18). People with different personality types react differently to external pressure, and they develop different coping mechanisms to bear those stressors (46), potentially resulting in maladaptive coping mechanisms such as the manifestation of EDs or the use of illicit drugs (26).

4.2.2 Abuse

One quarter of models (25.0%) mentioned in our study that they have experienced some type of emotional, psychological or physical harassment during their modelling career. Most of the time, these abuses are of emotional or psychological nature, targeting body shaming, belittling and humiliation due to models' body measurements, mainly in front of other actors of the fashion industry. However, in our present study, agreement between the Coders was poor in terms of defining abuse (Krippendorff's $\alpha = .259$). Models were told 63.1% of the cases by agents that they would secure more modelling jobs if they lost weight (13), and are denied receiving financial aid if the measurement requirements are not met (18). Models are prone to be exposed to abuse of sexual nature, such as being photographed while changing backstage (10).

4.2.3 Psychotherapy

A total of 16.7% of the participants reported to have engaged in some form of psychotherapy. This is considerably higher compared to the 3.5–9.9% range observed by the 2019 EHIS survey (47) and higher than the percentage observed by the National Center for Health Statistics with 9.5% of adults reporting to have received counselling or therapy (48). This is understandable if we consider the traits of professional modelling, on an international level. On the one hand, for a successful psychotherapy, frequent therapy sessions are needed, and even if those sessions are conducted online, the unpredictability of a model's schedule and the different time zones make it difficult to adhere to a well-structured therapy program. On the other hand, it is questionable how supportive the fashion industry is towards mentally healthy models. Assertive personalities are potentially less likely to conform to such abusive and belittling environment. Having healthy bodily standards is also disadvantageous in the fashion world, as models might not meet the extreme size requirements once they adopt healthy lifestyle choices – both mentally and physically (17). The models engaging in psychotherapy mentioned more ED related content, more overeating, more self-induced vomiting and less positive remarks about eating, suggesting that fashion models mostly seek out professional help to treat ED symptoms. However, they made fewer negative remarks about their bodies, more about weight gain and less body image disorder symptoms which envisions that they were able to overcome bodily concerns and be more acceptive of themselves.

4.3 Extrinsic or intrinsic pressure?

It has been a debated question whether young women with already existing EDs or ED like tendencies chose to pursue modelling as it is an acceptable lifestyle to validate their illness or

if models start to manifest disordered eating habits and body image problems due to the external stressors (7). Considering all the above mentioned, the latter seems more accurate. It appears probable that fashion models manifest increased ED and body image concerns due to intense environmental pressure deriving from the fashion industry. This assumption might be further justified if we consider that agents prefer to choose young women with very slim, almost anorexic-like body frames to sign modelling contracts (49). It is questionable whether those girls possess unique natural body constitutions within genetic variability (35) or must take tedious efforts to maintain such measurements (13). Fashion models with higher BMI values show more ED symptoms (31) implying that aspiring models with normal body constructs engage in extreme weight loss methods to meet industry standards. Our overall interpretation of the data is that fashion models experience immense environmental pressure to conform to the extremely slim beauty ideal.

To our best knowledge, the current study involved a larger number of multicultural female fashion models than any previous qualitative research on the field. Furthermore, this is the first ever study to use thematic content analysis for the assessment of ED-like symptoms and body image disturbances in this population, thus we believe it makes a significant contribution to the existing literature.

Certain limitations must be considered regarding this study. Firstly, most of the respondents were not native English speaker which could cause discrepancy due to misunderstandings or in the ability to express complex ideas. However, the level of linguistic complexity in the testimonials contradict this assumption. Secondly, some of the participants were recruited during the COVID-19 pandemic, when less modelling jobs were available which could also alter their responses. Furthermore, the self-reported anthropometric data may differ from the factual values, so the calculation of BMI may be distorted (50). Thirdly, answers to sensitive questions may have been biased as we assume that those models participated in our study who are more active in creating change in the fashion industry and who disagree with current dynamics. At the same time, it is also possible that models decided to hide certain details in the hope of protecting their career, even though complete anonymity was ensured. Furthermore, underestimation of the symptoms might be possible not only due to career-protection, but also due to the nature of the questions, as they were not explicitly asked from the participants. Models were not examined by health care professionals, and self-reported diagnosis might not be accurate. The first author's personal experience as a former fashion model may introduce an inherent bias to this research, potentially influencing the framing of questions, interpretation of responses, and overall analysis, despite efforts to maintain objectivity throughout the study. Lastly, we have to mention that hand-coding a big number of lengthy testimonials is an exceptionally strenuous task, challenging the most experienced coders as well. The enduring efforts might have caused discrepancies.

5 Conclusion

The fashion industry plays a vital role in shaping cultural ideals. Based on the personal testimonies of fashion models, it can be

concluded that there is a significant risk for developing EDs within this specific population, either in clinically severe forms or more often, manifested as subclinical symptoms. These phenomena can be occurrent due to the intense environmental pressure towards maintaining a slim physique. The physical and mental health of models must be taken into consideration when defining beauty standards of the fashion industry. There is a need to revise unrealistic measurement requirements, and agencies should refrain from pressuring models into engaging in such health-damaging behaviours to conform industry standards.

Further studies are required to investigate the risk factors and the actual frequency of EDs and body image disorders among professional fashion models. The symptoms assessed should go beyond AN and BN. The consequences of the environmental pressure can highly influence the mental health status of the fashion models. Emotional or sexual abuse, exploitation and humiliation are also parts of the fashion industry. The results hold significant relevance in shaping health regulations within the fashion industry to curb the prevalence of EDs among models and individuals exposed to model imagery. It is imperative for the fashion industry to implement alterations that prioritize the physical and mental well-being of fashion models and to reconceive existing regulation relying on BMI values as broader mental and physical aspects should be evaluated for effective preventive measures against eating and body image disorders amongst fashion models. This entails discontinuing the promotion of health-detrimental practices enforced by agents or designers and establishing a system of regular medical consultations.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Regional Research Ethical Board of the Semmelweis University Budapest (No. 3/2020). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

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Author contributions

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2024.1360962/full#supplementary-material>

SUPPLEMENTARY MATERIAL 1

Series of open questions used for the present study.

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Reading tea leaves or tracking true constructs? An assessment of personality-based latent profiles in eating disorders

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Background: Eating disorder (ED) subtyping studies have often extracted an undercontrolled, an overcontrolled and a resilient profile based on trait impulsivity and perfectionism. However, the extent to which methodological choices impact the coherence and distinctness of resulting subtypes remains unclear.

Objective: In this paper, we aimed to assess the robustness of these findings by extracting personality-based subtypes on a sample of ED patients ($N = 221$) under different analytic conditions.

Methods: We ran four latent profile analyses (LPA), varying the extent to which we constrained variances and covariances during model parametrization. We then performed a comparative analysis also including state ED symptom measures as indicators. Finally, we used cross-method validation via k-means clustering to further assess the robustness of our profiles.

Results: Our results demonstrated a four-profile model based on variances in impulsivity and perfectionism to fit the data well. Across model solutions, the profiles with the most and least state and trait disturbances were replicated most stably, while more nuanced variations in trait variables resulted in less consistent profiles. Inclusion of ED symptoms as indicator variables increased subtype differentiation and similarity across profiles. Validation cluster analyses aligned most with more restrictive LPA models.

Conclusion: These results suggest that ED subtypes track true constructs, since subtypes emerged method-independently. We found analytic methods to constrain the theoretical and practical conclusions that can be drawn. This underscores the importance of objective-driven analytic design and highlights its relevance in applying research findings in clinical practice.

KEYWORDS

personality profiles, eating disorder subtypes, latent profile analysis, cluster analysis, perfectionism, impulsivity

1 Introduction

Personality traits play a significant role in eating disorders (EDs), interacting with state symptomatology and impacting treatment prognosis (1, 2). This interplay has been investigated by creating personality-based typologies. Subtyping emphasizes the importance of dimensional traits in meaningfully interpreting clinical phenotypes: they can make explanations more substantial and help tailor treatment. Among various personality traits, impulsivity and perfectionism have arguably received the most attention among ED samples (3). We take impulsivity to reflect a trait-level disposition toward rapid reactions to varied stimuli, which can lead to both unwanted (inadequate deliberation, insufficient perseverance) and wanted (quick and adaptive responding) outcomes (4–6). We interpret perfectionism as a tendency to base one's self-worth on achievements which are, in turn, defined by high personal standards and the desire to avoid mistakes (7, 8).

Based on these traits, researchers have identified three main personality subtypes that reflect varied levels of self-regulation among people with EDs: the overcontrolled, the undercontrolled and the resilient profile (3). The overcontrolled profile features high perfectionism, rigidity and inhibition; the undercontrolled profile impulsivity, disinhibition and emotional reactivity, while the resilient profile exhibits limited personality disturbances [e.g. (9)].

However, previous reviews of personality subtypes in EDs have shown heterogeneity due to various factors (3). These include differences in sample composition (e.g. only anorexia nervosa (AN), bulimia nervosa (BN) or binge eating disorder (BED), or transdiagnostic samples), sample sizes, research settings and statistical methods (3). This variability makes generalizing findings to different populations challenging. Two additional reasons for non-convergence emerge. Firstly, the threshold for extracting and identifying discrete personality profiles differs across studies. This leads to fuzzy subtype borders and difficulties in comparing results (10). Secondly, since impulsivity and perfectionism are multidimensional traits, the meanings of “undercontrol” and “overcontrol” become context-dependent (10). This can result in the 3-profile model being overfitted to demonstrate alignment with previous results (10).

Examination of methodological choices can showcase reasons behind the discrepancies. Subtyping studies often utilize person-centered methods, most commonly latent profile analysis [LPA (11, 12)]. LPA is a probabilistic mixture modelling method used to construct latent patterns based on observed variance in continuous indicator variables (13–15). LPA is a theory-informed model-based method that assumes that any covariation among indicator variables should be accounted for by the extracted latent variables (conditional independence; 16). Researchers determine the number of profiles to be extracted and model fit is estimated using different indices (17). Person-centered research has also used cluster analysis (CA): a set of classification procedures aiming to construct subgroups based on observed variances in clustering variables (18). In comparison to LPA, CA is not reliant on a pre-specified measurement model and

aims to optimize clusters to align with the inputted data structure (18).

Personality-based LPAs on ED samples have yielded varied results, detecting 3–6 profiles (9, 19–25). Differences have arisen upon extracting smaller additional classes with either combined impulsivity and perfectionism [e.g. (23)] or facets of undercontrol/overcontrol (24, 25).

This divergence raises the question of whether the well-documented triadic model tracks the existence of three true dimensional constructs or stems partly from methodological artefacts. Three points of potential methodological bias are highlighted.

Firstly, LPA parametrization choices impact pattern detection (26–28). LPA axiomatically presumes conditional independence and in many software programs, variable variances are fixed to be equal across profiles and covariances are set to 0 (15, 27, 29). While this approach results in parsimonious models and shorter computation time, it might not reflect psychiatric constructs that are often correlated, leading to misleading descriptions (26, 30). Simulation studies have demonstrated model misspecification to result in overextraction of classes (27). Additionally, the suitability and accuracy of fit indices depends on mathematical model specifications (27). Given that these methodological decisions are often undisclosed, their impact on results remains unclear (30–32).

Secondly, discordant findings can stem from the use of different indicator or clustering variables for subtype construction. Previous studies have employed various personality inventories, some tapping specific traits, some aiming to describe personality or temperament more broadly (19–23). Recently, the level of indicator data has also been shown to be significant – composite scores might fail to encapsulate underlying measurement models, further contributing to biased estimates (33). While an increased number of indicators can enhance model convergence, inclusion of individual items might result in uninterpretable solutions in smaller samples (34, 35).

Thirdly, there is ongoing debate about whether ED symptom measures should be included as indicator variables [e.g. (25)] or as external validators of the derived subtypes (9, 19–21, 23). This choice hinges on both the theoretical model underlying the postulated state-trait interactions, and data analytic choices. If personality and ED symptoms are viewed as mutually influencing each other, then separation into distinct state- and trait-models might be unmerited – two-way causation complicates the distinction of causal antecedents and consequences (36). However, there is also support in favor of competing models that do not presuppose a bidirectional interaction (37). Similarly, there are methodological advantages and disadvantages to including ED symptoms as indicators. Inclusion of more theoretically relevant indicators can lead to stronger and more interpretable associations between the latent variable and distal outcomes (34, 38). However, incorporation of symptoms derived from categorical classification systems can hinder progress towards a bottom-up dimensional theoretical space.

A review of previous literature reveals no clear consensus on recommended methodology. This raises the question: to what

extent do these analytical nuances really matter? This study aims to address these gaps by examining the similarities and differences between personality-based subtypes that have been extracted under different methodological conditions. We derived 8 models based on 2 sets of indicators (symptoms excluded and included) and 4 model parametrization options. As such, our objective is to refine and validate an existing theory, as opposed to proposing more competing solutions or an entirely new measurement model, e.g. a network-based conceptualization (39). Such a latent variable approach holds potential to, upon repeated and longitudinal validation, move from descriptions to explanations. To assess our solutions' robustness and provide cross-method replicability, we used CA post-extraction (40). Previous studies have primarily used constrained LPAs and not included ED symptoms as indicator variables. To ease interpretation, we took this model to serve as a baseline that we compared other models against (12). However, we do not suggest this model to be conceptually superior.

Based on previous research, we hypothesized that the derived models would reflect the self-regulation model with undercontrolled, overcontrolled and resilient personality subtypes. Additionally, we expected inclusion of ED symptoms as indicator variables to further differentiate subtypes. Literature on the impact of methodology is scarce, however, we did also anticipate that models would be comparable and profiles overlapping across analytic conditions. Furthermore, we predicted that the more constrained and parsimonious LPA models would align more with CA validation results, and that less-constrained models would exhibit more non-convergence [for previous non-ED overlap studies (41, 42)].

2 Method

2.1 Participants

The sample comprised 249 women with a primary diagnosis of an ED, with a mean age of 21.91 ($SD = 6.78$). In total, 48.2% of the participants had been diagnosed with AN, 43.8% with BN and 6.8% with BED; participants had $M = 2.54$ comorbid diagnoses ($Mdn = 2$). On average, they reported their ED as having lasted for 4.4 years ($Mdn = 3$ years; minimum 2 months, maximum 30 years); illness duration was highly correlated with age ($r = .72$). Exclusion criteria included intellectual disability, acute psychotic episodes, and involuntary hospitalization.

Participants were recruited and completed assessment in an inpatient setting at the Psychiatric Clinic of the Tartu University Hospital. Data were collected by trained clinical psychologists. Participants' written informed consent was obtained after the nature of the procedures had been fully explained. Study design was reviewed and approved by the Research Ethics Committee of the University of Tartu (243/T-20, 196/T-17). Data used in this research is available upon request and can be accessed in line with participants' informed consent.

2.2 Measures

2.2.1 Psychiatric diagnoses

Psychiatric diagnoses were established using the Mini-International Neuropsychiatric Interview [M.I.N.I. 5.0.0 (43)]. Clinical interviews were conducted by trained licensed clinical psychologists and diagnoses were confirmed by treating psychiatrists.

2.2.2 Perfectionism

Perfectionism was assessed with Frost's Multidimensional Perfectionism Scale [FMPS (44)]. FMPS is a self-report questionnaire with items rated on a 5-point scale, the Estonian version has 28 items (45). The adapted questionnaire's factor structure resembles the original FMPS, items make up four subscales: concern over mistakes and doubts about actions (concern over mistakes), excessive concern with parents' expectations and evaluation (parental standards), excessively high personal standards (personal standards) and concern with precision, order and organization [organization (45)]. The first two scales reflect negative perfectionism, the latter two positive facets of perfectionism. The internal consistency of the subscales varied between $\alpha = .82-.95$. ($\omega = .83-.95$; fit in a principal factor analysis (PFA)). Subscale scores were used as indicator variables.

2.2.3 Impulsivity

Trait impulsivity was assessed with Dickman's Impulsivity Inventory [DII (6)]. DII is a self-report questionnaire with items rated on a 5-point scale, the Estonian version has 24 items, making up two subscales: functional and dysfunctional impulsivity (46). The internal consistency of both subscales was $\alpha = .85$ (PFA $\omega = .85-.86$). Subscale scores were used as indicator variables.

2.2.4 Eating disorder symptoms

ED symptoms were assessed with the Eating Disorder Assessment Scale [EDAS (47)]. EDAS is a self-report questionnaire with 29 items rated on a 6-point scale, making up four subscales: restrained eating, binge eating, purging, and preoccupation with weight and body image. The internal consistency of the subscales varied between $\alpha = .91-.96$. (PFA $\omega = .92-.96$). Subscale scores were used as indicator variables.

2.3 Data analysis

Data were first assessed for missingness. All individuals ($n = 28$) whose data were missing across all subscales of at least one indicator measure were excluded from the sample. Given the limited data available for these participants and the relatively small sample size, imputation might not accurately represent the population of interest (48, 49). Two individuals' data were missing at random on one indicator subscale. Due to violating the multivariate normality assumption, MissForest non-parametric imputation was used to impute these data (50). Analyses were run with 1000

random trees and the out-of-bag imputation error was found satisfactory at $\text{NRMSE} = 0.29$. Imputed values were rounded up to the first whole number.

To evaluate our hypotheses, 1–8-profile LPA models were assessed under four conditions based on the constriction of variances and covariances:

- (1) Model 1: equal variances and covariances fixed to 0;
- (2) Model 2: varying variances and covariances fixed to 0;
- (3) Model 3: equal variances and equal covariances;
- (4) Model 4: varying variances and varying covariances (26–28).

Allowing for varying variances and covariances curtails the conditional independence criterion and enables assessment of parametrization's impact on model choice (29).

All analyses were first run on personality indicators; a second set of analyses was performed with ED symptom measures included.

To avoid converging on local maxima, we increased random starting value sets to 1000 and 250; the maximum number of initial stage iterations was fixed at 20. Model fit was assessed using several fit indices. We primarily relied on the Bayesian Information Criterion (BIC) and the sample-adjusted Bayesian Information Criterion (SABIC), as previous research has demonstrated their superior performance (51–54). While Akaike's Information Criterion (AIC) can have lower pattern detection accuracy, it remains useful in small samples where meaningful subgroups include few people (53, 54). Entropy estimates, which quantify the accuracy of classification, were used as rule-of-thumb heuristics (53). Values surpassing .80 indicate good fit (53). Additionally, the fit of k versus $k-1$ profile models was assessed using the bootstrapped likelihood ratio test (BLRT, 20 bootstrap draws) which has shown to be a more reliable test in comparison to other bootstrap methods (53). Finally, models were assessed for parsimony and theoretical interpretability (17, 35).

After conducting LPAs, the best fitting models were validated via k -means clustering. K -means clustering is a type of iterative partitioning clustering that attempts to derive cohesive and non-overlapping clusters by assigning datapoints to the closest cluster centroid based on Euclidean distance, thus minimizing within-cluster variance (55, 56). The number of clusters was predetermined by the LPA results. Data were scaled and subjected to 25 different random starting assignments to stabilize the cluster solution (56).

Data analyses were performed in R 4.1.1. using the `mclust`, `MplusAutomation` (Mplus version 6.12 was used via R), `NbClust`, `ggplot2` and `circlize` packages (15, 57–61).

3 Results

The final sample comprised 221 individuals ($M_{\text{age}} = 21.46$, $SD_{\text{age}} = 6.53$; $M_{\text{illness_duration}} = 4.35$, $SD_{\text{illness_duration}} = 4.73$; 49.3% AN, 43.0% BN and 7.7% BED). Descriptive statistics are presented in [Supplementary Table 1](#).

3.1 Profile extraction

The results of the personality-only and the symptoms-included sets of LPAs are presented in [Tables 1](#) and [2](#), respectively. Upon running the LPAs, R produced warning messages without indicating errors, highlighting the necessity of further analysis of results. To avoid confirmation bias, we will refer to the extracted profiles with their numbers, instead of labelling the subtypes (10).

In the personality-only analyses, the absolute values of log likelihood (LL) decrease consistently across parametrization conditions, predicting the 8-profile model to be best-fitting. AIC and SABIC showed similar trends across Models 1, 2 and 3. In Model 4, AIC and SABIC values indicate the 5-profile model to describe the data the best. There is more variance in BIC estimates. Under the constrained Model 1, BIC predicts the 4-profile solution to be best-fitting; under Models 2 and 3, it flags 3–4-profile solutions. Value differences between these solutions remain trivial. BIC points to a 2-profile solution being best-fitting under Model 4. Since the second-best solution only has one profile, this can suggest underprediction.

Entropy values approximate or surpass the .80 benchmark in nearly all solutions, rendering this indicator relatively unhelpful in determining model fit. Similarly, the BLRT estimates yield unsatisfactory power to distinguish between solutions. Regardless, significant BLRT p -values indicate that solutions with a smaller number of profiles, 1–4, are generally preferred.

Across models, BIC, AIC and SABIC values were generally comparable, with Models 2 and 3 performing slightly better based on the BIC, and Models 2 and 4 following AIC and SABIC. Non-convergence emerged for the 7-profile solution (Model 4) due to the model's instability.

Similar trends emerged upon running the analyses with ED measures included. Models 1–3 were comparable, as the BIC indicated 3–5-profile solutions to fit the data the best and the absolute values of LL and AIC decreased with added number of profiles extracted. Model 4 also highlighted the 4-profile model as best-fitting. Similarly to the personality-only analyses, Models 2 and 4 appeared to fit the data slightly better based on the AIC and SABIC, while the BIC indicated Models 2 and 3 to be the best-fitting.

The 4-profile model was chosen for further investigation across all 8 analytic conditions. While evidence for best-fitting model was mixed, several indicators that did distinguish between profile solutions sufficiently flagged the 4-profile solution. Since no compelling evidence arose for the 1–2 and 7–8 profile solutions, we decided against using them as the basis for comparisons of invariance, as parsimony might reduce clinical usefulness and high complexity lead to less interpretability.

3.2 Comparison of profiles

The 4-profile personality-only models are presented in [Figure 1](#). Regardless of analysis parametrization, a profile with low perfectionism, low dysfunctional impulsivity and heightened

TABLE 1 Fit indices for 1–8 profile LPAs for personality-only models under four parametrization conditions.

No	LL	Entropy	BIC	AIC	SABIC	BLRT	BLRT (p)	Smallest profile %
Equal variances and covariances fixed to 0								
1	–4,499.38	—	9,063.53	9,022.75	9,025.50	—	—	—
2	–4,424.21	.76	8,950.99	8,886.42	8,890.78	150.33	<.001	44.3%
3	–4,396.12	.77	8,932.58	8,844.23	8,850.19	56.19	<.001	23.5%
4	–4,366.02	.80	8,910.18	8,798.04	8,805.60	60.19	<.001	14.9%
5	–4,351.81	.78	8,919.54	8,783.61	8,792.78	28.42	<.001	13.1%
6	–4,338.28	.81	8,930.27	8,770.55	8,781.32	27.06	<.001	3.6%
7	–4,322.02	.82	8,935.54	8,752.03	8,764.41	32.52	.01	5.4%
8	–4,309.60	.84	8,948.49	8,741.20	8,755.17	24.84	.07	0.9%
Varying variances and covariances fixed to 0								
1	–4,499.38	—	9,063.53	9,022.75	9,025.50	—	—	—
2	–4,393.57	.91	8,922.10	8,837.15	8,842.87	211.61	<.001	21.7%
3	–4,333.93	.87	8,872.99	8,743.86	8,752.57	119.28	<.001	6.3%
4	–4,299.87	.90	8,875.04	8,701.74	8,713.42	68.13	<.001	6.3%
5	–4,272.98	.83	8,891.43	8,673.95	8,688.62	54.45	<.001	6.3%
6	–4,249.49	.86	8,914.63	8,652.97	8,670.62	53.13	.06	5.8%
7	–4,229.17	.86	8,944.17	8,638.33	8,658.95	46.42	.07	6.3%
8	–4,220.00	.87	8,996.02	8,646.01	8,669.61	36.87	.38	2.3%
Equal variances and equal covariances								
1	–4,384.38	—	8,914.51	8,822.76	8,828.95	—	—	—
2	–4,354.68	.86	8,892.90	8,777.37	8,785.16	59.40	<.001	30.3%
3	–4,333.16	.86	8,887.65	8,748.32	8,757.71	43.05	<.001	10.9%
4	–4,314.93	.85	8,888.97	8,725.85	8,736.85	36.47	<.001	4.5%
5	–4,302.40	.83	8,901.71	8,714.81	8,727.41	25.05	.06	4.1%
6	–4,291.66	.84	8,919.01	8,707.32	8,721.53	21.48	.18	4.1%
7	–4,278.60	.87	8,929.68	8,695.21	8,711.02	26.12	<.001	2.3%
8	–4,266.30	.87	8,942.87	8,684.61	8,702.02	24.60	.09	2.3%
Varying variances and varying covariances								
1	–4,384.38	—	8,914.51	8,822.76	8,828.95	—	—	—
2	–4,298.57	.99	8,894.05	8,707.15	8,719.75	171.62	<.001	9.5%
3	–4,244.22	.88	8,936.49	8,654.44	8,673.46	108.71	<.001	6.3%
4	–4,203.70	.91	9,006.59	8,629.39	8,654.82	78.47	.17	4.1%
5	–4,171.87	.90	9,094.09	8,621.74	8,653.59	52.67	.60	6.3%
6	–4,145.00	.92	9,191.50	8,624.00	8,662.27	32.16	1.00	4.1%
7	NA	NA	NA	NA	NA	NA	NA	NA
8	–4,097.50	.91	9,398.78	8,640.99	8,692.09	117.03	.50	3.2%

4-profile model in bold. One computation resulted in an error (NA). No, number of classes in model; LL, log likelihood; BIC, Bayesian Information Criterion; AIC, Akaike's Information Criterion; SABIC, sample-adjusted Bayesian Information Criterion; LMR, adjusted Lo–Mendell–Rubin likelihood ratio test; BLRT, bootstrap likelihood ratio test.

TABLE 2 Fit indices for 1–8 profile LPAs for symptoms-included models under four parametrization conditions.

No	LL	Entropy	BIC	AIC	SABIC	BLRT	BLRT (p)	Smallest profile %
Equal variances and covariances fixed to 0								
1	–7,771.16	—	15,650.28	15,582.32	15,586.90	—	—	—
2	–7,631.38	.85	15,430.09	15,324.75	15,331.85	279.567	<.001	29.9%
3	–7,566.41	.85	15,359.55	15,216.83	15,226.45	129.923	<.001	25.9%
4	–7,534.64	.84	15,355.38	15,175.28	15,187.43	63.544	<.001	19.9%
5	–7,504.46	.90	15,354.39	15,136.91	15,151.58	60.371	<.001	3.6%
6	–7,477.84	.88	15,360.54	15,105.68	15,122.87	53.229	<.001	3.1%
7	–7,454.87	.89	15,373.98	15,081.73	15,101.44	45.949	<.001	6.3%
8	–7,429.63	.89	15,382.88	15,053.25	15,075.48	50.480	<.001	4.1%
Varying variances and covariances fixed to 0								
1	–7,771.16	—	15,650.28	15,582.32	15,586.90	—	—	—
2	–7,557.86	.94	15,337.04	15,197.72	15,207.11	426.60	<.001	26.2%
3	–7,463.09	.94	15,260.86	15,050.17	15,064.38	189.54	<.001	6.3%
4	–7,394.64	.94	15,237.33	14,955.28	14,974.30	136.89	<.001	6.3%
5	–7,331.11	.91	15,223.62	14,870.22	14,894.04	122.69	<.001	5.8%
6	–7,287.72	.94	15,250.21	14,825.44	14,854.08	91.27	<.001	5.8%
7	–7,261.60	.94	15,311.34	14,815.21	14,848.66	35.33	1.00	7.7%
8	–7,237.45	.92	15,376.39	14,808.90	14,847.16	27.01	1.00	6.3%
Equal variances and equal covariances								
1	–7,489.40	—	15,329.68	15,108.80	15,123.69	—	—	—
2	–7,443.16	.90	15,296.57	15,038.31	15,055.72	92.49	<.001	34.8%
3	–7,404.00	.91	15,277.64	14,982.00	15,001.93	78.31	<.001	16.3%
4	–7,372.44	.92	15,273.90	14,940.88	14,963.33	63.12	<.001	15.8%
5	–7,350.35	.94	15,289.09	14,918.69	14,943.67	44.19	<.001	13.6%
6	–7,336.88	.91	15,321.53	14,913.75	14,941.25	26.94	1.00	3.6%
7	–7,316.33	.93	15,339.82	14,894.66	14,924.68	34.90	.11	3.6%
8	–7,298.41	.92	15,363.36	14,880.82	14,913.35	34.33	.02	3.6%
Varying variances and varying covariances								
1	–7,489.40	—	15,329.68	15,108.80	15,123.69	—	—	—
2	–7,331.56	.95	15,370.28	14,925.12	14,955.13	315.69	<.001	24.9%
3	–7,224.79	.95	15,513.02	14,843.58	14,888.71	213.54	<.001	5.8%
4	–7,143.40	.95	15,706.51	14,812.80	14,873.06	201.65	<.001	19.5%
5	–7,102.45	.97	15,980.90	14,862.90	14,938.28	86.85	.67	9.1%
6	–7,037.11	.98	16,206.49	14,864.22	14,954.72	101.51	1.00	5.0%
7	–7,010.39	.97	16,509.32	14,942.77	15,048.39	182.74	1.00	5.0%
8	–6,944.56	.97	16,733.95	14,943.12	15,063.86	180.22	<.001	<.1%

4-profile model in bold. No, number of classes in model; LL, log likelihood; BIC, Bayesian Information Criterion; AIC, Akaike's Information Criterion; SABIC, sample-adjusted Bayesian Information Criterion; LMR, adjusted Lo–Mendell–Rubin likelihood ratio test; BLRT, bootstrap likelihood ratio test.

4-profile LPA solutions with only personality measures

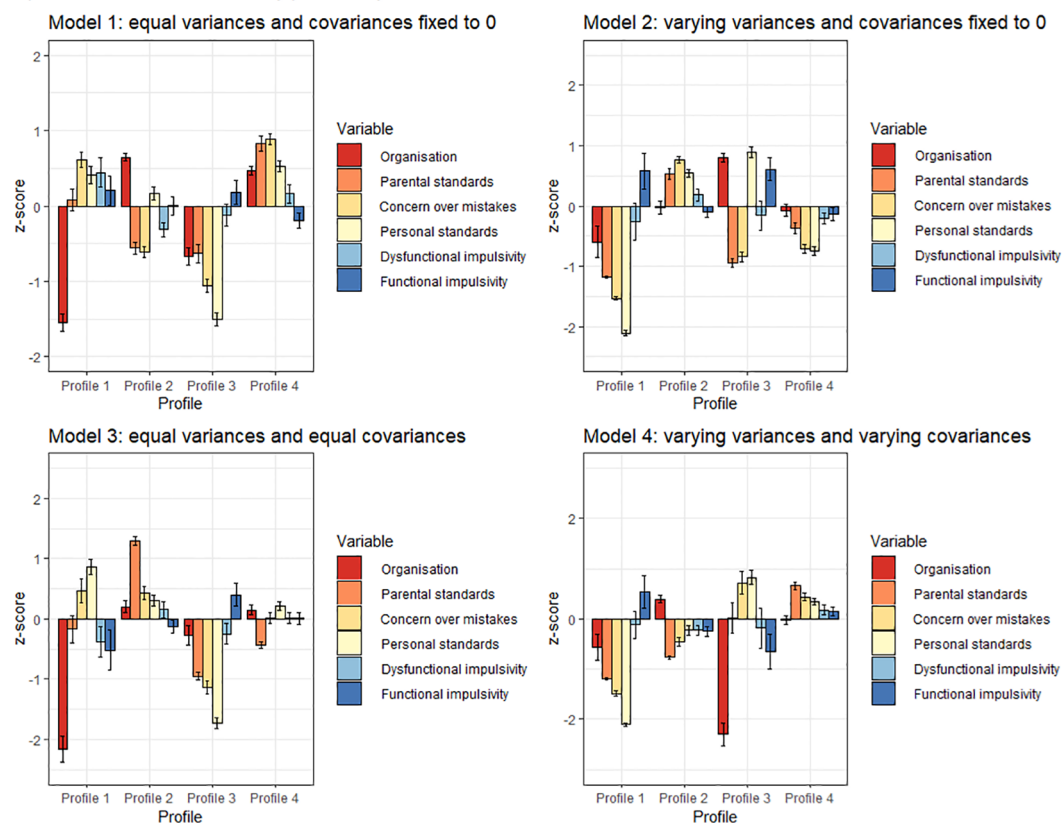


FIGURE 1

Personality-based 4-profile LPA solutions across four analytical conditions. Confidence intervals depict standard errors.

functional impulsivity arose (Model 1, Profile 3; Model 2, Profile 1; Model 3, Profile 3; Model 4, Profile 1). There was more variance across the other profiles. In Models 1, 2 and 4, profiles differentiated by high positive perfectionism were extracted (respectively, Profile 2, Profile 3 and Profile 2), in Model 3, levels of high positive perfectionism covaried with increased negative perfectionism, or remained near-average (Profile 1 and Profile 4). Model 1 produced a profile characterized by elevated dysfunctional impulsivity and low organization (Profile 1), purely impulsive classes were less pronounced under other analytic conditions.

Addition of ED symptoms resulted in distinct trends across models (see Figure 2). Firstly, the profile with low scores on all indicator measures besides functional impulsivity (Model 1, Profile 3; Model 2, Profile 3; Model 3, Profile 1) remained intact. Models 2 (Profiles 2 and 3) and 4 (Profiles 1 and 2) detected two profiles with less pronounced overall psychopathology, as opposed to one. Secondly, a profile with high perfectionism, high impulsivity and elevated scores on ED measures emerged in all models but was most pronounced in Models 1 (Profile 2) and 2 (Profile 4) – in Model 3, perfectionism scores were less elevated (Profile 4) and in Model 4, low organization was more pronounced than high impulsivity (Profile 3). Thirdly, in Models 1–3 (respectively, Profile 1, Profile 1 and Profile 2), a profile with high perfectionism and high restrictive ED pathology was detected. Finally, Model 1 (Profile 4) and Model 3 (Profile 4) pointed towards the emergence of a highly

impulsive and purging profile. A trend towards a similar profile (Profile 3) was apparent in Model 4, however, other ED measures besides purging were also elevated.

3.3 Predictive power of personality-only profiles

We assessed the extent to which personality-only profiles predicted ED scores to further evaluate if adding ED symptoms as indicator variables was merited. Due to violations of normality, Kruskal-Wallis tests were run. For Model 1, the effect sizes for comparisons of means across different profiles were $\eta^2 = .03-.10$ for different ED pathology measures; for Model 2 $\eta^2 = .04-.10$, Model 3 $\eta^2 = .01-.10$ and Model 4 $\eta^2 = .04-.10$. Overall, profile categorization most sufficiently predicted variation in restraint scores (moderate effect of $\eta^2 = .10$) for all models.

3.4 Validation of profiles via K-means clustering

LPA findings were validated via k-means clustering. Results are presented in Figure 3.

4-profile LPA solutions with personality and eating disorder symptom measures

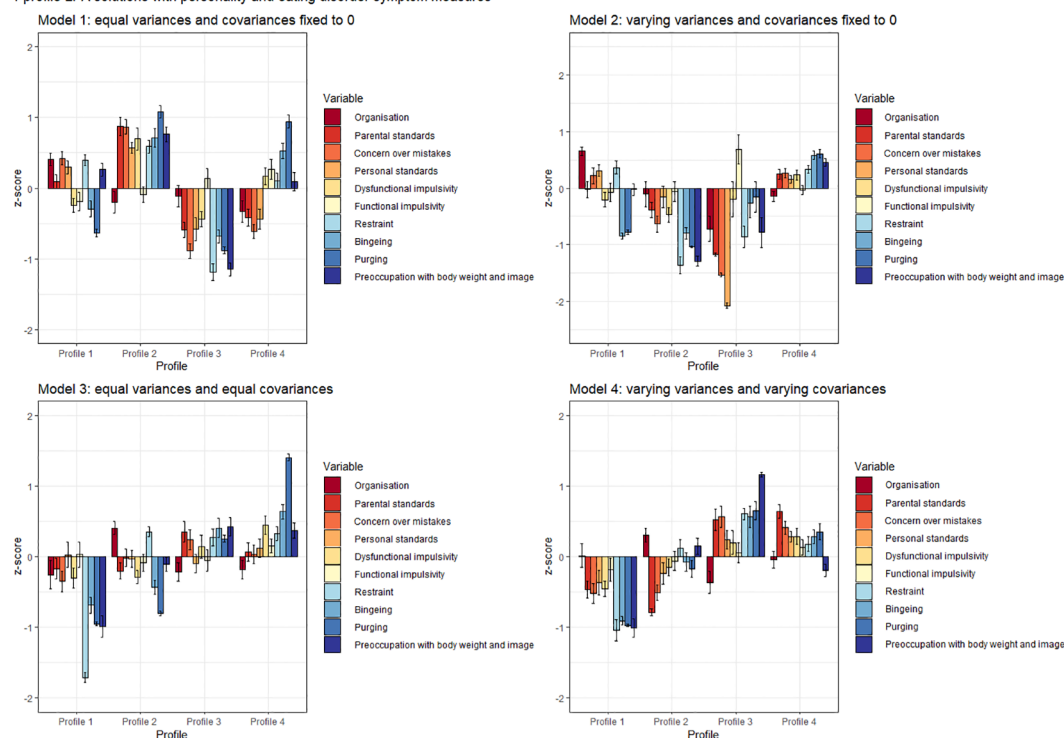


FIGURE 2

Personality and eating disorder symptoms 4-profile LPA solutions across four analytical conditions. Confidence intervals depict standard errors.

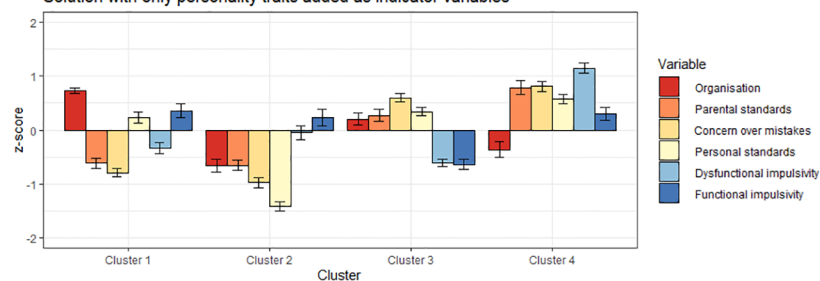
Personality-only clusters generally mirrored subtypes emerging via LPA. A cluster with low trait pathology was detectable (Cluster 2). Cluster 4 was characterized by combined high impulsivity and high perfectionism, while the two remaining clusters were mainly

distinguished by varying levels of positive (Cluster 1) and negative perfectionism (Cluster 3).

When ED symptoms were added, we observed the emergence of a low pathology group (Cluster 2), as well as a subtype of individuals

4-cluster k-means clustering solutions

Solution with only personality traits added as indicator variables



Solution with personality traits and ED symptoms added as indicator variables

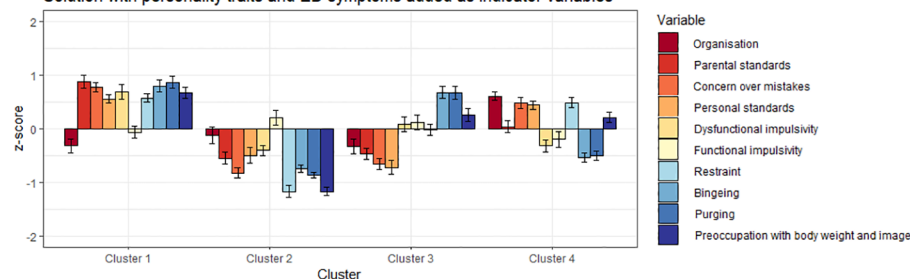


FIGURE 3

Cluster analytic solutions for personality-only and symptoms-added models. Confidence intervals depict standard errors.

with low trait pathology but elevated ED symptoms (Cluster 3). One cluster was characterized by overall high trait and ED pathology (Cluster 1) and one by predominantly overcontrolled-restrictive pathology (Cluster 4). As such, the cluster solutions were similar to the most constrained LPAs under Model 1 parametrization conditions.

3.5 Overlap between extracted profiles and clusters

Since constrained models are more often reported on (26), and our LPA Model 1 was easily interpretable and had larger profile sizes that allowed for more informative comparisons, it was chosen as basis for calculations of subtype overlap.

Classification overlap and the size of all subtypes for personality-only models is depicted in Figure 4. Profile 1 with low organization and high impulsivity overlapped significantly with Profile 2 of Model 2 (90.9%), however, across other parametrizations where subtypes were more equally sized, this profile divided into 2–3 different profiles. The positively perfectionistic Profile 2 overlapped with Cluster 1 (69.6%), Profile

4 of Model 3 (81.2%) and Profile 2 of Model 4 (71.0%). Profile 3 – individuals with low pathology – overlapped with Cluster 2 (95.3%) and Profile 4 of Model 2 (67.4%), however, participants in this profile were divided into separate subtypes under parametrization conditions of Models 3–4. The largest Profile 4 with heightened overall perfectionism and above-average impulsivity aligned with Profile 2 of Model 2 (98.7%, however, this profile was disproportionately large) and Profile 4 of Model 4 (86.8%).

Figure 5 depicts overlap between symptoms-added models. Profile 1 with high perfectionism, restraint and preoccupation overlapped significantly with Cluster 4 (80.0%) and Profile 2 of Model 3 (76.0%). Profile 2 with elevated trait and eating pathology was also replicated, with 93.9% overlap with Cluster 1. While all participants of Profile 2 of Model 1 fell into Profile 4 of Model 2, this resulted from the latter profile being disproportionately large (also encompassing 90.9% of Profile 4). Low pathology Profile 3 of Model 1 was relatively robust, demonstrating 96.2% overlap with Cluster 2 and aligning with Profile 2 of Model 2 (60.4%) and Profile 1 of Model 4 (64.2%). The impulsive and bingeing-purging Profile 4 aligned well with Cluster 3 (86.4%), and profile 4 of Model 3 (68.2%).

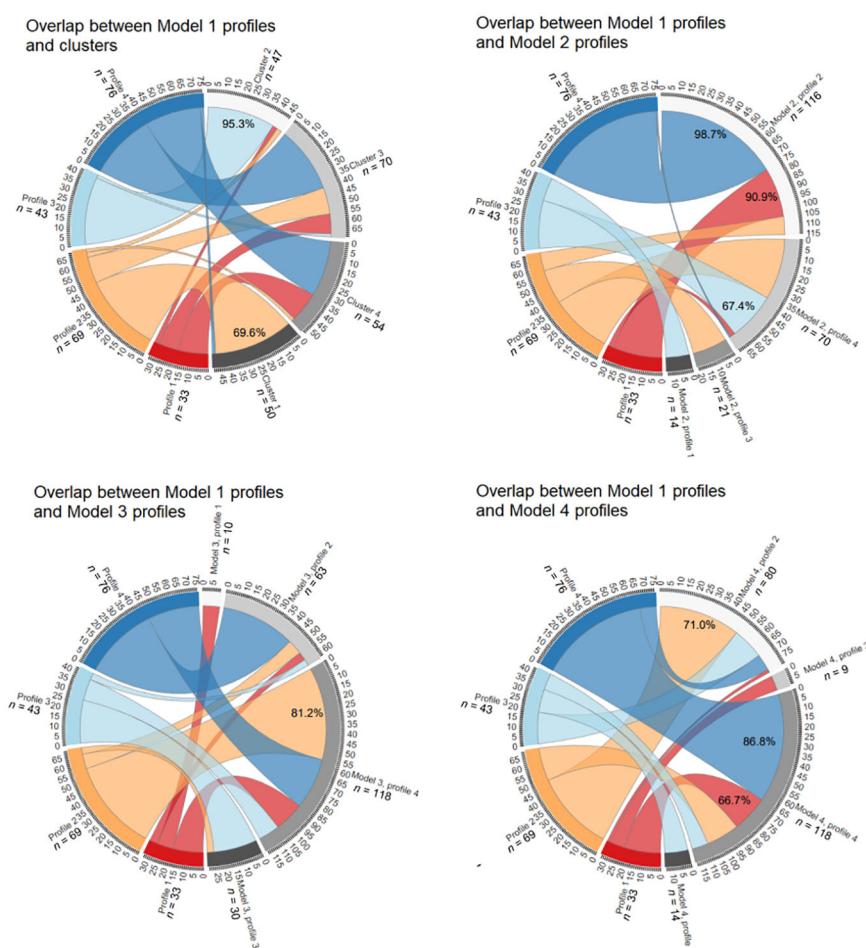


FIGURE 4

Overlap between personality-only LPA Model 1 and the k-means model, LPA Model 2, LPA Model 3 and LPA Model 4. See [Supplementary Material](#) for an interactive .html file.

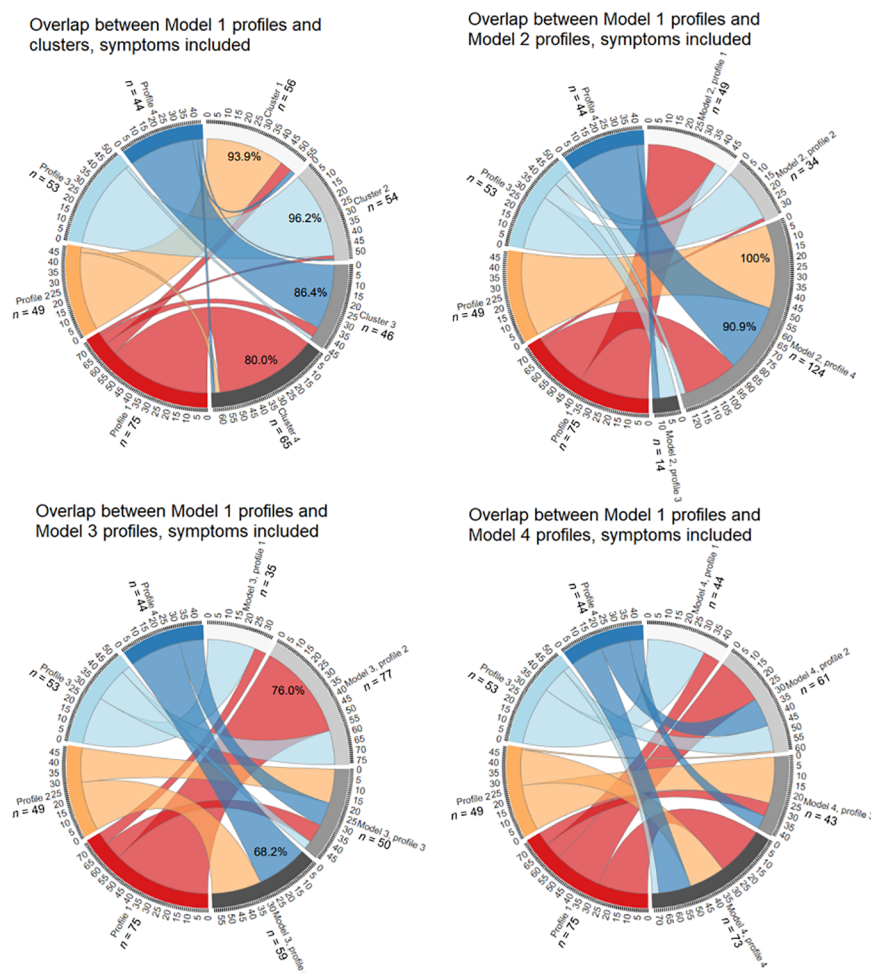


FIGURE 5

Overlap between symptoms-included LPA Model 1 and the k-means model, LPA Model 2, LPA Model 3 and LPA Model 4. See [Supplementary Material](#) for an interactive .html file.

4 Discussion

This study aimed to assess how methodological choices influence personality subtypes among individuals with EDs. Our findings support a self-regulation-based model and identified a 4-subtype solution as best-fitting, with impulsivity and perfectionism playing key roles in distinguishing between the profiles. We found inclusion of ED symptoms as indicators to help differentiate subtypes and increase subtype overlap. Our second hypothesis regarding model comparability found partial support, with some profiles overlapping significantly and others being relatively unique to model configurations. Finally, cluster analytic validation analyses aligned the most with constrained model parametrization, while less-constrained models were also less stable.

While we refrained from labelling our profiles to prevent bias, the detection of a 4-subtype personality-based model generally aligns with prior studies that have postulated a high impulsivity, a high perfectionism, and a resilient class (19, 22, 23). Under several configurations, we observed the emergence of a fourth, combined perfectionism-impulsivity subtype which has previously been

demonstrated in both non-clinical populations and on ED samples (62, 63).

Comparing the different personality-only LPA models, Model 1 with equal variances and covariances coerced to be zero yielded the most equally sized profiles. Other parametrization conditions led to disproportionately small or large profiles. Model 1 also aligned the best with cluster analysis results. Varying subtype sizes across models contributed to reduced overlap between them. Both positively and negatively perfectionistic profiles arose, while impulsivity impacted profile differentiation less, possibly because we used only two subscales to reflect this construct. In the personality-only model, the resilient individuals with limited trait pathology were detected most reliably. Previous studies on non-ED populations have shown that 2- and 3-profile models that quantitatively distinguish between low and high disturbance can fit data well [e.g., for exercise behavior (64); trait impulsivity (65); cognition (66)]. It is possible that even if qualitatively distinct profiles are not robustly detectable, personality-based profiling can indicate which groups of individuals display high and low trait psychopathology.

Inclusion of ED symptoms increased differentiation among profiles. While personality profiles characterized by high organization and personal standards were concealed by the variation of ED symptoms' contribution to profile differentiation, the impact of impulsive traits was more pronounced under the symptoms-included model. Generally, subtypes with low personality pathology also demonstrated low state symptomatology. Profiles with higher levels of perfectionism tended to be further characterized by restraint and preoccupation. Profiles with more pronounced impulsivity had high scores on all ED symptom measures, especially purging. Importantly, if ED symptomatology was included, extracted subtypes became more robust and overlap between models increased: profiles with low overall pathology, heightened overall pathology and heightened internalizing pathology were reliably replicated. Furthermore, including ED symptom measures proved useful, as personality-only subtypes had limited power in predicting ED symptomatology. These results mirror those in (62) who found personality profiles to explain 5–8% of variance in ED symptoms.

This study has several important limitations. Firstly, the relatively small sample size for LPA may have limited our ability to detect true classes and precluded item-based profile construction (53). Sample size constraints also made subgroup analyses impossible. Secondly, we did not compare model solutions across external validation measures, opting for a more data analytic validation design in alignment with our study objectives. Additionally, while we used k-means clustering to validate LPA models, future studies could explore fuzzy clustering approaches that help detect probabilities of belonging to a specific cluster and thus ensure better correspondence to the LPA methodology (67). Finally, due to an ethnically homogenous sample of women, the cross-cultural generalizability of our findings requires further research. Despite these limitations, we believe this study to introduce a novel methodology-focused perspective on ED subtyping studies.

In summary, our results underscore the robustness of impulsivity- and perfectionism-based subtypes, while highlighting that more nuanced profile characteristics are dependent on methodological choices. This variability is reflected in fit indices operating differently across different models, subtype sizes varying and the smaller resultant profiles diverging qualitatively. So, there is proof of the bottom-up constructed profiles tracking real entities, but methodology's impact is significant. Failure to report specific results instead of general labels can conceal this influence. For instance, if our personality-only Model 1 Profile 1 was deemed the “undercontrolled” class in virtue of individuals' low organization and elevated dysfunctional impulsivity, heightened levels of some facets of perfectionism would gain no attention. Or, if an individual was grouped in Profile 1 under symptoms-included Model 1 and labelled “overcontrolled and restricting”, it would be missed that under Model 2 parametrization, 42.7% of these individuals fall under a profile that demonstrated heightened bingeing-purging symptoms as well. While subtype labelling eases dissemination of results and can, at heuristic level, contribute to meaningful interpretations, we believe the risk of overfitting models to be high.

Based on these findings, we present two key recommendations for subtyping research. Firstly, profiling methodology should be derived from study objectives, data characteristics and the criteria for choosing best-fitting models. These choices should be transparently reported. We showed more constrained LPA models to produce more equally-sized and more easily interpretable profiles, while the relaxation of analytic constraints resulted in less cohesive solutions but allowed to account for potential conditional dependence. Furthermore, personality-only subtyping enabled the delineation of multidimensional trait constructs, while the addition of symptoms as indicators provided added explanatory power in terms of conceptualizing the entire clinical phenotype. Either approach could be suitable, if in alignment with study objectives. Secondly, given the divergent yet complementary results, different model solutions should be presented comparatively. For example, if a constrained model is chosen as reflecting the data structure the best, using this as baseline for later analyses can introduce additional bias. However, if covariances are allowed and variances are not coerced to be equal, non-convergence can hinder choosing models with more relaxed parametrization as baseline. In the future, latent variable models could be supplemented with network and other machine learning approaches to further elucidate the associations between variables of interest, without subscribing to causal interpretations (39, 68). Regardless, we believe a demonstration of the robustness of latent variable models to contribute to theory-building and offer input for network variable selection – to arrive at better descriptions of psychopathology in line with the principle of epistemic iteration (69–71).

We also believe that these findings hold clinical significance. Identifying if people align with an overcontrolled, undercontrolled, resilient, or combined impulsivity-perfectionism profile can help determine most suitable treatment options and tailor assessments to target the personality-level mechanisms that maintain disordered eating (72, 73). However, our research underscores that caution should be taken when generalizing from subtype to individual clinical presentations, and points towards the utility of idiographic approaches to integrating personality and psychopathology (74). In clinical practice, this suggests the importance of routinely assessing personality traits for both treatment matching and outcome assessment. To further validate the existence of subtype entities that are independent of methodology and have predictive and explanatory value, self-report measures of personality traits could be supplemented by behavioral or physiological markers reflective of trait-level disturbance [e.g., impulsivity (5)]. Additionally, incorporating more clinical variables, such as history of traumatic life events and longitudinal data about illness development and severity trajectories would increase results' generalizability across the ED spectrum.

Data availability statement

The data supporting the conclusions of this article will be made available by the authors upon request and in line with participants' informed consent.

Ethics statement

The studies involving humans were approved by Research Ethics Committee of the University of Tartu. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

HLS: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. KS: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. KA: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2024.1376565/full#supplementary-material>

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Role of parental educational level as psychosocial factor in a sample of inpatients with anorexia nervosa and bulimia nervosa

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Introduction: Evidence on parental educational level (PEL) as a risk factor for Eating Disorders (EDs) is mixed, and no study has assessed its role in relation to the compliance and outcomes of treatments in EDs. Further, no study differentiated from the educational level of mothers and fathers, nor considered the possible mediation of perfectionism in fostering EDs.

Methods: A clinical sample of 242 first-ever admitted inpatients with EDs provided information on PEL and completed the following questionnaires: the Eating Disorder Examination Questionnaire (EDE-Q) and the Frost Multidimensional Perfectionism Scale (F-MPS). Clinicians also provided information on the Hamilton Rating Scale for Anxiety (HAM-A) and the Hamilton Rating Scale for Depression (HAM-D) for each participant.

Results: Individuals with high PEL (whether mothers, fathers, or both parents) showed significantly higher scores on depressive symptoms and lower on parental criticism, were younger, had an earlier age of onset, had fewer years of illness, more were students and employed, and fewer had offspring. Individuals with fathers or both parents with high educational levels suffered more from Anorexia Nervosa rather than Bulimia Nervosa, had a longer length of stay during the current hospitalization, had less dietary restraint, and had higher personal standards. Individuals with mothers with high educational levels showed a lower rate of previous substance or alcohol addiction. Personal standards partially mediated the relationship between higher PEL and lower dietary restraint.

Discussion: PEL emerged to be a twofold psychosocial risk factor, being associated with higher depressive symptoms and a longer length of stay, but also with a shorter duration of illness and better scholar and working involvement. Higher PEL was related to higher personal standards but not to global perfectionism. Patterns of eating psychopathology emerged based on the high PEL of mothers or fathers.

KEYWORDS

eating disorders, eating psychopathology, anorexia nervosa, psychosocial risk factors, parental educational level

1 Introduction

Educational level (EL) refers to the highest level of education an individual has completed. Parental educational attainment or parental educational level (PEL) is thought to influence in many ways children's development (Kraaykamp and van Eijck, 2010), behavior (Horoz et al., 2022), academic achievement (Schlechter and Milevsky, 2010), and physical health (Naess et al., 2018; Balaj et al., 2021). On the one hand, highly educated parents are believed to have better time spent with their children in terms of quality and quantity and provide them with better socioeconomic conditions and opportunities (Reiss et al., 2019). Also, a higher parental educational level was associated with a less permissive and less authoritarian parenting style (Hadjicharalambous and Dimitriou, 2020), higher assistance in their children's school performance (Hadjicharalambous and Dimitriou, 2020), and greater use of the contingent shift principle rather than fixed failure feedback (Carr and Pike, 2012). Through the mediation of early maladaptive schemas, a link between perceived parent styles and eating disorder symptoms emerged in recent studies (Khosravi et al., 2023; Joshua et al., 2024). On the other hand, higher parents' academic attainment may cause adolescent offspring to have increased academic distress perception and worsen well-being (Jang et al., 2020). In some studies, highly educated mothers have been described as perceiving more distress concerning motherhood, with worse parenting styles (Andersson and Hildingsson, 2016). Higher PEL was also described as a risk factor for schizophrenia (Byrne et al., 2004). Conversely, a lower PEL was associated with increased psychiatric disorders prevalence among offspring. Two longitudinal studies of 2,810 participants of the German KiGGS study (Meyrose et al., 2018) and of 10,257 participants from the Norwegian Patient Registry (Bøe et al., 2021) evidenced that children of mothers with low education have a significantly higher risk of mental health issues compared to those of mothers with high education, especially during the first phase of childhood. Three extensive longitudinal studies evidenced that children of parents with low PEL have a significantly increased risk of depression (Quesnel-Vallée and Taylor, 2012; Park et al., 2013; Fakhrunnisak and Patria, 2022). Results from the Canadian National Population Health Survey (Park et al., 2013) showed that the offspring of mothers with less than secondary school education had twofold higher odds of major depressive episodes during adulthood. Results from the Indonesia Family Life Survey (Fakhrunnisak and Patria, 2022) replicated those findings, evidencing slight differences depending on the educational level of mothers or fathers and the sex of children. A recent meta-analysis (Xiang et al., 2023) confirmed this evidence, displaying that overall parental education level was negatively correlated with adolescent depressive symptoms with a dose-response relationship. Low parents' educational level was also associated with ADHD prevalence (Torvik et al., 2020) and suicidal behaviors (Chen et al., 2022) in children.

For what regards eating disorders (EDs), evidence is mixed. In detail, six extensive longitudinal studies evidenced an increased prevalence of EDs in families with higher PEL (Ahrén-Moonga et al., 2009; Ahrén et al., 2013; Goodman et al., 2014; Bould et al., 2016; Sundquist et al., 2016; Koch et al., 2022). Parents' educational attainment as an associated factor was independent of parents' social class, parental income (Ahrén et al., 2013; Goodman et al., 2014; Bould et al., 2016), also regarded grandparents' educational level (Ahrén-Moonga et al., 2009; Goodman et al., 2014), selectively female

offspring (Ahrén et al., 2013; Sundquist et al., 2016), and was related to health outcomes (O'Brien et al., 2017). However, another large longitudinal study of 11,721 children from the ABCD Study showed no differences in lifetime ED prevalence based on PEL (Sanzari et al., 2023). Other studies also repeated these findings of the non-significance of PEL on ED prevalence among children (Roberts et al., 2007; Pilecki et al., 2016; Udo and Grilo, 2018). This heterogeneity among findings suggests that the relationship between PEL and EDs may be complex and depending on several reasons.

Educational attainment in individuals themselves – which is influenced by PEL (Schlechter and Milevsky, 2010) – is debated as a risk factor. Most of the evidence proposes school performance as a promoting factor for EDs (Ahrén-Moonga et al., 2009; Sundquist et al., 2016; Claydon and Zullig, 2020; Schilder et al., 2021; Barakat et al., 2023; Nielsen and Vilmar, 2024), but some studies have evidenced a negative association between academic grades and prevalence of EDs (Maxwell et al., 2011; Adelantado-Renau et al., 2018). A systematic review of 149 full-text articles also concluded that education level is inconsistent as a risk factor for EDs (Mitchison and Hay, 2014).

The contrasting findings could be partially explained, considering that academic performance and parental push to excel in studying could be experienced in different ways by individuals. From this perspective, scholar attainment and parents' education should be considered not only as possible risk factors but also in relation to their psychological consequences on individuals. Perfectionism has been proposed to be, in some cases, the link factor between high educational achievement and the risk of EDs (Schilder et al., 2021), given its well-established action on fostering eating psychopathology (Dahlenburg et al., 2019; Longo et al., 2024). A meta-analysis of 23 studies for 3,561 participants (Dahlenburg et al., 2019) showed that maladaptive and adaptive perfectionism (i.e., perfectionism consisting of high personal standards and aims) is increased in AN patients compared to healthy controls. This finding was also confirmed by a recent study (Longo et al., 2022) through a cluster analysis based on the Frost Multidimensional Perfectionism Scale (F-MPS), which outlined how the "high-perfectionism" subgroup was significantly more extensive compared to the group of healthy controls with this feature. The same research also evidenced that perfectionism scores were linked to more severe eating psychopathology – both in patients and controls – and to heavier depression and anxiety levels. Also, a network analysis (Martini et al., 2021) identified essential associations among perfectionism, interoceptive sensibility, and eating symptomatology. Among other possible links between higher PEL and ED psychopathology, psychological characteristics associated with high academic studies include introversion, locus of control, and engagement (Hakimi et al., 2011; Muca et al., 2023). Further, maintaining school performance despite weight loss has been found to produce empowerment, consequently becoming a factor of resistance to treatment (Abbate-Daga et al., 2013). Conversely, impairment of school marks during illness is perceived as an egodystonic factor and could reinforce compliance to treatments (Gregertsen et al., 2017).

The experience of academic pressure on individuals is a complex issue. Many variables could mediate the connection between PEL and eating psychopathology among offspring, and the same educational situation might foster different behaviors in different individuals. A deeper and more precise analysis of this relation would allow more

knowledge of the pathways that lead to eating psychopathology and possibly open the way for more tailored possibilities for treatments.

Particularly interesting in the perspective of care would be to analyze the association of PEL with treatment outcomes. In this sense, a crucial event in the course of illness is the first-ever hospitalization since individuals experience acute and substantial difficulties. Further, clinicians should provide a prognosis during hospitalization to define the most appropriate path of care for individuals (Monteleone et al., 2023). As more variables are considered in the process of prognosis formulation, the course of treatment post-discharge will be better tailored. To our knowledge, no study has assessed the role of PEL on the compliance and outcome of treatment in EDs. Furthermore, no evidence is available concerning the association of PEL with ED outcomes during hospitalization, and no study in the literature has explored the role of PEL concerning ED psychopathology distinguished by the educational level of mothers and fathers. These are significant gaps in the literature that incited us to examine the role of PEL as a psychosocial factor associated with EDs, particularly contextualized to the first-ever hospitalization.

Given these premises, we intended to conduct an exploratory analysis to assess how PEL is associated with eating and general psychopathology differences in individuals with Anorexia Nervosa (AN) and Bulimia Nervosa (BN). To do that, we aimed to compare ED individuals with high and low PEL for what involves clinical data and psychometric questionnaires, separately considering mothers' educational level (MPEL), fathers' educational level (FPEL), and both parents' educational level (PPEL). From this perspective, we were especially interested in the dimension of perfectionism, given the described role of perfectionism both in EDs and at the educational level.

Based on the evidence available in the literature, we expected that higher PPEL was related to AN but not BN symptomatology and lower PPEL to anxiety and depression (Quesnel-Vallée and Taylor, 2012; Park et al., 2013; Sundquist et al., 2016; Fakhrunnisak and Patria, 2022; Koch et al., 2022). We did not expect any finding based on selective MPEL and FPEL since no evidence was available in the literature.

2 Methods

2.1 Participants

Two hundred and forty-two first-ever admitted inpatients with AN or BN at the Eating Disorders Center of the "Città della Salute e della Scienza" hospital of the University of Turin, Italy, were recruited. This specialized psychiatric unit for ED recruits individuals during the acute stage of illness. This unit is the only in the Piedmont region to do so, thus recruiting individuals from different and varied care pathways. All patients were diagnosed with EDs according to DSM-5 (American Psychiatric Association, 2013) by an experienced psychiatrist following the Structured Clinical Interview for DSM-5 (First, 2015). The following inclusion criteria were respected: (a) age range: 18–35 years old; (b) diagnosis of EDs according to the Structured Clinical Interview for DSM-5 (First, 2015). No exclusion criteria were set.

We chose to investigate young adults since we aimed to study the effects of PPEL during a time of life in which the influence of parental

characteristics may be considered relevant. The age span of 18–35 for young adults has been chosen by comparison with other work on the same issue (Franssen et al., 2020). We did not include underage patients since the sample was collected in an adult psychiatric service.

No participant refused to fill in the questionnaires. All individuals voluntarily agreed to get involved in our study, declaring it through written informed consent according to the Ethical Committee of our Institution, which also approved the present study under registration number 00295/2021 of 9/6/2021.

2.2 Procedure and measures

Trained nursing personnel measured individuals in height and weight. Subsequently, participants were interviewed by an experienced psychiatrist who collected clinical and demographic data. Specifically, for each patient, we collected information regarding age, gender, marital status, education level, illness onset, caloric intake, working and studying status, having siblings and children, previous failure of psychotherapeutic or pharmacological treatments (as reported by patients), self-harm, suicidal behavior, sexual abuse, current and previous substance or alcohol abuse, and family history of psychiatric and eating disorders. Each psychiatrist filled in the Hamilton Rating Scale for Anxiety (HAM-A; Hamilton, 1959) and the Hamilton Rating Scale for Depression (HAM-D; Hamilton, 1960), to have clinician-rated measures of anxious and depressive symptomatology, respectively. At the end of the hospitalization, nursing personnel measured individuals' weight to derive the difference in BMI between hospital admission and discharge (Δ BMI). Information regarding PEL was also collected. The academic course in Italy is divided into steps. Specifically, elementary school (5 years of education), middle school (in total 8 years of education), first three-year period of secondary school (end of the mandatory schooling – in total 11 years of education), secondary school (in total 13 years of education), and academic degree (in total > thirteen years of education). For data collection, it was not possible to obtain information on the parents' academic level attainment (i.e., elementary school, middle school, high school diploma, academic degree), hence, we used the parents' years of schooling reported by participants.

All participants were asked to complete the following self-report questionnaires:

- Eating Disorder Examination Questionnaire (EDE-Q; Fairburn and Beglin, 1994). This questionnaire assess attitudes and behaviors of eating disorders during the previous 28 days. It is composed of 28 items with four subscales: "dietary restraint," "eating concerns," "weight concerns," "shape concerns," and a total score. The Italian version of the questionnaire provided a high internal consistency, as suggested by a Cronbach alpha value >0.90 (Calugi et al., 2017).
- Frost Multidimensional Perfectionism Scale (F-MPS; Frost et al., 1990). This questionnaire was included to explore the main aspects of perfectionism. It is made up of 35 items on a five-point scale ranging from 1 (total disagreement) to 5 (complete agreement), and its answers constitute seven subscales: "concern over mistakes," "personal standards," "parental expectations," "parental criticism," "doubts about actions," "organization," and

total score. Higher scores indicate more pronounced perfectionism traits. The Italian version of this tool proved to have good internal consistency, with a Cronbach alpha value >0.75 (Lombardo, 2008).

- The clinicians were trained to assess anxiety and depression using the Italian translation of the following tools:
 - Hamilton Rating Scale for Anxiety (HAM-A; Hamilton, 1959). This clinician-rated scale was included to measure the severity of anxiety symptoms. It provides measures of “overall anxiety,” “psychic anxiety,” and “somatic anxiety.”
 - Hamilton Rating Scale for Depression (HAM-D; Hamilton, 1960). This clinician-rated scale was utilized to measure the severity of depressive symptoms in individuals. The score indicates “possible” (10–15), “light” (16–25), “moderate” (26–28), and “severe” (>28) depression. The scale proved to be effective in separating depressive and healthy individuals in an Italian sample (Fava et al., 1982).

2.3 Statistical analysis

All statistical analyses were performed utilizing IBM SPSS 28.0 Statistics Software (SPSS).

To compare individuals based on the PEL, we referred to the parents' years of education as described above. We decided to group individuals with parents of PEL <13 years of education and PEL ≥ 13 years of education. This partition was set up for two reasons. First, in Italian education, ≥ 13 years of education corresponds to having an academic degree, and so having accomplished a high-school diploma. We believed the high-school diploma was generally the most significant step across the educational path of an individual. Second, it provided us with two subgroups of individuals with similar numerosness, thus allowing us statistical comparisons between them. Specifically, we compared individuals with mothers of <13 and ≥ 13 years of education (MPEL), individuals with fathers of <13 and ≥ 13 years of education (FPEL), and individuals with at least one parent of PEL <13 years of education with individuals with both parents of PEL ≥ 13 years of education (PPEL). Hence, our comparison was between parents with the education of “high-school diploma or above” and “below high-school diploma.” The detailed description of PEL in fathers and mothers is described in [Supplementary Table S1](#).

These comparisons were conducted with a chi-squared test for nominal variables and a t-test for continuous variables. Furthermore a chi-squared test was conducted between MPEL and FPEL.

Secondly, we ran a logistic regression in which PPEL was the dependent variable. The independent variables were those that significantly differed (at least one among MPEL, FPEL, and PPEL) at the previous analysis (i.e., age, age of onset, years of illness, being student, being employed, HAM-D, EDE-Q dietary restraint, F-MPS personal standard, F-MPS parental criticism). Cox and Snell R^2 was calculated.

Since our analysis was exploratory and there was no omnibus null hypothesis about which all the tests speak collectively, according to

Garcia-Perez's indications (García-Pérez, 2023) we decided to avoid a correction for multiple testing.

Finally, two mediation models of the relationship between PEL and EDE-Q restraint were employed to assess the possible mediating effects of participants' personal standards and perceived parental criticism. We utilized the corresponding subscores on the F-MPS. These variables were chosen because they agreed with the hypothesis of perfectionism as a mediator and were significant in the previous analysis.

3 Results

The clinical sample was composed of 242 individuals. All individuals provided information on the mothers' and 238 on the fathers' educational level. Hundred and fifty-two individuals were diagnosed with the restricting AN (AN-R) subtype (62.8%), 64 with the binge-purging subtype (AN-BP) (26.4%), and 26 with BN (10.7%) (see [Supplementary Table S2](#)). The AN sample was characterized by severe underweight and a long duration of illness. Mothers were 28.2% with <13 years and 64.4% with ≥ 13 years of education. Fathers were 32.2% with <13 years and 54.6% with ≥ 13 years of education. Individuals with high PEL (MPEL, FPEL and PPEL) were more frequently single and less frequently married/cohabitant as described in [Supplementary Table S3](#). The distribution of PEL in parents was asymmetrical. The vast majority (87.6%) of parental pairs were homogeneous for PEL (i.e., with both parents having a high or low PEL) as described in [Supplementary Table S4](#). The distribution of PEL and the individuals' marital status are described in [Supplementary Tables S1, S3](#).

3.1 Differences between ED individuals with high and low PEL

Differences between ED individuals with high and low PEL are described in [Table 1](#).

Individuals with high MPEL, high FPEL, and high PPEL were younger, had an earlier age of onset, had fewer years of illness, a lower probability of having children, and a higher likelihood of being a student and being a worker. Individuals with high MPEL, high FPEL, and high PPEL showed significantly higher HAM-D scores and lower F-MPS parental criticism scores.

Individuals with high MPEL showed a lower probability of previous substance or alcohol addiction, but this was not present for individuals with high FPEL and PPEL.

Individuals with high FPEL and PPEL, but not MPEL, displayed a significantly higher probability of suffering from AN rather than BN, a longer length of stay during hospitalization, lower scores on EDE-Q dietary restraint, and higher scores on F-MPS personal standards.

No significant differences based on PEL emerged for what concerns the probability of having siblings, educational level, failure of previous pharmacological or psychotherapeutic trials, self-harm and suicidal behaviors, history of suicidal attempts, history of sexual abuse, current substance or alcohol abuse, family history of psychiatric diseases or ED, HAM-A score, the eating concerns, shape concerns, weight concerns and global score of EDE-Q, the concern over mistakes, parental expectations, doubts about actions,

TABLE 1 Differences between EDs individuals with parents with high and low PEL.

ED Inpatients	Mothers of ≥ 13 years of education ($n = 156$) Mean (SD) or N (%)	Mothers of < 13 years of education ($n = 86$) Mean (SD) or N (%)	χ^2	F	p	Fathers of ≥ 13 years of education ($n = 135$) Mean (SD) or N (%)	Fathers of < 13 years of education ($n = 103$) Mean (SD) or N (%)	χ^2	F	p	Both parents of ≥ 13 years of education ($n = 124$) Mean (SD) or N (%)	At least one parent of < 13 years of education ($n = 114$) Mean (SD) or N (%)	χ^2	F	p
AN	141 (90.4%)	75 (87.2%)	0.583	–	0.445	128 (94.8%)	86 (83.5%)	8.256	–	0.004	118 (95.2%)	96 (84.2%)	8.581	–	0.003
BN	15 (9.6%)	11 (12.8%)	0.583	–	0.445	7 (5.2%)	17 (16.5%)	8.256	–	0.004	6 (4.8%)	18 (15.8%)	8.581	–	0.003
Age	22.0 (7.1)	26.5 (10.2)	–	15.789	<0.001	21.4 (6.4)	26.3 (10.0)	–	21.329	<0.001	21.5 (6.6)	26.0 (9.8)	–	16.742	<0.001
Age of onset	16.8 (4.2)	18.3 (6.1)	–	6.283	0.013	16.5 (3.1)	18.1 (6.1)	–	16.822	<0.001	16.6 (3.2)	18.5 (6.3)	–	18.067	<0.001
Years of Illness	5.4 (6.4)	8.1 (9.5)	–	12.581	0.008	8.1 (9.3)	5.0 (6.2)	–	15.488	0.002	5.0 (6.3)	7.8 (9.0)	–	10.905	0.006
Having siblings	115 (73.7%)	71 (82.6%)	2.197	–	0.138	97 (71.5%)	84 (81.6%)	1.855	–	0.173	92 (74.2%)	94 (82.5%)	1.888	–	0.169
Having offspring	0 (0.0%)	6 (7.0%)	11.160	–	<0.001	0 (0.0%)	6 (5.8%)	7.891	–	0.005	0 (0.0%)	6 (5.3%)	6.683	–	0.010
Being student	112 (71.8%)	30 (34.9%)	31.151	–	<0.001	94 (69.6%)	42 (40.8%)	21.982	–	<0.001	92 (74.2%)	50 (43.9%)	22.287	–	<0.001
Being employed	120 (76.9%)	38 (44.2%)	25.293	–	<0.001	99 (73.3%)	53 (51.5%)	14.733	–	<0.001	97 (78.2%)	61 (53.5%)	15.262	–	<0.001
Educational level in years	13.4 (2.7)	13.3 (2.8)	–	0.032	0.651	13.3 (2.7)	13.4 (2.7)	–	0.097	0.903	13.3 (2.7)	13.4 (2.7)	–	0.133	0.808
Previous failure of psychotherapy	72 (46.1%)	32 (37.2%)	2.304	–	0.129	63 (46.7%)	39 (37.9%)	2.596	–	0.107	61 (49.2%)	43 (37.7%)	3.597	–	0.058
Previous failure of pharmacotherapy	49 (31.4%)	27 (31.4%)	0.040	–	0.841	45 (33.3%)	31 (30.1%)	0.648	–	0.421	42 (33.9%)	34 (29.8%)	0.715	–	0.398
Presence of self-harm behaviors	27 (17.3%)	9 (10.5%)	2.162	–	0.141	19 (14.1%)	15 (14.6%)	<0.001	–	0.991	19 (15.3%)	17 (14.9%)	0.021	–	0.885
Presence of suicidal behaviors	16 (10.3%)	12 (13.9%)	0.680	–	0.410	12 (8.9%)	13 (12.6%)	0.690	–	0.406	11 (8.9%)	17 (14.9%)	1.946	–	0.163
Number of suicidal attempts in anamnesis	0.2 (0.7)	0.4 (0.8)	–	3.157	0.074	0.2 (0.7)	0.3 (0.9)	–	2.994	0.316	0.2 (0.6)	0.4 (0.9)	–	7.260	0.127
History of sexual abuse	14 (9.0%)	9 (10.5%)	0.120	–	0.729	8 (5.9%)	13 (12.6%)	2.996	–	0.083	8 (6.4%)	15 (13.2%)	3.051	–	0.081
Current substance or alcohol abuse	6 (3.8%)	6 (7.0%)	1.128	–	0.288	7 (5.2%)	5 (4.8%)	0.028	–	0.866	6 (4.8%)	6 (5.3%)	0.018	–	0.894

(Continued)

TABLE 1 (Continued)

ED Inpatients	Mothers of ≥ 13 years of education ($n = 156$) Mean (SD) or N (%)	Mothers of <13 years of education ($n = 86$) Mean (SD) or N (%)	χ^2	F	p	Fathers of ≥ 13 years of education ($n = 135$) Mean (SD) or N (%)	Fathers of <13 years of education ($n = 103$) Mean (SD) or N (%)	χ^2	F	p	Both parents of ≥ 13 years of education ($n = 124$) Mean (SD) or N (%)	At least one parent of <13 years of education ($n = 114$) Mean (SD) or N (%)	χ^2	F	p
Previous substance or alcohol addiction	5 (3.2%)	9 (10.5%)	5.468	–	0.019	6 (4.4%)	8 (7.8%)	1.069	–	0.301	5 (4.0%)	9 (7.9%)	1.565	–	0.211
Family history of psychiatric diseases	62 (39.7%)	25 (29.1%)	2.663	–	0.103	46 (34.1%)	36 (34.9%)	0.005	–	0.945	44 (35.5%)	43 (37.7%)	0.124	–	0.724
Family history of Eating Disorders	30 (19.2%)	9 (10.5%)	3.223	–	0.073	23 (17.0%)	14 (13.6%)	0.681	–	0.409	23 (18.5%)	16 (14.0%)	0.941	–	0.332
HAM-A	19.9 (7.0)	18.6 (6.2)	–	1.363	0.204	19.7 (6.4)	18.9 (7.0)	–	0.060	0.360	19.8 (6.5)	19.0 (7.0)	–	0.024	0.392
HAM-D	19.4 (7.7)	16.5 (5.8)	–	5.079	0.004	19.3 (7.5)	17.2 (6.8)	–	1.960	0.035	19.4 (7.5)	17.3 (6.7)	–	2.590	0.036
EDE-Q, dietary restraint	3.2 (2.0)	3.8 (1.9)	–	1.091	0.074	3.1 (2.0)	3.9 (1.9)	–	3.577	0.008	3.1 (2.0)	3.8 (2.0)	–	1.130	0.029
EDE-Q, eating concerns	3.1 (1.6)	3.3 (1.7)	–	0.108	0.365	3.0 (1.6)	3.4 (1.7)	–	0.501	0.080	3.0 (1.6)	3.3 (1.7)	–	0.913	0.145
EDE-Q, shape concerns	4.2 (1.7)	4.4 (1.6)	–	0.888	0.476	4.2 (1.7)	4.5 (1.5)	–	4.125	0.112	4.2 (1.7)	4.5 (1.5)	–	2.739	0.183
EDE-Q, weight concerns	3.8 (1.9)	3.8 (1.8)	–	0.400	0.948	3.7 (1.9)	3.9 (1.7)	–	2.068	0.393	3.7 (1.9)	3.8 (1.8)	–	0.980	0.593
EDE-Q, global score	3.6 (1.7)	3.8 (1.6)	–	0.911	0.352	3.5 (1.7)	3.9 (1.5)	–	2.796	0.085	3.5 (1.7)	3.8 (1.6)	–	1.263	0.173
F–MPS, concern over mistakes	30.8 (10.1)	31.6 (9.5)	–	1.176	0.557	30.8 (9.6)	31.5 (10.2)	–	0.038	0.602	30.9 (9.7)	31.3 (10.2)	–	0.007	0.728
F–MPS, personal standards	25.3 (6.7)	24.1 (6.5)	–	0.298	0.192	25.9 (6.4)	23.8 (6.7)	–	0.050	0.023	25.9 (6.4)	23.8 (6.7)	–	0.156	0.019
F–MPS, parental expectations	10.8 (5.3)	11.1 (5.4)	–	0.163	0.734	10.7 (5.2)	11.4 (5.5)	–	0.965	0.354	10.9 (5.3)	10.9 (5.4)	–	0.267	0.965

(Continued)

TABLE 1 (Continued)

ED Inpatients	Mothers of ≥ 13 years of education ($n = 156$) Mean (SD) or N (%)	Mothers of < 13 years of education ($n = 86$) Mean (SD) or N (%)	χ^2	F	p	Fathers of ≥ 13 years of education ($n = 135$) Mean (SD) or N (%)	Fathers of < 13 years of education ($n = 103$) Mean (SD) or N (%)	χ^2	F	p	Both parents of ≥ 13 years of education ($n = 124$) Mean (SD) or N (%)	At least one parent of < 13 years of education ($n = 114$) Mean (SD) or N (%)	χ^2	F	p
F-MPS, parental criticism	9.5 (4.1)	10.9 (4.2)	–	0.120	0.014	9.3 (4.1)	11.0 (4.2)	–	0.185	0.004	9.3 (4.1)	10.6 (4.2)	–	0.010	0.029
F-MPS, doubts about actions	13.0 (3.9)	13.8 (3.9)	–	0.352	0.170	12.9 (3.9)	13.8 (4.0)	–	0.028	0.112	13.0 (3.9)	13.6 (4.0)	–	0.002	0.223
F-MPS, organization	23.9 (5.4)	24.0 (4.8)	–	0.778	0.917	24.2 (5.2)	23.6 (5.3)	–	0.068	0.411	24.2 (5.2)	23.6 (5.2)	–	0.011	0.429
F-MPS, global score	113.0 (24.7)	114.9 (24.1)	–	0.716	0.597	113.9 (23.2)	114.2 (26.3)	–	0.214	0.916	114.2 (23.4)	113.0 (25.7)	–	0.021	0.719
BMI	15.0 (3.0)	15.0 (3.0)	–	0.470	0.976	14.7 (2.6)	15.3 (3.3)	–	1.289	0.149	14.8 (2.6)	15.3 (3.3)	–	2.303	0.153
Caloric Intake (kcal/day)	756.3 (421.8)	688.4 (348.4)	–	4.742	0.226	755.1 (414.7)	695.0 (359.5)	–	3.085	0.267	756.6 (417.3)	705.6 (375.6)	–	2.043	0.343
Length of stay during current hospitalization (in days)	35.0 (18.7)	31.5 (16.3)	–	2.125	0.157	36.7 (19.7)	30.4 (15.3)	–	4.590	0.009	36.8 (20.0)	30.5 (14.8)	–	5.681	0.007
Hospital discharge against physicians' decision during the current hospitalization	4 (2.6%)	1 (1.2%)	0.467	–	0.495	2 (1.5%)	3 (2.9%)	0.567	–	0.452	2 (16.1%)	3 (2.6%)	0.326	–	0.568
Δ BMI	0.6 (0.9)	0.5 (0.7)	–	1.732	0.634	0.6 (0.9)	0.5 (0.7)	–	1.662	0.260	0.6 (0.9)	0.5 (0.8)	–	0.153	0.491
Δ BMI in the AN individuals' subgroup	0.67 (0.91)	0.59 (0.69)	–	1.695	0.194	0.64 (0.87)	0.58 (0.65)	–	2.393	0.123	0.64 (0.88)	0.59 (0.80)	–	0.283	0.595

EDs, eating disorders; AN, Anorexia Nervosa; BN, Bulimia Nervosa; SD, standard deviation; N, number of individuals; χ^2 , chi-squared value; F = F-value; p , p -value; BMI, body mass index; Δ BMI, variation of BMI during the current hospitalization; HAM-A, Hamilton Anxiety Rating Scale; HAM-D, Hamilton Depression Rating Scale; EDE-Q, Eating Disorder Examination Questionnaire; F-MPS, Frost Multidimensional Perfectionism Scale. *Statistical significance if $p < 0.05$. Bold values $p < 0.05$.

organization and global score of F-MPS, the state and trait STAI scores, the BSQ score, the Rosenberg score, caloric intake, BMI, Δ BMI, Δ BMI in the AN individuals' subgroup, and hospital discharge against physicians' decision during the current hospitalization.

3.2 Linear regression of PEL in ED individuals

We performed a linear regression to derive what dimensions correlate with the high PPEL in ED parents. Results are detailed in Table 2.

The linear regression model showed Cox and Snell R^2 score = 0.264, $\chi^2 = 54.461$, and $p < 0.001$. Significant PPEL-related factors emerged to be F-MPS "personal standards," EDE-Q "dietary restraint," age, and HAM-D.

As shown in Figure 1 and Supplementary Tables S5, S6, the mediational model revealed personal standard's significant partial mediation role in the relationships between PEL and dietary restraints. No mediation effect emerged regarding parental criticism in the same relationship. Even though no mediation effect of parental criticism emerged, the analysis confirmed a statistically significant association between parental criticism and dietary restraint (Supplementary Table S6).

4 Discussion

In our sample of first-ever admitted inpatients with EDs, individuals with high PEL (MPEL, FPEL, and PPEL) were younger, had an earlier age of onset, had fewer years of illness, fewer had offspring, and more were students and employed. Also, individuals with high PEL (MPEL, FPEL, and PPEL) showed significantly higher scores on depressive symptoms and lower scores on parental criticism. Individuals with fathers and both parents (FPEL and PPEL) but not mothers with high educational levels (MPEL) suffered more from AN rather than BN, had a longer length of stay (LoS) during the current hospitalization, and had less dietary restraint and higher personal standards. Individuals with mothers (MPEL) but not fathers and both parents with high educational

levels (FPEL and PPEL) showed a significantly lower rate of previous substance or alcohol addiction.

No significant difference between the groups with high and low PEL (neither MPEL, FPEL, nor PPEL) was shown regarding BMI at admission, eating psychopathology (except for restraints), family history of psychiatric and eating disorders, and history of suffered events (i.e., sexual abuse, suicidal behavior, self-harm).

Hence, PEL *per se* did not emerge as a predictor of worse eating disorder symptoms presentation at admission. Still, higher PEL proved to be a psychosocial factor positively associated with comorbidities, such as the presence of depressive symptoms, which are a factor described as associated with longer LoS during inpatient treatments (Panero et al., 2021), and a history of substance abuse. Surprisingly in our sample, higher PEL did not entail higher scores for patients' perfectionism. This non-association can be explained by the fact that we measured perfectionism in the acute phase of the disease. In contrast, perfectionism may have played a role predominantly in the premorbid period.

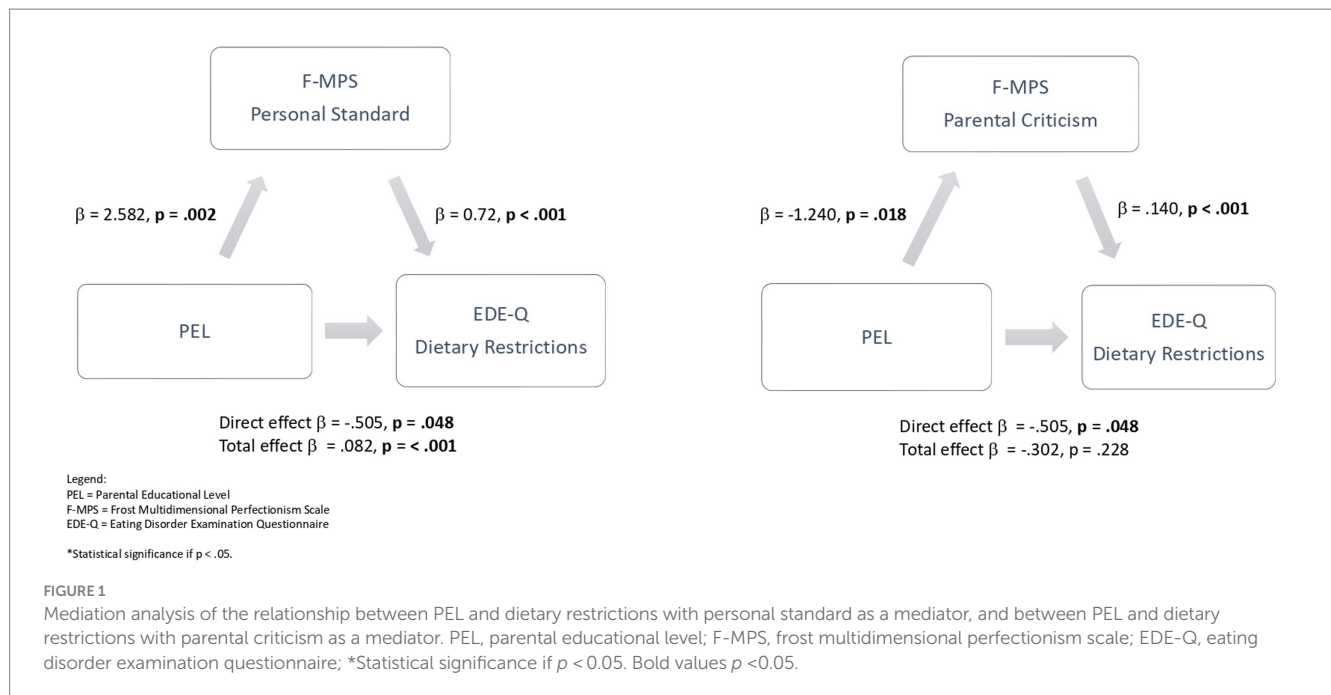
The finding of higher depressive symptoms among ED individuals with high PEL was apparently in contrast with evidence showing a higher risk of depression among offspring of parents with low educational levels (Quesnel-Vallée and Taylor, 2012; Park et al., 2013; Fakhrunnisak and Patria, 2022). However, the cited studies measured the prevalence of clinically diagnosed cases of depression in the general population, while we assessed the depressive symptomatology among ED individuals. ED persons with high PEL might have a higher insight and awareness of their condition and possibly bear parental expectations that may produce a sense of failure. EDs have peculiar characteristics, and psychosocial risk factors like PEL can be different from other mental disorders.

FPEL and PPEL, but not MPEL, were associated with a significantly higher probability of suffering from AN than BN. These findings reinforced the hypothesis that AN is more frequently associated with higher PEL (Sundquist et al., 2016; Koch et al., 2022). Our study has the limitation of having involved mainly AN individuals (89.3%), and not having considered the individuals' socioeconomic status. Consequently, we cannot exclude whether higher socioeconomic status partially or totally mediated the relationship between higher PEL and AN. Nevertheless, whether mediated by socioeconomic status or not, our data propose that the presence of a

TABLE 2 Linear regression model for having both parents with high level of education (≥ 13 years of education) in EDs individuals.

Variables	Multivariate Regression				Properties of the Model		
	Beta	SE	W	p	R	χ^2	p
F-MPS, personal standards	0.080	0.030	6.956	0.008	0.264	54.461	<0.001
EDE-Q, dietary restraint	-0.276	0.106	6.753	0.009			
Age	-0.099	0.049	4.148	0.042			
HAM-D	0.054	0.027	4.089	0.043			
F-MPS, parental criticism	-0.086	0.047	3.285	0.070			
Being student	0.786	0.475	2.737	0.098			
Being employed	0.558	0.427	1.709	0.191			
Years of illness	0.061	0.048	1.628	0.202			

EDs, eating disorders; SE, standard Error; W, Wald's score; R, Cox and Snell R^2 score; EDE-Q, eating disorder examination questionnaire; HAM-D, Hamilton depression rating scale; F-MPS, Frost multidimensional perfectionism scale.
*Statistical significance if $p < 0.05$. Degrees of freedom = 8. Bold values $p < 0.05$.



highly educated father is associated with having AN rather than BN. Among fathers themselves, higher education might be associated with restrictive and orthorexic rather than binge eating and purging eating habits (McComb and Mills, 2019; Gkiouleka et al., 2022), which might influence siblings' eating behavior.

The subscores of perfectionism dimensions on F-MPS indicated a lower perception of parental criticism among individuals with high PEL (MPEL, FPEL, and PPEL), but higher personal standards in individuals with high FPEL and PPEL. We can hypothesize that individuals may perceive highly educated parents not as strict and pressing but as encouraging. However, higher personal standards scores might entail parents internalized as hard-to-reach models, resulting in difficulties in perceiving themselves as effective and successful (Panero et al., 2022). These findings reinforce the need for complex models based on several variables. Perfectionism has been repeatedly associated with restricting eating behaviors (Dahlenburg et al., 2019; Martini et al., 2021; Longo et al., 2022, 2024). In our sample, global perfectionism was not significantly different between the groups with high and low PEL. However, features of perfectionism, such as high personal standards, were related to higher PEL. In our sample, individuals with high PEL were more involved in scholarly and working activities. On the one hand, this could be viewed as the result of more educational and career opportunities for the offspring of parents with high PEL. On the other hand, individuals with high PEL and higher personal functioning may also present higher individuals' expectations that are linked to perfectionism (Longo et al., 2024). In the linear regression model, the personal standards dimension of perfectionism was shown to be the strongest factor for having both parents with high PEL (see Table 2).

Higher PEL was associated with lower dietary restraint (EDE-Q) among participants. This relationship had a partial mediation of personal standards, and no mediation emerged for parental criticism. In previous research, perfectionism has been proposed to be the link between high educational achievement and the risk of EDs (Schilder

et al., 2021). This exploratory analysis described how the presence of high parental criticism may be the feature of perfectionism that mediated between PEL and eating symptoms, thus deepening the knowledge of the association between ED and perfectionism (Dahlenburg et al., 2019). As we described above, higher PEL was linked to a higher prevalence of AN than BN. However, in our sample of ED individuals, higher PEL was associated with lower restrictive symptoms. We must underline that we recruited ED individuals during their first-ever hospitalization, thus in a very acute stage. In this context, higher PEL might be associated with lower restrictive symptoms in the context of a clinical diagnosis of AN, thus playing a positive role.

High PEL was associated with a younger age, earlier onset, and fewer years of illness. The earlier age of onset was explainable in two ways. On the one hand, it could represent an earlier distress sign and negative prognostic factor. However, on the other hand, higher PEL may correspond to an increased and improved time parents spend with their children (Oreopoulos et al., 2006), thus to higher attention on children's suffering and more economical and social possibilities of treatment. In this perspective, the younger age of onset might be due to an earlier detection of EDs cases. If the data are confirmed, higher PEL could be connected to earlier detection and intervention, representing a positive psychosocial factor associated with better outcomes in the long period (Treasure and Russell, 2011; Fukutomi et al., 2020; Austin et al., 2022).

Individuals with high PEL were more single and less engaged/married (see Supplementary Table S3). As we have seen, they were also more likely to be students and workers. These data could be at least partially due to an increased emphasis of families with high PEL on the importance of study and career, resulting in higher rates of schooling and employment, and a delay in romantic relationships.

Finally, individuals with fathers and both parents with high EL required a longer duration of the first-ever hospitalization, whereas no difference emerged concerning discharge against physicians'

decision. Since depression levels in a previous study were shown to increase the length of stay of hospitalization in AN (Panero et al., 2021), this association might be at least partially due to the higher depressive symptomatology among individuals with high PEL. In any case, clinicians must consider higher PEL as a psychosocial factor that could foster a lengthening of hospital treatments. This finding underscores the importance of considering the broader social context when developing treatment plans, and how therapeutic approaches could be tailored to accommodate the diverse needs of individuals from varying socioeconomic backgrounds (Marzola et al., 2022; Monteleone et al., 2023). Further, providing education and support to ED individuals and their families could enhance understanding of the condition and empower families to play a more active role in the treatment process (Couturier et al., 2010; Datta et al., 2023). This may involve offering resources such as psychoeducation, support groups, or counseling services (Treasure and Schmidt, 2013). In fact, in the Italian context of ED paths of care, multidisciplinary treatment models involving and including interventions on family members proved to lead to a better prognosis (Castellini et al., 2023). In this perspective, it would be all the more essential to identify moderators (like PEL).

5 Conclusion

Our study evidenced some interesting findings. First, PEL emerged as a twofold psychosocial factor. On the one hand, during hospitalization in an acute phase of the illness, in our sample of ED individuals, high PEL was associated with higher depressive symptoms and a longer length of stay. To achieve the same weight gain, patients with high PEL required more time and effort, and hence, more resources to be allocated. However, on the other hand, higher PEL was linked to a shorter duration of illness, and a higher scholar and working involvement. Second, higher PEL was not straightforwardly related to global perfectionism. Nevertheless, it was associated with higher personal standards, the strongest factor related to high PEL. Third, personal standards mediated the relationship between PEL and dietary restraint. Finally, the presence of a high educational level only in one parent presented some peculiar patterns. Specifically, suffering from AN rather than BN was associated with high paternal EL, and a history of substance abuse with low maternal EL. More research is required to identify peculiarities like these to differentiate factors such as paternal and maternal EL.

Some limitations of our study must be acknowledged. Firstly, we observed ED individuals during their first-ever hospitalization, hence during a very acute phase of the disorder. This offered us the possibility of a point of view different from what is available in literature. On the other hand, this implicated the bias of the possible existence of state effects that could be in addition to the trait ones. Second, the small size of the BN sample did not allow any sub-analysis based on diagnostic subtypes. Third, we utilized mainly self-report measures for what concerns psychological variables, and the parents' years of schooling as a proxy for their education level. Further, it was not possible to have information on the parents' marital status, which could act as a confounding factor. Fourth, the cross-sectional study design did not allow us to

conclude any causal relation but only statistical associations between variables. Fifth, since the sample was collected in an adult psychiatric service, we could not include underage patients. Finally, we assessed parental educational levels in families studying fathers and mothers. New forms of family are increasingly emerging inside our society, like, for example, single-parent and homogenitorial families. More research is required to expand the analysis to these possibilities other than traditional and assess whether our findings are replicated.

Identifying the psychosocial factors that contribute to modulating some aspects of EDs is important to improving and tailoring the treatments offered. According to the present study's findings, clinicians are recommended to consider family dynamics, parental educational level, and the role of features of perfectionism. Considering these psychosocial factors might lead clinicians to provide a more refined approach to individuals with EDs and their families.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Comitato etico Città Della Salute e della Scienza di Torino. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

FB: Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft. MM: Conceptualization, Data curation, Formal analysis, Writing – review & editing. PL: Conceptualization, Data curation, Writing – original draft. FT: Conceptualization, Data curation, Writing – original draft. AM: Data curation, Formal analysis, Writing – review & editing. LA: Data curation, Formal analysis, Writing – original draft. GA: Conceptualization, Data curation, Formal analysis, Supervision, Writing – review & editing, Writing – original draft. MP: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2024.1408695/full#supplementary-material>

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Direct and indirect effects of psychological well-being and therapeutic alliance on therapy outcome in eating disorders

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Introduction: Outcome research in eating disorders (EDs) is commonly focused on psychopathological dysfunction. However, Ryff’s model of psychological well-being (PWB) has shown promising—yet preliminary—results with ED patients. Additionally, despite substantial evidence highlighting the association between the therapeutic alliance and treatment outcome, findings in ED samples remain unclear. The present study aimed at exploring the direct effect of PWB dimensions and the early therapeutic alliance on ED patients’ individual treatment responses, as well as the mediating role played by the early therapeutic alliance in the relationship between PWB dimensions and overall pre-post symptom change.

Methods: A sample of $N = 165$ ED patients assigned female at birth, who were receiving treatment in a residential program, completed the Psychological Well-Being Scale at treatment intake and the Working Alliance Inventory after the first four psychotherapy sessions. Patients also completed the Outcome Questionnaire-45.2 at the same time point and during the week prior to discharge.

Results: The PWB dimensions of autonomy, positive relations, and self-acceptance were associated with clinically significant change, while the dimensions of personal growth and self-acceptance were associated with reliable change. The early therapeutic alliance showed both direct and indirect effects on therapy outcome, predicting clinically significant and reliable symptom reduction. It also emerged as a significant mediator in the relationship between all PWB dimensions and overall symptomatic change.

Conclusion: The identification of individual, adaptive characteristics in ED patients that might influence their development of an early therapeutic alliance may help therapists to predict relationship ruptures and tailor their interventions to enhance treatment effectiveness.

KEYWORDS

psychological well-being, therapeutic alliance, anorexia nervosa, bulimia nervosa, residential treatments, therapy outcome

1 Introduction

Eating disorders (EDs) are severe pathologies characterized by persistent disturbances in eating or weight control behaviors, as well as overconcern with weight and shape (Hilbert et al., 2017; Treasure et al., 2022). Due to their high complexity and tendency towards chronicity, they represent major areas of concern for clinicians, families, and society. EDs not only significantly impact patients' health, psychosocial functioning, and quality of life, but they also incur large costs for the healthcare system (Ágh et al., 2016). Despite ongoing progress in the development of ED treatment, data suggest that outcomes across diagnoses remain less than optimal. For instance, recent meta-analytic reviews (e.g., Solmi et al., 2024) have underlined high dropout rates and limited outcomes, especially for patients at lower weights, as well as high mortality, low recovery rates, and a significant rate of relapse or hospitalization, even after periods of significant symptomatic remission.

The severity and chronicity of EDs might explain the significantly greater focus on psychopathological symptoms over adaptive and positive functioning in the literature (de Vos et al., 2018). However, as the World Health Organization has described since 1948, mental health is more than simply the absence of mental disorder or pathological symptoms (World Health Organization, 2022). Rather, mental health exists on a continuum and is also influenced by protective factors, including well-being (Vaillant, 2012; Lingardi and McWilliams, 2017).

One of the most rigorously tested theoretically grounded models of *psychological well-being* (PWB) was introduced by Ryff (1989) and Ryff and Keyes (1995), whose framework refers to reliable indicators of positive functioning based on clinical and personality theories. In response to criticism of *subjective well-being* indicators (e.g., positive affect, life satisfaction) for ignoring key components of positive psychological functioning (Ryff and Singer, 2006), Ryff's PWB model evaluates how individuals function psychologically in response to life demands, based on the *eudaimonic* notion that well-being derives from the realization of human potential (Ryan and Deci, 2001). In more detail, PWB is a multidimensional concept comprised of six dimensions: (a) self-acceptance, referring to an awareness and acceptance of one's strengths and weaknesses; (b) positive relations, referring to deep and meaningful relationships with others; (c) personal growth, referring to progress as a result of the development of one's strengths; (d) autonomy, referring to self-determination and independent decision-making; (e) environmental mastery, referring to the management of one's personal circumstances to take advantage of opportunities; and (f) purpose in life, referring to the establishment and directed pursuit of personal goals. This conceptualization has also been operationalized into a structured, self-report instrument (Ryff and Keyes, 1995), which has found support on the basis of six evidential sources: factor validity, psychological correlates, cross-time dynamics, sociodemographic correlates, biological correlates, and therapeutic intervention efficacy (Ryff and Singer, 2006; Ryff, 2014; Browne et al., 2017; Blasco-Belled and Alsinet, 2022; van Dierendonck and Lam, 2023).

Within the field of EDs, most research has focused on health-related dimensions such as quality of life or subjective well-being (de la Rie et al., 2005; Doll et al., 2005; Jenkins et al., 2011; Mond et al., 2012). However, two relevant studies have explored PWB among ED outpatients (Tomba et al., 2014, 2017). The first study found that ED patients—and especially

those with bulimia nervosa (BN)—showed more severe impairment in PWB dimensions compared to a healthy control group, and that most PWB dimensions were negatively related to ED symptom severity (Tomba et al., 2014). A subsequent study on a sample of patients with mixed ED diagnoses found improvement in all PWB domains following the completion of an ED-specialized outpatient treatment program (Tomba et al., 2017). These findings suggest the relevance of assessing PWB in ED samples, in addition to the standard measurement of Body Mass Index (BMI), ED-related symptomatology, and behavioral parameters. Furthermore, other studies, despite not specifically related to Ryff's PWB model, have found that ED patients tend to adopt maladaptive interpersonal behaviors to regulate emotions, avoid confrontation, and manage negative experiences (Mason et al., 2022). ED patients have also been shown to suffer in the areas of self-directedness, self-awareness, and self-understanding, and to struggle with finding “meaning in life” (i.e., establishing a sense of personal coherence, purpose, and significance) (Marco et al., 2019). Although these variables have been found to influence ED treatment response (e.g., Jones et al., 2015; Muzi et al., 2021; Mirabella et al., 2023), evidence on the possible predictive role played by baseline PWB dimensions on therapy outcomes in this population are lacking.

Another widely debated variable in the ED field is the therapeutic alliance, defined as the collaborative relationship between patient and therapist, and comprised of three main elements: agreement on treatment goals, consensus on treatment tasks, and development of an affective bond (Bordin, 1979). Several meta-analyses have shown the therapeutic alliance to be a reliable predictor of positive treatment outcomes for various disorders, even after controlling for possible confounding variables (e.g., treatment setting, theoretical orientation), particularly in the early phases of psychotherapy (Flückiger et al., 2018; Del Re et al., 2021). However, the effect appears less clear for patients with EDs compared to those with other disorders, as quantitative research on the relationship between the therapeutic alliance and ED treatment outcome has yielded mixed results (Graves et al., 2017). Three meta-analytic studies have suggested that the therapeutic alliance is a central factor in the psychotherapy process and outcome for ED patients, given its apparent association with treatment completion, weight gain, decrease in depressive symptomatology and overall ED symptoms, and faster recovery, especially in patients with anorexia nervosa (AN) (Zaitsoff et al., 2015; Graves et al., 2017; Werz et al., 2022). Furthermore, research has also suggested that the therapeutic alliance might mediate symptom reduction in psychotherapy, providing greater clarity regarding the processes by which treatment leads to change (Baier et al., 2020). On the other hand, some studies have found no direct or interactive relation between the therapeutic alliance and ED treatment outcome (e.g., Brown et al., 2013; Raykos et al., 2014).

Related to the therapeutic alliance, research has shown that clinicians tend to report negative perceptions, attitudes, and emotional responses towards their ED patients (e.g., Colli et al., 2015; Groth et al., 2020). A potential explanation for this is that ED patients' struggle to maintain their body condition and their general difficulties in self-regulation may hinder the formation of a therapeutic alliance (Antonioni and Cooper, 2013). Additionally, the general egosyntonic nature of EDs may reinforce patients' ambivalence towards change and disagreement regarding treatment goals and tasks (Lev Ari et al., 2024).

These observations underline the need for a deeper understanding of the role played by the therapeutic alliance in ED treatment, and its

potential association with ED patient characteristics (Zaitsoff et al., 2015; Graves et al., 2017; Marzola et al., 2019). Nevertheless, to date, little is known about the individual factors that may contribute to (or hinder) the development of a strong therapeutic alliance with ED patients (Waller et al., 2012; Katznelson et al., 2020; Lev Ari et al., 2024). In this regard, several PWB dimensions may be explored as potential predictive factors for the therapeutic alliance with ED patients and the influence of the therapeutic alliance on ED treatment outcome (e.g., Prusiński, 2022). For instance, ED patients who experience empathic, satisfying, and trusting relationships with others may be more willing to establish a collaborative relationship with the therapist which, in turn, may positively affect their treatment response. Additionally, ED patients' strong sense of mastery and perceived capacity to make effective use of opportunities in their environment, as well as greater self-acceptance and self-directedness, may foster shared agreement on treatment goals and tasks, helping them bear the ambivalent feelings towards symptom change that are demonstrated by many ED patients, thereby enhancing treatment compliance.

1.1 Present study

Consistent with the clinical and empirical literature referenced above, the present study aimed at addressing two main issues. First, it explored the direct effects of PWB dimensions and the early therapeutic alliance on ED patients' responses to treatment. To address the impact of these variables on symptomatic change of each individual patient, the study applied the twofold criterion developed by Jacobson and Truax (1991). This criterion not only identifies patients who fail to improve during psychotherapy, but it also distinguishes between patients who improve to a level of normal functioning and those who improve significantly yet remain in a symptomatic range. Second, the research evaluated whether the early therapeutic alliance mediated the association between different PWB dimensions and treatment outcome, defined as the pre-post change in overall symptomatic impairment. Despite the limited research on this topic, we expected that baseline PWB dimensions—especially positive relations, self-acceptance, environmental mastery, and purpose in life (Tomba et al., 2014; Browne et al., 2017)—would predict clinically significant and reliable therapeutic change. Furthermore, despite the mixed findings on ED samples, we hypothesized that the early therapeutic alliance would significantly predict clinically significant and reliable symptom reduction (Zaitsoff et al., 2015; Graves et al., 2017). Furthermore, in line with studies showing an indirect effect of the therapeutic alliance on therapy outcome (Baier et al., 2020) and the potential relevance of ED patients' individual characteristics in determining this association (Prusiński, 2022; Lev Ari et al., 2024), we expected that the therapeutic alliance would mediate the relationship between PWB dimensions and overall symptomatic change.

2 Materials and methods

2.1 Participants

Participants were patients who had been consecutively admitted to a specialized, intensive, and psychodynamic-oriented residential

ED treatment center in Bologna (Italy) between September 2019 and June 2023. The inclusion criteria were: (a) at least 18 years of age; (b) a DSM-5/DSM-5-TR diagnosis of AN or BN, established at intake by the consensus of a licensed staff psychiatrist and a clinical psychologist, based on the Structured Clinical Interview for DSM-5 (SCID-5-CV; First et al., 2016); (c) assigned female at birth; and (d) lacking any organic syndrome, psychotic disorder, or syndrome with psychotic symptoms that could complicate the assessment of any study variable.

An initial sample of $N = 187$ patients met these criteria. Of these, five patients (2.7%) were excluded due to premature discharge or dropout and 17 (9.1%) were not considered due to missing data at treatment intake or discharge. Out of the final study sample of $N = 165$ patients who completed all assessment measures, 78 (47.3%) were diagnosed with AN-Restricting Type (AN-R), with an average baseline BMI of 15.46 kg/m^2 ($SD = 2.56$); 26 (15.8%) met the diagnostic criteria for AN-Purging Type (AN-P), with an average baseline BMI of 16.71 kg/m^2 ($SD = 2.28$); and 61 (37%) fulfilled the diagnostic criteria for BN, with an average BMI of 23.31 kg/m^2 ($SD = 2.82$). Participants' mean age was 22.7 years ($SD = 6.90$), and all were cisgender and White. Most patients were single or separated ($n = 159$, 96.4%) and had no previous instance of hospitalization in an ED specialized treatment center ($n = 86$, 58.9%). Their mean age of ED onset was 15.6 years ($SD = 4.01$). The majority of patients ($n = 103$, 67.3%) showed at least one comorbid DSM-5/DSM-5-TR clinical syndrome, as assessed by the SCID-5-CV. More specifically, 22 patients (13.3%) fulfilled the diagnostic criteria for major depressive disorder, 16 (9.7%) for obsessive-compulsive disorder, and 12 (7.2%) for a persistent depressive disorder. Other comorbid clinical syndromes were present in less than 5% of all patients. Additionally, 113 patients (72%) showed at least one comorbid DSM-5/DSM-5-TR personality disorder. Most patients met the diagnostic criteria for borderline personality disorder ($n = 49$, 29.7%) and obsessive-compulsive personality disorder ($n = 41$, 24.8%) as primary diagnoses, whereas a lower percentage of patients fulfilled the diagnostic criteria for avoidant personality disorder ($n = 7$, 4.2%), dependent personality disorder ($n = 4$, 2.4%), narcissistic personality disorder ($n = 3$, 1.8%), and schizoid personality disorder ($n = 3$, 1.8%). The remaining patients ($n = 6$, 3.6%) showed an other specified/unspecified personality disorder.

2.2 Measures

Sociodemographic and baseline clinical characteristics (e.g., age, marital status, length of stay in residential treatment, age of ED onset) were available from each patient's clinical chart.

2.2.1 Structured Clinical Interview for DSM-5, clinician version (SCID-5-CV)

The SCID-5-CV (First et al., 2016; see also Fossati and Borroni, 2017) is a semi-structured interview that is used to categorically assess psychopathology according to the DSM-5/DSM-5-TR. It is typically administered by a clinician who is familiar with the DSM diagnostic criteria. Interview questions are provided alongside each DSM criterion to aid users in rating each criterion as either present or absent. The SCID-5-CV has shown excellent reliability and high specificity, as assessed using different methods, as well as good clinical validity (Osório et al., 2019).

2.2.2 Psychological Well-Being scale (PWB)

The Psychological Well-Being Scale (PWB; Ryff and Singer, 1996; see also Ruini et al., 2003) is an 84-item measure derived from Ryff's (1989) theoretically grounded, multidimensional model of psychological well-being. It captures six PWB dimensions: autonomy, environmental mastery, personal growth, positive relations, purpose in life, and self-acceptance. Participants respond to each item using a 6-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Responses to negatively formulated items are reversed scored, so that higher scores indicate a higher self-rating on the assessed dimension. Scores for each dimensional scale range from 14–84. Previous studies have provided support for the PWB's good-to-excellent internal consistency and high test–retest reliability (Ryff, 1989, 2014). In the present sample, Cronbach's alpha for the six dimensions were: 0.84 for autonomy, 0.77 for environmental mastery, 0.76 for personal growth, 0.85 for positive relations, 0.81 for purpose in life, and 0.73 for self-acceptance.

2.2.3 Working Alliance Inventory-Patient Version (WAI-P)

The Working Alliance Inventory (WAI; Horvath and Greenberg, 1989; see also Lingardi, 2002) is a widely used 36-item self-report questionnaire based on Bordin's (1979) conceptualization of the therapeutic alliance. It consists of three subscales (i.e., Bond, Task, Goal) and also generates a total score. Each item is rated on a 7-point Likert scale ranging from 1 (*never*) to 7 (*always*). The inventory is comprised of a set of related measures that include client-, therapist-, and observer-rated versions. The present study utilized the patient-rated version and the WAI overall score. A large body of research supports the reliability (Hanson et al., 2002), construct validity (e.g., Tichenor and Hill, 1989), and predictive validity (e.g., Horvath et al., 2011) of the measure. Cronbach's alpha for the current sample was 0.89.

2.2.4 Outcome Questionnaire-45.2 (OQ-45.2)

The OQ-45.2 (Lambert et al., 2004; see also Chiappelli et al., 2008) is a 45-item self-report instrument that was designed to measure important areas of functioning (i.e., symptoms, interpersonal problems, social role) of central interest to mental health. Each item is rated on a 5-point Likert scale ranging from 0 (*never*) to 4 (*almost always*). The sum of item scores (after reverse coding select items) provides a total score, which the present study used as the outcome index. Previous studies have demonstrated the good internal consistency and test–retest reliability of the measure (Doerfler et al., 2002). In the present study, Cronbach's alpha for the OQ-45.2 total score was 0.87.

2.3 Residential treatment program

Patients were attending a multimodal residential treatment program with a main psychodynamic orientation applied to eating pathologies. Treatment included both individual and group psychotherapy (along with recreational and art therapy, social cooking, and social skills training), and the average treatment length was 175.9 days ($SD=67.31$, range=71–583). According to the most widespread practice guidelines for ED treatment, a team approach and patient-tailored perspective were the cornerstones of the therapeutic

program (American Psychiatric Association, 2006). A multidisciplinary team of specialized professionals (i.e., psychiatrists, psychologists, social workers, nutritionists, physicians, and nurses) met on a weekly basis to discuss cases within a psychodynamic theoretical framework.

Each patient received individual psychotherapy once or twice a week on the basis of a comprehensive examination of their psychological development, psychodynamic issues, cognitive style, comorbid psychopathology, and family situation. Contents of the individual psychotherapy sessions included interventions that focused on patients' feelings or desires, linked their current feelings and perceptions to past experiences in order to identify recurrent patterns, addressed patients' use of symptoms to manage intense and painful emotions, and used the therapeutic relationship as both a source of information about patients' interpersonal functioning and a vehicle through which to offer them a different model for relationships. In order to provide a therapeutic intervention that was tailored to each patient, therapists might also use more eclectic interventions such as psycho-education on ED symptoms, potential physical consequences of EDs, and treatment goals.

2.4 Procedures

During the first week of treatment, all patients were evaluated using the SCID-5-CV by a licensed staff psychiatrist and a clinical psychologist, to ensure fulfillment of the inclusion criteria. Patients were also asked to complete a self-report measure on psychological well-being. Additionally, height and weight were measured during a full medical examination, to calculate BMI. Moreover, at the same time point and during the week prior to discharge, all patients who agreed to participate completed self-report measures to assess overall psychopathological impairment. The therapeutic alliance was evaluated following the first four sessions of individual psychotherapy. Patients were asked to complete the self-report questionnaire on the therapeutic alliance referring to the clinician who was providing their individual psychotherapy. To reduce social desirability bias, patients were informed that their answers would not be shared with their treating clinicians, but would only be available to researchers. Participation was voluntary and written informed consent was provided by all study subjects prior to the assessments, following the review and approval of the study protocol by the local research ethics committee.

3 Statistical analyses

All analyses were performed using SPSS Version 27 for Windows and the *jAMM* package of the statistical software Jamovi (Gallucci, 2020), based on the R Studio package *lavaan* (Rosseel, 2019). Preliminarily, multivariate analyses of variance (MANOVAs) and bivariate correlations were conducted to check whether the PWB dimensions and early therapeutic alliance were influenced by the DSM-5 ED diagnosis (i.e., AN or BN), patient age, baseline BMI, previous hospitalizations for an ED, and treatment length. Subsequently, the clinical significance of therapeutic change was determined according to the criterion proposed by Jacobson and Truax (1991). To determine whether a patient's change was reliable or

the result of measurement error or chance, a reliable change index (RCI) was calculated by subtracting the post-treatment score from the pre-treatment score and dividing the resulting figure by the standard error of difference between the test scores. Patient change was considered reliable when it exceeded the measurement error at a 0.05 level of confidence. In the second step, a cut-off point (i.e., “criterion c”) was determined to assess whether a patient outcome score fell within the functional or dysfunctional population range. In the Italian population, the cut-off score was estimated as a total OQ-45.2 score of 66 (Chiappelli et al., 2008). Thus, the sample was classified into four outcome groups: (a) *clinically significant improvement*, with a pre-post decrease in the OQ-45.2 total score of more than 14 points and a cut-off score in the functional range; (b) *reliable improvement*, with a significant pre-post decrease in the OQ-45.2 total score but a cut-off score in the dysfunctional range; (c) *no change*, with no reliable change and a cut-off score in the dysfunctional range; and (d) *reliable deterioration*, with a pre-post increase in the OQ-45.2 total score of more than 14 points and a cut-off score in the dysfunctional range.

For the purpose of this study, and due to the small percentage of patients who deteriorated, patients were divided into three groups: those showing clinically significant change, those showing reliable therapeutic change, and those showing minimal change (i.e., unchanged and deteriorated patients).

Subsequently, multinomial logistic regression was used to investigate the direct effects of baseline PWB dimensions and the early therapeutic alliance on therapy outcome, with group membership at the end of therapy used as the outcome variable and scores for the six PWB dimensional scales and the WAI overall score used as predictors. The results were presented as odds ratios (ORs), showing how the likelihood of being in one outcome category changed when the value of the predictor was raised by one unit. If an OR was smaller than 1, the predictor was associated with a lower likelihood; in contrast, an OR greater than 1 suggested a higher likelihood by unit for the predictor.

Finally, separate mediation models of the relationship between pre-treatment PWB dimensions (i.e., PWB dimensional scale scores) and therapy outcome (i.e., OQ-45.2 total score) were tested to identify the mediating, indirect effect of the early therapeutic alliance (i.e., WAI overall score) on these relationships. A residualized change score was calculated for the OQ-45.2 total score by running a linear regression with the discharge values as the outcome and the baseline scores as the predictor. This score was then used in the mediation analyses. Bias-corrected 95% confidence intervals (CIs) were evaluated using the bootstrap percentiles method ($N=1,000$), with effects considered significant when the resulting CI did not contain 0. All continuous variables were grand mean centered to reduce collinearity. Any patient lacking an OQ-45.2 assessment at treatment intake or discharge was excluded from the analyses.

4 Results

4.1 Preliminary analyses

A preliminary MANOVA revealed no significant differences between AN and BN patients in baseline PWB dimensions (Wilks' λ [6,158] = 0.912, $p=0.22$, $\eta^2_p=0.04$) and the early therapeutic alliance (Wilks' λ [4,159] = 0.833, $p=0.51$, $\eta^2_p=0.02$). Similarly, no significant

differences were found between those patients who were previously hospitalized in an ED unit and those who did not with respect to both baseline PWB dimensions (Wilks' λ [6,158] = 1.504, $p=0.18$, $\eta^2_p=0.05$) and the early therapeutic alliance (Wilks' λ [4,159] = 0.856, $p=0.49$, $\eta^2_p=0.02$). PWB dimensions were unrelated to baseline BMI (i.e., autonomy $r=0.06$, $p=0.46$; environmental mastery $r=0.02$, $p=0.79$; personal growth $r=0.03$, $p=0.74$; positive relations $r=-0.03$, $p=0.66$; purpose in life $r=0.02$, $p=0.82$; self-acceptance $r=-0.01$, $p=0.92$) and patient age (i.e., autonomy $r=0.14$, $p=0.07$; environmental mastery $r=0.08$, $p=0.33$; personal growth $r=0.05$, $p=0.51$; positive relations $r=0.10$, $p=0.21$; purpose in life $r=0.02$, $p=0.85$; self-acceptance $r=0.03$, $p=0.74$). Furthermore, no significant associations were found between baseline PWB dimensions and treatment length (i.e., autonomy $r=-0.10$, $p=0.18$; environmental mastery $r=-0.14$, $p=0.09$; personal growth $r=-0.07$, $p=0.39$; purpose in life $r=-0.11$, $p=0.16$; self-acceptance $r=-0.12$, $p=0.12$), with the exception of the positive relations' dimension ($r=-0.19$, $p=0.02$). Lastly, the correlational analyses showed that the early therapeutic alliance was unrelated to patients' baseline BMI ($r=-0.08$, $p=0.30$) and age ($r=0.14$, $p=0.07$), as well as to treatment length ($r=-0.13$, $p=0.09$).

4.2 Clinical significance of pre-post treatment symptomatic change

Figure 1 shows the results pertaining to the clinical significance of symptomatic change. In detail, 43% of patients ($n=71$) met the twofold criterion for clinically significant improvement, and an additional 18.2% ($n=30$) showed reliable symptomatic change, despite remaining within the dysfunctional range of functioning. On the other hand, 33.9% ($n=56$) showed no significant change in overall symptomatic impairment and 6% ($n=8$) deteriorated.

4.3 Direct effects of baseline psychological well-being and the early therapeutic alliance on therapy outcome

As described above, patients with no significant post-treatment change and those who deteriorated were grouped together. Table 1 shows the results of the multinomial logistic regression analyses predicting therapy outcome based on the clinical significance criterion. All variables were entered simultaneously. Of note, the early therapeutic alliance was strongly associated with a greater likelihood of clinically significant change (OR = 2.58, CI [0.33, 1.57]) and reliable change (OR = 2.80, CI [0.24, 1.82]), rather than no change and deterioration. PWB autonomy, positive relations, and self-acceptance were also connected to clinically significant change, rather than no change and deterioration (respectively OR = 1.04, CI [0.01, 0.07]; OR = 1.06, CI [0.01, 0.10]; and OR = 1.11, CI [0.02, 0.19]). On the other hand, PWB personal growth and self-acceptance were significantly associated with reliable change, rather than no change and deterioration (respectively OR = 1.07, CI [0.01, 1.22]; and OR = 1.06, CI [0.01, 0.11]). Moreover, PWB autonomy was associated with a lower likelihood of reliable change compared to no change and deterioration (OR = 0.95, CI [-0.09, -0.01]). No significant effects of PWB dimensions and the early therapeutic alliance emerged

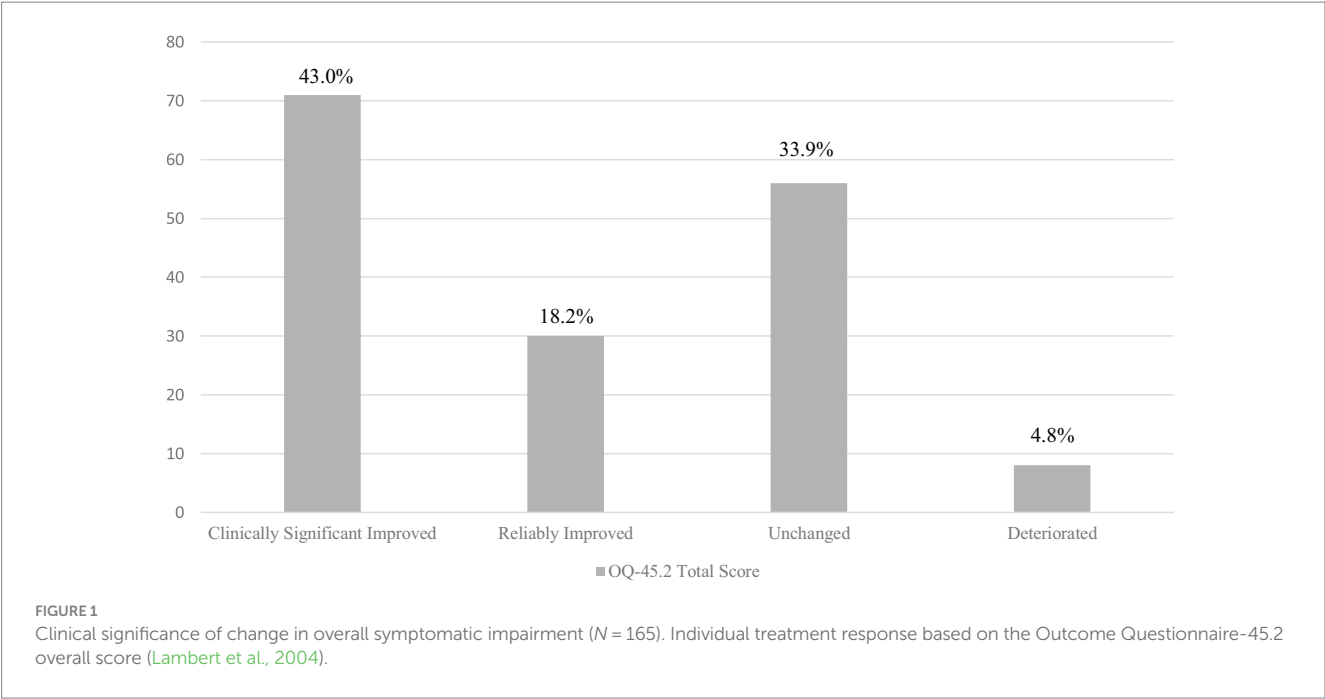


TABLE 1 Multinomial logistic regression analyses predicting individual treatment response (N = 165).

	Outcome groups		
	Clinically significant change vs. unchanged/deteriorated OR (95% CI)	Reliable change vs. unchanged/deteriorated OR (95% CI)	Clinically significant change vs. reliable change OR (95% CI)
PWB			
Autonomy	1.04 (0.002, 0.077)*	0.95 (−0.086, −0.006)*	1.01 (−0.024, 0.060)
Environmental mastery	1.01 (−0.042, 0.069)	0.98 (−0.076, 0.049)	1.02 (−0.043, 0.089)
Personal growth	1.03 (−0.018, 0.079)	1.07 (0.012, 0.122)**	0.96 (−0.099, 0.022)
Positive relations	1.06 (0.012, 0.099)**	0.98 (−0.064, 0.025)	0.98 (−0.076, 0.043)
Purpose in life	1.03 (−0.035, 0.090)	1.01 (−0.059, 0.077)	1.01 (−0.054, 0.092)
Self-acceptance	1.11 (0.022, 0.194)**	1.06 (0.008, 0.108)*	1.04 (−0.020, 0.099)
WAI			
Total score	2.58 (0.325, 1.572)***	2.80 (0.238, 1.823)**	1.01 (−0.949, 0.786)

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.
PWB, Psychological Well-Being scale (Ryff and Keyes, 1995); WAI, Working Alliance Inventory – Patient Version (WAI-P; Horvath and Greenberg, 1989). 95% CI, confidence interval; OR, odds ratio.
The reference groups were unchanged/deteriorated patients and patients with reliable change.

pertaining to the likelihood of clinically significant versus reliable change.

4.4 Indirect effects of the early therapeutic alliance in the relationship between psychological well-being and therapy outcome

Table 2 displays the complete associations between the six PWB dimensions, the early therapeutic alliance, and therapy outcome (i.e., the residualized change score from the pre-post OQ-45.2 total score).

The six mediational models—one for each PWB dimension—revealed significant indirect effects of the therapeutic alliance in the relationships between different PWB components and therapy outcome (see Table 3). Additionally, higher levels of different PWB dimensions predicted a better therapy outcome through an increased therapeutic alliance. Specifically, the first mediation model showed that the point estimate of the indirect effect between PWB autonomy and therapy outcome through the early therapeutic alliance was -0.091 ($SE = 0.04$, $p = 0.042$), and the bootstrapped 95% CI $[-0.196, -0.020]$ did not include 0, indicating that the indirect effect of the therapeutic alliance was significant. The total effect of the baseline PWB autonomy on therapy outcome was significant ($\beta = -0.22$, $p = 0.006$), whereas its direct effect was not

TABLE 2 Associations among psychological well-being dimensions, the therapeutic alliance, and therapy outcome (N = 165).

	1.	2.	3.	4.	5.	6.	7.	8.
1. PWB autonomy	—							
2. PWB environmental mastery	0.534	***	—					
3. PWB personal growth	0.458	***	0.634	***	—			
4. PWB positive relations	0.493	***	0.665	***	0.581	***	—	
5. PWB purpose in life	0.447	***	0.845	***	0.717	***	0.613	***
6. PWB self-acceptance	0.575	***	0.823	***	0.625	***	0.633	***
7. WAI total score	0.231	**	0.284	***	0.360	***	0.391	***
8. OQ-45.2 therapy outcome	−0.215	**	−0.434	***	−0.414	***	−0.357	***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
PWB, Psychological Well-Being scale (Ryff and Keyes, 1995); WAI, Working Alliance Inventory – Patient Version (WAI-P; Horvath and Greenberg, 1989); OQ-45.2, Outcome Questionnaire-45.2 (Lambert et al., 2004).

significant after controlling for the mediator ($\beta = -0.15$, $p = 0.077$). Also in the second mediation model, greater PWB environmental mastery was associated with better therapy outcome, through a better therapeutic alliance ($\beta = -0.07$, $p = 0.029$). The total effect of the baseline PWB environmental mastery on therapy outcome was significant ($\beta = -0.43$, $p < 0.001$), as was its direct effect after controlling for the mediator ($\beta = -0.35$, $p < 0.001$). The indirect effect of PWB personal growth through the therapeutic alliance on therapy outcome was also significant ($\beta = -0.09$, $p = 0.041$). The total effect of the baseline PWB personal growth on therapy outcome was significant ($\beta = -0.41$, $p < 0.001$), as was its direct effect after controlling for the mediator ($\beta = -0.31$, $p < 0.001$). Similar findings emerged in the fourth mediation model, which found that the therapeutic alliance mediated the link between PWB positive relations and therapy outcome ($\beta = -0.10$, $p = 0.025$). Both the total and the direct effects of the baseline PW positive relations on therapy outcome were also significant (respectively $\beta = -0.36$, $p < 0.001$; and $\beta = -0.30$, $p = 0.013$). The indirect effect of PWB purpose in life through the therapeutic alliance on therapy outcome was also significant ($\beta = -0.07$, $p = 0.042$), as were the total and direct effects of PWB purpose in life on therapy outcome (respectively $\beta = -0.48$, $p < 0.001$; and $\beta = -0.40$, $p < 0.001$). Finally, greater PWB self-acceptance was associated with better therapy outcome, through a better therapeutic alliance ($\beta = -0.07$, $p = 0.020$). The total effect of the baseline PWB self-acceptance on therapy outcome was significant ($\beta = -0.49$, $p < 0.001$), as was its direct effect after controlling for the mediator ($\beta = -0.42$, $p < 0.001$).

5 Discussion

To the best of our knowledge, the present study was the first to investigate both the role of baseline PWB dimensions in determining individual responses to ED treatment and the indirect effects of the

early therapeutic alliance in the relationship between the theoretically grounded concept of eudaimonic psychological well-being and ED therapy outcomes. Although previous studies have included measures of subjective well-being and health-related dimensions (e.g., Jenkins et al., 2011; Mond et al., 2012), or compared PWB dimensions in ED patients to those of healthy controls (e.g., Tomba et al., 2014), the present research shed new light on the relationship between ED patients' dimensions of positive psychological functioning and their trusting, collaborative relationships with treating clinicians in determining symptomatic change through psychotherapy. The findings align with broader recognition that outcome research in the field of EDs is dramatically biased towards psychopathological dysfunction, on the assumption that mental health is predicated on the absence of illness rather than the presence of psychological wellness (Fava and Tomba, 2009; de Vos et al., 2018). Additionally, evidence relating the therapeutic alliance to ED treatment outcome are of limited clinical use without a better understanding of the facilitators or barriers to therapeutic alliance formation in ED patients (Lev Ari et al., 2024).

Applying the clinical significance criterion of therapeutic change (Jacobson and Truax, 1991), the present study found that 43% of patients experienced clinically significant symptomatic improvement (shifting into the functional population range) and a further 18.2% responded reliably in terms of overall symptom reduction. However, a significant percentage of patients (33.9%) remained unchanged and an additional 4.8% showed reliable deterioration. These findings are congruent with previous studies on ED-specific residential treatment settings (Muzi et al., 2020) and inpatient facilities (Schlegl et al., 2014, 2016). Of note, when exploring the direct effects of PWB dimensions on individual treatment response, the results showed that patients' capacity to be self-determined and adhere to personal standards, to establish empathic, warm, and intimate relationships with others, and to maintain a nuanced and compassionate attitude towards the self were related to clinically significant change. In

TABLE 3 Mediation of the early therapeutic alliance in the relationship between psychological well-being dimensions and therapy outcome ($N = 165$).

Type	Effect	Estimate	SE	95% CI		β	p
				Lower	Upper		
Indirect	Autonomy \Rightarrow alliance \Rightarrow outcome	-0.091	0.043	-0.196	-0.020	-0.059	0.042
Component	Autonomy \Rightarrow alliance	0.012	0.005	0.002	0.022	0.192	0.004
	Alliance \Rightarrow outcome	-7.437	2.180	-12.317	-3.762	-0.309	<0.001
Direct	Autonomy \Rightarrow outcome	-0.231	0.130	-0.478	-0.016	-0.151	0.077
Total	Autonomy \Rightarrow outcome	-0.327	0.118	-0.532	-0.082	-0.215	0.006
Indirect	Environmental mastery \Rightarrow alliance \Rightarrow outcome	-0.106	0.048	-0.216	-0.021	-0.074	0.029
Component	Environmental mastery \Rightarrow alliance	0.020	0.005	0.011	0.031	0.341	<0.001
	Alliance \Rightarrow outcome	-5.214	2.309	-10.196	-1.141	-0.216	0.024
Direct	Environmental mastery \Rightarrow outcome	-0.513	0.128	-0.766	-0.258	-0.355	<0.001
Total	Environmental mastery \Rightarrow outcome	-0.622	0.106	-0.838	-0.409	-0.434	<0.001
Indirect	Personal Growth \Rightarrow Alliance \Rightarrow Outcome	-0.155	0.077	-0.329	-0.024	-0.086	0.041
Component	Personal Growth \Rightarrow Alliance	0.031	0.007	0.019	0.046	0.422	<0.001
	Alliance \Rightarrow Outcome	-4.911	2.171	-9.921	-0.869	-0.204	0.024
Direct	Personal Growth \Rightarrow Outcome	-0.571	0.148	-0.874	-0.287	-0.317	<0.001
Total	Personal Growth \Rightarrow Outcome	-0.735	0.119	-0.966	-0.515	-0.414	<0.001
Indirect	Positive Relations \Rightarrow Alliance \Rightarrow Outcome	-0.151	0.068	-0.291	-0.024	-0.095	0.025
Component	Positive Relations \Rightarrow Alliance	0.027	0.005	0.018	0.037	0.413	<0.001
	Alliance \Rightarrow outcome	-5.555	2.589	-11.055	-0.910	-0.230	0.032
Direct	Positive relations \Rightarrow outcome	-0.413	0.165	-0.751	-0.105	-0.296	0.013
Total	Positive relations \Rightarrow outcome	-0.570	0.133	-0.832	-0.319	-0.356	<0.001
Indirect	Purpose in life \Rightarrow alliance \Rightarrow outcome	-0.106	0.053	-0.224	-0.018	-0.069	0.042
Component	Purpose in life \Rightarrow alliance	0.023	0.005	0.014	0.035	0.360	<0.001
	Alliance \Rightarrow outcome	-4.635	2.285	-9.667	-0.840	-0.192	0.043
Direct	Purpose in life \Rightarrow outcome	-0.618	0.136	-0.887	-0.355	-0.403	<0.001
Total	Purpose in life \Rightarrow outcome	-0.724	0.108	-0.931	-0.508	-0.479	<0.001
Indirect	Self-acceptance \Rightarrow alliance \Rightarrow outcome	-0.085	0.036	-0.155	-0.013	-0.065	0.020
Component	Self-acceptance \Rightarrow alliance	0.017	0.004	0.009	0.025	0.322	<0.001
	Alliance \Rightarrow outcome	-4.890	1.749	-8.318	-1.462	-0.203	0.005
Direct	Self-acceptance \Rightarrow outcome	-0.544	0.094	-0.728	-0.360	-0.419	<0.001
Total	Self-acceptance \Rightarrow outcome	-0.627	0.090	-0.804	-0.450	-0.485	<0.001

CI, confidence interval; SE, standardized error.

Confidence intervals computed using bootstrap percentiles.

contrast, self-acceptance and personal growth (i.e., openness to new experiences and the realization of personal potential) were associated with reliable change. Previous ED research has shown that patients with greater identity confusion, greater difficulty distinguishing internal representations from external circumstances, more severe impairment in interpersonal functioning, and lower self-compassion are more likely to experience poor therapeutic outcomes (Kelly et al., 2013; Verschuere et al., 2017; Muzi et al., 2021). On the other hand, a higher baseline ability to construct a coherent and meaningful personal narrative, better interpersonal functioning, and a sense of directedness and purpose has been shown to be related to better therapeutic outcomes (Vall and Wade, 2015; Marco et al., 2019; Muzi et al., 2021). Thus, interventions targeting these areas of psychological strength may have pivotal clinical implications,

increasing motivation, treatment adherence, and therapeutic progress.

The present findings also showed that the early therapeutic alliance (i.e., within the first four therapy sessions) was associated with clinically significant and reliable change. Despite substantial evidence highlighting a potential alliance-outcome association in EDs (Zaitsoff et al., 2015; Graves et al., 2017), the precise implications of this association remain unclear. A possible explanation for the present result may lie in the time point at which this variable was measured: as the therapeutic alliance begins to form from the first meeting between therapist and patient, and early phases of the therapeutic relationship have been found to predict positive psychotherapy outcomes later on (Werz et al., 2022), the early therapeutic alliance may be significant to the relationship between the therapeutic alliance

and therapy outcome over time. Furthermore, this direct effect may be particularly relevant to specialized, full-time residential ED treatment settings, which are more likely to reward strong interpersonal relationships with members of the treatment team and other patients, compared to less intensive care settings (e.g., outpatient treatments, day treatment programs) (Peckmezier and Paxton, 2020).

With respect to the second aim of the study, the early therapeutic alliance also emerged as a significant mediator in the relationship between all baseline PWB dimensions and overall symptomatic change. While some studies have suggested an association between the therapeutic alliance and Ryff's concept of psychological well-being (Prusiński, 2022), evidence beyond the mental health context also suggests that the doctor–patient alliance, defined by agreement over treatment goals and tasks and mutual trust and liking, may be associated with patients' life satisfaction and quality of life (Fuertes et al., 2009). Additionally, the present results align with evidence showing the indirect effect of the therapeutic alliance on therapeutic change, despite heterogeneity between study designs, clinical populations, and treatment settings (Baier et al., 2020). These findings may have significant clinical implications for ED treatment. First, patients' baseline ability to build deep and trust-based relations with others may significantly impact their contribution to the collaborative relationships with their treating clinicians over the course of therapy, then, in turn, leading to better outcomes (Hersoug et al., 2013). Moreover, a sense of agency and the capacity to cope with complex environmental factors may influence, through a better therapeutic alliance, the therapeutic dyad's ability to tailor the therapeutic space to support the intense work process needed to recover from EDs (Bardone-Cone et al., 2018). This is also consistent with Ryff's (1989) psychological well-being model, which outlines that the most crucial factor for human development is an increase in the sense of self-directedness and the ability to transform the environment in accordance with one's values and needs. Furthermore, a positive but realistic attitude towards oneself and effective intrinsic behavioral regulation may help to foster the therapeutic relationship as an important stabilizing condition to counteract ED patients' fluctuating levels of subjective discomfort and ambivalence towards change (Lev Ari et al., 2024).

Notwithstanding these promising results, the present study suffered from several limitations that must be acknowledged in the interpretation of the results. First, all patients were recruited from a single residential ED treatment program, which hinders the generalizability of the findings to patients in other ED treatment settings (e.g., day programs, outpatient settings) and individuals suffering from other baseline EDs other than AN and BN (e.g., binge eating disorder, avoidant/restrictive food intake disorder). Furthermore, despite patients were asked to evaluate the perceived therapeutic alliance referring to clinicians who were providing individual psychotherapy, the multidisciplinary nature of the overall therapeutic approach may still represent a potential confounding variable (Elran-Barak et al., 2024). Second, the study only included White assigned females at birth, which limits the generalizability of the findings to assigned males, minority demographic populations, and individuals with other gender identities (e.g., Mirabella et al., 2024). Third, the present study only relied on self-report measures, which may be susceptible to response bias. Therefore, future research should address the study hypotheses using more diverse samples with different ED diagnoses using multi-informant assessment methods,

while also controlling for the treatment setting and therapeutic approach (e.g., psychodynamic, cognitive-behavioral, interpersonal). Given increasing evidence of relevant clinical challenges with less-studied ED diagnoses (Kambanis and Thomas, 2023; Solmi et al., 2024), further replication considering other ED patient groups is especially needed. Fourth, future research should also include therapists' and/or external ratings of the early therapeutic alliance. As the therapeutic alliance reflects a dyadic process in which both the patient and the therapist continuously perceive and influence each other's perspectives (Atzil-Slonim et al., 2015), it would be crucial to also examine the level of congruence between patient and therapist perspectives on the therapeutic alliance within ED treatment (e.g., Whelen et al., 2022). Of note, due to the complex nature of EDs, measures of therapeutic change should also take into account pre-post data on other parameters such as BMI and number of dietary restrictions, inappropriate compensatory behaviors or binge eating episodes per week. Future studies should also investigate the potential role of other relevant baseline variables (e.g., duration of illness; Broomfield et al., 2017), as well as the influence of individual factors such as attachment patterns (e.g., Tasca, 2019) or early traumatic experiences (e.g., Musetti et al., 2023), on both PWB dimensions and early therapeutic alliance.

Despite these limitations, the present study, which applied a theoretically grounded model of psychological well-being, enhances our understanding of the complex interplay between ED patients' positive psychological functioning, the early therapeutic alliance, and therapeutic change at both individual and overall levels. From a clinical standpoint, interventions targeting and promoting experiences of well-being may address the growing awareness that standard, symptom-oriented treatment for EDs may not be sufficient to determine a full recovery (Fava, 2016; Bardone-Cone et al., 2018). Conversely, previous studies have shown promising results on the effectiveness of interventions aimed at improving eudaemonic well-being in both clinical and nonclinical populations (van Dierendonck and Lam, 2023). Since EDs still represent a major global clinical and public health challenge, these findings suggest that current therapeutic programs might benefit from including interventions aimed at increasing overall positive human functioning. Such observations seem particularly relevant for residential treatments, which are commonly administered to patients with chronic, severe, and enduring forms of eating pathologies that are more likely to be unresponsive to treatment approaches that are solely symptom-oriented. Furthermore, a stronger alliance in the earliest stages of treatment appears to be an independent and interactive predictor of symptom reduction and one of the many processes driving change in ED patients. By identifying patient factors that may positively or negatively influence the therapeutic alliance in ED treatment, therapists may better prevent relationship ruptures and tailor their interventions to overcome these (Safran et al., 2011; Lingardi et al., 2018; Colli et al., 2019), thereby enhancing therapeutic outcomes for this difficult-to-treat population.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Research Ethics Committee of the Department of Dynamic and Clinical Psychology, and Health Studies, Sapienza University of Rome; reference number: 0000398. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

LM: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. NC: Data curation, Formal analysis, Methodology, Software, Writing – review & editing. MM: Investigation, Methodology, Supervision, Writing – review & editing. AF: Investigation, Project administration, Supervision, Writing – review & editing. MR: Methodology, Project administration, Supervision, Writing – review & editing. CM: Investigation, Methodology, Supervision, Writing – review & editing. VL: Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Is my body better than yours? Validation of the German version of the Upward and Downward Physical Appearance Comparison Scales in individuals with and without eating disorders

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Introduction: This study examines the psychometric properties of a German version of the Upward and Downward Physical Appearance Comparison Scales (UPACS and DACS).

Methods: A total of 2,114 participants, consisting of 1,360 women without eating disorders ($M_{age} = 25.73$, $SD_{age} = 6.84$), 304 men without eating disorders ($M_{age} = 24.48$, $SD_{age} = 6.34$), and 450 women with eating disorders ($M_{age} = 27.11$, $SD_{age} = 7.21$), completed the UPACS and DACS as well as further questionnaires on appearance comparisons, eating disorder pathology, and self-esteem.

Results: Structural equation modeling confirmed the proposed one-factor structure of the original English-language version of the DACS but not of the UPACS. Both scales showed good internal consistency and test-retest reliability. The UPACS and DACS showed the expected correlations with related constructs, indicating acceptable construct validity, with some limitations for women with eating disorders.

Discussion: Overall, this study indicates that the German versions of the UPACS and DACS are psychometrically suitable for assessing upward and downward physical appearance comparisons in women and men without eating disorders and women with eating disorders in research and clinical practice.

KEYWORDS

social comparison, upward physical appearance comparison, downward physical appearance comparison, validation, eating disorders, body image, body dissatisfaction

1 Introduction

Body dissatisfaction is a risk factor for the development of eating disorders (EDs, [Grabe et al., 2008](#); [Rohde et al., 2015](#)) and is strongly associated with appearance comparisons: The tripartite influence model of body image and eating disturbance proposes that comparing one's appearance to that of others mediates the influence of peers, parents, and media on body dissatisfaction ([Thompson et al., 1999](#)). In line with this, girls and women with ED symptoms have been found to engage more frequently in appearance comparisons than women without ED symptoms ([Corning et al., 2006](#); [Hamel et al., 2012](#)). Moreover, the association between appearance comparisons and body dissatisfaction is assumed to be stronger in women than

in men (Myers and Crowther, 2009), and research shows that women are more likely to engage in such comparisons (Strahan et al., 2006).

Adapted from Festinger (1954), appearance comparisons can take the form of upward comparisons, in which others are perceived as more attractive than oneself, or downward comparisons, in which others are perceived as less attractive. Upward appearance comparisons have frequently been related to lower self-esteem (Schmuck et al., 2019; Rütter et al., 2023), disordered eating (Blechert et al., 2009; Arigo et al., 2014), negative mood, and body dissatisfaction (Leahey et al., 2007, 2011; Ridolfi et al., 2011; Myers et al., 2012). The associations and effects of downward appearance comparisons, by contrast, are less clear. While many studies have reported associations of downward appearance comparisons with increased self-esteem (Pan and Peña, 2020), positive mood, and body satisfaction (van den Berg and Thompson, 2007; Bailey and Ricciardelli, 2010), others suggested that downward appearance comparisons do not have protective effects against body dissatisfaction and eating pathology (Fitzsimmons-Craft, 2017; Rogers et al., 2017), or even found associations with higher levels of body dissatisfaction (Vartanian and Dey, 2013), disordered eating (Drutschinin et al., 2018), drive for thinness, and restrained eating among women (Lin and Soby, 2016). The latter effect might be explained by the consideration that in general, downward comparisons are more commonly used as a coping strategy by individuals with low self-esteem (Wills, 1981). Additionally, the tendency to make upward appearance comparisons and the tendency to make downward appearance comparisons are associated with one another (O'Brien et al., 2009), indicating that people who engage in appearance comparisons do so in both directions, although upward appearance comparisons are often more prevalent (Ridolfi et al., 2011; McCarthy et al., 2023).

To assess general appearance comparisons in German-speaking individuals, the German version of the Physical Appearance Comparison Scale (PACS, original version: Thompson et al., 1991) is available and has been validated for women and men without EDs and women with anorexia nervosa (Mölbart et al., 2017). However, the PACS does not differentiate between upward and downward appearance comparisons. To overcome this limitation, O'Brien et al. (2009) developed the English-language Upward and Downward Physical Appearance Comparison Scales (UPACS and DACS). The UPACS and DACS are short and therefore economic scales consisting of 10 and eight items, respectively, with good internal reliability and construct validity. Principal component analysis revealed a one-factor solution for each scale. To the best of our knowledge, to date, there is no validated German-language questionnaire for the assessment of upward and downward appearance comparisons.

Therefore, the aim of the present study was to translate the UPACS and DACS into German and to examine the psychometric properties of the translated versions of both scales in a sample of women and men without EDs and women with EDs. We expected that women without EDs would show higher scores on the UPACS and DACS than men without EDs, as women tend to engage in appearance comparisons to a greater extent than men (Davison and McCabe, 2005; Strahan et al., 2006; O'Brien et al., 2009). Furthermore, we assumed that women with EDs would show higher scores on both scales than women without EDs, as appearance comparisons play a crucial role in the development of body dissatisfaction, which is in turn associated with EDs (Thompson et al., 1999; Leahey et al., 2011). Consistent with the original versions of the scales, we hypothesized a

one-factor structure for both the UPACS and the DACS for all examined subsamples (O'Brien et al., 2009). In terms of construct validity, when examining the correlations of the UPACS and DACS with related measures, we assumed (1) positive correlations with established questionnaires regarding general physical appearance comparisons and eating pathology, in line with the original research (O'Brien et al., 2009), and (2) negative correlations with self-esteem, given that upward appearance comparisons have been found to be harmful for self-esteem (Schmuck et al., 2019), while downward comparisons are more frequently used as a coping mechanism by individuals with low self-esteem (Wills, 1981). Overall, from a descriptive perspective, we postulated stronger effects for the UPACS than for the DACS, as upward appearance comparisons have been more conclusively related to body image disturbances.

2 Materials and methods

2.1 Participants

The sample for the present study consisted of $N = 2,114$ participants aged between 18 and 78 years ($M_{\text{age}} = 25.84$, $SD_{\text{age}} = 6.89$) who completed the UPACS and DACS and related measures across nine studies. The sample comprised $n = 1,360$ women without eating disorders ($M_{\text{age}} = 25.73$, $SD_{\text{age}} = 6.84$), $n = 304$ men without eating disorders ($M_{\text{age}} = 24.48$, $SD_{\text{age}} = 6.34$), and $n = 450$ women with eating disorders ($M_{\text{age}} = 27.11$, $SD_{\text{age}} = 7.21$, $n = 191$ anorexia nervosa, $n = 132$ bulimia nervosa, $n = 127$ binge eating disorder). Across the studies, $n = 338$ diagnoses were self-reported and $n = 112$ diagnoses were assessed using a structured clinical interview within the respective study (Structured Clinical Interview for DSM-IV, Wittchen et al., 1997; or Diagnostic Interview for Mental Disorders, Margraf et al., 2017). Some participants who took part in one of the nine studies were not included in the final sample: e.g., one man, who was the only man to self-report an ED, meaning that it was not possible to analyze a subsample of men with EDs; 117 participants with other or unclear EDs; nine participants with implausible or missing data (e.g., values outside the range of the respective scales); and seven participants under the age of 18 years. Participants' body mass index (BMI) ranged from 12.89 kg/m² to 65.31 kg/m² ($M_{\text{BMI}} = 23.68$, $SD_{\text{BMI}} = 6.37$). Across all participants, 9.46% were underweight (BMI < 18.50), 66.65% were of normal weight (BMI 18.50–24.99), 12.16% were overweight (BMI 25.00–29.99), and 11.73% were obese (BMI > 30.00). The characteristics of the subsamples of the different studies are displayed in Table 1.

2.2 Measures

2.2.1 Upward and Downward Physical Appearance Comparison Scales (UPACS and DACS)

The UPACS consists of 10 items assessing upward physical appearance comparisons and the DACS consists of eight items assessing downward physical appearance comparisons (O'Brien et al., 2009). For both scales, items are rated on a 5-point Likert scale from 1 = *strongly disagree* to 5 = *strongly agree*, with higher scores

TABLE 1 Sample characteristics within the different studies.

Study	<i>n</i> included in this study ^a	EDs ^b	ED assessment	BMI in kg/m ²	Age	UPACS	DACS
1. Voges et al. (2018)	<i>n</i> = 186 women (8.80%)	<i>n</i> = 33 AN <i>n</i> = 30 BN <i>n</i> = 9 BED	SCID-I	<i>Rg</i> = 12.89–45.17 <i>M</i> = 21.18 <i>SD</i> = 4.76	<i>Rg</i> = 18–34 <i>M</i> = 21.99 <i>SD</i> = 3.44	<i>Rg</i> = 1.00–5.00 <i>M</i> = 3.47 <i>SD</i> = 0.83	<i>Rg</i> = 1.00–4.75 <i>M</i> = 2.39 <i>SD</i> = 0.93
2. Voges et al. (2019)	<i>n</i> = 109 men (5.16%)	None		<i>Rg</i> = 18.59–26.88 <i>M</i> = 22.84 <i>SD</i> = 1.61	<i>Rg</i> = 18–31 <i>M</i> = 23.13 <i>SD</i> = 3.07	<i>Rg</i> = 1.00–4.80 <i>M</i> = 2.86 <i>SD</i> = 0.88	<i>Rg</i> = 1.00–5.00 <i>M</i> = 2.18 <i>SD</i> = 0.90
3. Voges et al. (2020)	<i>n</i> = 53 women (2.51%)	None		<i>Rg</i> = 19.05–22.76 <i>M</i> = 20.69 <i>SD</i> = 1.06	<i>Rg</i> = 18–28 <i>M</i> = 22.09 <i>SD</i> = 2.48	<i>Rg</i> = 1.00–5.00 <i>M</i> = 3.28 <i>SD</i> = 1.02	<i>Rg</i> = 1.00–4.13 <i>M</i> = 2.17 <i>SD</i> = 0.91
4. Voges et al. (2022)	<i>n</i> = 64 women <i>n</i> = 64 men (6.05%)	None		<i>Rg</i> = 17.59–30.64 <i>M</i> = 22.37 <i>SD</i> = 2.73	<i>Rg</i> = 18–30 <i>M</i> = 22.62 <i>SD</i> = 2.89	<i>Rg</i> = 1.00–4.90 <i>M</i> = 3.23 <i>SD</i> = 0.92	<i>Rg</i> = 1.00–4.00 <i>M</i> = 2.18 <i>SD</i> = 0.88
5. Quittkat et al. ^c	<i>n</i> = 58 women <i>n</i> = 53 men (5.25%)	None		<i>Rg</i> = 18.72–29.48 <i>M</i> = 22.93 <i>SD</i> = 2.50	<i>Rg</i> = 18–27 <i>M</i> = 22.41 <i>SD</i> = 2.18	<i>Rg</i> = 1.00–4.80 <i>M</i> = 3.21 <i>SD</i> = 0.91	<i>Rg</i> = 1.00–4.13 <i>M</i> = 2.30 <i>SD</i> = 0.86
6. Quittkat et al. (2023)	<i>n</i> = 120 women (5.68%)	<i>n</i> = 40 BED	DIPS	<i>Rg</i> = 18.71–61.56 <i>M</i> = 33.53 <i>SD</i> = 10.99	<i>Rg</i> = 22–49 <i>M</i> = 32.15 <i>SD</i> = 6.02	<i>Rg</i> = 1.00–4.90 <i>M</i> = 3.00 <i>SD</i> = 0.96	<i>Rg</i> = 1.00–5.00 <i>M</i> = 2.65 <i>SD</i> = 1.03
7. Ladwig et al. (2024) ^d	<i>n</i> = 651 women (30.79%)	<i>n</i> = 101 AN <i>n</i> = 66 BN <i>n</i> = 47 BED	Self-report	<i>Rg</i> = 13.38–65.31 <i>M</i> = 24.09 <i>SD</i> = 6.81	<i>Rg</i> = 18–63 <i>M</i> = 28.48 <i>SD</i> = 7.43	<i>Rg</i> = 1.00–5.00 <i>M</i> = 3.54 <i>SD</i> = 0.88	<i>Rg</i> = 1.00–5.00 <i>M</i> = 2.48 <i>SD</i> = 0.95
8. Holtmann et al. (2024) ^e	<i>n</i> = 396 women (18.73%)	<i>n</i> = 34 AN <i>n</i> = 23 BN <i>n</i> = 17 BED	Self-report	<i>Rg</i> = 13.96–49.47 <i>M</i> = 22.51 <i>SD</i> = 5.09	<i>Rg</i> = 18–78 <i>M</i> = 23.75 <i>SD</i> = 5.82	<i>Rg</i> = 1.00–5.00 <i>M</i> = 3.51 <i>SD</i> = 0.88	<i>Rg</i> = 1.00–5.00 <i>M</i> = 2.43 <i>SD</i> = 0.97
9. Present study	<i>n</i> = 282 women <i>n</i> = 78 men (17.03%)	<i>n</i> = 23 AN <i>n</i> = 13 BN <i>n</i> = 14 BED	Self-report	<i>Rg</i> = 14.20–62.10 <i>M</i> = 23.63 <i>SD</i> = 5.40	<i>Rg</i> = 18–68 <i>M</i> = 26.86 <i>SD</i> = 8.08	<i>Rg</i> = 1.00–5.00 <i>M</i> = 3.18 <i>SD</i> = 0.98	<i>Rg</i> = 1.00–5.00 <i>M</i> = 2.31 <i>SD</i> = 0.98

ED, eating disorder; BMI, body mass index; UPACS, Upward Physical Appearance Comparison Scale; DACS, Downward Physical Appearance Comparison Scale; AN, anorexia nervosa; BN, bulimia nervosa; BED, binge eating disorder; SCID-I, Structured Clinical Interview for DSM-IV; DIPS, Diagnostic Interview for Mental Disorders; *Rg*, range; *M*, mean; *SD*, standard deviation.
^aPercentage in parentheses: Proportion of the sample forming the whole sample (*N* = 2,114).
^bOnly women.
^cUnpublished data.
^dManuscript submitted for publication.
^eManuscript in preparation.

indicating a higher tendency for upward or downward physical appearance comparisons, respectively. In the original study, Cronbach's alpha was $\alpha = 0.93$ (women: $\alpha = 0.94$, men: $\alpha = 0.91$) for the UPACS and $\alpha = 0.90$ (women: $\alpha = 0.90$, men: $\alpha = 0.89$) for the DACS, and the two-week test–retest reliability was $r_{tt} = 0.79$ (UPACS) and $r_{tt} = 0.70$ (DACS). The English versions of the scales were translated into German by German-speaking members of the Department of Clinical Psychology and Psychotherapy of Osnabrück University (see [Supplementary material](#)). No back-translation process was administered; however, a bilingual translator compared the two versions of the scales and found only three minor expressions that could have been adapted but do not alter the content of the items.

2.2.2 Physical Appearance Comparison Scale

The PACS (Thompson et al., 1991) assesses the frequency of general appearance comparisons. The German version of the scale

consists of five items that are rated on a 5-point Likert scale ($1 = \textit{never}$ to $5 = \textit{always}$, Mölbert et al., 2017), with higher scores indicating a higher tendency for general physical appearance comparisons. The internal consistency for the current sample was acceptable, at McDonald's $\omega_t = 0.84$.

2.2.3 Eating Disorder Examination Questionnaire

The EDE-Q assesses the psychopathology of EDs (Fairburn and Beglin, 1994). The German version used in the present study encompasses 22 items across the four subscales *Restraint*, *Eating concern*, *Weight concern* and *Shape concern*. Items are rated on a 6-point Likert scale based on the frequency of certain behaviors in the past 28 days ($0 = \textit{no day}$ to $6 = \textit{every day}$) or the severity of the behaviors ($0 = \textit{not at all}$ to $6 = \textit{very much}$, Hilbert and Tuschen-Caffier, 2016). Higher scores indicate higher ED pathology. The internal consistency for the current sample was acceptable, at McDonald's $\omega_t = 0.98$ for the global score across the four subscales.

2.2.4 Eating Disorder Inventory-2

The EDI-2 assesses ED-related characteristics (Garner, 1991). The two subscales *Drive for thinness* and *Body dissatisfaction* of the German version used in the present study contain 16 items combined, rated on a 6-point Likert scale (1 = *never* to 6 = *always*, Paul and Thiel, 2005), with higher scores indicating a higher level of drive for thinness and body dissatisfaction, respectively. The internal consistencies for the current sample were acceptable, at McDonald's $\omega_1 = 0.95$ for the *Drive for thinness* subscale, and McDonald's $\omega_1 = 0.95$ for the *Body dissatisfaction* subscale.

2.2.5 Rosenberg Self-Esteem Scale

The RSES assesses general self-esteem (Rosenberg, 1965). The German version contains 10 items rated on a 4-point Likert scale (0 = *strongly disagree* to 3 = *strongly agree*, Ferring and Filipp, 1996), with higher scores indicating higher self-esteem. The internal consistency for the current sample was acceptable, at McDonald's $\omega_1 = 0.95$.

2.3 Procedure

As the German-language versions of the UPACS and DACS were part of several different studies conducted at the Department of Clinical Psychology and Psychotherapy of Osnabrück University, data were available from eight studies conducted between 2016 and 2023 [Study 1: Voges et al., 2018; Study 2: Voges et al., 2019; Study 3: Voges et al., 2020; Study 4: Voges et al., 2022; Study 5: unpublished data; Study 6: Quittkat et al., 2023; Study 7: Ladwig et al., 2024 (manuscript submitted for publication); Study 8: Holtmann et al., 2024 (manuscript in preparation)]. Study 9 was performed in order to obtain additional data, particularly regarding convergent validity with the PACS, to ensure an appropriate sample size for men, and to examine the test–retest reliability. The ninth study was the only study in which men with eating disorders or non-binary people could have participated. Unfortunately, only one man with an eating disorder and no non-binary people participated; therefore, no analyses for these groups could be conducted. In the nine studies, data were collected using either an online survey presented in Unipark or LimeSurvey, or through paper-and-pencil questionnaires. Participants were required to be at least 18 years old and were primarily recruited through email distribution lists, flyers, social media posts (e.g., on Instagram), and cooperation with clinics.

In all nine studies, participants provided sociodemographic information and completed the UPACS and DACS, EDE-Q, EDI-2, and RSES. The PACS was administered in Studies 8 and 9 only. Participants who completed the questionnaires in Study 9 received an email asking them to complete the UPACS and DACS again 2 weeks later, and were reminded to take part in the retest a further week later. In total, $n = 232$ participants ($n = 142$ women without EDs, $n = 50$ men without EDs, $n = 40$ women with EDs) completed both assessments.

For the sample of women with EDs, EDs were either self-reported by participants or assessed using a structured clinical interview. While Study 1 used the Structured Clinical Interview for DSM-IV (SCID-I, Wittchen et al., 1997), Study 6 examined EDs using the Diagnostic Interview for Mental Disorders (DIPS, Margraf et al., 2017).

2.4 Data analysis

Descriptive data, comparisons between groups, and correlation analyses were calculated using IBM SPSS (version 28.0.1.1). McDonald's ω_1 was calculated using the *psych* package in R (version 4.3.2). Structural equation modeling (SEM) was performed using the *lavaan* package in R. As the assumption of normality was violated (Kolmogorov–Smirnov tests with Lilliefors correction, $p < 0.001$ for each respective scale in every subsample), Mann–Whitney U tests were performed to compare (a) the scores on the EDI-2 subscales and the EDE-Q global score between women with self-reported EDs and women with EDs diagnosed within a respective study, and (b) the UPACS and DACS scores between women and men without EDs and between women with and without EDs. All further analyses were conducted separately for (1) women without EDs, (2) men without EDs, and (3) women with EDs. The internal consistency was considered acceptable at McDonald's $\omega_1 > 0.65$ (Kalkbrenner, 2023). SEM with maximum likelihood estimation was used to examine whether the one-factor structure of the original scales can be transferred to the German versions. The fit/misfit indices χ^2 , CFI, NNFI, RMSEA, and SRMR were determined to assess the goodness of fit of the one-factor models. The thresholds for good fit were CFI ≥ 0.97 , NNFI ≥ 0.97 , RMSEA ≤ 0.05 and SRMR ≤ 0.05 , and the thresholds for acceptable fit were CFI ≥ 0.95 , NNFI ≥ 0.95 , RMSEA ≤ 0.08 and SRMR ≤ 0.10 (adapted from West et al., 2012). In the case of a poor model fit, possible re-specifications were examined through modification indices, solely for exploratory purposes in order to discuss possible future adaptations of the scales. Furthermore, measurement invariance across all subsamples was examined. Following Putnick and Bornstein (2016), measurement invariance was tested in four steps: (1) configural invariance, (2) metric invariance (loading invariance), (3) scalar invariance (intercept invariance) and (4) residual invariance. Invariance was defined based on the recommendations by Chen (2007). Thresholds that indicated non-invariance were $\Delta\text{CFI} \leq -0.005$, $\Delta\text{RMSEA} \geq 0.010$, and $\Delta\text{SRMR} \geq 0.025$ for metric invariance and $\Delta\text{SRMR} \geq 0.005$ for scalar and residual invariance. As tests of correlations against 0 are robust to non-normality (Fowler, 1987), Pearson correlations were used to assess test–retest reliability and correlations with related constructs. The test–retest reliability was calculated by correlating the first and second assessments of the UPACS and DACS. To examine construct validity, the PACS, the subscales of the EDI-2, the EDE-Q, and the RSES were correlated with the UPACS and DACS. Furthermore, the UPACS and DACS were correlated with each other. Bonferroni correction was applied for the correlations regarding construct validity within each subsample, thus correcting for 11 significance tests in each case.

3 Results

3.1 Preliminary analyses

When comparing women with self-reported EDs and women with EDs diagnosed within one of the studies, no significant differences emerged regarding the *Body dissatisfaction* subscale of the EDI-2, $z = 0.48$, $p = 0.64$. However, the two groups differed significantly on the *Drive for thinness* subscale of the EDI-2, $z = 3.34$, $p < 0.001$, and on the EDE-Q, $z = 3.69$, $p < 0.001$, with women with

self-reported EDs showing significantly higher levels of ED pathology. In order to include a greater range and variability of ED pathology, the further analyses include both women with diagnosed and self-reported EDs.

As expected, women without EDs showed significantly higher scores on the UPACS than men without EDs, $z=6.75$, $p<0.001$, and significantly lower scores than women with EDs, $z=12.21$, $p<0.001$. Likewise, women without EDs showed significantly higher scores on the DACS than men without EDs, $z=4.56$, $p<0.001$, and significantly lower scores than women with EDs, $z=6.66$, $p<0.001$.

The corrected item-total correlations (all ≥ 0.50) for the UPACS and DACS items were good in every subsample, indicating that all items correlate sufficiently with each respective scale (see [Tables 2, 3](#)). None of the items were normally distributed, as indicated by Kolmogorov–Smirnov tests with Lilliefors correction (all $p<0.001$). Skewness and kurtosis of all items as well as box plots for the UPACS and DACS can be derived from the [Supplementary material](#).

3.2 Confirmatory factor analyses

The results of the SEM analyses for the different subsamples are displayed in [Table 4](#). Regarding the UPACS, the one-factor structure showed a poor fit on all examined indices, with the exception of the

SRMR for all subsamples, which indicated an acceptable fit. Across all subsamples, the standardized loadings of the items were $0.46 \leq \lambda^* \leq 0.92$ (see [Table 5](#)). Invariance testing did not support configural invariance in the CFI and RMSEA; only the SRMR indicated an acceptable fit. Therefore, the further steps are not reported, but can be derived from [Table 6](#). In sum, these results indicate that the proposed one-factor structure of the German UPACS is not adequate for all subsamples. For exploratory purposes, we examined re-specifications based on modification indices. In all subsamples, modification indices indicated a substantial improvement of the model fit when allowing for correlations of the errors of the two items “I find myself thinking about whether my own appearance compares well with models and movie stars” and “I tend to compare my own physical attractiveness to that of magazine models” (see [Table 4](#), all $MI>90$), indicating a redundancy of the item contents ([Byrne, 2016](#)). Despite the poor fit, the further analyses were nevertheless conducted for the entire 10-item UPACS in order to examine the psychometric properties in parallel to the original version, and because the good item-total correlations still indicate sufficient relations of each item with the rest of the scale.

Concerning the DACS, for all subsamples, the one-factor structure showed a good fit according to the CFI and SRMR, an acceptable fit according to the NNFI, and a mediocre fit according to the RMSEA. Across all subsamples, the standardized loadings of the items

TABLE 2 Means, standard deviations, and corrected item-total correlations for the UPACS in different subsamples.

UPACS items	Women without EDs (<i>n</i> = 1,360)			Men without EDs (<i>n</i> = 304)			Women with EDs (<i>n</i> = 450)		
	<i>M</i>	<i>SD</i>	Corrected item-total correlation	<i>MD</i>	<i>SD</i>	Corrected item-total correlation	<i>M</i>	<i>SD</i>	Corrected item-total correlation
1. I compare myself to those who are better looking than me rather than those who are not.	3.68	1.02	0.58	3.45	1.05	0.62	4.21	0.90	0.50
2. I tend to compare my own physical attractiveness to that of magazine models.	2.35	1.27	0.54	1.87	1.10	0.50	2.98	1.28	0.53
3. I find myself thinking about whether my own appearance compares well with models and movie stars.	2.52	1.28	0.55	2.22	1.22	0.55	2.89	1.37	0.50
4. At the beach or athletic events (sports, gym, etc.) I wonder if my body is as attractive as the people I see there with very attractive bodies.	3.30	1.25	0.68	3.00	1.20	0.70	3.62	1.30	0.53
5. I tend to compare myself to people I think look better than me.	3.65	1.08	0.79	3.20	1.19	0.81	4.22	0.95	0.66
6. When I see a person with a great body, I tend to wonder how I 'match up' with them.	3.46	1.16	0.78	3.06	1.27	0.83	4.15	1.01	0.71
7. When I see good-looking people I wonder how I compare to them.	3.49	1.14	0.82	3.03	1.20	0.85	4.12	0.98	0.75
8. At parties or other social events, I compare my physical appearance to the physical appearance of the very attractive people.	3.38	1.21	0.81	2.87	1.24	0.83	4.00	1.07	0.74
9. I find myself comparing my appearance with people who are better looking than me.	3.56	1.09	0.84	3.11	1.20	0.85	4.14	0.96	0.77
10. I compare my body to people who have a better body than me.	3.58	1.12	0.83	3.21	1.22	0.82	4.20	0.92	0.79

UPACS, Upward Physical Appearance Comparison Scale; ED, eating disorder; M, mean; SD, standard deviation.

TABLE 3 Means, standard deviations and corrected item-total correlations for the DACS in different subsamples.

DACS items	Women without EDs (<i>n</i> = 1,360)			Men without EDs (<i>n</i> = 304)			Women with EDs (<i>n</i> = 450)		
	<i>M</i>	<i>SD</i>	Corrected item-total correlation	<i>M</i>	<i>SD</i>	Corrected item-total correlation	<i>M</i>	<i>SD</i>	Corrected item-total correlation
1. When I see a person who is physically unattractive I think about how my body compares to theirs.	2.86	1.26	0.69	2.54	1.27	0.73	3.42	1.29	0.60
2. I tend to compare my body to those who have below average bodies.	2.26	1.10	0.69	1.98	1.03	0.76	2.75	1.25	0.55
3. At the beach, gym, or sporting events I compare my body to those with less athletic bodies.	2.49	1.19	0.69	2.21	1.08	0.66	2.73	1.27	0.64
4. I compare myself to people less good looking than me.	2.39	1.11	0.82	2.07	0.98	0.83	2.55	1.20	0.79
5. I think about how attractive my body is compared to overweight people.	2.39	1.27	0.69	2.08	1.15	0.62	2.90	1.37	0.64
6. At parties I often compare my looks to the looks of unattractive people.	2.04	1.06	0.79	1.88	0.95	0.79	2.41	1.22	0.80
7. I often compare myself to those who are less physically attractive.	2.16	1.09	0.85	1.92	0.99	0.85	2.48	1.27	0.83
8. I tend to compare my physical appearance with people whose bodies are not as physically appealing.	2.23	1.11	0.84	1.98	1.02	0.83	2.50	1.21	0.84

DACS, Downward Physical Appearance Comparison Scale; ED, eating disorder; *M*, mean; *SD*, standard deviation.

TABLE 4 Structural equation modeling for the UPACS and DACS in different subsamples.

Model	MI	χ^2	<i>df</i>	CFI	NNFI	RMSEA [90% CI]	SRMR
Women without EDs (<i>n</i> =1,360)							
UPACS		883.25***	35	0.918	0.895	0.133 [0.126, 0.141]	0.060
UPACS mod. Items 2 and 3	320.67	523.42***	34	0.953	0.938	0.103 [0.095, 0.111]	0.036
DACS		202.70***	20	0.977	0.967	0.082 [0.072, 0.092]	0.024
Men without EDs (<i>n</i> =304)							
UPACS		241.09***	35	0.915	0.890	0.139 [0.123, 0.156]	0.060
UPACS mod. Items 2 and 3	74.42	157.14***	34	0.949	0.933	0.109 [0.092, 0.127]	0.034
DACS		68.83***	20	0.973	0.962	0.090 [0.067, 0.113]	0.033
Women with EDs (<i>n</i> =450)							
UPACS		287.18***	35	0.899	0.871	0.127 [0.113, 0.140]	0.064
UPACS mod. Items 2 and 3	94.64	183.13***	34	0.941	0.921	0.099 [0.085, 0.113]	0.044
DACS		90.35***	20	0.970	0.957	0.088 [0.070, 0.107]	0.035

Structural equation modeling with maximum likelihood estimation, including re-specification analysis for the UPACS, in which suggestions are made to allow for correlation of errors between items. The suggestion with the highest MI in each subsample is reported. UPACS, Upward Physical Appearance Comparison Scale; UPACS mod., re-specification analysis for the UPACS; DACS, Downward Physical Appearance Comparison Scale; CFI, comparative fit index; NNFI, non-normed fit index; RMSEA, root mean square error of approximation; CI, confidence interval; SRMR, standardized root mean square residual; ED, eating disorder. The specific items can be derived from [Tables 2, 3](#). **p* < 0.05, ***p* < 0.01, ****p* < 0.001.

lay at $0.55 \leq \lambda^* \leq 0.91$ (see [Table 7](#)). Tests of measurement invariance supported configural and metric invariance (see [Table 6](#)). For scalar and residual invariance, the changes in the CFI lay above the threshold, indicating non-invariance, but the changes in the RMSEA and SRMR lay below the respective thresholds. Therefore, scalar and residual invariance were only partially supported. Taken together, these results indicate that the proposed one-factor structure of the German DACS is acceptable for all subsamples.

3.3 Internal consistency

For women without EDs (*n* = 1,360), the internal consistencies of the two scales were acceptable, at McDonald's $\omega_i = 0.95$ for the UPACS and McDonald's $\omega_i = 0.94$ for the DACS. Similarly, for men without EDs (*n* = 304), the internal consistencies were acceptable, at McDonald's $\omega_i = 0.96$ for the UPACS and McDonald's $\omega_i = 0.95$ for the DACS. For women with EDs (*n* = 450), internal consistency was

acceptable for the UPACS, at McDonald's $\omega_1 = 0.93$, and for the DACS, at McDonald's $\omega_1 = 0.94$.

3.4 Test–retest reliability

The test–retest reliability could only be determined for participants who took part in the retest in Study 9 ($n = 232$). On average, the interval between the first and second assessment of the UPACS and DACS lay at $M = 16.47$ days ($SD = 4.65$). For women without EDs ($n = 142$), the test–retest reliability was $r_{tt} = 0.86$, $p < 0.001$ for the UPACS and $r_{tt} = 0.70$, $p < 0.001$ for the DACS. For men without EDs ($n = 50$), the test–retest reliability was $r_{tt} = 0.80$, $p < 0.001$ for the UPACS and $r_{tt} = 0.64$, $p < 0.001$ for

the DACS. For women with EDs ($n = 40$), the test–retest reliability was $r_{tt} = 0.84$, $p < 0.001$ for the UPACS and $r_{tt} = 0.71$, $p < 0.001$ for the DACS.

3.5 Construct validity

In women and men without EDs, the UPACS and DACS showed significant positive correlations with each other, indicating that a higher tendency for upward appearance comparisons is associated with a higher tendency for downward comparisons, and vice versa (see Tables 8, 9). For women without EDs, the correlation between the UPACS and DACS was not significant (see Table 10).

As hypothesized, in women without EDs (see Table 8), the UPACS and DACS scores showed significant positive correlations with the PACS, the two subscales of the EDI-2 and the EDE-Q. The UPACS and DACS scores showed significant negative correlations with the RSES scores. All effect sizes were descriptively higher for the correlations with the UPACS than for the correlations with the DACS.

In men without EDs, the correlations followed a similar pattern as in women without EDs (see Table 9). From a descriptive perspective, in men, the effect sizes for the correlations of the EDE-Q with the UPACS and DACS differed marginally. Furthermore, the effect size of the correlation of the EDI-2 subscale *Drive for thinness* with the DACS was slightly higher than that with the UPACS. Overall, all effect sizes were descriptively smaller in men than in women without EDs, indicating stronger associations of upward and downward appearance comparisons with related constructs in women than in men without EDs.

A different pattern emerged in women with EDs (see Table 10). The correlations of the PACS, the EDI-2 subscale *Drive for thinness*, and the EDE-Q with the UPACS and DACS were in the expected direction, with stronger effect sizes for the UPACS. The RSES showed a significant negative correlation with the UPACS but not with the DACS. The EDI-2 subscale *Body dissatisfaction* was not significantly correlated with either the UPACS or the DACS.

TABLE 5 Standardized loadings for structural equation modeling for the UPACS in different subsamples.

UPACS item	Standardized loadings λ^* for women without EDs ($n = 1,360$)	Standardized loadings λ^* for men without EDs ($n = 304$)	Standardized loadings λ^* for women with EDs ($n = 450$)
Item 1	0.61	0.65	0.56
Item 2	0.49	0.47	0.49
Item 3	0.50	0.53	0.46
Item 4	0.68	0.72	0.54
Item 5	0.84	0.84	0.73
Item 6	0.81	0.85	0.75
Item 7	0.86	0.89	0.79
Item 8	0.86	0.87	0.82
Item 9	0.92	0.91	0.87
Item 10	0.90	0.87	0.87

Structural equation modeling with maximum likelihood estimation. UPACS, Upward Physical Appearance Comparison Scale. ED, eating disorder. The specific items can be derived from Table 2.

TABLE 6 Measurement invariance across all subsamples.

Model	χ^2	$\Delta\chi^2$	df	Δdf	CFI	ΔCFI	RMSEA [90% CI]	$\Delta RMSEA$	SRMR	$\Delta SRMR$
UPACS										
Configural	1411.52***		105		0.915		0.133 [0.127, 0.139]		0.056	
Metric	1436.89***	25.37	123	18	0.914	−0.001	0.123 [0.117, 0.129]	−0.010	0.062	0.006
Scalar	1512.51***	75.62***	141	18	0.910	−0.004	0.117 [0.112, 0.123]	−0.006	0.065	0.003
Residual	1609.19***	96.68***	161	20	0.905	−0.005	0.113 [0.108, 0.118]	−0.004	0.069	0.004
DACS										
Configural	361.88***		60		0.975		0.084 [0.076, 0.093]		0.025	
Metric	416.17***	54.29***	74	14	0.971	−0.004	0.081 [0.074, 0.089]	−0.003	0.044	0.019
Scalar	527.63***	111.46***	88	14	0.963	−0.008	0.084 [0.077, 0.091]	0.003	0.048	0.004
Residual	749.27**	221.64***	104	16	0.946	−0.017	0.094 [0.088, 0.100]	0.010	0.051	0.003

Test of measurement invariance via structural equation modeling with maximum likelihood estimation. Differences Δ indicate the change in the respective index between two consecutive steps. UPACS, Upward Physical Appearance Comparison Scale; DACS, Downward Physical Appearance Comparison Scale; CFI, comparative fit index; NNFI, non-normed fit index; RMSEA, root mean square error of approximation; CI, confidence interval; SRMR, standardized root mean square residual; ED, eating disorder.

** $p < 0.01$, *** $p < 0.001$.

TABLE 7 Standardized loadings for structural equation modeling for the DACS in different subsamples.

DACS item	Standardized loadings λ^* for women without EDs ($n = 1,360$)	Standardized loadings λ^* for men without EDs ($n = 304$)	Standardized loadings λ^* for women with EDs ($n = 450$)
Item 1	0.70	0.73	0.60
Item 2	0.71	0.76	0.55
Item 3	0.70	0.67	0.65
Item 4	0.85	0.88	0.84
Item 5	0.71	0.63	0.66
Item 6	0.84	0.83	0.87
Item 7	0.90	0.91	0.90
Item 8	0.89	0.89	0.90

Structural equation modeling with maximum likelihood estimation. DACS, Downward Physical Appearance Comparison Scale. ED, eating disorder. The specific items can be derived from Table 3.

TABLE 8 Means, standard deviations, and correlations of the UPACS and DACS and related measures in women without eating disorders.

Scale	<i>n</i>	<i>M</i>	<i>SD</i>	UPACS	DACS
UPACS	1,360	3.30	0.90	–	0.31***
DACS	1,360	2.35	0.94	0.31***	–
PACS	554	2.84	0.79	0.73***	0.42***
EDI-2 BD	1,360	3.21	1.20	0.29***	0.23***
EDI-2 DFT	1,360	2.64	1.21	0.39***	0.27***
EDE-Q	1,360	1.42	1.17	0.36***	0.24***
RSES	1,360	2.15	0.60	–0.37***	–0.20***

UPACS, Upward Physical Appearance Comparison Scale; DACS, Downward Physical Appearance Comparison Scale; PACS, Physical Appearance Comparison Scale; EDI-2, Eating Disorder Inventory-2; BD, Body dissatisfaction; DFT, Drive for thinness; EDE-Q, Eating Disorder Examination Questionnaire; RSES, Rosenberg Self-Esteem Scale; *M*, mean; *SD*, standard deviation. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ with Bonferroni correction.

4 Discussion

The aim of the present study was to investigate the German-language versions of the UPACS and DACS in different samples of women and men without EDs and women with EDs. Using data collected over nine studies, we examined the psychometric properties and factor structure of both scales.

Regarding the factor structure of the scales, the results of the SEM and tests of measurement invariance indicated that the one-factor structure of the original English-language version is adequate for the DACS but not for the UPACS in all subsamples. Exploratory re-specifications based on modification indices indicated that the poor fit could be due to two similar items, concerning upward appearance comparisons with “magazine models” and with “models and movie stars.” When allowing for correlation of the residuals of these two items, the fit of the one-factor model improved noticeably, suggesting that these items are closely interrelated, possibly due to the similar wording of the items. As both items

TABLE 9 Means, standard deviations, and correlations of the UPACS and DACS and related measures in men without eating disorders.

Scale	<i>n</i>	<i>M</i>	<i>SD</i>	UPACS	DACS
UPACS	304	2.90	0.94	–	0.41***
DACS	304	2.08	0.86	0.41***	–
PACS	78	2.56	0.78	0.59***	0.38**
EDI-2 BD	304	2.41	0.93	0.28***	0.20**
EDI-2 DFT	304	1.88	0.89	0.24***	0.27***
EDE-Q	304	0.93	0.85	0.27***	0.26***
RSES	304	2.33	0.55	–0.27***	–0.21**

UPACS, Upward Physical Appearance Comparison Scale; DACS, Downward Physical Appearance Comparison Scale; PACS, Physical Appearance Comparison Scale; EDI-2, Eating Disorder Inventory-2; BD, Body dissatisfaction; DFT, Drive for thinness; EDE-Q, Eating Disorder Examination Questionnaire; RSES, Rosenberg Self-Esteem Scale; *M*, mean; *SD*, standard deviation. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ with Bonferroni correction.

TABLE 10 Means, standard deviations, and correlations of the UPACS and DACS and related measures in women with eating disorders.

Scale	<i>n</i>	<i>M</i>	<i>SD</i>	UPACS	DACS
UPACS	450	3.85	0.77	–	0.11
DACS	450	2.71	0.98	0.11	–
PACS	124	3.52	0.72	0.51***	0.34**
EDI-2 BD	450	4.86	0.91	0.08	0.10
EDI-2 DFT	450	4.87	0.92	0.35***	0.16*
EDE-Q	450	4.01	1.13	0.26***	0.17**
RSES	450	1.13	0.62	–0.30***	–0.05

UPACS, Upward Physical Appearance Comparison Scale; DACS, Downward Physical Appearance Comparison Scale; PACS, Physical Appearance Comparison Scale; EDI-2, Eating Disorder Inventory-2; BD, Body dissatisfaction; DFT, Drive for thinness; EDE-Q, Eating Disorder Examination Questionnaire; RSES, Rosenberg Self-Esteem Scale; *M*, mean; *SD*, standard deviation. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ with Bonferroni correction.

include comparisons with models, with one specifying comparisons with magazine models, it is evident that the two items heavily overlap in content and in item wording. Moreover, it is questionable whether comparisons with models and celebrities like movie stars have the same qualities as they did back in 2009, when the original scale was developed, as the rise of social media since that time has led to a new type of comparisons, namely with so-called influencers (Ye et al., 2021). Nowadays, people tend to compare themselves with celebrities and influencers on social media rather than with models seen in traditional media, especially magazines or billboard advertisements (Fardouly et al., 2017), and may therefore identify themselves more with influencers than with other celebrities (Schouten et al., 2020). To account for this change, Roberts et al. (2022) adapted the tripartite influence model (Thompson et al., 1999) and identified social media as a separate factor influencing body dissatisfaction apart from traditional media. Additionally, the standardized loadings and item-total correlations of the two items in question were descriptively the smallest in each subsample, indicating that they are not associated as strongly with the underlying factor or the rest of the scale, respectively. Therefore, future studies should consider adapting the wording to the modern context or the removal of these two items. Until then, the complete version of the UPACS should only be used

while taking into account the possible limitations regarding the factor structure and the possibly outdated item wording.

The internal consistencies were acceptable for both scales in all examined subsamples. The item-total correlations indicate that each item correlates sufficiently with each respective scale. Furthermore, the test–retest reliability was good in all examined subsamples. Taken together, the reliability of the UPACS and DACS can be considered adequate.

Additionally, women without EDs showed significantly higher scores on the UPACS and DACS than did men without EDs, which was expected due to women's greater tendency to engage in appearance comparisons (Davison and McCabe, 2005; Strahan et al., 2006). Moreover, in line with expectations, women with EDs scored significantly higher on both scales than did women without EDs, which confirms the higher tendency for appearance comparisons in women with EDs (Bleichert et al., 2009; Arigo et al., 2014). The findings indicate that the UPACS and DACS are able to detect differences in the tendency for upward and downward appearance comparisons.

Regarding the construct validity, the correlation patterns differed between the examined subsamples. It is important to note that the following discussion is based on descriptive effect sizes, as the correlations were not tested against each other. A further study evaluating the construct validity and including further inferential statistical data analyses is needed. Nevertheless, the correlation patterns provide a first overview indicating the construct validity of the scales. Most importantly, in each subsample, the UPACS and DACS correlated with the PACS. This is in line with expectation, as the PACS assesses general appearance comparisons and is therefore closely connected to the constructs of upward and downward physical appearance comparisons. In accordance with this, the effect sizes of the correlations with the PACS were descriptively higher than the effect sizes of the correlations with other related measures in each subsample. As expected, the effect size for the correlation between the UPACS and PACS was descriptively higher than that between the DACS and PACS, as upward appearance comparisons are generally more prevalent than downward appearance comparisons (Ridolfi et al., 2011; McCarthy et al., 2023) and should therefore be more closely related to the general tendency of making appearance comparisons. Accordingly, these results indicate that the scales do, in fact, assess appearance comparisons.

For women without EDs, the correlation patterns followed the overall expectations regarding positive associations with eating pathology, body dissatisfaction, and drive for thinness and negative associations with self-esteem. Furthermore, all effect sizes were descriptively higher for the correlations of the UPACS compared to those of the DACS, supporting the more conclusive and closer relationship of upward appearance comparisons with body image disturbance (Leahey et al., 2007). Findings regarding the influence of downward appearance comparisons on body image, by contrast, are inconsistent, with some studies reporting a positive influence (van den Berg and Thompson, 2007; Bailey and Ricciardelli, 2010) and others showing no positive effects, or even detrimental effects (Lin and Soby, 2016; Fitzsimmons-Craft, 2017; Drutschinin et al., 2018). The present study tends to support the latter findings.

For men without EDs, the UPACS and DACS showed positive correlations with the measures of eating pathology, body

dissatisfaction, and drive for thinness and negative correlations with self-esteem. The pattern of effect sizes was not as conclusive as for women without EDs, as descriptively, the effect sizes for the correlations with the EDE-Q only differed marginally between the UPACS and DACS, and the effect size for the correlation of the DACS with the EDI-2 subscale *Drive for thinness* was descriptively slightly smaller than the correlation of the UPACS with this subscale. The similar effect sizes for the correlations with the UPACS and DACS might be due to the overall low scores and the limited variability on the EDE-Q and EDI-2 subscale *Drive for thinness* in men without EDs, because men generally show lower eating disorder pathology than women (Smink et al., 2012) and because thinness might be less important for evaluating one's own appearance in men compared to women (Anderson and Bulik, 2004).

For women with EDs, the lack of association of both the UPACS and DACS with the EDI-2 subscale *Body dissatisfaction* might be due to a lack of variance in the subscale. The distribution of scores on the EDI-2 is left-skewed in this subsample, since most women with EDs show high body dissatisfaction *per se*, given that body dissatisfaction is a prevalent risk factor for EDs (Grabe et al., 2008; Rohde et al., 2015). The RSES only showed a negative correlation with the UPACS and not with the DACS, which might indicate that comparisons with people who are perceived to look better have a greater impact on self-esteem in women with EDs. This finding might be attributable to negative cognitive biases in women with EDs, which lead to more body checking behavior (Williamson et al., 2004) that possibly encompasses more upward appearance comparisons with women perceived to be more attractive than oneself as compared to downward comparisons.

Several limitations of the present study should be mentioned. First, the initial translation process did not include a back-translation by a native English speaker; thus, complete correspondence between the original version and the German version of the UPACS and DACS cannot be fully ensured. However, a bilingual translator did subsequently compare the two versions and found only three minor expressions that could have been altered but would not have meaningfully changed the item contents. This suggests that the translation can be deemed as acceptable. Second, the data are derived from nine different studies with varying study aims, designs, and target populations, conducted at different time points between 2016 and 2023. While all studies included the same German-language version of the UPACS and DACS, the studies differed in length and the questionnaires were administered at different positions within the studies. Therefore, it cannot be ensured that certain preceding questionnaires or contents in the respective studies influenced participants' responses to the UPACS and DACS. Third, in three of the studies, EDs were not diagnosed with a structured clinical interview, but rather relied on participants' self-reports. It is possible that some participants may have provided a false or only presumed diagnosis. However, compared to participants with EDs diagnosed as part of a study, those with self-reported EDs had comparable or even higher scores on relevant questionnaires regarding ED pathology, suggesting that the majority of self-reported diagnoses were appropriate for the category of EDs. It might be the case that individuals with higher levels of ED pathology were more likely to participate in studies in which self-reported diagnoses were sufficient because the procedure was less stressful, more anonymous, and the studies were easier to

access. Fourth, the psychometric properties and factor structure of the UPACS and DACS were examined for women with EDs in general rather than separately for women with anorexia nervosa, bulimia nervosa, and binge eating disorder. Despite some overlap in the characteristics of the different EDs, e.g., possible binge-eating episodes, the EDs differ, for instance, regarding weight and compensatory behavior (American Psychiatric Association, 2013). We chose to analyze all EDs within one group to enable sufficient sample sizes, especially for the SEM analyses and the assessment of test–retest reliability. However, future studies should examine the validity of the scales for each form of ED separately. Fifth, due to the lack of men with eating disorders and non-binary people in the final sample, no statement can be made regarding the suitability of the UPACS and DACS for assessing upward and downward appearance comparisons in these two groups. Future evaluations of the scales should therefore endeavor to include these groups. Finally, we only examined questionnaires that were related to the concepts of appearance comparisons in some way, thus focusing most on convergent validity. To ensure divergent validity, future studies should encompass more measures assessing variables that are less or not related to appearance comparisons.

Despite these limitations, the present study is the first to evaluate German-language versions of the UPACS and DACS, and might thus constitute a first step towards enabling the use of both scales in future research. Overall, the reliability and validity of the German-language UPACS and DACS are satisfactory, with limitations especially regarding the factor structure of the UPACS. Moreover, as the data were collected across nine studies, it was possible to examine the properties of the UPACS and DACS in women and men without EDs as well as women with EDs with sufficient sample sizes.

Future studies should seek to refine the scales, especially the UPACS, to account for modern-day developments in comparison processes or to generate a more general assessment of appearance comparisons that can be used outside the context of the rapidly changing media environment. The proposed re-specifications of the UPACS were only examined for exploratory purposes and need to be confirmed in independent samples. As the data were derived from several different studies, a future study should be designed and conducted solely for the purpose of validating the UPACS and the DACS.

Overall, the German-language versions of the UPACS and DACS seem to be useful scales to assess upward and downward appearance comparisons in women and men without EDs and women with EDs. Differentiating the direction of appearance comparisons allows for a more specific examination of the influence of appearance comparisons on body image and related constructs and as a risk factor for EDs. In sum, this study is the first to indicate that the German-language UPACS and DACS might be suitable for use in research and clinical practice.

Data availability statement

The datasets presented in this article are not readily available because the informed consent in four of the studies (Voges et al., 2018, 2019, 2020; Quittkat et al., 2023) excludes the distribution of data to

third parties, so that only the data from the remaining five study waves can be made available upon request. Requests to access the datasets should be directed to kristine.schoenhals@uni-osnabrueck.de.

Ethics statement

The studies involving humans were approved by the Ethics committee of Osnabrück University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

KS: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft. HQ: Conceptualization, Investigation, Writing – review & editing. MV: Investigation, Writing – review & editing. GL: Investigation, Writing – review & editing. F-JH: Investigation, Writing – review & editing. SV: Conceptualization, Resources, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2024.1390063/full#supplementary-material>

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Similarities and differences between eating disorders and obsessive-compulsive disorder in childhood and adolescence: a systematic review

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Background: The developmental age, comprising childhood and adolescence, constitutes an extremely important phase of neurodevelopment during which various psychiatric disorders can emerge. Obsessive-Compulsive Disorder (OCD) and Eating Disorders (ED) often manifest during this critical developmental period sharing similarities but also differences in psychopathology, neurobiology, and etiopathogenesis. The aim of this study is to focus on clinical, genetic and neurobiological similarities and differences in OCD and ED.

Methods: This study is based on a PubMed/MEDLINE and Cochrane Central Register for Controlled Trial (CENTRAL). The research adhered to the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Results: The aforementioned search yielded an initial collection of 335 articles, published from 1968 to September 2023. Through the application of inclusion and exclusion criteria, a total of 324 articles were excluded, culminating in a final selection of 10 articles.

Conclusions: Our findings showed both differences and similarities between OCD and ED. Obsessive-compulsive (OC) symptoms are more prevalent in ED characterized by a binge/purge profile than in those with a restrictive profile during developmental age. OC symptomatology appears to be a common dimension in both OCD and ED. When presents, OC symptomatology, exhibits transversal characteristic alterations in the anterior cingulate cortex and poorer cognitive flexibility. These correlations could be highlighted by genetic overlaps between disorders. A comprehensive definition, integrating psychopathological and neurobiological aspects could significantly aid treatment selection and thereby influence the prognosis of these patients.

KEYWORDS

eating disorders, obsessive-compulsive disorder, childhood, adolescence, comorbidity, clinical features

1 Introduction

The developmental age, comprising childhood and adolescence, constitutes an extremely important phase of neurodevelopment during which various psychiatric disorders can emerge. Obsessive-Compulsive Disorder (OCD) and Eating Disorders (ED) often manifest during this critical developmental period (1) sharing similarities but also distinctions in psychopathology, neurobiology, and etiopathogenesis. Specifically, the obsessive-compulsive (OC) symptomatology evident in ED, usually focusing on food and body shape themes, appears to be a connecting factor between the two disorders, resulting in high rates of comorbidity (2).

OCD, as defined by the Diagnostic and Statistical Manual of Mental Disorders, 5th edition text revision (3), is characterized by obsessions, compulsions, or both. Obsessions involve unwanted, repetitive, and distressing thoughts or images, often accompanied by compulsions, which are behaviors or mental actions the individual feels compelled to perform (3). One criterion of the DSM-5-TR is that obsessions and compulsions should not revolve around food, eating, or body shape, distinguishing it from ED. When OC symptomatology encompasses these themes, it can be regarded as ED-related OC symptomatology. The OCD symptoms can often be chronic, significantly impairing an individual's functioning, especially when accompanied by poor insight and a substantial amount of time dedicated to OC rituals (4–6). OCD often emerges in late adolescence and early adulthood but can also onset in childhood (1, 7). Typically, it shows no gender differences, except in children where it predominantly affects males (8).

ED are psychiatric disorders characterized by disturbances in eating and the relationship with weight and body shape. They include Anorexia Nervosa (AN), Bulimia Nervosa (BN), Binge Eating Disorder (BED), Pica, Avoidant/Restrictive Food Intake Disorder (ARFID), and Rumination Disorder (3). They usually debut in adolescence and early adulthood (9, 10), with AN showing a progressive decrease in age of onset in recent years, including a higher prevalence in childhood (11). Scientific literature, exploring the correlation between ED and OCD, tends to focus primarily on three main ED: AN, BN, and BED. Furthermore, these three disorders exhibit similarities on a psychopathological level among them compared to the remaining three. AN, BN, and BED entail thoughts and behaviors focused on weight, body shape, and food in a consistent and repetitive manner, significantly impacting the self-esteem and mood of the individuals afflicted by them. Consequently, this review will specifically examine these three ED. AN is characterized by an intense fear of gaining weight and is associated with distorted body image. Patients with AN engage in behaviors to avoid eating and lose weight, such as elimination behaviors (exercise or vomiting/laxative use), leading to being underweight as calculated by the Body Mass Index (BMI). In BN, there is also an altered relationship with one's body and body image, translating into repeated cycles of binge eating (consumption of a large amount of food in a short time) and subsequent compensatory or elimination behaviors. In BN, weight is maintained within normal limits or increased. BED is characterized by binge eating episodes without specific compensatory behaviors, as seen in BN, and is often associated with overweight or obesity.

As mentioned earlier, OCD and ED exhibit high comorbidity, especially with AN and BN. Specifically, in general population, BN shows a higher lifetime comorbidity with OCD in community studies (14–17%), while AN is higher in clinical populations (0–69%). This could be due to the low prevalence of AN in the general population, AN greater severity, and the scarcity of data on AN in community studies (2). Similarly, in clinical populations, the lifetime prevalence of AN in OCD (3–17%) is higher than that of BN (3–10%) (2). The presence of comorbidity usually indicates greater severity compared to the disorder alone. For example, ED with comorbid OCD show more severe ED symptoms and higher rates of hospitalization (12, 13). Moreover, OCD is sometimes identified as a risk factor for the later development of ED (2, 14), especially in a study by Micali et al. (15), suggesting that the presence of OCD in childhood and adolescence is associated with the development of ED in adulthood (15). Some longitudinal and familial studies suggest possible common etiological factors (2). Additionally, from a genetic perspective, common aspects have emerged. Although different genes have been identified, genome and twin studies confirm genetic affinity among OCD, ED, major depression, anxiety disorders, and substance use disorders (16). Furthermore, affinity between AN and OCD has been observed in Genome-Wide Association Studies (17), specifically for genes corresponding to the prefrontal cortex and serotonergic network, indicating the presence of similar altered pathways (16, 18, 19). The implicated brain circuits in the two disorders partially overlap. These brain networks involve connections among various prefrontal cortex areas, including the anterior cingulate cortex (ACC), and the striatal region (20). The partial overlap of the neurocircuits involved in the disorders is also evident when investigating neurotransmitter aspects. It emerges that both OCD and ED show a pharmacological response to selective serotonin reuptake inhibitors (SSRIs), indicating a common alteration in the serotonin system (21–24).

Beyond epidemiological and neurobiological aspects, psychopathological characteristics also unite OCD and ED. Both disorders feature intrusive and compelling thoughts on a particular theme, leading to psychological distress and, consequently, behaviors aimed at reducing the state of distress. Based on these characteristics, some authors have hypothesized that ED and OCD may belong to the same psychopathological spectrum (2, 25–28). Other authors support the idea that ED may fall under an OC spectrum (29, 30), particularly in association with certain types of obsessions-compulsions, such as symmetry, aggression (31, 32), and cleanliness/contamination (33), and certain personality traits like perfectionism and impulsivity (34–36).

The aim of this study is to analyze these characteristics, similarities, and differences between ED and OCD specifically in children and adolescents, a less studied population. Studies focusing solely on epidemiological analyses of OCD and ED have been excluded from this review. These studies generally show overlapping data with those on adults with ED, indicating high comorbidity with OCD (37–39). Beyond comorbidity data, our study specifically aims to focus on the clinical, genetic, and neurobiological similarities and differences in OCD and ED. For this aim, studies presenting both disorders separately and in

comorbidity have been included. Studies where individuals with OCD or ED exhibit traits of the other disorder without clear comorbidity were also considered.

Studying disorders at early-onset can provide crucial insights into etiology, characteristics, and potential treatments. Especially in disorders that show significant overlap in adulthood and where the childhood and adolescence are pivotal phases. Considering the literature on OCD and ED in adulthood, it is conceivable that also OCD and ED in developmental age may exhibit points of convergence and divergence. We hypothesize that OCD may have overlapping features with BN and AN, especially AN with restrictive symptoms. However, it could be suggested that ED do not strictly belong to an OC spectrum, as some authors assumed. Instead, there may be a shared OC dimension between OCD and ED, while each disorder still retains specific unique characteristics. Moreover, this hypothesis should be supported by evidence not only in the psychopathology but also in the neurobiological and genetic domains.

2 Methods

2.1 Search strategy

This study is based on a PubMed/MEDLINE and Cochrane Central Register for Controlled Trial (CENTRAL) search for studies published from the beginning of the databases until November 30, 2023, employing the following search terms: (“eating disorder” OR “anorexia nervosa” OR “binge eating disorder” OR “pica” OR “avoidant restrictive food intake disorder” OR “rumination disorder”) AND “obsessive-compulsive disorder” AND (“childhood” OR “child” OR “adolescence” OR “adolescent”). The entire research team reached a consensus on the search approach and collectively contributed to the examination of the literature. The chosen articles fulfilled the subsequent eligibility criteria (1): They constituted original research studies (2); they included subjects with a diagnosis of ED or OCD as assessed by Structured Clinical Interview for Diagnostic and statistical manual of mental disorders third/fourth/fifth edition/fifth edition text revision (DSM- III/IV/5/5-TR) or the Classification of Diseases ninth/tenth edition (ICD-9/10) (3); they compared ED to OCD patients in clinical, genetic or neurobiological features and vice versa. Otherwise they assessed clinical, genetic or neurobiological characteristics in OCD patients with ED comorbidity or symptoms or in ED patients with OCD comorbidity or symptoms (4); they separated data for ED and OCD (5); they included subjects with less than 18 years old.

2.2 Eligibility and study selection

The subsequent studies were not considered (1): reviews and meta-analyses (nevertheless, the reference lists of these studies were scrutinized to identify potentially eligible studies that might have been missed during the initial database search.) (i.e., “Review”) (2); case reports or case series (i.e., “Case Report”) (3); studies that did not assess individuals with OCD or ED with OCD comorbidity/symptoms (i.e., “No OCD”) (4); studies that did not assess individuals with ED or OCD with ED comorbidity/symptoms

(i.e., “No ED”) (5); qualitative studies not supported by statistical analysis (i.e., “No Data”) (6); research that did not offer distinct data for OCD, ED, healthy controls or individuals with different psychiatric diagnoses (i.e., “Lumping”) (7); studies unrelated to the pertinent topic (i.e., “Unrelated”) (8); studies that assessed animals (i.e., “Animal”) (9); protocols and ongoing studies (10); correction to existing article (11); studies for which no English translation was available (i.e., “No English”) (12); studies that included subjects over 18 years old (i.e., “Adult”). Duplicate records in the two databases were removed. The criteria for including and excluding studies, established through two rounds of the Delphi method, gained unanimous acceptance from all authors. The research adhered to the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (40). The online [Supplementary Materials](#) comprise the PRISMA flowchart and checklist, along with comprehensive results and data regarding included/excluded studies (refer to Online Supplement, [Supplementary Figures 1, 2, and Supplementary Table 1](#)).

2.3 Data extraction and synthesis

Information extracted from the chosen articles were systematically recorded in a standardized spreadsheet. Precisely, the subsequent variables were recorded: primary author, publication year, sample size, participant age, gender ratio (male/female), study design (incorporating interviews, tests, tools or questionnaire employed), and outcomes pertaining to key clinical characteristics among individuals diagnosed with ED and OCD. The summary of included studies was reported in [Table 1](#).

2.4 Risk of bias assessment

In order to evaluate the reliability of the review, its quality, and to rigorously analyze the outcomes of the chosen studies, a risk of bias analysis was performed. This analysis adhered to the indications and criteria put forth by the Agency for Health Care Research and Quality (51). Each study underwent bias assessment in accordance with the stipulated criteria, encompassing selection bias, performance bias, detection bias, attrition bias, and reporting bias. Subsequently, a bias level, categorized as low, medium, or high, was assigned to each study based on the assessment. The included studies were independently evaluated by the authors, and any disparities in the assessments were resolved through discussions. The evaluation of the risk of bias is detailed in the online supplements, specifically in [Supplementary Table 2](#).

3 Results

3.1 Search results

The aforementioned search yielded an initial collection of 335 articles, published from 1968 to September 2023. Through the application of inclusion and exclusion criteria, a total of 324 articles

TABLE 1 Summary of included studies.

Study	Population	Design	Results	Observations
Stein et al., 2012 (41)	40 ids with AN-R (F40, \bar{x} = 15.6 \pm 1.7); 23 ids with AN-B/P (F23, \bar{x} = 16.3 \pm 1.3); 33 ids with BN \EDONS-P (F33, \bar{x} = 16.6 \pm 1.3); 20 ids HC (F26, \bar{x} = 16.5 \pm 2.0)	LS. BDI; Y-BOCS; YBC-ED; RSPM	In admission all ED groups showed \uparrow scores for OC symptoms ED-related and non-ED-related vs the HC group ($p < 0.001$). BN/EDNOS-P group showed \uparrow in OC ED-related symptoms compared to AN-R group ($p < 0.05$). BN/EDNOS-P group show \uparrow psychometric ED-related and no related OC symptoms ($p < 0.05$). AN-R \uparrow OC symptoms ED-related at discharge vs the AN-B/P group ($p < 0.05$). AN-B/P group showed no changes at discharge related to OC symptoms. At admission no differences were found between all the groups for orbitofrontal functioning and alternation learning. In AN-R group, olfactory discrimination is positively correlated with compulsive ED symptoms (Y-BC-ED, $p < 0.01$) and with the Y-BC-ED total score ($p = 0.05$). BN/EDNOS-P group alteration learning is \uparrow correlated with ED-related OC symptoms ($p < 0.01$). In the AN-R group, olfactory discrimination is \uparrow correlated with ED related OC symptoms ($p < 0.05$).	The present study investigated orbitofrontal functioning in ED which share many features with OC symptoms and consequently with OCD. A better orbitofrontal functioning in ED ids could be associated with ED-related OC symptoms. This findings may represent a core feature of the ED that is independent of malnutrition behaviors, but is associated with ED related obsessiveness. Larger sample of subjects may be an interesting suggestion for future researches.
Breithaupt et al., 2014 (42)	9 ids with AN (F9, \bar{x} = 16.00 \pm 1.00)	CS. EDE-Q; BCQ; WASI; ChOCI; CBOCI;	\uparrow BC behaviors positively correlates with OC behaviors ($p < 0.5$). Patients with BC behaviors report \uparrow OC symptoms. Idiosyncratic checking behaviors were significantly related to cognition inhibition ($p < 0.05$): Ids with \downarrow levels of cognitive inhibition had \uparrow of idiosyncratic checking Ids with \uparrow cognitive inhibition had \downarrow idiosyncratic checking.	A negative relationship between cognitive inhibition and idiosyncratic BC was found out. These findings provide preliminary evidence that idiosyncratic BC in AN patients may suggest a neuropsychological profile similar in those with checking behaviors in OCD. Results are based on 9 ids, a larger sample of subjects may be an interesting suggestion for future researches.
Brooks et al., 2014 (43)	15 ids with EDNOS (F15, \bar{x} = 15.00 \pm 1.36); 20 ids HC (F20, \bar{x} = 14.20 \pm 1.11)	CS. EDE-Q; OCI-R; BIS-11 N-BACK; fMRI	EDNOS group showed \uparrow scores on OCI scale ($p < 0.001$) compared to HC. EDNOS showed \uparrow scores on BIS 11 ($p = 0.0005$) compared to HC. At fMRI the EDNOS group showed \uparrow activation in the medial frontal gyrus ($p < 0.0001$). HC group did not show any brain region with \uparrow activation than the EDNOS group.	EDONS patients showed marked activation in the PFC circuitry associated with better WM performance and higher OC symptoms. These results were not found in the HC group. These findings show that ED-related thoughts may be related to a neuronal response in the early stages of the disease. Results are based only on the Sweden population.
Lewis et al., 2018 (44)	94 ids with AN-R (F94, \bar{x} = 15.75 \pm 1.50); 67 ids with AN-B/P (F67, \bar{x} = 16.23 \pm 1.33); 48 ids with BN (F48, \bar{x} = 16.70 \pm 0.99)	LS. Y-BOCS; YBC-ED; EAT-26; BDI; STAI;	AN-B/P group patients showed \uparrow in Y-BOCS ($p = 0.006$), YBC-EDS ($p = 0.017$), EAT-26 ($p = 0.003$) and BDI ($p < 0.001$) compared to AN-R or BN patients. AN-B/P and BN group patients showed \uparrow on Y-BOCS ($p = 0.006$), compared to AN-R patients. No difference was found between the groups AN-R, AN-B/P, BN for YBC-EDS and EAT 26. Results showed \uparrow for ED, OC and depressive symptoms in AN-B/P patients ($p < 0.05$) in the acute phase of disease compared with patients with AN-R or BN. AN-B/P patients showed \uparrow OC symptoms in the stabilized phase of the disease compared to the patients with restrictive symptoms ($p < 0.05$).	The present study aimed to investigate the relationship between OCD symptoms and different types of ED. It was found that OC symptoms are more marked in the acute phase of AN-B/P patients compared to AN-R and BN patients. Differently, an improvement in obsessiveness was found from the acute phase to the stabilized phase in patients with AN-B/P compared to the AN-R group. These results could be influenced by the stages that have been considered of ED.
Tyszkiewicz-Nwafor et al., 2018 (45)	76 is with AN (F 76 \bar{x} = 15.6 \pm 2.3); 30 ids HC (F 30 \bar{x} = 15.3 \pm 1.5)	CS EAT-26; BDI; YBOCS; BS; ELISA kit.	The concentration of adiponectin in the acAN was \uparrow than in HC ($P = 0.05$) and \uparrow in the recAN ($p = 0.01$). Resistin concentrations were \downarrow in acAN and recAN than in HC ($P = 0.00$). No difference was observed in resistin concentration in the acAN and recAN groups ($p = 0.20$). In the acAN group, a negative correlation was noted between adiponectin concentration and YBOCS scores ($p = 0.049$).	Association between adiponectin with OC symptoms and resistin with depressive symptoms indicate their potential contribution to emotion regulation and AN pathogenesis.
Plana et al., 2019 (46)	116 ids with AN (F 113, VEO 34 \bar{x} =); 74	CS EAT-40; LOI-CV;	This study confirms a genetic overlap between OCD and AN. Specifically, it describes genetic	Psychometric evaluations to detect association between comorbidities and genetic risk were not

(Continued)

TABLE 1 Continued

Study	Population	Design	Results	Observations
	ids with OCD(F 37, VEO 31 \bar{x} =); 65 ids VEO (\bar{x} = 14,4 \pm 2.2); 125 EO (\bar{x} = 16,3 \pm 1.4)	CAPS; CDI; BS in EDTA; MagNA Pure LC DNA isolation Kit III; LC MagNA Pure system; Illumina	pleiotropy for age at onset across these disorders, associating two SNPs (rs6311, rs4942587) of the HTR2A with the very-early onset phenotype.	performed. it might be interesting to evaluate this association in combination with the genetic study using a larger sample as well.
Flamarique et al., 2019 (47)	79 ids with AN (F 77 \bar{x} =16.1 \pm 1.2); 32 ids with OCD (F 10 \bar{x} =15.5 \pm 2.6); 74 ids with HC (F 52 \bar{x} = 16.5 \pm 1.4)	CS CAPS; CBT; CDI; CY-BOCS; EAT-40; K-SADS; LOI-CV.	SOP seemed \uparrow in AN ids than in OCD ids ($p<0.001$) or HC ids ($p<0.001$). SOP predicted OC, depressive, and ED symptoms in the AN group ($p<0.001$). SPP total score among HC ids was similar to that in the AN ids and \uparrow than that in the OCD ids ($p = 0.003$). In HC, SPP was related to OC ($p = 0.002$), depressive ($p = 0.011$), and ED symptomatology ($p = 0.006$).	This is the first study comparing different dimensions of perfectionism. It could have clinical implications in general treatment of AN ids and also in order to prevent from developing obsessive, depressive and eating symptoms in both AN and healthy ids. A limitation can be related to the fact that comparison with other studies that have used different scales may make these results difficult to compare and generalize.
Bohon et al., 2020 (48)	14 ids with WR-AN (F14, \bar{x} = 15.79 \pm 1.93); 11 ids with OCD (F11, \bar{x} = 15.64 \pm 2.01); 24 HC (F24, \bar{x} = 15.29 \pm 1.65)	CS. WCTS during fMRI.	OCD ids showed \uparrow perseverative errors (set shifting deficits) than WR-AN ($p=0.010$) and HC ($p=0.047$). WR-AN and HC had no differences. No differences in neural activity at fMRI during WCTS between groups. OCD ids showed positive correlation between perseverative errors and brain activity in the rFP, rIFG and rMFG ($p=0.002$). This correlation was not significant examining the whole brain. This correlation was not present in HC. In WR-AN perseverative errors and brain activity were related with no differences compare to both HC and OCD.	Set shifting deficits could be related to OC symptoms in adolescence, more than ED symptoms. rIFG is related to inhibition, in OCD ids a \uparrow perseverative errors could be related to a \uparrow effort to inhibit responses. A limitation is that authors assessed WR-AN and not AN in an acute phase.
Reilly et al., 2022 (49)	110 ids with BN (F 103, \bar{x} = 15.80 \pm 1.51)	RCT: CBT vs FBT. EDE; CYBOCS; YBC-ED	In BN ids ED related OC symptoms \downarrow after an 18 session treatment with CBT or FBT and \downarrow at 6- and 12-months follow-up ($p<0.001$). ED related OC symptoms account for ED-symptoms level at 12-month follow-up ($p<0.001$). OC general symptoms did not change significantly after CBT or FBT treatment or at follow-up. OC general symptom changes were not related to ED symptoms variations.	BN in adolescence shows a strong relationship between ED symptoms and ED related OC symptoms, but not with general OC symptoms. These results could be influenced by the overlapping in content of EDE and YBC-ED.
Camprodon-Boadas et al., 2023 (50)	20 ids with OCD (F11, \bar{x} = 14.10 \pm 1.86); 20 ids with AN (F20 \bar{x} = 14.85 \pm 1.59); 20 with FEP (F12 (\bar{x} = 15.79 \pm 1.26)	CS. BABS; BDI-II	AN group showed \uparrow severity of depressive symptoms than OCD group ($p<0.001$). At BABS OCD group had \downarrow scores in almost all items than AN and FEP groups ($p<0.001$). No differences between AN and OCD groups in fixation of ideas (item 4). OCD group had \downarrow scores than the AN group in insight (item 6)($p = 0.016$). Both OCD group ($p = 0.006$) and AN group ($p < 0.001$) had \downarrow scores than FEP group in delusions of reference (item 7). AN and FEP appeared to be different only in item 7. OCD group scored \downarrow than the FEP ($p = 0.001$) and AN ($p < 0.001$) groups in the total delusional belief score.	Results highlight a \uparrow presence and severity of delusional thinking in AN ids than OCD ids, that showed low scores in BABS. Intriguing AN seems to be more similar to FEP level of delusional beliefs compared to OCD in adolescent patients. In particular AN group shows \downarrow level of insight than OCD, this could cause the development of delusional features in thought, preoccupations and beliefs related to the disorder. Results are based only on the assessment of patients throughout the BABS.

acAN, acute phase of anorexia nervosa; AN, anorexia nervosa; AN-R, anorexia nervosa-restricting type; AN-B/P, anorexia nervosa -binge/purge type; BABS, Brown Assessment of Beliefs Scale; BC, Body Checking; BCQ, Body Checking Questionnaire; BDI-II, Beck Depression Inventory; BIS-11, Barratt impulsiveness scale; BMI, Body Mass Index; BN, bulimia nervosa; BS, blood samples; CAPS, Child and Adolescent Perfectionism Scale; CBOCI, Clark-Beck Obsessive Compulsive Scale; CBT, Cognitive Behavioral Therapy; CDI, Childhood Depression Inventory; ChOCI, Children Obsessive Compulsive Inventory; CS, cross-sectional study; CYBOCS, Children's Yale-Brown Obsessive Compulsive Scale; EAT-26, Eating Attitude Test; EAT-40, Eating Attitudes Test; ED, eating disorder; EDE-Q, eating disorder examination questionnaire; EDNOS, eating disorder not otherwise specified; EDNOS-P, eating disorder not otherwise specified-purging type; EO, early onset; F, female; FBT, Family-Based Treatment; FEP, first-episode psychosis; fMRI, functional resonance magnetic imaging; HC, healthy controls; ids, individuals; LOI-CV, Leyton Obsessional Inventory - Child Version; LS, longitudinal study; K-SADS, Kiddie Schedule for Affective Disorders and Schizophrenia; N-BACK, n-back task; OC, obsessive compulsive; OCI-R, Obsessive-compulsiveness inventory; OCD, obsessive-compulsive disorder; PC, psychiatric controls; RCT, randomized controlled trial; recAN, anorexia nervosa recovery; rFP, right frontal pole; rIFG, right inferior frontal gyrus; rMFG, right middle frontal gyrus; RSPM, Raven Standard Progressive Matrices; SNPs, single-nucleotide polymorphism; SOP, self-oriented perfectionism; SPP, self-oriented perfectionism; STAI, State-Trait Anxiety Inventory; VEO, very early onset; vs, versus; WASI, Wechsler Abbreviated Scale of Intelligence; WCTS, Wisconsin Card Sorting Test; WM, working memory; WR-AN, weight-restored anorexia nervosa; \bar{x} , mean age; YBC-ED, Yale-Brown-Cornell Eating Disorders Scale; YBOCS, Yale-Brown Obsessive Compulsive Scale; \uparrow , higher/more/increased; \downarrow , lower/lesser/decreased.

were excluded, culminating in a final selection of 10 articles (refer to [Table 1](#)). Detailed explanations for the rejection of each study can be found in the online supplements, specifically [Supplementary Table 1](#). The complete search results, along with reasons for exclusion when applicable, are depicted in the PRISMA flowchart, accessible in the online supplements ([Supplementary Figure 1](#)).

3.2 Overview of the included studies

The 10 included studies examined various different aspects. Many focused on OC symptomatology in patients with ED, while others analyzed clinical differences between patients with OCD and ED. None assessed the presence of ED symptomatology in OCD patients. Furthermore, the studies evaluated neuroimaging, genetic, neurobiological, and neurocognitive factors. In this paragraph, we provide summaries of each study included in the review.

Stein and colleagues (41) conducted a longitudinal study in 2012 in a sample of adolescent females. According to DSM-IV, 40 were diagnosed with anorexia nervosa, restricting type (mean age 15.6); 23 with AN, binge/purge (B/P) type (mean age 16.3); 33 with BN or eating disorder not otherwise specified (EDNOS) B/P type (mean age 16.6); and 20 healthy controls (HC) (mean age 16.5). The 4 groups with ED were inpatients. They were assessed within 14 days of admission. As orbitofrontal dysfunction is an important feature of OCD, the aim of the study was to assess orbitofrontal function in ED. Orbitofrontal function was assessed using alternative learning and olfactory threshold and discrimination. The sample were assessed by Beck Depression Inventory (BDI), a scale to measure the severity of depression; Yale-Brown Obsessive Compulsive Scale (YBOCS), which assesses the severity and type of symptoms in patients with OCD; Yale Brown-Cornell Eating Disorders Scale (YBC-ED) to assess core concerns and rituals associated with ED; Raven Standard Progressive Matrices to measure intelligence. The results showed that ED-related obsessionality is associated in ED with better orbitofrontal cortex (OFC) functioning than in non-ED-related obsessionality.

It appears noteworthy to specify that obsessionality does not refer only to obsession but to the broader cognitive disturbance caused by obsessive-compulsive symptoms (52). Furthermore, all of the ED groups have better scores than the HC on olfactory threshold and olfactory discrimination, but worse scores than the HC on alternative learning.

In 2014, Breithaupt et al. (42) investigated the role of body checking in anorexia nervosa as a behavioral link to OCD in a cross-sectional study, with a sample of 9 female in-patients with AN. The age range was 14 to 17 years. They were assessed using the Eating Disorder Examination Questionnaire (EDE-Q), a self-report questionnaire that evaluates the frequency and severity of behaviors associated with ED diagnosis; Body Checking Questionnaire (BCQ), which assesses the frequency of body checking behaviors; Children Obsessive Compulsive Inventory (ChOCI), which assesses the presence and severity of OCD in children and adolescents up to 17 years old; Clark-Beck Obsessive Compulsive Scale (CBOCI), which assesses the frequency and severity of obsessive-compulsive symptoms; Wechsler

Abbreviated Scale of Intelligence (WASI), which evaluates intelligence. The results showed a significant correlation between body checking symptoms and OCD behaviors; indeed, patients with body checking behaviors reported OCD symptoms. The idiosyncratic checking behavior was significantly related to cognitive inhibition. Patients with lower levels of cognitive inhibition had higher symptoms of idiosyncratic body checking. Patients with higher cognitive inhibition had lower symptoms of idiosyncratic body checking. The study showed that increased symptoms of body checking were correlated with symptoms of OCD: idiosyncratic body checking may be an indication of a similar neuropsychological profile between patients with AN and those with obsessive-compulsive checking behavior.

Brooks and colleagues (43) in 2014 conducted a cross-sectional study of 15 outpatients with an eating disorder non otherwise specified (EDNOS) and 20 HC. The average age of the sample with EDNOS was 15 years. The main hypothesis of the study was that impulsivity, rumination and food restriction could be associated with neuronal activity in response to eating stimuli in adolescent patients with an eating disorder. The sample was assessed using the EDE-Q; the Obsessive-Compulsiveness Inventory (OCI), which measures obsessive-compulsive symptoms with 6 subscales investigating scavenging, chewing, neutralizing, obsessing, hoarding and ordering; Barratt Impulsiveness Scale (BIS-11) which is a self-report measuring the trait of impulsivity based on sensation seeking and anxiety; the N-Back Task assesses working memory by presenting a sequence of stimuli one by one. They also used functional magnetic resonance imaging (fMRI) to measure neural responses. The EDNOS patients had higher OCD symptom scores on the OCI scale than the HC. The EDNOS patients also had higher impulsivity scores at BIS-11 than the HC. During fMRI, the EDNOS patients showed greater activation of the medial frontal gyrus, unlike the HC, who showed no activation of brain regions.

In one longitudinal study conducted in 2018, Lewis and colleagues (44) explored the relationship between OCD symptoms and different types of ED. The sample included adolescent female inpatients of whom 94 with a diagnosis of restrictive AN (AN-R) (mean age: 15.7); 67 with a type of binge/purge AN (AN-B/P) (mean age: 16.7) and 48 with BN (mean age: 16.7). The following scales were used to assess the sample: YBOCS; YBC-ED; Eating Attitude Test (EAT-26) which is used to measure symptoms and concerns related to the eating disorder; BDI; and the State-Trait Anxiety Inventory (STAI) which assesses trait and state anxiety and aids in the differentiation between anxiety and depression diagnoses. The results showed that in more eating, obsessive and depressive symptoms are discovered in the most acute phase of the illness compared to AN-R or BN. It was also noted that patients with a diagnosis of AN-B/P showed an improvement of OCD symptoms from the acute phase to the stabilization of ED compared to the patients with AN-R. Given this, we can state that OC symptomatology is more severe in the worst phase for patients with AN-B/P than for patients with AN-R and BN. This study demonstrates different patterns of OC symptomatology in different types of ED during the course of the disease.

In a longitudinal study conducted in 2018, Tyszkiewicz-Nwafor and colleagues (45) investigated the different adiponectin and

resistin serum levels between acute phase of anorexia nervosa (acAN) and anorexia nervosa recovery (recAN) and the relationship between serum concentrations of selected adipokines and other psychiatric behaviors, such as OC symptoms. The sample included 76 female inpatients acAN from Child and Adolescent Psychiatric Department (mean age: 15,6) and 30 female HC recruited among middle school students (mean age: 15,3). AN patients were diagnosed according to DSM-IV criteria. The following scales were used to assess the sample: EAT-26, BDI, YBOCS. The ELISA kit was used to conduct the biochemical analysis to determine the concentration of adiponectin and resistin on a venous blood sample. The same procedure was repeated on discharge 10.8 ± 1.4 weeks later. The results showed an higher concentration of adiponectin in the acAN than in HC, and was higher in the recAN than in the acAN and in HC. There were lower resistin concentrations in acAN and recAN than in HC, without differences between the acAN and recAN groups. In the acAN group, a negative correlation was noted between adiponectin concentration and YBOCS scores. The association between adiponectin with OC symptoms and resistin with depressive symptoms indicate their potential contribution to emotion regulation and AN pathogenesis.

In 2019 Flamarique and colleagues (46) conducted a cross-sectional study on self-oriented perfectionism (SOP) and socially prescribed perfectionism (SPP) in patients with OCD and patients with ED, in order to investigate their different role in OCD and ED and to find out how perfectionism influenced OC, depressive, and eating symptomatology. Perfectionism is a trait marked by setting unreachable personal standards. SOP and SPP are two different dimensions of perfectionism. SOP is delineated as an internal pursuit of perfection and the establishment of high self-expectations that are unattainable. SPP represents an individual's perception of external high expectations, with acceptance contingent upon meeting these standards. The sample included out-patients recruited from the Department of Child and Adolescent Psychiatry and Psychology at the Hospital Clinic in Barcelona. According to DSM-IV-TR 79 were diagnosed with anorexia nervosa (mean age: 16.1), 32 were diagnosed with OCD (mean age: 15.5) and 74 were HC (mean age: 16.5). The sample was assessed by Child and Adolescent Perfectionism Scale (CAPS), a scale used in pediatric population to measure perfectionism, which includes two subscales that measure SOP and SPP; Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS), which assesses the severity and type of symptoms in child and adolescent patients with OCD; Childhood Depression Inventory (CDI) that assesses depressive symptoms in children and adolescents; Eating Attitudes Test (EAT-40) to assess attitudes and symptoms usually associated with ED; Leyton Obsessional Inventory - Child Version (LOI-CV) to assess OC symptomatology and estimates the level of interference with daily activities; Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS) semi-structured interview that assesses current and past psychopathology in children and adolescents. The results showed that SOP seemed predominant in patients with AN than in patients with OCD or HC. SOP predicted OC, depressive, and ED symptoms in the AN group. SPP total score among HC was similar to the total score among patients with AN

and higher than that totalized by the patients with OCD. In HC, SPP was related to OC, depressive, and eating symptomatology.

In Plana et al. (47), a cross-sectional study of 2019, authors investigated the existence of a genetic overlap between very early onset AN and OCD. The study recruited 116 adolescents diagnosed with AN and 74 adolescents diagnosed with OCD from Department of Child and Adolescent Psychiatry and Psychology at the Hospital Clínic in Barcelona. Diagnoses were made using the department's clinical interview, which assessed the patients' current psychopathology and developmental history according to DSM-IV criteria. Twelve patients from the OCD group also had comorbid AN. Patients were divided based on the age of onset of the disorder into "very early onset" (VEO) and "early onset" (EO). For AN patients, VEO AN was defined as onset before age 13, while EO was defined as onset from 13 to 18 years. For OCD patients, VEO OCD was defined as onset before age 10, and EO was defined as onset from 10 to 18 years. Dividing patients by age, the sample resulted composed by 65 patients with VEO (mean age 14,4) and 125 patients with EO (mean age 16,3). Several tests and questionnaires were provided: EAT-40, LOI-CV, CAPS and CDI. All patients underwent blood sampling, using EDTA tubes. These samples were then subjected to genomic DNA extraction employing the MagNA Pure LC DNA Isolation Kit III along with an LC MagNA Pure system (Roche Diagnostics GmbH, Mannheim, Germany). Subsequently, the concentration of the extracted DNA was determined by measuring absorbance, a process carried out using the ND1000 device (NanoDrop, Wilmington, Delaware). A total of 44 single nucleotide polymorphism (SNPs) covering the target loci and surrounding regions were chosen from 5 candidate genes related to the serotonin system. The study confirmed genetic pleiotropy between OCD and AN for age at onset, associating two SNPs (rs6311, rs4942587) of the HTR2A gene (located on chromosome 13q14) with the VEO phenotype.

In 2020 Bohon and colleagues (48) conducted a cross sectional study using a sample of 14 patients with weight-restored AN (WR-AN), mean age 15.79; 11 patients with OCD, mean age 15.64; 24 HC, mean age 15.29. The sample consisted entirely of out-patients and was assessed using the Wisconsin Card Sorting Test (WCST) while they underwent fMRI. The WCST is a tool used to assess patients' frontal functions, including flexibility in strategy choice, problem solving, and is also used to assess inability to abstract and persevere through 128 cards. The aim of the study was to evaluate set shifting and task switching in adolescents with AN or OCD and the brain activity corresponding to these processes, comparing the three groups (AN, OCD, HC). They measured brain activity by fMRI imaging while performing the WCTS. The results demonstrated that the OCD groups showed more perseverative errors (set shifting deficits) than the WR-AN and the HC groups for whom no difference was found. Also, no difference was also found in neural activity at fMRI during WCTS between the groups. The OCD group showed a positive correlation between perseverative errors and brain activity in the right frontal pole, right inferior frontal gyrus and in the right middle frontal gyrus; this correlation was not found in HC group. In WR-AN group perseverative errors and brain activity were related with no differences compare to both HC and OCD groups. These results suggest that the similarities

between OCD and AN are determined by OC features that are also present in the AN group, rather than by a common neurocognitive signature.

Reilly and colleagues (49) conducted a randomized controlled trial study in 2022, using a sample of 110 out-patients with BN, their mean age was 15.8. OCD traits are often noted in adolescents with ED and predict poor response to therapeutic treatment but emerging data on adults suggests that there may be changes in ED-related OCD symptoms after appropriate treatment. Therefore, the aim of this study was to evaluate possible changes in OCD symptoms with Family-Based Treatment (FBT) or Cognitive Behavioral Therapy (CBT) for BN. The sample was submitted to 18 sessions of FBT or CBT and was evaluated with 6- or 12-month follow-ups by EDE-Q; CYBOCS; and YBC-ED. The results showed that, for patients with BN, after 18 sessions of CBT or FBT, the OC symptoms related to ED decreased; they also decreased at 6- and 12-month follow-ups. At the same time, the OC general symptoms of OCD did not change significantly after CBT or FBT treatment. Furthermore, changes in symptoms of OCD were not correlated with changes in the ED symptoms. Therefore, BN in adolescence has a strong correlation with ED-related OC symptoms but not with general OC symptoms. Both FBT and CBT can be helpful in reducing ED-related OC symptoms but not general OC symptoms which showed no changes during treatment.

Camprodon-Boadas and colleagues (50) conducted a cross-sectional study in 2023 with a sample of 60 individuals divided as follows: 20 diagnosed with OCD average age 14.10, 20 patients diagnosed with AN average age 14.85 years and 20 patients with a diagnosis of first-episode psychosis (FEP) and mean age of 15.79 years. They were all in-patients. The aim of the study was to compare the presence of delusional thinking between the different samples (OCD, AN, FEP) using the Brown Assessment of Beliefs Scale (BABS). The BABS assesses through delusionality of beliefs in several psychiatric disorders with several items exploring concepts such as conception and fixity of ideas, insight, idea of the other. BDI, on the other hand, measures the severity of depressive symptoms. The results showed that the AN group had higher scores than the OCD group for depressive symptoms. The OCD group had lower scores in almost all items of the BABS than the AN and FEP groups; but no differences were found between the AN and OCD group on fixation of ideas (item 4). Differently, the OCD group showed lower scores than the AN group on insight (item 6). In comparison to the FEP group, lower scores were found in the AN and OCD groups for delusions of reference (item 7), the only item in which AN and FEP showed differences. Lastly, the OCD group scored lower than the FEP and AN group in the total score for delusional beliefs and show an higher level of insight.

4 Discussion

The results of the studies included in the review show a complex scenario of overlaps and divergences between ED and OCD during developmental age. These findings explore various neurobiological and clinical aspects and should be contextualized in relation to

broader literature findings in the adult population. As mentioned in the introduction section, this review did not include studies solely examining comorbidity rates between OCD and ED in developmental age. However, we hereby present the key results found in the literature, which seem to align with those observed in adulthood. Indeed, in community studies conducted on children and adolescents, ED show high comorbidity rates with OCD, ranging from 28% (37) to 20% (39). Among ED, a particularly high comorbidity between BN and OCD was found in a North American study (65%) (37), while greater comorbidity with AN (3.2%) compared to BN (1.2%) was reported in a German study (38). Epidemiological studies on children and adolescents align with those on adults, indicating high comorbidity of OCD not only with ED but also with other disorders such as depressive and anxiety disorders (2, 37–39). However, unlike in adults, there is no co-occurrence of personality disorders and substance use disorders, as these disorders are generally not present in children (37). In fact, according to the DSM-5-TR (3), a diagnosis of personality disorder can be made for patients with a clinical pattern which is stable and of long duration, typically beginning in adolescence or early adulthood. Furthermore while maladaptive personality traits and patterns may have their roots in early development, personality traits observed during early and middle childhood do not consistently indicate later personality disorder (53).

In the following paragraphs, we discuss the results of the review considering evidences available in the scientific literature. For clarity, we have organized the discussion into paragraphs based on the topics addressed, as follows.

4.1 Clinical features

The scientific literature on developmental age presents interesting findings, particularly regarding the clinical relationship and overlap between OCD, AN, and BN. It is observed that there is a general presence of OC symptoms, both ED-related and non-ED-related, in the population with ED. These latter include specific (AN and BN) and unspecified disorders. This underscores the pervasiveness of overlap between ED and OCD during developmental age (41, 43, 44).

In the beginning, it appears that AN-B/P exhibits greater OC symptoms compared to both BN and AN-R (44). Patients with AN-B/P may encompass aspects of the broad spectrum of OC symptomatology, ranging from impulsivity to obsessiveness and compulsiveness, displaying mixed characteristics of both BN and AN (44). Impulsivity might play a significant role as a factor contributing to OC symptom presence (54). In this light, it seems that ED with binge-purge aspects show more prominent and evident OC symptoms, as BN also displays more OC symptoms than AN-R (44). These differences are particularly pronounced in developmental age and early adulthood, as demonstrated by similar findings from Speranza and colleagues (55). In contrast, in adulthood, the differences between various ED types seem to diminish in favor of a generalized presence of severe OC symptoms, indicating a progressive increase in OC symptoms

with age (31, 56, 57). AN-R, however, presents a profile with less pronounced obsessiveness but perhaps more resistant to treatment and more prone to chronicity, at least during developmental age (44). This may be due to a comorbidity profile with a higher presence of non-ED-related OC symptoms, such as checking behaviors, showing a lower response to treatments, including psychotherapeutic interventions for ED, and requiring specific treatment for general OC symptoms (42, 49, 58, 59).

A distinction seems to exist within OC symptoms between those related to eating behaviors and those unrelated. OC ED-related symptoms appear to be associated with a better response to treatments, especially those specifically addressing eating pathology. Both CBT and FBT, whether in outpatient or intensive inpatient settings, have been shown to reduce both eating symptoms and OC ED-related symptoms in adolescents with binge-purge ED (41, 49). OC ED-related symptomatology also seems to be more closely linked to the proper functioning of the OFC, one of the areas most affected in OCD (41). The higher presence of non-ED-related obsessive symptoms associated with ED might signify a worse prognosis in adulthood (12, 13).

From a clinical perspective, perfectionism can also represent a worsening element in the psychopathological picture in both OCD and AN. Perfectionism is a characteristic associated with various psychiatric disorders, often observed in OCD and AN in adolescent and adult populations (60, 61). Despite this, in the only study directly comparing adolescent patients with OCD and AN, AN shows a higher presence of perfectionism, particularly self-oriented perfectionism (46). This aspect seems to correlate AN more strongly with the development of depressive symptoms, eating disorders, as well as OC symptoms, indicating a greater complexity of the disorder in terms of comorbidities. Other studies have confirmed the presence of a high level of perfectionism in adolescent patients with AN and a higher presence of perfectionism in adult patients with AN compared to those with OCD (62–65).

Another interesting result emerging from the review is the greater clinical similarity between AN and early-onset psychotic disorders compared to OCD. Patients with AN tend to exhibit increased delusional thinking and a lower level of insight compared to those with OCD (50). This not only suggests a possible greater severity for AN compared to OCD but also indicates another substantial difference between EDs and OCD. While various authors suggest the potential membership of ED and OCD in the same psychopathological spectrum due to common OC characteristics (2, 25–28), the presence of an egodystonic nature in OCD obsessions and compulsions compared to ED could be crucial (66). However, regarding egosyntonicity and egodystonicity in ED and OCD Roncero and colleagues (67) pointed out that there is no difference between egosyntonicity and egodystonicity between different types of ED, therefore ED patients are not completely egosyntonic (67). Indeed, was also found that egosyntonicity and egodystonicity are not associated with any comorbidity (67). Furthermore, Purdon and colleagues in 2007 found for OCD that the association between egosyntonicity and disorder severity may not be linear. Furthermore, Purdon developed an instrument, the

Ego-Dystonicity Questionnaire (68) which, when applied to patients with OCD, showed no linear correlations between OCD and egodystonicity (68). These findings suggest a non-linear association between egosyntonicity/egodystonicity and ED or OCD. In conclusion, from a clinical standpoint, a common OC dimension among the disorders is apparent, but there is no evidence that ED belong to the OCD dimension.”

4.2 Cognitive flexibility and executive functions

Given the symptomatic manifestations of OCD and ED, characterized by rigid and repetitive behaviors in both disorders, a reduction in executive functions that ensure good cognitive flexibility and inhibition of actions and thoughts could be present. In adolescents with OCD, there appears to be a decrease in cognitive flexibility and inhibition abilities, as evidenced by a deficit in set shifting and an increase in perseverative errors. This impairment seems more pronounced in OCD than in ED, particularly in AN (WR-AN) (48). These results for OCD align with findings in adults, where a greater presence of set shifting alterations has been observed (69, 70), while studies on adolescent OCD have shown inconsistent results (71, 72).

In the adult AN population, inconsistent results emerge, but there is a greater impairment in cognitive inhibition compared to adolescents with AN (73, 74). This might suggest a worsening of this characteristic over time in AN, which, however, remains lower compared to OCD. Alternatively, it could be attributed to the increased development of OC symptoms in ED. Indeed, adult AN patients exhibit more OC symptoms than adolescents (75). The presence of alterations in cognitive flexibility and cognitive inhibition may be linked to the presence of OC symptoms rather than the disorders themselves. The association between worsened cognitive inhibition in AN and the presence of OC symptoms is also suggested by the results of Beithraup and colleagues (42), showing a negative correlation between checking symptoms and cognitive inhibition. In line with this perspective, one of the studies in the review (41) highlights better executive functions in ED patients with ED-related OC symptoms compared to those with no-ED-related OC symptoms, which are more typical of OCD.

4.3 Neural circuits and neurobiological aspects

Examining brain functioning in OCD and ED reveals the existence of various brain regions with alterations that partially overlap. In OCD, the cortico-striato-thalamo-cortical (CSTC) circuit appears central, involving the OFC, ACC, and basal ganglia such as the caudate (dorsal caudate) (76–78). The CSTC circuit, responsible for controlling movement execution, habit formation, and reward aspects typical of OCD and ED symptomatology, not only exhibits hyperactivity (79) but also

seems to normalize its activity after OCD treatment (80–82). The differences in the functional alterations of these structures between developmental and adult age in OCD are not clear. Evaluating some studies, structural differences seem to exist, especially in the OFC, with an increase in size of OFC and ACC in the infantile form (83) and a decrease in the adult form (84). However, more in-depth longitudinal studies are needed to better define this aspect.

On the other hand, ED predominantly exhibit alterations in mesolimbic and mesocortical reward circuits (18). Some studies emphasize the possible presence of alterations in the striatum, especially the ventral part (85), in the prefrontal cortex, and thus in some parts of the CSTC circuit (86, 87) in AN and BN. In these latter ED, the ACC and striatum seem relevant as areas implicated in behavioral and thought control, similarly to OCD. However, significant areas involved in the reward system, like the ventral striatum, appear less involved in OCD (88). Therefore, OCD and ED seem to share functional alterations in partially overlapping areas of the prefrontal cortex, striatum, and connecting circuits between these two regions. One region implicated in both types of disorders seems to be the ACC, as there is evidence of its involvement in OCD (89–91), AN (92) and BN (93). The ACC appears to be one of the brain regions most associated with executive processes such as cognitive flexibility and inhibition (20, 94), along with the dorsolateral prefrontal cortex (95).

The developmental age is a time during which the capacity for self-regulation develops rapidly (96–98). The maturation of the prefrontal cortex and the development of this capability are believed to be closely linked (98, 99). Consequently, disruptions in the maturation of these circuits may play a role in the common challenges associated with regulating thoughts, urges, and behaviors observed in these disorders. In OCD and ED, a connection seems to emerge between poorer cognitive inhibition, a greater presence of OC symptoms, and alterations in the functioning of the prefrontal cortex in both adolescents (48) and adults (20). The presence of hyperactivity in the prefrontal cortex appears to be an important aspect in OCD patients as well as in those with ED showing OC symptoms (43, 100, 101). Hyperactivity in the prefrontal cortex in the presence of OC symptoms could be an indirect effect of the attempt to control actions and thoughts by brain areas dedicated to inhibition (102). Consistent with the previous paragraph, alterations in cognitive flexibility and the greater difficulty in inhibiting dysfunctional behaviors, requiring hyperactivity of the prefrontal region, are more associated with the common OC symptomatology than the two disorders per se. In this perspective, OCD shows increased ACC activation (103), while AN shows decreased activation during tests assessing inhibition control and error evaluation (104).

In addition to the functional aspects of brain areas, further partial overlaps between OCD and ED emerge from the study of neurotransmitter systems. The serotonergic system appears to be a common network. However, OCD does not seem to show clear and unequivocal alterations in the serotonergic system but rather in the glutamatergic system (105). In contrast, EDs exhibit major alterations in the serotonin and dopamine systems (18). The

evidence of this overlap is mainly empirical, as it arises from the common effectiveness of SSRI drugs in both OCD and ED (21–24). Specifically, among ED, those with a greater response to SSRIs are those with a binge/purge profile (BED and BN) (23, 24), supporting a possible greater presence of common elements between binge/purge profile and OCD.

Another indirect way to demonstrate the common dysfunction of the serotonergic network is by evaluating differences in the presence of adipokines in these patients. Adipokines (adiponectin and resistin) have altered production in AN due to the decrease in adipocytes. Studies show a tendency toward an increase in adiponectin and a reduction in resistin in AN patients (106). These changes in the blood appear to influence the regulation of food intake with an effect on the cortico-limbic circuit. The alterations persist even in AN during the compensatory phase, suggesting a role in maintaining some symptoms or susceptibility to anorexia-like symptomatology. The correlation between OC symptoms and adiponectin suggests an additional neurobiological connection between OCD and AN (45). Adipokines seem to play a role in regulating brain neurotransmitters; it has been observed that resistin inhibits serotonin and norepinephrine at the level of the hypothalamus (107), while adiponectin appears to (102) increase brain serotonin levels (108). A possible negative correlation has emerged between OC symptoms and adiponectin concentration in AN patients (45). Furthermore, other studies (109, 110) confirm that adiponectin levels are decreased in OCD. These results, along with those found in the study by Tyszkiewicz-Nwafor, seem to confirm the presence of a correlation between adipokines and serotonin, and thus between adipokines and disorders such as OCD or ED. In AN patients, comorbidity with OC symptoms could be associated with a decreased presence of adiponectin and thus a decrease in serotonin levels with greater dysfunction of the serotonergic system. This appears particularly significant considering that comorbidity with OCD makes AN more severe (12, 13). However, contrasting results seem to emerge regarding adiponectin levels, as it would be decreased in OCD, while it would be increased in AN, despite the two disorders, as mentioned, showing many common neurobiological and symptomatic aspects. This difference could be explained by distinct profiles of alteration in the serotonergic system and symptomatic manifestations.

4.4 Genetic implications

A genetic correlation exists between AN and OCD, as evidenced by GWAS; a recent genetic association study identified a genetic overlap (111). However, it is noteworthy that there are no GWAS for BN and BED or other ED (18). Possible common SNPs between ED and OCD have been identified, as emphasized by GWAS studies for AN and OCD. Two SNPs (rs6311, rs4942587) in the HTR2A gene, which encodes for the 5HT2A receptor, appear to be linked to the development of OCD and AN. These SNPs are particularly correlated in patients with childhood onset, suggesting that patients with earlier onset may have greater genetic overlap (47). The HTR2A gene encodes the 5HT2A receptor, and the rs6311

polymorphism is one of the most studied. The rs6311 polymorphism is linked to a promoter variant called -1438 G/A, where the A allele causes an increase in promoter activity and, consequently, receptor activity. Specifically, the presence of the A allele is associated with the development of OCD with earlier onset and more severe symptom manifestation (112, 113). The 5HT2A receptor appears to be one of the most important elements among the pathogenetic alterations of the serotonergic system in OCD. In fact, the efficacy of 5HT2A receptor antagonist agents (such as atypical antipsychotics) as adjunct therapy to SSRIs in OCD patients suggests that blocking this receptor may play a central role in the pathophysiology of OC symptoms (114). In ED, there are less clear results regarding the correlation with alterations of the HTR2A gene and the rs6311 polymorphism. Some studies confirm the association, particularly with the presence of the A allele, especially in restrictive AN, while others deny the association (115). It appears that the G allele may be more prevalent in BN (115). The presence of a common polymorphism in a gene encoding for the 5-HT2A receptor underscores how the alteration of the serotonergic system may be crucial in these two forms of disorders, albeit possibly in different ways. These results confirm the heterogeneous presence of common characteristics; the alteration of the serotonergic system, particularly involving the 5HT2A gene, might be more typical of OCD and be present in both OCD and ED with onset in childhood. This higher genetic overlap could be more typical of childhood onset forms compared to adolescent and adult onset disorders. The study of Plana and colleagues (47), included in this review, focused only on genes related to the serotonergic system. In adults, evaluating a broader range of genes related to different networks, it is evident that OCD and AN show overlapping polymorphisms in genes related to both the serotonergic and glutamatergic systems, as well as neurotrophin genes (111). However, does not appear a specific correlation with the HTR2A gene, despite being examined. Building on the information provided in the previous paragraphs, the increased occurrence of serotonergic system alterations in patients with childhood onset AN should correspond to a higher prevalence of OC symptoms compared to cases with onset in adolescence or adulthood. However, specific studies on clinical features of ED with childhood onset are required to better delineate these differences.

5 Limitations and strengths

This study is characterized by several strengths and limitations. Firstly, to the best of our knowledge, this is the first systematic review delving into the relationship between OCD and ED in children and adolescents. This may prompt other authors and clinicians to engage in new considerations and reflections on this topic. Nevertheless, it should be noted that despite the limited sample of studies, they represent different research groups with diverse and non-overlapping populations. Moreover, these studies approach the investigated topic from various perspectives,

including clinical, genetic, and neurobiological, also with the use of neuroimaging. However, research in this field is constrained, and the final selection of included studies is relatively small. Some of the studies included have small sample sizes, often below 20 subjects. Literature on this topic, both in developmental and adult populations, predominantly focuses on AN and BN within the broader category of ED. There is a notable lack of studies that analyze the relationship between OCD and BED. Studies in this regard could be promising, given the potential correlation between B/P-type symptoms and OC symptoms. This gap is even more apparent in genetic studies, where the only available GWAS is solely for AN. A consequence of the focus on disorders like AN and BN is that the majority of individuals studied are female. This could potentially influence results since OCD often presents a higher frequency in males during the developmental age. A final limitation to highlight is that existing literature primarily concentrates on the presence of OC symptoms in ED, seldom exploring the reverse scenario of potential ED symptoms in the OCD population. This could be an intriguing field for further researches. Another aspect not thoroughly explored in the included studies, yet potentially very intriguing, is the correlation between ED and different subtypes of OCD. This could be an intriguing area for future research given the heterogeneity of OC manifestations.

6 Conclusions

The hypotheses formulated by us have been partially confirmed by the results of the review. As hypothesized, mixed results emerge, indicating both differences and similarities between OCD and ED. However, one aspect of our hypotheses is not confirmed. Indeed, OC symptoms are more frequent in ED with a B/P profile (BN and AN-B/P) than in ED with a restrictive profile (AN-R) in developmental age. This difference seems to disappear in adulthood, possibly due to an increase in OC symptoms in ED over time. Therefore, our incorrect hypothesis may be due to the age of patients evaluated in the studies. On the other hand, in developmental age, there may be a greater severity, a lesser response to treatments, and a higher rate of chronicity of OC symptoms in AN-R patients. This could be as ED with a B/P profile, compared to AN-R, present more ED-related OC symptoms. These show a better response to ED psychotherapeutic treatments and a better neurocognitive profile than non-ED-related OC symptoms. A take home message is that OC symptomatology appears to be a common dimension in both OCD and ED, with a wide range of manifestations, rather than representing just a comorbidity or the inclusion of ED within the OCD spectrum. When presents, OC symptomatology, exhibits transversal characteristic alterations in the ACC and poorer cognitive flexibility. These correlations could be highlighted by genetic overlaps between disorders. These aspects may be particularly evident analyzing the developmental age population. Further studies in this area are needed to gain deeper insights into the characteristics of OCD and ED. A better clinical

and neurobiological definition, delineating differences and overlaps, could significantly improve treatment selection and thereby influence the outcome of these patients.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Author contributions

ML: Conceptualization, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. DB: Writing – original draft, Writing – review & editing. AB: Methodology, Writing – original draft, Writing – review & editing. VV: Writing – original draft, Writing – review & editing. CDV: Writing – original draft, Writing – review & editing. SV: Writing – original draft, Writing – review & editing. MP: Writing – original draft, Writing – review & editing. VZ: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2024.1407872/full#supplementary-material>

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Non-interpersonal traumatic events in patients with eating disorders: a systematic review

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Objectives: The purpose of the systematic review was to synthesize literature on eating disorders (ED) and non-interpersonal traumatic events (NTE) and consolidate the reported prevalence of NTE in patients with an ED.

Methods: The literature search was performed in Embase, PsycInfo, and PubMed. The keywords in the search were “eating disorder,” “trauma” and “non-interpersonal,” using index-terms and free-search keywords related to NTE and ED. The PRISMA guidelines were followed. Relevant studies were screened using Rayyan.

Results: Of the 16 studies included in the quantitative synthesis, five overall types of NTE were identified: *accidents, illness, injury, natural disaster* and *war*. Findings provided tentative evidence for *illness* and *injury* being more prevalent in patients suffering from an ED compared to controls. The remaining subtypes of NTE did not show a higher prevalence in patients with an ED when compared to controls. Findings also suggest that those with binge/purge subtype of anorexia nervosa (AN) had a higher prevalence of non-interpersonal traumatic events compared to the restrictive subtype of AN.

Discussion: This systematic review provided a clear synthesis of previous findings related to NTE among patients with an ED. Noteworthy, is that many studies do not take into account if the trauma happened prior or after to ED onset, which may affect the association. Furthermore, the body of research on NTE in patients with ED is exceedingly limited, and more research is needed.

KEYWORDS

trauma, non-interpersonal, eating disorder, anorexia nervosa, bulimia nervosa

Introduction

Trauma involves a wide variety of potentially stressful exposures traditionally divided into two types of trauma, namely, interpersonal trauma (e.g., the direct result of actions by others, such as abuse and neglect), and non-interpersonal trauma (e.g., other life-threatening events, such as accident, injury, illness, war, and natural disaster; [Forbes et al., 2011](#); [Hughesdon et al., 2021](#); [Thomas et al., 2021](#)).

Highly stressful and traumatic events are regarded as potential precipitating factors for the onset of ED, and studies indicate that individuals with an ED are more prone to report a history of trauma ([Garner and Garfinkel, 1980](#); [Meneguzzo et al., 2021](#); [Sundhedsstyrelsen, 2021](#); [Rienecke et al., 2022](#)). This was also highlighted in the systematic review by [Rossi et al.](#)

(2024) on the concept of the maltreated eco-phenotype of ED, exploring the distinctive biological and clinical features associated with childhood maltreatment (CM). Rossi et al. (2024) synthesized evidence revealing significant neuroanatomical changes, stress response alterations, inflammation markers, and gut microbiota composition differences among individuals with EDs who had experienced CM. Importantly, these findings stress the significance of viewing CM and interpersonal trauma not only as risk factors but also as causal agents shaping various eco-phenotypic variants of EDs. The comprehensive nature of this review provides a valuable framework for understanding the complex interplay between trauma and the development of EDs, an association that may also apply to other types of trauma, such as NTE. Prior research investigating NTE's association with psychopathology found that NTE had a significant association with PTSD, anxiety, and depressive symptoms (Haldane and Nickerson, 2016; Smith et al., 2023). This raises the question of whether there is also evidence of an association between NTE and ED across studies. The majority of studies examining the link between trauma and ED tend to focus on interpersonal traumas as observed by Rossi et al. (2024), thus leaving NTE relatively understudied (Trottier and MacDonald, 2017). The primary domains of interpersonal trauma that have been investigated in the literature of ED, are physical-, emotional-, and sexual abuse (Forman-Hoffman et al., 2012; Kothari et al., 2015; Trottier and MacDonald, 2017). Two meta-analyses have found that these interpersonal forms of traumatic events were associated with increased ED pathology (Caslini et al., 2016; Molendijk et al., 2017). Thus, Caslini et al. (2016) found a noteworthy association between distinct types of childhood abuse and ED subtypes, but it was discovered that only BN and BED demonstrated distinct connections with all forms of child abuse (Caslini et al., 2016). Molendijk et al. (2017) showed overall consistent results with the meta-analyses of Caslini et al. (2016). However, in addition, Molendijk et al. (2017) found a high prevalence of child abuse in each type of ED, AN included (Molendijk et al., 2017). Overall, the literature suggests that the binge/purge subtypes of EDs are frequently associated with different types of interpersonal traumatic events. Beyond the association observed between interpersonal trauma and AN, BN, and BED, more recent studies have also uncovered a link between interpersonal trauma and the ED subtypes OSFED and ARFID (Scharff et al., 2021; Rienecke et al., 2022). Nevertheless, few studies have examined the relationship between NTE and different ED subtypes. Moreover, the investigation of NTE in patients with an ED possesses clinical importance because trauma exposure has been identified as a complicating factor in the treatment of ED, leading to increased rates of dropout and ED pathology post-treatment (Convertino and Mendoza, 2023; Day et al., 2024). Research has shown that individuals with an ED who have experienced a traumatic event exhibit heightened severity of ED pathology, elevated levels of anxiety and depressive symptoms, and lower levels of mindfulness compared to those who have not experienced trauma (Rabito-Alcon et al., 2021; Scharff et al., 2021). Hence, it is imperative to investigate the prevalence of NTE in patients with ED to determine the necessity of incorporating this trauma type into ED treatment strategies. Additionally, it has not been investigated, which subtypes of NTE have the highest prevalence among patients with ED. Regarding interpersonal traumas, the traumas with a bodily dimension, such as sexual and physical abuse are often found to have a high prevalence in patients with ED (Caslini et al., 2016). Therefore, we predict that

non-interpersonal traumas with a bodily dimension such as *illness* and *injury* have the highest prevalence in patients with ED. Given this knowledge gap in the literature concerning NTE in the context of ED, it is deemed relevant to investigate the prevalence of NTE in patients with ED in a systematic review.

Objectives and aim

This systematic review aimed to investigate the prevalence of NTE in patients diagnosed with ED.

Based on existing literature on the association between interpersonal traumatic events and ED, the following hypotheses were proposed:

1. Individuals with an ED are more likely to have been exposed to a NTE
2. The prevalence of NTE varies across different subtypes of ED with a higher prevalence in the binge/purge subtypes
3. The NTE subtypes of *injury* and *illness* have are more prevalent than other NTEs in individuals with ED.

Literature regarding traumatic events and ED describes traumatic events as a triggering factor (Garner and Garfinkel, 1980). Therefore, if data allows it, we wish to investigate the temporal frame by the following hypothesis.

4. The traumatic event happened prior to ED onset.

Method

Search strategy

The systematic review followed the 2020 *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) standard (Page et al., 2021). Additionally, the systematic review protocol was structured in accordance with the PRISMA-P guidelines. A literature search was carried out by the chief librarian of Aalborg University Hospital, Denmark on 17 October 2023, in the databases PubMed, PsycInfo, and Embase. No time restrictions were imposed, and all identified relevant articles found in the databases were included in the systematic review. The search phases combined controlled vocabularies (e.g., Mesh, thesaurus, and Emtree) and free-search terms relevant to the Population (individuals with an ED), Comparison (presence or absence of ED), and Outcome (prevalence of NTE) components of the PICO framework. Besides these keywords, other reviews were excluded by filters in PubMed and Embase in the search. A comprehensive list of the search terms, synonyms, and controlled vocabularies, used in the different databases can be found in [Supplementary Table 1](#). The extraction files were then uploaded into Rayyan:¹ an online reference management software. After removing duplicates by Rayyan's duplicate-identification strategies the articles were screened for relevance, language, and availability. All searches, starting from the

¹ <http://rayyan.qcri.org>

initial screening of the title and abstract to the final decision on inclusion through full-text reading, were conducted independently by two reviewers (K.M.J., K.E.N.). To reduce the risk of errors made in the selection of studies, the reviewers were blinded to each other. Discrepancies between the two reviewers were resolved through consensus. If persistent disagreements arose, a senior researcher (G.K.T.) was consulted as a third party to reach a final decision. This approach ensured a rigorous screening process and minimized the potential for bias in study selection.

Inclusion and exclusion criteria

All studies collected from the literature search were screened based on the predetermined inclusion and exclusion criteria. To be included in the systematic review, studies had to be peer-reviewed and have a quantitative research design. Additionally, the prevalence had to be extractable or calculable from the articles' data. Participants in the studies were required to have or have had a clinical diagnosis of ED according to the *International Classification of Diseases* (ICD-10) or the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV and DSM-5), to be included. Studies on comorbid disorders and medical conditions were not excluded from the systematic review. This decision stemmed from the well-established overlap between EDs, and diverse medical and psychiatric conditions documented in existing literature (Hudson et al., 2007). By incorporating individuals with comorbidity, a more nuanced depiction of the complex presentation of EDs was achieved. Additionally, the studies had to include NTE among participants with a current or previous ED diagnosis. Inclusion criteria specified that studies had to have a sample size of 10 or more individuals diagnosed with an ED.

Studies that only reported an overall category of trauma were excluded, as NTE could not be differentiated from interpersonal traumatic events. Studies were also excluded if they had other research designs than empirical study designs. Moreover, studies in languages other than Danish, English, Swedish, or Norwegian were excluded.

Data extraction

In the data collection process, the following information was extracted from the included studies: (a) author names, (b) year of publication, (c) country, (e) population frame (e.g., in-patients, out-patients, etc.), (f) the different ED subcategories and assessment tools, (g) trauma type and measurement, (h) main findings regarding prevalence among individuals with and without ED. This form was used to summarize and synthesize the overall findings in relation to the objectives of the systematic review. The primary outcome of interest of the included studies was prevalence. If data were raw or numerical, the percentage was calculated. Only the relevant control groups for the objectives of this study were stated in the form. Throughout the article, we employed the term 'control group'. This designation encompassed both reference groups as well as matched control groups without ED. We contacted the corresponding authors by mail if the prevalence of NTE could not be extracted from the articles but was expected to be in the possession of the authors. Articles were excluded if no response was received.

Quality assessment

All included studies were assessed using the *Joanna Briggs Institute* (JBI) *Critical Appraisal Checklist for Studies Reporting Prevalence Data*, to critically evaluate the methodological quality of the included studies (Munn et al., 2020). This tool was used to evaluate different items in the studies, with responses categorized as "Yes," "No," "Unclear," or "Not applicable." JBI checklist was applied as it offered tailored evaluation criteria for prevalence studies, ensuring a thorough assessment of methodological quality in the included studies in a systematic and standardized way. With inspiration from Rasmussen et al. (2023), the total score for the JBI checklist for prevalence studies ranged from 1 to 9. The overall evaluation of the quality of the studies clarified the impact of the studies.

Results

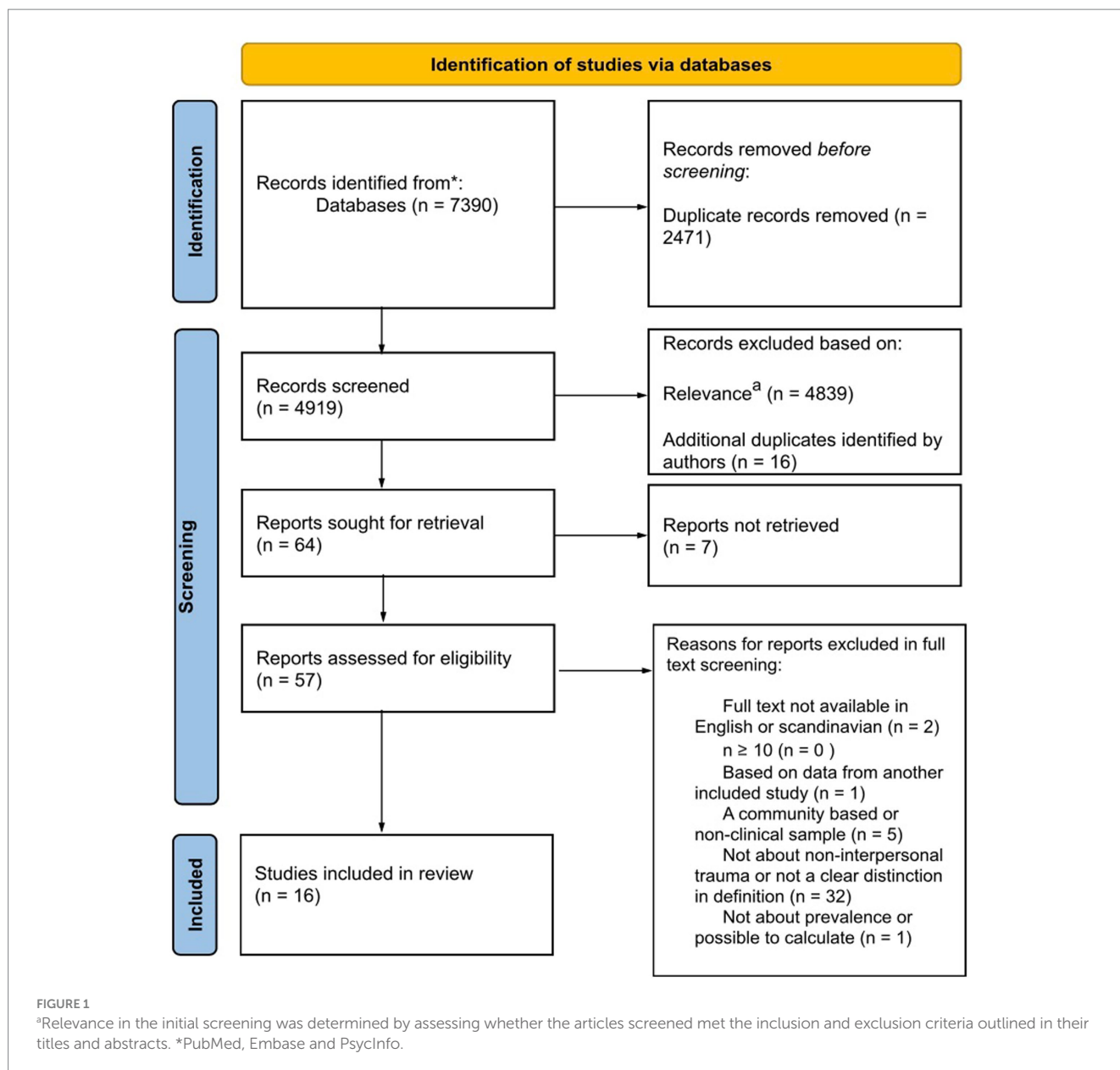
Study selection

A total of 7,390 articles were retrieved in the initial search. From these, 2,624 came from PubMed, 3,160 from Embase, and 1,606 from PsycInfo. Five articles were identified under the subheading PsycTest that were excluded in the initial search process. Only references under the subheadings PsycInfo and PsycArticles were included. The removal of duplicates resulted in 2471 articles, and another 16 duplicates were subsequently removed. The following screening by title and abstract resulted in 64 articles, of which seven articles could not be retrieved. The agreement rate between authors in the independent screening was 97.9%. 57 articles were assessed according to the predetermined exclusion and inclusion criteria, of which 16 were included. Figure 1 depicts a detailed description of the study selection in a flow diagram.

Study characteristics

Supplementary Table 2 shows data from the 16 included research articles. The number of participants in the ED group ranged from $n = 21$ (Thornley et al., 2016) to $n = 4,524$ (Backholm et al., 2013). For the control groups included in the studies, the sample sizes ranged from $n = 245$ (Lejonclou et al., 2014) to $n = 35,709$ (Convertino et al., 2022). Thirty-seven-point 5 % of the studies involved only adult participants (>18 years; Reyes-Rodríguez et al., 2011; Backholm et al., 2013; Tagay et al., 2014; Thornley et al., 2016; Longo et al., 2019; Brewerton et al., 2020) while 6.25% included child/adolescent participants (<18 years; Groth et al., 2020). When including Kjaersdam Telléus et al. (2021), who also investigated adolescence, but in the age range from 15 to 19.5, the percentage increased to 12.5%. Half of the studies either included both age groups or did not clarify the age range (Tagay et al., 2010; Degortes et al., 2014; Lejonclou et al., 2014; Vieira et al., 2018; White et al., 2018; Longo et al., 2020; Lie et al., 2021; Convertino et al., 2022). Results indicated a varied prevalence of NTE in the child/adolescent and adult age groups, with no consistent trend observed between the two groups.

The included studies predominantly originated from the United States and Europe, with minimal to no representation from other regions such as Asia or Africa. Of the included studies six and four studies investigated only out- and inpatients, respectively. When



comparing the two groups, inpatients exhibited a higher prevalence of *illness or injury* ranging from 20 to 59% (Thornley et al., 2016; Longo et al., 2019; Brewerton et al., 2020; Longo et al., 2020), while outpatients showed a range of 6.5–19.4%, when Lejonclou et al. (2014) study was excluded from the outpatient range due to significantly higher results (e.g., 60% had been in the hospital and 70% had experienced having a family member in the hospital; Tagay et al., 2010; Degortes et al., 2014; Vieira et al., 2018; White et al., 2018; Convertino et al., 2022).

In general, different measurements were used to measure eating pathology and exposure to traumatic events, including both structured clinical interviews and self-report questionnaires. Supplementary Table 3 provides a list of all the measurements used in the studies. Overall, 31% of the studies used the *Life Events Checklist* (LEC) to assess the prevalence of traumatic events in patients with an ED (Backholm et al., 2013; Thornley et al., 2016; Longo et al., 2019; Brewerton et al., 2020; Longo et al., 2020).

Despite using the same measurement instrument, LEC, no consistency was observed in the prevalence of NTE subtypes across the five studies, but rather a significant variation ranging from 0–59%. For instance, in Backholm et al. (2013), only 1.57% of patients with ED had experienced life-threatening *illness or injury*, whereas Thornley et al. (2016) reported a much higher prevalence of 43% for this variable.

NTE experienced by patients with ED

Two of the 16 studies presented the prevalence of an overall category of NTE in patients suffering from ED. In these, the prevalence was, respectively, 75.2% (Convertino et al., 2022) and 14.3% (Longo et al., 2020). Across the 16 studies, NTE could be grouped under five broad subheadings: *accidents, injury, illness, war, and natural disaster*. Overall, the prevalence of the different NTEs in patients with an ED

across all included studies ranged from 0 to 72%. The results were ambiguous, but generally, the prevalence was between 0 and 30%. The studies that showed the highest prevalence were Brewerton et al. (2020), Lejonclou et al. (2014), Tagay et al. (2014) and Thornley et al. (2016). Generally, *illness* and *injury* showed the highest prevalence compared to the other subtypes of NTE (Backholm et al., 2013; Degortes et al., 2014; Lejonclou et al., 2014; Tagay et al., 2014; Thornley et al., 2016; Longo et al., 2019; Convertino et al., 2022). When differentiating these, *illness* had the highest prevalence of the two variables (Convertino et al., 2022). In contrast to these findings, Tagay et al. (2010) and Brewerton et al. (2020) found that *accidents* were the subtype with the highest prevalence. However, most of the studies showed that *accidents* had a lower prevalence than *illness* and *injury*, but a higher prevalence than *natural disasters* and *war* (Reyes-Rodríguez et al., 2011; White et al., 2018).

Patients with ED vs. control group

The studies that incorporated a control group were conducted by Convertino et al. (2022), Lejonclou et al. (2014), Lie et al. (2021), and Thornley et al. (2016). The included control groups used as a reference consisted of populations pooled from internet samples (Thornley et al., 2016; Lie et al., 2021), national surveys regarding alcohol and related conditions (Convertino et al., 2022), and recruitment from Secondary Schools and High Schools (Lejonclou et al., 2014). The clinical group was predominantly females, whereas gender was mixed in the control groups. Most of the studies had a control group that was representative of the clinical group in terms of age. However, Thornley et al. (2016) exhibited a greater difference.

Only one study reported the prevalence of the overall category of NTE in comparison to a control group (Convertino et al., 2022). In this study, the overall prevalence of NTE in patients suffering from ED was 75.2%, whereas the prevalence in the group without ED was 62.2%. Across studies with a control group, the prevalence of the subtypes of NTE in the ED group ranged from 0 to 70%, in comparison to 0.18–72% in the control group without ED. Two studies demonstrated a generally higher prevalence of *accidents* in the control group compared to the ED group (Thornley et al., 2016; Lie et al., 2021). The findings in Lejonclou et al. (2014) presented varied results regarding the prevalence of multiple items related to *accidents*.

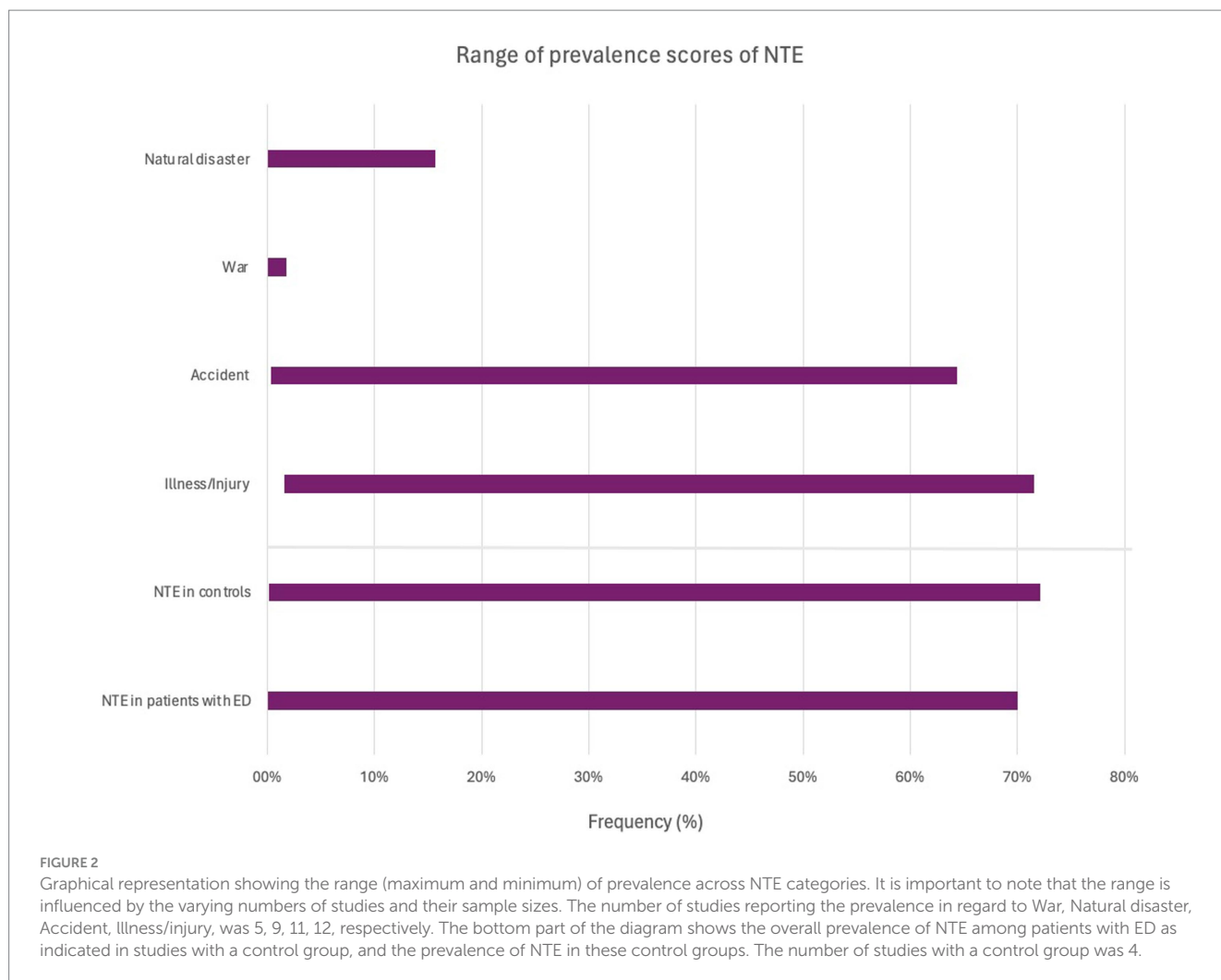
In all studies the prevalence of war exposure was more than twice as high in the control group, which indicated that the prevalence was considerably lower in the ED sample (Lejonclou et al., 2014; Thornley et al., 2016; Convertino et al., 2022). Likewise, ED groups demonstrated lower levels of exposure to *natural disasters* compared to control groups (Lejonclou et al., 2014; Thornley et al., 2016). In contrast, Convertino et al. (2022) reported that the rates of *natural disaster* did not differ between those with and without ED. The two variables *injury* and *illness* were sometimes combined in the measurement instruments for exposure to NTE (Thornley et al., 2016). Other studies separated the categories or only reported one of them (Lie et al., 2021; Convertino et al., 2022). The trauma measurement used in Lejonclou et al. (2014) included hospitalization as an item, which made it unclear whether it belonged to the category of *injury* or *illness*. Generally, the ED groups demonstrated a considerably higher prevalence of *illness* compared to the control

groups (Lejonclou et al., 2014; Thornley et al., 2016; Lie et al., 2021; Convertino et al., 2022), although Lejonclou et al. (2014) showed no significant difference in the prevalence of *illness* when measuring hospitalization in a family member or close relative. In terms of *injury* there was not a significant difference between the ED- and control groups (Convertino et al., 2022). For a general overview of the main results regarding the minimum and maximum range for the prevalence of NTE, refer to Figure 2. Here, the difference in prevalence between the ED and control groups is also displayed within this interval range.

Subtypes of ED

Most studies distinguished between the subtypes of ED: AN (Tagay et al., 2010; Reyes-Rodríguez et al., 2011; Lejonclou et al., 2014; Tagay et al., 2014; White et al., 2018; Longo et al., 2019; Groth et al., 2020; Longo et al., 2020; Kjaersdam Telléus et al., 2021; Lie et al., 2021; Convertino et al., 2022), BN (Tagay et al., 2010; Reyes-Rodríguez et al., 2011; Degortes et al., 2014; Lejonclou et al., 2014; Tagay et al., 2014; White et al., 2018; Groth et al., 2020; Kjaersdam Telléus et al., 2021; Lie et al., 2021; Convertino et al., 2022), BED (Degortes et al., 2014; Groth et al., 2020; Lie et al., 2021; Convertino et al., 2022) and OSFED (White et al., 2018; Groth et al., 2020; Kjaersdam Telléus et al., 2021). In terms of NTE reported in the single studies, there was not a large difference between AN, BN, BED, and OSFED. When the participants had the opportunity to report multiple lifetime ED diagnoses, it was shown that these participants (e.g., AN/BN and AN/BN/BED) had a higher prevalence than the participants with a single lifetime ED diagnosis (e.g., AN, BN or BED; Reyes-Rodríguez et al., 2011; Lie et al., 2021). The finding that the participants reporting multiple lifetime ED diagnoses, exhibits a higher prevalence of NTE compared to those with a single lifetime ED diagnosis, aligns with the findings of Rossi et al. (2024), which show an increased prevalence of the so-called diagnostic crossover in the maltreated eco-phenotype. The presence of diagnostic crossovers, such as individuals experiencing multiple forms of eating pathology over their lifetime, underscores the dynamic nature of EDs and emphasizes the need for a more nuanced understanding of ED that considers the interplay between trauma exposure, symptom expression, and diagnostic trajectories. Moreover, these findings underscore the importance of adopting a transdiagnostic approach clinically in assessment and treatment that accounts for the diverse pathways to ED development and maintenance.

It was demonstrated in Tagay et al. (2014), that participants with BN had experienced *accidents* and *illness/injury* to a higher extent compared to AN. However, other studies found that AN had the highest or same prevalence in relation to *accidents* and *illness/injury* (Tagay et al., 2010; Kjaersdam Telléus et al., 2021). When differentiating *illness* and *injury* it was shown in Convertino et al. (2022) that the highest prevalence of *injury* was seen in individuals with BED, in comparison to AN and BN. In contrast, BN was the ED subtype with the highest prevalence of *illness*. Only one study reported on *war* in relation to ED subtypes (Convertino et al., 2022). It was demonstrated that individuals with BN had been exposed to more war-related traumatic events, than AN and BED. However, the difference was minimal, and the percentage was very low. Findings showed that there



was no consistent difference in the prevalence of *natural disasters* between AN- and BN subgroups in the included studies. ED subgroup comparisons showed that individuals with BED experienced fewer events related to *natural disaster*.

Regarding the difference between AN-R and AN-BP, it was demonstrated by Lie et al. (2021), Longo et al. (2019), and Kjaersdam Telléus et al. (2021), that individuals with AN-R had a lower prevalence of *accident* and *illness* than AN-BP. In terms of *natural disasters*, Longo et al. (2019) found that AN-R had the highest prevalence, in comparison to AN-BP. Similarly, Reyes-Rodríguez et al. (2011) showed a higher prevalence in individuals with AN-R compared to AN-P and AN-B in terms of *accidents*. However, this was not the case regarding *natural disaster*, where AN-P had the highest prevalence.

Timing of NTE

Seven studies either exclusively reported the prevalence of NTE, when the events occurred before the onset of the ED diagnosis or provided information on the number of individuals who reported experiencing at least one NTE prior to the onset of the ED

(Reyes-Rodríguez et al., 2011; Degortes et al., 2014; Tagay et al., 2014; Vieira et al., 2018; Longo et al., 2019, 2020; Lie et al., 2021). Between 58.3–81.1% of the ED sample reported the traumatic event happened before the ED onset. Noteworthy is that Tagay et al. (2014) and Reyes-Rodríguez et al. (2011), exclusively provided information on the timing of NTE in the subset of individuals with both ED and PTSD, omitting those who did not have PTSD. Additionally, two studies only investigated the prevalence of NTE occurring prior to the onset of ED (Degortes et al., 2014; Vieira et al., 2018).

Quality of evidence

Thirteen of the 16 articles were assessed to have a quality that scored between four and six points out of nine, on the *Critical Appraisal Checklist for Studies Reporting Prevalence Data* in JBI. These articles were considered to have medium quality. Two studies achieved a score of eight, indicating a high quality. On the contrary, one of the included studies had a score of two, which is classified as low quality. Overall, the two high-quality studies showed a relatively low prevalence compared to the other studies, ranging from 0.15–14%.

Discussion

The purpose of this systematic review was to investigate the prevalence of NTE in patients with ED through a quantitative overview of studies. Following a systematic literature search, 16 relevant articles were included in the systematic review. This is the first systematic review in the literature to investigate the prevalence of NTE in patients with ED.

Overall, the findings showed that there was a considerable variation in the reported prevalence of the different NTE in patients with ED in the included studies. There was evidence to suggest that *illness* was the NTE with the highest prevalence among patients with ED, whereas *war* and *natural disasters* had the lowest. Regarding this finding, *illness* was shown to be the only NTE subtype with a higher prevalence among patients with ED compared to controls. This is supported by the literature, which describes *physical illness* to be a significant risk factor for the development of an ED (Watkins et al., 2001; Goodwin et al., 2003). Additionally, the variable *illness* had a higher prevalence among individuals with ED compared to their respective control groups, as observed in Welch et al.'s (1997) study, which examined a community-based sample. This suggests that NTE with a bodily dimension has a stronger correlation with eating pathology, than other types of NTE. However, it is important to note that studies have shown that ED can prompt *physical illness* and *injury* such as bone fractures, osteoporosis, and heart diseases (Hall et al., 1989; Solmi et al., 2016). This could explain the elevated incidence of *illness* and *injury* among individuals with ED when the temporal frame is not taken into account. Beyond the explanation that individuals with ED may experience *illness* more frequently, there are indeed other hypotheses that could explain this association. One potential explanation involves the altered relationship with the body that individuals may develop following an illness. Prior studies have found that conditions like diabetes can profoundly affect one's perception of and relationship with the body (Gemeay et al., 2015; Yagci et al., 2023). Additionally, the meta-analysis by Pinquart (2013) found that children and adolescents with chronic illnesses exhibited a less positive body image compared to a healthy control group. This altered relationship with the body could manifest in various ways, potentially contributing to the development or exacerbation of ED. Further investigation into these potential mechanisms could provide valuable insights into the complex interplay between *illness* and ED.

Significantly, half of the included studies failed to account for the timing of trauma, with nearly all utilizing a cross-sectional design. This aligns with existing literature highlighting the scarcity of longitudinal studies exploring trauma and ED (Trottier and MacDonald, 2017; Vanderlinden and Palmisano, 2018). The oversight regarding the timing of trauma impedes the establishment of a clear temporal relationship between trauma exposure and the onset of eating pathology, emphasizing the necessity of discussing causality. The absence of a temporal framework in these studies makes it difficult to determine the directionality of the observed association, as highlighted in the discussions by Kjaersdam Tell us et al. (2021) and Thomas et al. (2021). Consequently, it remains unclear whether trauma preceded the manifestation of ED symptoms or if the diagnosis of ED was prior to the traumatic event. Future research could benefit from incorporating prospective longitudinal study designs. Such an approach would facilitate a more nuanced exploration of the temporal

framework, thereby enabling researchers to draw more informed conclusions about risk factors, causality, and maintenance factors (Trottier and MacDonald, 2017). By examining the timing of NTE in relation to ED symptoms, researchers may gain insights into the causal pathways and better elucidate the nature of the observed associations. Additionally, incorporating a causal perspective when assessing NTE could provide a more accurate description of the impact of traumatic experiences on the development and maintenance of ED.

The study by Thornley et al. (2016) did not explicitly state the temporal frame of the reported prevalence. Consequently, this study could not be included in the results section concerning the timing of NTE. However, Thornley et al. (2016) utilized the Perceived Causal Relations scale to assess the patient's perception of a potential causal relationship between PTSD symptoms and the onset of the ED. Their findings suggested that the majority of patients with an ED perceived the development of the disorder to be influenced by PTSD symptoms.

According to prior literature, it can be assumed to be important to investigate when the trauma occurred in the individual's life. This exploration is crucial for identifying critical periods and determining whether there are heightened rates of trauma in patients suffering from ED during specific life stages (Brewerton et al., 2022). In the included studies it was unclear whether exposure to a traumatic event mostly occurred in childhood, adolescence, or adulthood. The studies primarily investigated adults with only a few investigating children and/or adolescents. No difference was observed between these age groups. Vida a et al. (2020) found in their study, that serious and life-threatening illness or injury and transportation accidents had a higher prevalence in individuals with disordered eating when these events occurred during childhood rather than adulthood. Conversely, the prevalence of *war* and *natural disasters* was higher in adulthood than in childhood. Most of the study participants were women and gender was not differentiated in the investigation of prevalence in the included studies. This complicated a generalization of the results to men with an ED. Previous studies have shown that gender has a moderating role in the psychological outcome of exposure to trauma (Cromer and Smyth, 2010; Haldane and Nickerson, 2016). The findings of the studies demonstrated that NTE in men was more strongly associated with psychological distress. In contrast, it is observed that interpersonal traumas had a greater impact on women. Gender differences regarding exposure to NTE and ED should therefore be considered in future research.

In relation to NTE in the various ED subtypes (e.g., AN, BN, BED, OSFED) the systematic review yielded mixed results. Nevertheless, the studies indicated that individuals with more than one ED diagnosis during their lifetime tended to exhibit a higher prevalence of NTE compared to those with a single ED diagnosis. In addition, we found that the association between NTE and ED was particularly strong for AN-BP, in comparison to AN-R. This aligns with previous studies that investigated other types of traumatic events (i.e., interpersonal traumatic events; Caslini et al., 2016; Molendijk et al., 2017; Palmisano et al., 2018; Rienecke et al., 2022). Additionally, the study by Longo et al. (2023) found that individuals with a history of childhood trauma and bingeing-purging behaviors, had a higher occurrence of dissociative symptoms, in comparison to those with restrictive eating behaviors.

Many of the studies excluded individuals with *Avoidant/Restrictive Food Intake Disorder* (ARFID) from their investigation, due to a small sample size. However, studies have suggested that ARFID is often a

condition that emerges following a traumatic event that is attributed to eating (e.g., choking and vomiting; Kambanis et al., 2020; De Toro et al., 2021). Thus, incorporating ARFID into future research studies could provide insights into the prevalence of NTE in ARFID patients and enable comparison to the findings of the other ED subtypes.

Overall, the pooled data indicated that the prevalence of NTE ranged from 0 to 75.2%. In comparison to this, Molendijk et al. (2017) found that 21–59% of patients suffering from ED had been exposed to childhood maltreatment (CM), including emotional, physical, and sexual abuse. This is supported by a more recent study that found a prevalence between 45.2–62.9% (Eielsen et al., 2024). This association between ED and CM is well-established in the literature (Caslini et al., 2016; Quilliot et al., 2019; Rabito-Alcon et al., 2021; Chu et al., 2022). The higher prevalence of NTE among patients with a history of ED can be attributable to the higher prevalence of NTE in the general population compared to CM. Convertino et al. (2022) reported that the prevalence of any sexual interpersonal trauma, any other nonsexual interpersonal trauma, and any NTE in the non-ED group, were 9.1, 17.7, and 62.2%, respectively. Additionally, individuals with ED were found to be more likely to experience interpersonal traumatic events than NTEs compared to those without ED (Convertino et al., 2022). This is in line with studies comparing the association of NTE and interpersonal trauma to other types of psychopathologies (Forbes et al., 2011; Hughesdon et al., 2021; Thomas et al., 2021). Therefore, the association between NTE and ED may not be as robust as that observed between interpersonal traumas and ED. One possible explanation for this might be that interpersonal traumatic events involve a perpetrator, unlike NTE. Studies suggest that such involvement can result in feelings of betrayal of trust, a negative self-image, and a disruption of assumed beliefs about the external world (Tang et al., 2012; Martin et al., 2013; Zaccagnino et al., 2017). This aligns with the finding of Tagay et al. (2010), which indicated that interpersonal traumas were more frequently associated with severe PTSD symptoms than NTE. These underlying mechanisms involved in the association between the experience of traumatic events and ED, cannot be underlined in this systematic review.

Besides differentiating trauma types in NTE and interpersonal traumatic events, it could be beneficial to specify the duration of the trauma and the number of traumatic events, because the characteristics behind traumas which are acute, persistent, or repeated, are observed to be different (Kira, 2001; Littleton et al., 2007).

Among the studies included, there was noticeable diversity in how NTE was defined, leading to variations in the overall measurement of NTE. For instance, Convertino et al. (2022) did not consider *war* as an NTE. Additionally, there was variation in whether studies differentiated between *illness* and *injury* or combined them into one variable. In some assessment tools (e.g., LEC) being a witness to an event and personally experiencing an event were combined in the same prevalence report, while this combination did not occur in other measurement instruments. In future research, it could be beneficial to use a more narrowly focused research question, focusing on a single NTE (e.g., *illness* or *accidents*) or ED subtype (e.g., AN or BN), to enable the use of meta-analytical approaches. This would help to determine whether NTEs are more strongly related to some ED subtypes using statistical means.

When exploring the connection between ED and trauma, it is crucial to recognize that prevalence alone cannot stand as a determining factor. The experience of traumatic events varies among individuals, and personal factors such as psychosocial resources and

biological vulnerabilities may contribute to determining whether an individual is traumatized by such events. Therefore, not everyone exposed to a potentially traumatic event exhibits PTSD symptoms (Wallick et al., 2022). Thus, it is important not only to document the prevalence of NTE but also to explore how the person has internalized the event and whether they qualify it as traumatic. To understand the association between the two, the focus should be on trauma-related symptoms rather than trauma exposure in future research.

Strengths and limitations

The review was carried out following PRISMA guidelines for systematic reviews, which is in line with best practice. A strength of this systematic review was that the results were based on a large sample size of diagnosed ED subjects and controls in total. However, the sample size of ED in most of the included studies was small, which influenced the generalizability of their findings and consequently affected the quality of the systematic review. The systematic review sought to reduce bias using multiple reviewers in the screening- and extraction process, who were blinded to each other. This resulted in moderate to high interrater reliability. The review's broad focus on ED diagnosis provided a comprehensive view of NTE in patients with ED, a topic not systematically reviewed previously. However, this breadth became a limitation due to high heterogeneity in study designs and measurement tools for assessing NTE and ED prevalence. This hindered comparison and prevented a reliable meta-analysis. Despite recognizing the potential benefits of a meta-analysis, the inherent data heterogeneity posed a significant barrier to its validity and reliability. Thus, we deliberately opted against a meta-analytic approach. Additionally, graphical representation of prevalence faced challenges due to inconsistent reporting standards and lack of confidence intervals in many studies, complicating aggregation, and visualization. The decision to exclude papers published in languages other than Danish, English, Swedish, or Norwegian was based on practical considerations. The researchers lacked proficiency in other languages, hindering their ability to assess the quality and relevance of papers accurately. While this approach may miss useful studies, it prioritizes the reliability, comprehensibility, and accessibility of the included literature.

Implications in clinical practice

The results underline that patients with ED have not been exposed to NTE more than individuals without ED. NTE should not be viewed as a specific and high-risk factor in the development of ED. Thus, there should not be attached importance to NTE in the clinical work with ED. In comparison, interpersonal traumatic events are evaluated to have a higher impact on the occurrence of ED, which is why events such as sexual assaults and emotional violence should be assigned a higher priority in the assessment and treatment of ED.

Conclusion

This study is, to the best of our knowledge, the first systematic review to investigate the prevalence of NTE in studies with clinical samples of individuals with ED. Overall, our results varied in prevalence across the studies but indicate that there was not a

significant difference between patients with ED and controls except for the variables *illness* and *injury*. This suggests that individuals with ED have experienced *illness* and *injury* more often relative to the background population. *Illness* is also the NTE reported to have the highest prevalence of the five NTE subtypes: *accidents*, *injury*, *illness*, *natural disaster*, and *war*. No consistent difference was found between AN, BN, and BED regarding NTE. Although, AN-BP demonstrated a higher prevalence of NTE than AN-R, which aligns with the third hypothesis.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Author contributions

KJ: Writing – original draft. KFN: Writing – original draft. KKN: Writing – review & editing. GKT: Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2024.1397952/full#supplementary-material>

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Genetic polymorphisms and their association with neurobiological and psychological factors in anorexia nervosa: a systematic review

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Background and aims: Anorexia nervosa (AN) is a complex neuropsychiatric disorder. This systematic review synthesizes evidence from diverse studies to assess and investigate the association between gene polymorphisms and psychological and neurobiological factors in patients with AN.

Methods: A systematic search across PubMed, PsycINFO, Scopus, and Web of Science databases, along with manual searching, was conducted. The review protocol was approved by PROSPERO (CRD42023452548). Out of 1,250 articles, 11 met the inclusion criteria. The quality of eligible articles was assessed using the Newcastle-Ottawa Scale (NOS) tool. The systematic review followed the PRISMA guidelines.

Results: The serotonergic system, particularly the 5-HTTLPR polymorphism, is consistently linked to altered connectivity in the ventral attention network, impaired inhibitory control, and increased susceptibility to AN. The 5-HTTLPR polymorphism affects reward processing, motivation, reasoning, working memory, inhibition, and outcome prediction in patients with AN. The dopaminergic system, involving genes like *COMT*, *DRD2*, *DRD3*, and *DAT1*, regulates reward, motivation, and decision-making. Genetic variations in these dopaminergic genes are associated with psychological manifestations and clinical severity in patients with AN. Across populations, the Val66Met polymorphism in the *BDNF* gene influences personality traits, eating behaviors, and emotional responses. Genes like *OXTR*, *TFAP2B*, and *KCTD15* are linked to social cognition, emotional processing, body image concerns, and personality dimensions in patients with AN.

Conclusion: There was an association linking multiple genes to the susceptibility and/or severity of AN. This genetic factor contributes to the complexity of AN and leads to higher diversity of its clinical presentation. Therefore, conducting more extensive research to elucidate the underlying mechanisms of anorexia nervosa pathology is imperative for advancing our understanding and potentially developing targeted therapeutic interventions for the disorder.

Systematic review registration: [<https://clinicaltrials.gov/>], identifier [CRD42023452548].

KEYWORDS

anorexia nervosa, eating disorder, genetic polymorphism, genetic susceptibility, neurobiological factors, psychological factors

1 Introduction

Anorexia nervosa (AN) is a complex neuropsychiatric disorder characterized by restricted caloric intake, resulting in dangerously low body weight, distorted body image, and an intense fear of weight gain (American Psychiatric Association, 2013). AN is a common eating disorder among female adolescents, with prevalence rates of 0.3–1.2% (Schwartz et al., 2008) and a female-to-male ratio of 10:1 (Smink et al., 2012). This gender disparity is most pronounced in female adolescents aged 15–19 years, where incidence rates are highest (Auger et al., 2023). The reasons for this gender imbalance are not fully understood, but they may involve a combination of biological, psychological, and sociocultural factors (Boerner et al., 2004; Crisp and Collaborators, 2006; Stanford and Lemberg, 2012). For instance, societal pressures and ideals regarding female body image, as well as differences in stress response and coping mechanisms between genders, may contribute to the higher prevalence in females (Crisp and Collaborators, 2006). Despite being less common in males, AN in men is often underdiagnosed and understudied, leading to a lack of awareness and understanding of the disorder in this population (Raevuori et al., 2014).

Additionally, AN is particularly serious due to the high rate of relapse (Klump et al., 2009), its medical complications resulting from severe malnutrition, as well as the elevated risk of suicidality (Attia, 2010). In 20–30% of cases, AN develops into a chronic illness persisting for many years and often over the lifetime of an individual, impairing social interaction and diminishing academic and professional potential. Notably, compared to age and sex-matched controls, people with AN have mortality rates that are five to ten times higher (Kirk et al., 2017). The chronic nature of the disease, coupled with a high relapse rate and significant personal, familial, and societal burdens, underscores the pressing need for increased research to understand its etiology and, therefore, improve treatment approaches.

Typically, patients with AN are assessed and diagnosed according to The Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) tool (American Psychiatric Association, 2013), which is the 2013 publication of the American Psychology Association (APA). A range of adverse outcomes are associated with AN, including medical and psychiatric comorbidities (Herzog et al., 1997; Fairburn and Harrison, 2003; Treasure et al., 2010), and is defined as the psychiatric disorder with the highest mortality rate (Arcelus et al., 2011; Zipfel et al., 2014). Anxiety and depression are prevalent comorbidities in individuals with AN that further exacerbate the severity and complexity of the disorder (Pleplé et al., 2021; Calvo-Rivera et al., 2022). In addition, individuals with AN tend to display personality traits characterized by a low impulsivity (Favaro et al., 2004; Testa et al., 2022), high harm avoidance (Frank et al., 2018), and perfectionism (Lloyd et al., 2014), suggesting a neurobiological basis for the disorder rooted in heightened inhibition and control mechanisms that govern behavior, emotion, and physiology (Ellison and Foong, 1998; Bulik et al., 2010; Wonderlich et al., 2018). Individuals with AN may have impairments in this inhibitory function, as seen in their struggles with set-shifting tasks that require redirecting attention away from previously relevant stimuli (Roberts et al., 2007). Psychological assessment tools such as semi-structured interviews and self-reporting questionnaires are pivotal in providing insights into diagnosis, disease severity, and comorbidities and understanding the various psychological traits and behavioral aspects

of eating disorders like AN, hence the impact on the quality of life of those individuals (Schaefer et al., 2021; Wade and Pellizzer, 2024). While to understand the underlying structural and functional changes in the brain associated with AN, neuroimaging tools like Magnetic Resonance Imaging (MRI), functional Magnetic Resonance Imaging (fMRI), and Resting-state functional magnetic resonance imaging (rs-fMRI) were used. These tools detect changes in brain activity, blood flow, and oxygenation, revealing functional connectivity patterns and baseline brain activity in which variability in connectivity may be linked to cognitive abilities and personality traits (van den Eynde et al., 2012; Zhu et al., 2012). Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) scans analyze metabolic and blood flow activity, aiding in the assessment of functional abnormalities (Blake et al., 2003). Brain research using these techniques has provided abundant evidence of neurobiological changes in eating disorders (ED).

The underlying mechanisms of the development and progression of AN are not yet fully understood. Present research indicates that the disease lies at an intersection of psychological characteristics and environmental and sociocultural factors, in addition to genetic and biological predispositions (Mazzeo and Bulik, 2009; Campbell and Peebles, 2014; Baker et al., 2017). Interestingly, family (Strober et al., 2000; Frisch et al., 2001) and twin (Klump et al., 2001; Bulik et al., 2010) studies strongly suggest a genetic component to the disorder by consistently showing that first-degree relatives of individuals with AN have an increased risk of developing the disorder compared with relatives of unaffected individuals (Bulik et al., 2007). This is reflected in the heritability rates of AN, which are estimated to be approximately 33–84% (Donato et al., 2022), indicating a significant genetic contribution to the disorder. Genetic polymorphisms, which are variations in DNA sequences among individuals, have emerged as potential candidates influencing susceptibility to the onset, progress, and development of AN (Paolacci et al., 2020). Recent advances in molecular genetics have enabled the identification of genetic polymorphisms that may confer susceptibility to AN. Variations in genes related to serotonergic, dopaminergic, opioid, and appetite regulation systems have gained particular attention for their involvement in mood and body weight regulation (Compan, 2021), reward and emotional behavior (Weiss et al., 1988; Hasan and Hunaid, 2011), as well as energy intake pathways (Monteleone et al., 2005; Perello and Dickson, 2015).

The intricate relationship between genetic polymorphisms and the traits found in AN is a critical area of investigation. Neurotransmitter imbalances, altered brain structure, and disrupted neural circuits contribute to the AN pathophysiology. The impact of hormones and neuroactive peptides, such as sex hormones and gut hormones, on brain responses disrupts normal food reward circuits (Monteleone and Maj, 2013). Structural brain alterations involve cerebral atrophy, enlarged ventricles, and changes in grey and white matter volumes (van den Eynde et al., 2012; Seitz et al., 2016). Studies examining gray matter volumes in AN demonstrate fluctuations across various brain regions, with some areas exhibiting smaller volumes, particularly linked to the severity of the illness (Martin Monzon et al., 2017). Similarly, research on white matter volume and integrity yields inconsistent findings, but alterations in structural connectivity patterns suggest compensatory changes during the recovery process (Frank et al., 2013). Functional and effective connectivity studies point to disruptions within networks associated with the executive function

(Lee et al., 2014), reward processing (Cha et al., 2016), and perception (Fonville et al., 2014), potentially contributing to the altered eating behaviors seen in AN. Body image distortion, a hallmark of AN, implicates parietal and frontal regions in encoding motivational relevance to sensory events (Wagner et al., 2003) as well as prefrontal and cingulate brain response (Xu et al., 2017). The exploration of genetic polymorphisms and their correlation with neurobiological and psychological factors in AN represents a crucial step toward unraveling the intricate complexities of this debilitating disorder.

This research investigates how specific genetic polymorphisms might amplify individuals' susceptibility to these psychological triggers, leading to the manifestation of AN. By examining the intricate gene–environment interplay, this study aims to provide a more nuanced understanding of the factors contributing to the disorder's heterogeneity. This systematic review synthesizes evidence from diverse studies to assess and investigate the association of gene polymorphisms with psychological and neurobiological factors in patients with AN.

2 Materials and methods

The International Prospective Registry of Systematic Reviews (PROSPERO CRD42023452548)¹ received and approved a copy of the review protocol. The guidelines of the Preferred Reporting of Systematic Reviews and Meta-Analyses (PRISMA) statement served as the basis for this systematic review (Liberati et al., 2009; Moher et al., 2009).

2.1 Search strategy

A comprehensive and systematic search was conducted across scientific databases PubMed, PsycINFO, Scopus, and Web of Science with additional hand search for relevant articles that were searched using the following search strategy: [(“anorexia nervosa” OR “eating disorders” OR “anorexia” OR “eating behavior”) AND (“genetics” OR “polymorphism” OR “genetic variation” OR “genetic factors”) AND (“brain” OR “neuroimaging” OR “neurobiology” OR “neurophysiology” OR “neurotransmitters”) AND (“psychology” OR “personality” OR “cognition” OR “emotion” OR “behavior”)]. The search was restricted to publications between 1990 and August 2023 to provide insight into the most recent developments in research within the field. Only English articles were considered for inclusion. Additionally, the reference lists of identified articles and relevant reviews were hand-searched to ensure the inclusiveness of the retrieved literature.

2.2 Eligibility criteria

As recommended in the PRISMA statement, eligibility was based on the PICOS criteria: population, interventions, comparison, outcome and study design (Moher et al., 2009). Through our

systematic review, we will try to answer the following PICO question: Among individuals diagnosed with anorexia nervosa (P), does the presence of specific genetic polymorphisms (I) correlate with variations in neurobiological and psychological factors (O), influencing the onset, development, or severity of the disorder, as compared to those without these polymorphisms (C)?

2.2.1 Population

Studies that included individuals with a confirmed diagnosis of AN, based on established diagnostic criteria such as the Diagnostic and Statistical Manual of Mental Disorders, 4th or 5th edition (DSM-4/5), were included. Studies had to exclude any participant with any past or current other medical condition, especially neuropsychiatric disorder that could misinterpreted as part of AN comorbidities. As this review focused on isolating the specific influence of genetic polymorphisms on AN and its associated neurobiological and psychological factors, included participants with other medical conditions (e.g., gastrointestinal disorders, endocrine disorders, chronic pain) or neuropsychiatric disorders (e.g., mood disorders, OCD, ADHD) could introduce confounding factors. These conditions might share symptoms with AN, potentially obscuring the true association between genetic polymorphisms and AN itself. By excluding participants with comorbidities, the review aims to achieve a clearer understanding of the independent genetic effects on AN development. Moreover, studies with an exclusive focus on populations other than individuals diagnosed with AN [e.g., Bulimia nervosa (BN), binge-eating disorder (BED), or any other disorder] were excluded.

2.2.2 Intervention

In order to be included, studies had to examine the presence of specific genetic polymorphisms in the AN case group through genotyping.

2.2.3 Comparison

As a comparison group, studies with a control group in which participants to be genotyped were healthy with no current or history of any ED were included. Healthy controls had to have a BMI of 18 and higher. They had to have no past or current metabolic, endocrine, or gastrointestinal illness that could affect their weight, nor should they suffer from any neuropsychiatric disorder. Studies with within-subject comparisons, i.e., where genotyped patients with AN, BN, or BED were compared, were also included. In addition, studies that only investigated one group of AN and compared those who harbor the studied SNP and those who do not are also included.

2.2.4 Outcome

Studies were considered to be eligible if they included at least one variation in neurobiological and/or psychological factors influencing the onset, development, or severity of AN, such as brain imaging data (MRI, fMRI), neuroendocrine markers, neurotransmitter systems, neuropsychological assessments, or psychological traits and behaviors related to AN.

2.2.5 Study design

Observational studies (case–control studies, cohort studies, and cross-sectional) investigating the association between specific genetic polymorphisms and neurobiological and/or psychological factors in

¹ <https://www.crd.york.ac.uk/prospero/>

individuals diagnosed with AN were considered for inclusion. Review articles, meta-analyses, systematic reviews, commentary papers, and editorials were all excluded to avoid duplication of information. Animal Studies conducted solely on animal models were excluded, as the focus is on human populations. Non-peer-reviewed sources such as conference abstracts, posters, and non-peer-reviewed publications were all excluded to ensure the quality and reliability of the included studies.

2.3 Study selection

Initial screening of titles and abstracts was conducted by two independent reviewers (HA and HB), followed by full-text assessments of potentially eligible articles. Discrepancies were resolved through consensus. For data screening and filtration, Rayyan,² an open-source website tool designed to assist researchers in systematic reviews and other knowledge synthesis initiatives, was utilized. After eliminating duplicate articles, titles and abstracts were evaluated using Rayyan, and articles were categorized as included, excluded, or maybe. Any records not meeting our inclusion criteria were excluded. During the secondary selection process, the full text of all articles was evaluated to address those initially categorized as “maybe” and finally included the eligible articles. In cases where the two reviewers disagreed on an article classified as “maybe” during the final review, discussion ensued until a consensus was reached. A PRISMA flowchart depicting the screening and selection procedure is presented in [Figure 1](#).

2.4 Data extraction

For articles included in this systematic review, HA and HB collected the data independently and then discussed the final extraction. If any important data was not understood, researchers of the meant report were contacted. Variables extracted are displayed in [Table 1](#). The following variables were extracted: (1) First Author and Year of publication; (2) study design (i.e., cross-sectional, case-control, or cohort); (3) characteristics of the study participants (sample size, gender distribution, and ethnicity); (4) Genetic polymorphisms studied (gene associated, variant investigated, and SNP ID) and finally, (5) summary of main findings as well as the associated *p* value were extracted.

2.5 Quality assessment

Two researchers (HA and HB) evaluated the quality of eligible articles for risk of bias of included cross-sectional and case-control studies using the Newcastle-Ottawa Scale (NOS) tool ([Stang, 2010](#)). When using the NOS tool, three domains of scoring criteria, totaling seven in all, were applied to the included cross-sectional and case-control studies. Study quality was determined by the studies' selection of study groups, generalizability and verification of exposure and results, with little differences in scoring parameters when adapted to

different study designs and a total of eight to nine points could be earned. For cross-sectional studies, the classification of quality was as follows: studies receiving more than seven points were categorized as very good, those earning 6–5 points were considered good quality, studies obtaining 4–3 points were deemed satisfactory, and those with 2 or fewer points were labeled as poor or unsatisfactory quality. For case-control studies, the quality categorization was as follows: studies accruing more than eight points were classified as very good, those receiving 7–6 points were termed good quality, studies earning 5–4 points were seen as satisfactory, and those with 3 or fewer points were designated as poor or unsatisfactory quality. Any instances of conflicts or disagreements arising during the evaluation process were resolved through consensus discussions between the researchers.

2.6 Ethical considerations

All included studies were scrutinized for evidence of ethical approval and participant consent. All the studies explicitly reported obtaining formal written informed consent from participants. This review is confined to the analysis of published data, and no primary data collection from human participants was conducted as part of this study.

2.7 Data synthesis

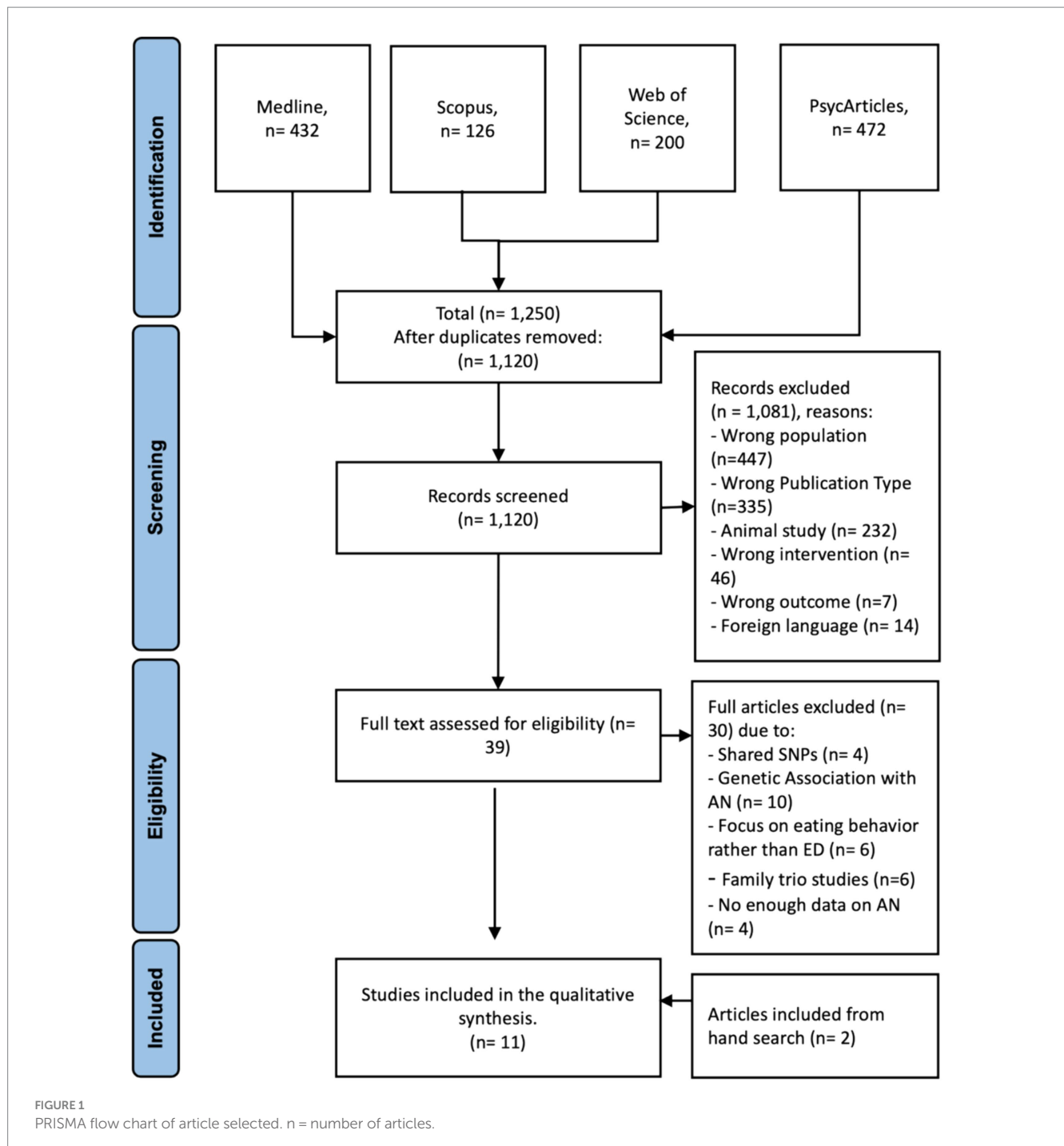
Considering the heterogeneity in study designs, the genetic polymorphisms investigated, neurobiological outcome measures, and psychological factors assessed, a narrative synthesis approach was utilized. The findings of the studies were systematically summarized and organized according to the impact of genetic polymorphisms on neurobiological and psychological factors in AN.

3 Results and discussion

3.1 Search results and study selection

An initial search through Medline, Scopus, Web of Science, and PsycArticles as of 20 August 2023 yielded 1,250 studies. Following the removal of 130 duplicates, the titles and abstracts of the remaining 1,120 articles were screened. Thirty-nine articles were identified for full paper review and were assessed for eligibility; of these, 30 articles were further excluded for not fulfilling one or more of the eligibility criteria. The reasons for exclusion were the investigation of different shared SNPs between AN and other psychiatric disorders or other EDs rather than isolated investigation on AN-associated SNPs (*n* = 4), studies that did not include the investigation of identified SNPs with neither neurobiological nor psychological factors, but only the genetic association and predisposition to AN (*n* = 9), studies focused on eating behaviors without explicitly focusing on AN (*n* = 6), family trio studies (*n* = 6) since we focused on population-based studies to enhance the generalization, a lack of enough data describing AN participants (*n* = 6). Further hand search, which involved reviewing the reference lists of the articles identified through our initial database search as well as relevant review articles and meta-analyses in the field of AN and genetic polymorphisms, resulted in two additional articles ([Chen](#)

² <https://rayyan.ai/>



et al., 2015; González et al., 2021), increasing the total included to 11. The PRISMA flowchart in Figure 1 presents the detailed selection procedure flow.

3.2 Quality assessment of eligible studies

Six of the eleven articles included were cross-sectional studies (Favaro et al., 2013; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017; Sala et al., 2018; González et al., 2021), whereas the remaining five were case-control studies

(Rybakowski et al., 2007; Kim et al., 2009; Ando et al., 2012; Chen et al., 2015; Genis-Mendoza et al., 2019), all of which were assessed in terms of quality using the Newcastle-Ottawa Scale (NOS) Quality Assessment criteria (Supplementary Figure S1) (Stang, 2010). None of the included studies was below the satisfactory level; in fact, nine included articles achieved a good quality level and above after the assessment (Kim et al., 2009; Ando et al., 2012; Favaro et al., 2013; Scott-van Zeeland et al., 2014; Chen et al., 2015; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017; Genis-Mendoza et al., 2019; González et al., 2021; Supplementary Table S1).

TABLE 1 Summary of the main characteristics and main findings of the included studies.

References	Study design	Study participants			Neurobiological and/or psychological assessment tools		Genetic polymorphisms studied			Findings
	Study type	Cases/ Controls	Ethnicity	% females	Neurobiological	Psychological	Gene	Variant/ Allele	SNP ID	
Collantoni et al. (2016)	Cross-sectional	35/34	Caucasian	100%	Resting-state fMRI imaging	Stop signal task	COMT SLC6A4	Val158Met 5-HTTLPR S/L 5-HTTLPR A/G	rs25531	AN had longer SST reaction times compared to HC ($p = 0.018$). The S allele mediates the negative correlation between the positive functional connectivity of the ventral attention network and the SST reaction time ($p = 0.043$).
Clarke et al. (2016)	Cross-sectional	71/20	Caucasian	100%	Skin conductive response	Body shape questionnaire (BSQ), categorization task, and appraisal task.	BDNF	Val66Met	rs6265	SCR within patients was more frequent during processing of underweight stimuli compared with normal-and overweight stimuli ($p = 0.007$). The Met allele of the BDNF gene was associated to an increased frequency of SCR in response to cues for starvation ($p = 0.008$).

(Continued)

TABLE 1 (Continued)

References	Study design	Study participants			Neurobiological and/or psychological assessment tools		Genetic polymorphisms studied			Findings
	Study type	Cases/ Controls	Ethnicity	% females	Neurobiological	Psychological	Gene	Variant/ Allele	SNP ID	
Rybakowski et al. (2007)	Case-control	149/100	Caucasian	100%	NA	Temperament and character inventory	<i>BDNF</i>	Val66Met -270C/T	rs6265	Patients with AN with Met allele showed higher harm avoidance than Val/ Val homozygotes ($p = 0.03$). Patients with AN, who carried the T allele of <i>BDNF</i> -270C/T polymorphism showed higher Persistence than C/C homozygotes ($P = <0.05$). Patients with AN, carriers of the T allele of <i>BDNF</i> -270C/T polymorphism showed higher harm avoidance than C/C homozygotes ($p = 0.006$).
Kim et al. (2009)	Case-control	62/131	Korean	100%	NA	Korean version of EDE, temperament and character inventory, Y-BOCS, beck depression inventory, state and trait anxiety inventory.	<i>TPH1</i>	A218C (A/A)	–	No differences in the <i>TPH1</i> A218C allele/ genotype frequency between the HC and the AN groups ($p = 0.800$). A218C allele is not associated with the psychopathologies or obsessionality of patients with AN ($p = 0.46$).

(Continued)

TABLE 1 (Continued)

References	Study design	Study participants			Neurobiological and/or psychological assessment tools		Genetic polymorphisms studied			Findings
	Study type	Cases/ Controls	Ethnicity	% females	Neurobiological	Psychological	Gene	Variant/ Allele	SNP ID	
Favaro et al. (2013)	Cross-sectional	33/30	Caucasian	100%	Resting-state fMRI imaging to measure prefrontal functional connectivity	Wisconsin card sorting test, Edinburgh handedness inventory	COMT	Val158Met	–	Met-homozygous patients with AN showed greater coactivation in connectivity of the prefrontal cortex than Val carriers ($P = <0.05$). Patients with AN with an increasing number of Met alleles were positively associated with set-shifting impairments ($p = 0.001$)
Ando et al. (2012)	Case-control	689/573	Japanese	100%	NA	Japanese version of temperament and character inventory	BDNF	Val66Met	rs6265	Patients with AN carriers of Met66 allele carriers were having lower Harm avoidance scores ($p = 0.007$)
Sala et al. (2018)	Cross-sectional	49/ -	NR	100%	fMRI to measure neural responses to social stimuli	Quick inventory of depressive symptomatology, SIGH-A, YBC-EDS, Y-BOCS, the 26-item eating attitudes test, BSQ	OXTR	G/A	rs2254298 rs53576	Carriers of the A allele for OXTR rs2254298 showed reduced neural activation in response to social stimuli in all of: Medial prefrontal cortex ($p = 0.008$), Dorsal anterior cingulate ($p = 0.02$), Posterior cingulate cortex ($p = 0.003$), and Precuneus ($p = 0.02$).

(Continued)

TABLE 1 (Continued)

References	Study design	Study participants			Neurobiological and/or psychological assessment tools		Genetic polymorphisms studied			Findings
	Study type	Cases/ Controls	Ethnicity	% females	Neurobiological	Psychological	Gene	Variant/ Allele	SNP ID	
Gamero-Villaruel et al. (2017)	Cross-sectional	106/ 181	Caucasian	100%	NA	Eating Disorders Inventory, and the anxiety subscale of the Symptom Checklist 90 Revised	TFAP2B KCTD15	A/G C/T G/A C/T	rs552393576 rs2817420 rs4805059 rs4239577	Carriers of A allele for TFAP2B rs552393576 showed significant association with the scores of drive for thinness ($p = 0.004$). Carriers of C allele for KCTD15 rs4239577 showed significant association with the scores of ineffectiveness ($p = 0.006$). Carriers of C allele for KCTD15 rs4239577 showed significant association with the scores of asceticism ($p = 0.004$).
Genis-Mendoza et al. (2019)	Case-control	30/292	Mexican	Cases: 76% HC: 49.7%	NA	MINI Kid, Questionnaire on Eating and Weight Pattern-Revised	5-HTR2A	A1438G	rs6311 rs6313	The frequency of the G allele in rs6311 SNP is higher in AN than in HC groups ($p = 2.23e-16$). Individuals with GG genotype in rs6311 SNP had an increased risk of suicide attempts ($p = 0.035$).

(Continued)

TABLE 1 (Continued)

References	Study design	Study participants			Neurobiological and/or psychological assessment tools		Genetic polymorphisms studied			Findings
	Study type	Cases/ Controls	Ethnicity	% females	Neurobiological	Psychological	Gene	Variant/ Allele	SNP ID	
González et al. (2021)	Cross-sectional	210/–	Caucasian	100%	NA	Eating Disorders Inventory, and the anxiety subscale of the Symptom Checklist 90 Revised	DRD2 DRD3 DAT1	A2/A1 Ser9Gly 10R/9R	rs1800497 rs6280 rs28363170	A1/A1 carriers in the DRD2 gene, the Gly9Gly genotype in the DRD3 gene, and 9R/9R carriers in the DAT1 genes all are associated with a more severe symptomology predisposition ($P = <0.05$).
Chen et al. (2015)	Case–control	255/351	Han Chinese	Cases: 95% HC: 97%	NA	EDE	SLC6A4	5-HTTLPR S/L	–	5-HTTLPR showed significant association with AN ($p = 0.03$). The frequency of S allele higher in AN than in HC ($p = 0.017$).

AN, Anorexia Nervosa; HC, Healthy Controls; SST, Stop Signal Task; SCR, Skin Conductance Response; EDE, Eating Disorders Examination Interview; Y-BOCS, Yale-Brown Obsessive Compulsive Scale; YBC-EDS, The Yale Brown Cornell Eating Disorder Survey; SIGH-A, The Structured Interview Guide for the Hamilton Anxiety Scale; MINI Kid, Mini International Neuropsychiatric Interview for Children and Adolescent; (–) was typed when the paper has not mentioned the intended information.

The final quality score for the six cross-sectional studies (Favaro et al., 2013; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017; Sala et al., 2018; González et al., 2021) that were evaluated for selection, comparability, and outcome were mostly positive—with the majority rated as “Very good” (score of 7 out of 10) for four studies (Favaro et al., 2013; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017). One study received a “Good” rating (score of 6 out of 10) (González et al., 2021), and another one study was considered “Satisfactory” (score of 4 out of 10) (Sala et al., 2018). At a similar rate, the final quality scores for the six case-control studies that were evaluated for selection, comparability and exposure were found to meet or exceed satisfactory standards, with two studies rated “Very good” with a score of 8 (Chen et al., 2015; Genis-Mendoza et al., 2019), two studies rated “good” with scores 6 and 7 (Kim et al., 2009; Ando et al., 2012) and one study deemed “satisfactory” with a score of 5 (Rybakowski et al., 2007).

3.3 Characteristics of the included studies

The main characteristics of the included articles are displayed in Table 1. All 11 articles were based on subjects presenting with AN (Rybakowski et al., 2007; Kim et al., 2009; Ando et al., 2012; Favaro et al., 2013; Chen et al., 2015; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017; Sala et al., 2018; Genis-Mendoza et al., 2019; González et al., 2021). All articles included outcomes related to relationship investigation between specific studied SNPs of genes to neurobiological and/or psychological factors to AN (Rybakowski et al., 2007; Kim et al., 2009; Ando et al., 2012; Favaro et al., 2013; Chen et al., 2015; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017; Sala et al., 2018; Genis-Mendoza et al., 2019; González et al., 2021). All the referenced studies in this review were published between 2007 and 2021 (Rybakowski et al., 2007; Kim et al., 2009; Ando et al., 2012; Favaro et al., 2013; Scott-van Zeeland et al., 2014; Chen et al., 2015; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017; Sala et al., 2018; Genis-Mendoza et al., 2019; Boehm et al., 2020; González et al., 2021), with a concentration of publications in the latter half of the 2010s (Ando et al., 2012; Favaro et al., 2013; Chen et al., 2015; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017; Sala et al., 2018; Genis-Mendoza et al., 2019). The participants were either healthy individuals or had the specific condition of interest (AN) typically including underweight patients who were diagnosed according to DSM criteria. The majority of the articles had the participant diagnosis based on the DSM-4 criteria (Rybakowski et al., 2007; Kim et al., 2009; Ando et al., 2012; Favaro et al., 2013; Chen et al., 2015; Collantoni et al., 2016; Sala et al., 2018), with a few re-evaluating to comply with the DSM-5 edition (Gamero-Villarroel et al., 2017; González et al., 2021), while others directly used the DSM-5 criteria for diagnosis (Clarke et al., 2016; Genis-Mendoza et al., 2019).

Those with other significant medical conditions, psychiatric comorbidities (except anxiety), and specific medication use were excluded. Healthy Controls (HC) were generally required to have no EDs with exclusions for significant medical or psychiatric conditions or substance abuse. All of the studies had all-female participants with the exception of two studies that had mixed-gender participants (Chen et al., 2015; Genis-Mendoza et al., 2019), with females comprising the majority of the group. The ethnic composition of the

study participants was diverse, with six studies involving Caucasian participants (Rybakowski et al., 2007; Favaro et al., 2013; Clarke et al., 2016; Collantoni et al., 2016; Gamero-Villarroel et al., 2017; González et al., 2021), one study involving Mexican participants (Genis-Mendoza et al., 2019), one involving Japanese participants (Ando et al., 2012), one involving Korean participants (Kim et al., 2009), one involving Han Chinese participants (Chen et al., 2015), and one study not specifying the ethnicity but mentioned that the participants were recruited from Texas in the United States (Sala et al., 2018), while another was conducted in Germany without specifying the recruitment source (Boehm et al., 2020). The sample size in these studies varied widely, ranging from smaller groups of 49 AN cases to large cohorts of 689 AN cases, often paired with a comparable number of HC. The age range and mean ages of AN and HC participants across the studies spanned from early adolescence to mid-adulthood.

Notably, the results of the included studies, which involved other subgroups of different EDs, such as BN or BED, were filtered to include only results related to patients with AN in comparison to healthy controls. This helped accurately identify the possible correlation between the studied polymorphism and the neurobiological or psychological factors of AN as a unique ED.

3.4 Genetic polymorphism characteristics

The genetic polymorphisms investigated in these 11 studies focused on the polymorphisms within 1 or 2 target genes. The most common gene evaluated was the *BDNF* gene (Rybakowski et al., 2007; Ando et al., 2012; Clarke et al., 2016), followed by the *SLC6A4* (Chen et al., 2015; Collantoni et al., 2016) and the *COMT* gene (Favaro et al., 2013; Collantoni et al., 2016), which were the genes of interest in 2 studies each. The rest of the genes *TPH1* (Kim et al., 2009), *OXTR* (Sala et al., 2018), *KCTD1* (Gamero-Villarroel et al., 2017), *TFAP2B* (Gamero-Villarroel et al., 2017), *5HTR2A* (Genis-Mendoza et al., 2019), *DRD2* (González et al., 2021), *DRD3* (González et al., 2021) and *DAT1* (González et al., 2021) were evaluated only in 1 study each. Among these 11, three studies evaluated the association of genetic polymorphism with both neurobiological factors and psychological factors (Favaro et al., 2013; Collantoni et al., 2016; Sala et al., 2018), whereas the other 8 studies evaluated the association with only psychological factors (Rybakowski et al., 2007; Kim et al., 2009; Ando et al., 2012; Chen et al., 2015; Clarke et al., 2016; Gamero-Villarroel et al., 2017; Genis-Mendoza et al., 2019; González et al., 2021). All the three studies that looked at neurobiological implications in the AN individuals employed neuroimaging techniques such as fMRI (Favaro et al., 2013; Collantoni et al., 2016; Sala et al., 2018). The correlation between the studied factors and the investigated genetic polymorphism was then reported in a separate column as studies' findings.

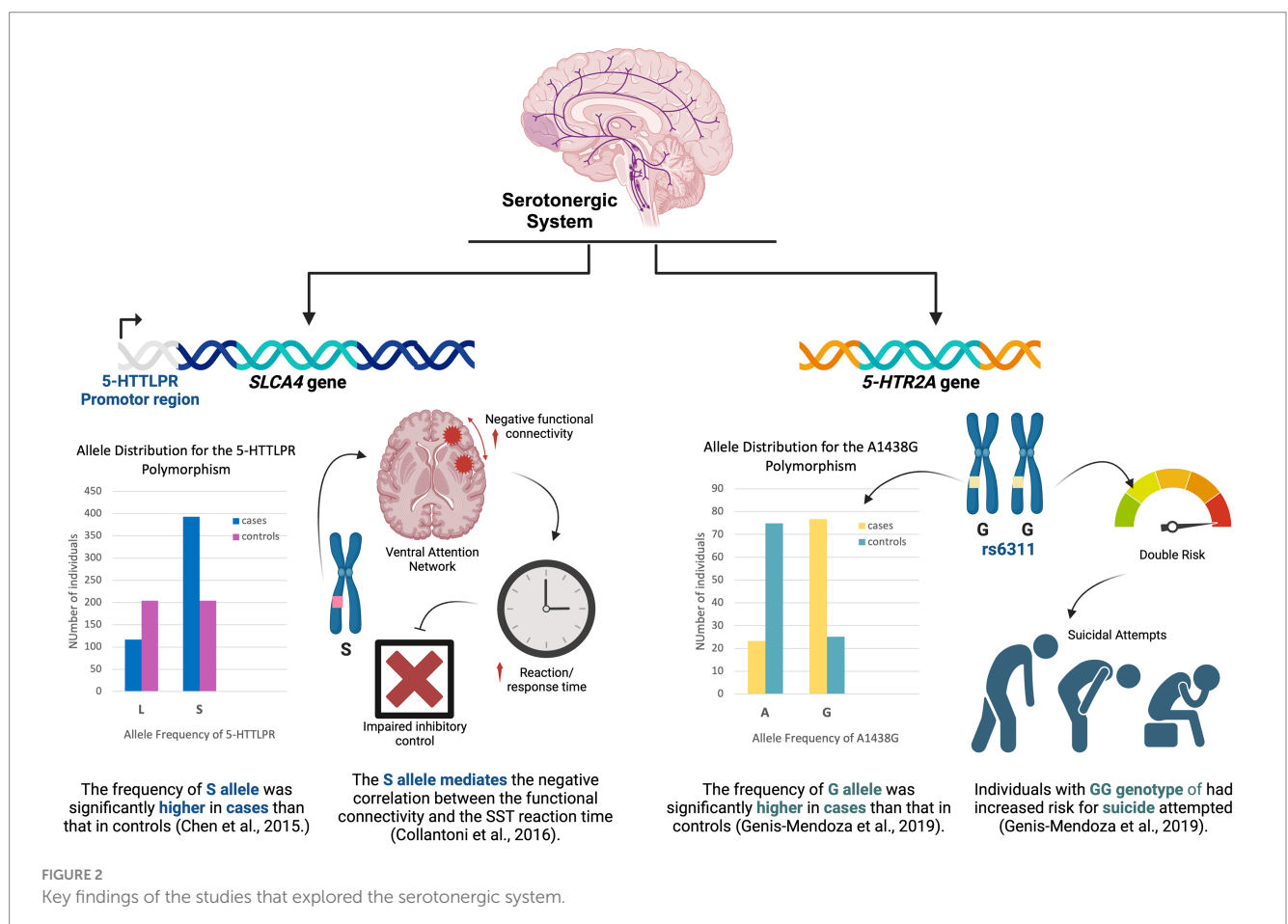
3.5 Association of serotonergic system-related gene polymorphisms with psychological and neurobiological factors in patients with AN

Serotonin dysfunction has been shown to have an involvement in almost all neuropsychiatric conditions (Marazziti, 2017), including EDs (Pugsley et al., 1978; Steiger, 2004). Its role in the

regulation of eating behavior has been well-confirmed (van Galen et al., 2021). Polymorphisms in the serotonin-related genes have been shown to influence the psychopathological features of EDs (Gervasini et al., 2012). Across the studies included in this review, four studies investigated the association of genetic polymorphisms in the serotonin-related genes including *SLC6A4* (Chen et al., 2015; Collantoni et al., 2016), *TPH1*, and *5-HT2R* with the psychological profiles and/or neurobiological characteristics of patients with AN. Figure 2 highlights the most important findings of the included studies which investigated the serotonergic system. The *SLC6A4* gene codes for the serotonin transporter protein that carries serotonin from the synaptic cleft back into the presynaptic neuron (Mia et al., 2022). The degenerate repeat sequence in the promoter region of this gene, called the 5HTTLPR (5HT Transporter Linked Promoter Region), occurs in two common polymorphs designated as the short “S” and the long “L” alleles (Heils et al., 1996). Two of the reviewed studies investigated the polymorphism in the 5HTTLPR region of this gene (Chen et al., 2015; Collantoni et al., 2016). The *TPH1* gene codes for the Tryptophan hydroxylase enzyme that catalyzes the rate-limiting step of serotonin synthesis. *TPH1* is expressed in the body but not the brain (Walther et al., 2003). Nevertheless, the effect of variations in the *TPH1* gene on brain-related variables, such as personality traits and neuropsychiatric disorders, has been studied (New et al., 1998; Allen et al., 2008). The *5HTR2A* gene belongs to the G-protein coupled serotonin receptor family and codes for a Gq/G11-coupled receptor, which mainly plays

a role in neuronal excitation in the central nervous system (Beliveau et al., 2017).

Collantoni et al. (2016) suggested that there is a correlation between the functional connectivity within the ventral attention network and reaction times measured by the stop signal task (SST), and that this relationship is mediated by the presence of the short allele (S allele) of the 5-HTTLPR polymorphism, proposing by that a potential modulatory role of the serotonergic system in the ventral attention network. In patients with AN, positive connectivity in the ventral attention circuit correlated with response times in carriers of the LL genotype, while the opposite was true in carriers of the S allele. In other words, for patients with AN S allele carriers, negative connectivity is associated with longer response times suggesting impaired inhibitory control. This subsequently correlates with the severity of the disorder since there was a significant negative correlation between task performance and the lowest lifetime BMI. Ultimately, these correlations may reflect alterations in the mechanisms that regulate goal-oriented attention and self-referential processes in patients with AN (McFadden et al., 2014). This effect on the ventral attention network suggests that genetic variation can disrupt the processing reward, motivation, reasoning, working memory, inhibition, as well as outcome prediction (Krawczyk, 2002). In addition, the modulatory effect of the 5-HTTLPR polymorphism on the connectivity of the ventral attention network can also explain the impaired response inhibition in patients with AN as this network has been implicated in stimulus-driven attentional control (Corbetta



and Shulman, 2002). Meanwhile, Chen et al. (2015) study looked into this gene polymorphism in Han Chinese patients with AN for association with psychological traits. These traits were measured using the Eating Disorders Examination (EDE) Interview as the assessment tool. They found that the frequency of the S allele of the 5-HTTLPR region of the SCL6A gene was significantly higher in patients than in controls, hence, associating with increased predisposition to AN. However, they did not find any clinical correlation or significant association between this genetic polymorphism and the severity of AN psychological symptoms. The same was reported by a meta-analysis done in 2015. Based on their results, the S allele was found to be significantly more prevalent in the AN group than in the control group ($p=0.006$). Moreover, upon ethnically stratified analysis, it was observed that only Caucasians showed a correlation between the 5-HTTLPR polymorphism and AN, while no such correlation was found in Asians (Chen and Qian, 2015). Another meta-analysis of 15 studies concluded that being a carrier of the 5-HTTLPR S allele represents a risk factor for eating disorders (Solmi et al., 2016).

Historically, in 1996, it was discovered that the human serotonin transporter gene (SLC6A4; also known as 5-HTT) has a repeat length polymorphism in its promoter region, which regulates gene expression *in vitro*. People with one or two copies of the S allele of 5-HTTLPR have been found to exhibit elevated neuroticism, a personality trait that is linked to depression (Lesch et al., 1996). In 2002, it was reported that individuals carrying the S allele show increased amygdala reactivity to threatening stimuli, as determined by functional MRI (Hariri et al., 2002). In 2003, it was reported that S-carriers are more likely to experience depressive symptoms, have diagnosable depression, and exhibit suicidal tendencies after experiencing stressful life events and childhood maltreatment (Caspi et al., 2003). From there, a study has suggested that carriers of the S allele tend to exhibit lower expression of the serotonin transporter (SLC6A4), resulting in reduced reuptake of serotonin (5-HT) from the synapse. As a result, this reduced reuptake may lead to stronger psychopathological reactions to stressful experiences in individuals with the S allele compared to those with the L allele (Li, 2006).

In sum, the collected evidence strongly suggests that 5-HTTLPR polymorphism, particularly the S allele, is associated with altered functional connectivity in the ventral attention network, impaired inhibitory control, and increased predisposition to AN. However, a meta-analysis that included biobank data analysis concluded no significant difference in low-functioning genotype (S allele) and allele frequencies between AN group and controls, suggesting no potential association of 5-HTTLPR polymorphism with AN (Solmi et al., 2016).

Another study by Genis-Mendoza et al. (2019) in the Mexican population investigated two different SNPs (rs6311 and rs6313) in the 5HTR2A gene. They used two different psychological assessment tools, the Mini International Neuropsychiatric Interview for Children and Adolescents (MINI Kid) and Questionnaire on Eating and Weight Pattern (QEW), to assess different comorbidities associated with AN disorder and other EDs, including major depressive episodes, suicidality, dysthymia disorder, attention-deficit/hyperactivity disorder, generalized anxiety disorder, oppositional defiant disorder, and psychotic disorder. The results were different between the two SNPs investigated. The G allele of rs6311 (−1438G/A) was much more common in the AN group and increased AN risk by almost nine-fold, as it was hypothesized that carriers of the G allele are susceptible to express the behavioral traits before the disease onset. It was also shown

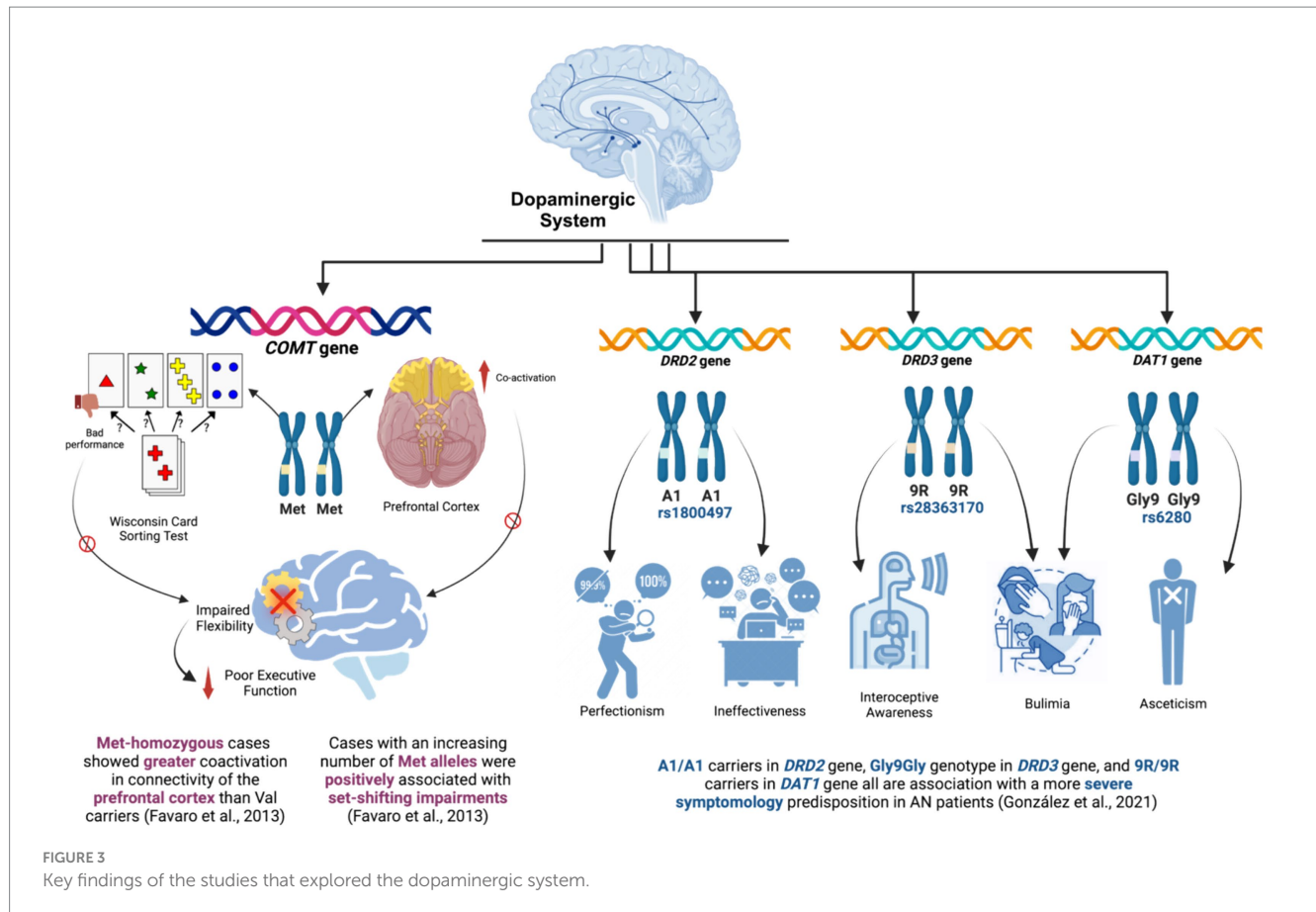
that rs6311 SNP is associated with an increased risk of suicide risk. No positive associations were observed for rs6313 SNP.

A study by Kim et al. (2009) looked at the *TPH1* gene variation in a group of Korean AN patients. They investigated the genetic variant A218C (rs1800532) in the *TPH1* gene among patients with AN and HC. Using the Korean version of Eating Disorder Examination (EDE), Temperament and Character Inventory (TCI), Yale-Brown Obsessive Compulsive Scale (Y-BOCS), and State-Trait Anxiety Inventory (STAI), they assessed the psychological factors of restraint, eating concern, weight concern, shape concern subscales, persistence and harm avoidance, obsessive-compulsive symptoms, as well as the level of depression and anxiety in patients with AN and HC. Interestingly, there were no differences in the *TPH1* A218C allele/genotype frequency between the healthy controls and the individuals with AN. In addition, although the A218C variant in the *TPH1* gene is reported to be related to a higher risk of suicidal behavior (Franken et al., 2005) and acute depression (Ikemoto and Panksepp, 1999), it was found by Kim et al. not to be associated with psychopathologies or obsessiveness of patients with AN. Thus far, one could speculate that the *SCL6A4* and the *5HTR2A* may have a more direct and potent impact on serotonin reuptake. This could influence behaviors associated with AN more significantly than the *TPH1* gene, which is involved in the earlier stages of serotonin synthesis and might be buffered by compensatory mechanisms.

3.6 Association of dopaminergic system-related gene polymorphisms with psychological and neurobiological factors in patients with AN

Dopamine has also long been proposed to play a central part in the pathophysiology symptoms observed in individuals with AN. Dopamine regulates the reward system (Lippa et al., 1973; Wise, 1978), specifically the mood (Ashby and Isen, 1999), feeding behavior (Szczypka et al., 1999), motivation (Blackburn et al., 1992), and decision-making (Assadi et al., 2009). Disruption of the brain reward system is a common observation in individuals with AN (Avena and Bocarsly, 2012). It has been proved that dopamine-related genes have been shown to influence the psychopathological features of EDs (Gervasini et al., 2013). Dopamine is thought to play a role in the development of AN by promoting reward and motivation (Franken et al., 2005). Higher levels of dopamine may make individuals with AN more susceptible to engaging in reward-seeking behaviors, such as restricting food intake (Ikemoto and Panksepp, 1999). A recent perspective article hypothesizes a two-stage role of dopamine in AN. In the first stage, when AN develops, dieting and exercise increase dopamine activity, which helps lock in the habits of severe dieting and weight loss. In the second stage, when these behaviors become deeply ingrained, an ongoing lack of food causes dopamine activity to drop as part of the body's response to long-term stress (Beeler and Burghardt, 2022).

In the present systematic review, three studies investigated the association of genetic polymorphisms in the dopamine-related genes, including *COMT* (Favaro et al., 2013; Collantoni et al., 2016) as well as *DRD2*, *DRD3*, and *DAT1* (González et al., 2021) with the psychological profiles and/or neurobiological characteristics of patients with AN. Figure 3 presents the key findings of the studies that



explored the dopaminergic system. The *COMT* gene codes for catechol-O-methyltransferase, an enzyme that plays a role in the breakdown of catecholamine neurotransmitters such as dopamine, norepinephrine, and epinephrine (Qayyum et al., 2015), hence regulating synaptic dopamine (Malhotra et al., 2002). *DRD2* and *DRD3* code for 2 subtypes of Dopamine receptors, coding for D2 and D3 subtypes, respectively. They have been found to regulate the synthesis, storage, and release of dopamine (Cooper, 2011). Whereas the *DAT1* gene (also known as *SLC6A3*) codes for dopamine transporter, an integral membrane protein that reuptakes and transports the dopamine from the synaptic cleft into the cytosol of surrounding cells (Baeuchl et al., 2019). Together, these three genes are an essential part of the dopamine pathway.

Firstly, the *COMT* gene was evaluated by two studies (Favaro et al., 2013; Collantoni et al., 2016) to investigate its association with the neurological factors of patients with AN. Favaro et al. (2013) studied the impact of the functional polymorphism Val158Met in the *COMT* gene on set-shifting abilities and prefrontal functional connectivity in patients with AN. The study provided evidence that the Val158Met *COMT* polymorphism has an effect on prefrontal cortex functional connectivity in patients with AN. In other words, Met-homozygous patients showed greater coactivation in the dorsolateral and ventromedial prefrontal cortex (PFC) compared to Val carriers. These brain areas relate to cognitive functions like conflict and error monitoring, reward-based learning, and decision-making (Nejati et al., 2021). Moreover, patients with an increasing number of Met alleles were positively associated with bad performance in the

Wisconsin Card Sorting Test (WCST), which assesses abstract reasoning and set-shifting abilities and is considered a measure of executive functions (Kohli and Kaur, 2006). Hence, the study suggests that the studied genetic polymorphism in the *COMT* gene is associated with poor executive performance, in terms of inflexibility, and PFC functional connectivity in patients with AN. However, in a later study by Collantoni et al. (2016) SST psychological tool was used to assess the emotional response inhibition, behavioral inhibition, cognitive flexibility, and response monitoring in patients with AN. Interestingly, when investigating significant associations between SST reaction times and connectivity of the right inferior gyrus according to the presence of the Val158Met variant of the *COMT* genotype, no significant correlation was found.

Executive functions are cognitive processes that support goal-directed behavior (Luciana and Nelson, 2001). These processes are orchestrated by activity within the prefrontal cortex (Shimamura, 2000), including inhibition (behavioral and interference control), working memory, decision-making, problem-solving, and cognitive flexibility (mental flexibility or set shifting, closely associated with creativity) (Miyake et al., 2000; Lehto et al., 2003). In a recent separate study, it was confirmed that executive function impairment in ED is significantly associated with more severe symptoms and may result in a negative treatment outcome (Diaz-Marsa et al., 2023). This conclusion was reached after observing that patients with ED had significantly lower scores than HC in the performance of several executive function tests, particularly in the domains of set-shifting, interference control, and processing speed (Diaz-Marsa et al., 2023).

According to the included study published by Favaro et al. (2013), patients with AN with Met homozygosity have poor set-shifting, leading to worse WCST performance than HC. The study also showed abnormal regional cortical processing in the prefrontal cortex area of the brain, which is responsible for executive functions, including cognitive flexibility and the other aforementioned processes. This can be explained by the effect of the Val158Met variant, a Val allele associated with a high-activity state of COMT, which increases the rate of dopamine degradation. This leads to lower levels of dopamine in PFC. On the other hand, the Met allele produces COMT with a low activity state, which slows the rate of degradation, resulting in higher levels of dopamine. Due to the crucial role that PFC dopamine plays in set-shifting and attention, these genetic-related differences in levels of PFC dopamine were found to be associated with different performances in executive function tasks (Esmail et al., 2020). Notably, elevated dopamine levels in the prefrontal cortex have been associated with impaired cognitive function mediated by this brain region since 1996 (Murphy et al., 1996). Contradictory to that conclusion, a systematic review done in 2020 suggested no association between the COMT gene and AN susceptibility. They suggested that the inconsistency observed could be due to the presence of other SNPs that are also in linkage disequilibrium or SNPs present in genes other than the COMT. These SNPs may have a controlling effect on the association of COMT Val158Met with AN patients (Abou Al Hassan et al., 2021).

Moreover, a large Spanish study by González et al. (2021) investigated genetic polymorphisms in 3 genes related to the dopaminergic system. This study evaluated the genetic polymorphisms of A2/A1 (rs1800497), Ser9Gly (rs6280) and 10R/9R (rs28363170) in the DRD2, DRD3, and DAT1 genes, respectively. Eating Disorder Inventory-2 (EDI-2) and the Symptom Checklist-90-Revised (SCL90R) were used as psychological assessment tools to investigate several AN-related symptoms, such as drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation, and social insecurity, with and without the aforementioned genetic variations in DRD2, DRD3, and DAT1 genes. The study found that patients with AN who carried the Gly9Gly genotype in the dopamine D3 receptor had an overall significantly worse symptomatology than those with other genotypes. In essence, those patients had far higher EDI-2 scores than the rest of the patients did (relating to bulimia and interoceptive awareness as AN-related symptoms). Whereas for DAT1 gene, DAT1 9R/9R carriers had higher scores for both bulimia and asceticism compared with 10R/10R-10R/9R carriers. Elevated scores for perfectionism and ineffectiveness were displayed in DRD2 A1/A1 carriers. Taken together, this study indicates that these specific genetic variations in the dopaminergic DRD2, DRD3, and DAT1 genes have illustrated significant association with the predisposition with a more severe clinical picture of psychological manifestations presented in patients with AN.

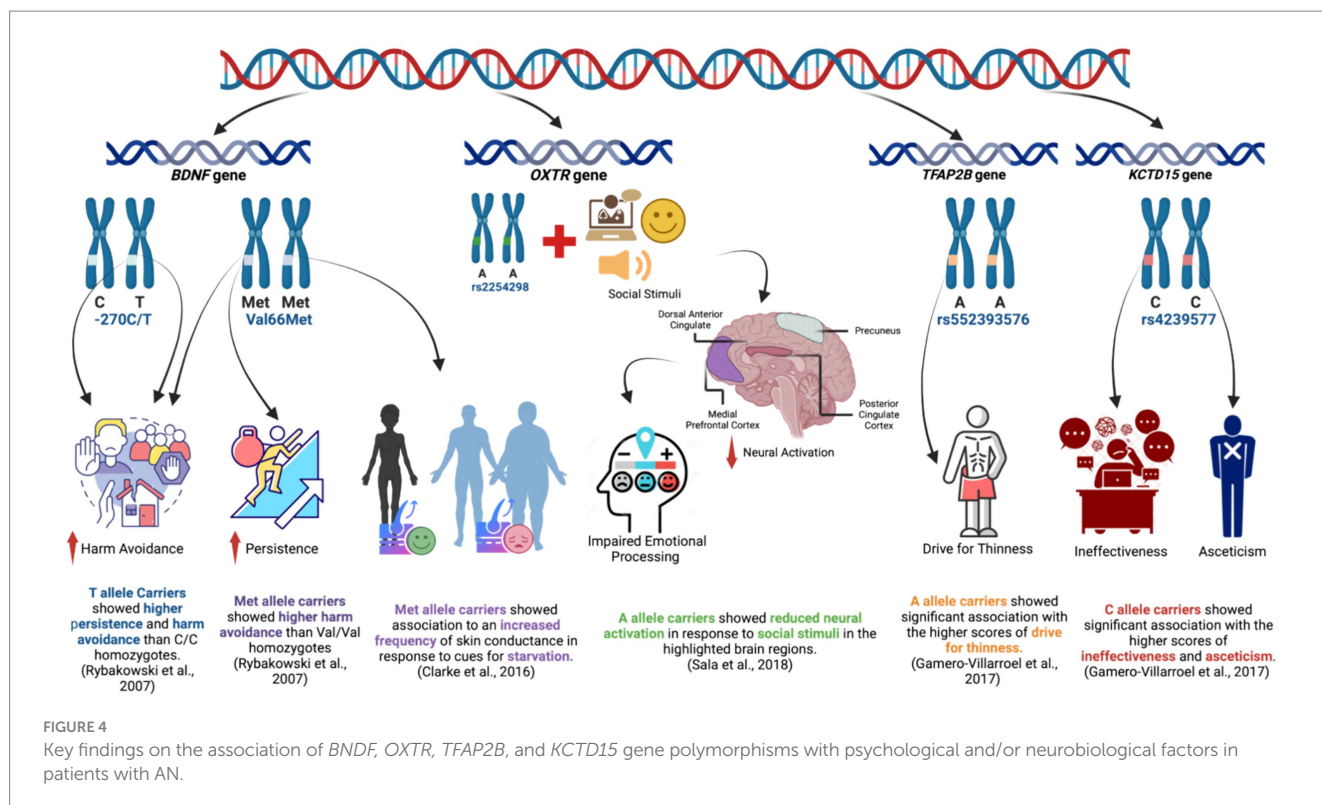
In the past years, different polymorphisms of the DRD2, DRD3, and DAT1 genes appear to play a role in the vulnerability to AN (Gervasini et al., 2013). In 2005, a research paper concluded that the D2 receptor gene is a susceptibility factor in the development of AN, establishing a foundational link between genetic variations in DRD2 and EDs (Bergen et al., 2005). Beyond AN, DRD2 was also linked to an increased risk of developing pathological eating behavior (Nisoli et al., 2007). In fact, previous studies suggested that homozygous A1/

A1 subjects possess a lower number of DRD2 in brain areas (Thompson et al., 1997). The A1 allele of DRD2 has been linked not only to perfectionism and ineffectiveness, but also to the dysregulation of the body's primary stress systems, namely the hypothalamic–pituitary–adrenal (HPA) axis (Belda and Armario, 2009), which predisposes to worse AN symptoms. Furthermore, researchers have noted a specific correlation between self-oriented perfectionism and EDs, distinguishing it from correlations with depression or adaptive disorders (Castro-Fornieles et al., 2007). Regarding the DRD3 gene, our included study suggests a significant effect of the Gly9Gly genotype on worsened AN symptoms predisposition, especially for bulimia and interoceptive awareness (González et al., 2021). This can correlate to the DRD3 gene association with emotional and food motivational responses (Sokoloff et al., 1990), given that D3 receptor is expressed in brain regions thought to govern emotion and emotional responses to stress, reward motivation, and executive function (Sokoloff et al., 1990). Notably, the DRD3 gene was found to play a role in the etiology of a wide range of psychopathologies, including obsessive-compulsive personality disorder (Light et al., 2006), which was found to be a very common comorbidity of AN (Serpell et al., 2002). On the other hand, the DAT1 gene is associated with higher scores for asceticism in patients with AN (González et al., 2021). Asceticism is the practice of self-denial, often for religious or moral reasons. Individuals with AN may engage in asceticism as a way to control their weight or to express their distress. Interestingly, one paper found that as BMI decreases, religious favor of asceticism increases (Smith et al., 2004). Suggesting a potential link between asceticism and the drive for thinness, which is one of the most common motivational cues leading to EDs (Chernyak and Lowe, 2010).

3.7 Association of other gene polymorphisms with psychological and/or neurobiological factors in patients with AN

In this systematic review, five included studies investigated the association of genetic polymorphisms in several other genes, apart from these monoamine neurotransmitter genes, with the psychological profiles and/or neurobiological characteristics of patients with AN. Out of these 3 studies investigated the BDNF gene polymorphism (Rybakowski et al., 2007; Ando et al., 2012; Clarke et al., 2016), one study looked into the OXTR gene (Sala et al., 2018), and another study focused on the polymorphisms within two genes, KCTD1 and TFAP2B (Gamero-Villarroel et al., 2017). Figure 4 illustrates the main findings of this section.

BDNF gene plays a crucial role in regulating neurotransmitter systems and has been of interest in the field of EDs (Hashimoto et al., 2005; Nakazato et al., 2012). The BDNF gene codes for the brain-derived neurotrophic factor (BDNF), a significant growth factor belonging to the neurotrophin family (Nagahara and Tuszynski, 2011). It greatly impacts the growth and differentiation of cells and also influences the plasticity of synapses and the survival of neurons (Bathina and Das, 2015). BDNF is released in varying amounts from neurons in different regions of the brain, such as the hippocampus and ventral tegmental area (Kowiański et al., 2018). These regions are known to play a vital role in learning and reward processes (Homan et al., 2014). In individuals with AN, these processes are believed to be affected (Wierenga et al., 2022). BDNF neurons in the anterior



paraventricular nucleus of the hypothalamus suppress hunger and food intake while promoting physical activity (An et al., 2015). Therefore, there is substantial evidence that supports the interaction between BDNF and eating behavior, as well as the regulation of body weight. Interestingly, The Val66Met rs6265 in the *BDNF* gene is a widely researched polymorphism in brain function, mental health, and a plethora of mental disorders (Shen et al., 2018; Wang et al., 2023).

Included in our systematic review is one of the earliest studies by Rybakowski et al. (2007), where they analyzed two polymorphisms in the *BDNF* gene, the Val66Met and -270C/T using the Temperament and Character Inventory (TCI) tool to assess different personality dimensions including novelty-seeking, harm avoidance, reward dependence, persistence, self-directedness, cooperativeness, self-transcendence in AN and HC (Aluja et al., 2010). They found that the Val66Met was associated with harm avoidance observed in patients with AN while the -270C/T was associated with both higher persistence and harm avoidance. However, both were not directly associated with AN diagnosis from the psychological point of view; rather, both were found to predispose to higher risk affecting specific personality traits, including higher persistence and harm avoidance. Harm avoidance is characterized by excessive worrying, pessimism, shyness, and being fearful, suspicious, and easily fatigued (Karppanen et al., 2023), while persistence is the tendency to continue working on something notwithstanding fatigue or frustration (Constantin et al., 2012), which are both common observations patients with AN.

The variant Val66Met of the *BDNF* gene was also investigated by Ando et al. (2012) using the same psychological tool used by Rybakowski et al. (2007), TCI, with some modifications that would suit the Japanese population. Their findings were contrary to

Rybakowski's in terms of having lower harm avoidance scores among Met66 carriers with no other association with reward-seeking, reward dependence, and persistence between Met66 carriers and non-carriers patients with AN. This was supported by a family trio study, which suggested that *BDNF* Val66Met polymorphism may not have shown a significant association with AN (Dardennes et al., 2007).

Most recently, Clarke et al. (2016) investigated the correlation between a specific SNP and psychological traits in individuals with AN. The study utilized multiple psychological assessment tools, including the skin conductance response, which is a psychophysiological measure related to the autonomic nervous system (ANS) that is responsible for various involuntary bodily functions related to stress and arousal (Bradley et al., 2001). The results showed that individuals with AN had a higher frequency of skin conductance response when exposed to images of underweight bodies. This suggests that underweight body images had a more pronounced emotional impact on individuals with AN. The study also explored the association between the Val66Met polymorphism and the frequency of skin conductance response during the processing of underweight stimuli. The findings revealed a significant association between skin conductance response frequency and the presence of the *BDNF* Met genotype. In addition, the Body Shape Questionnaire (BSQ) was also used, which is a self-report tool that assesses body image concerns and dissatisfaction (Yurtsever et al., 2022). According to the study, individuals with AN experienced more positive feelings when processing images of underweight bodies (Clarke et al., 2016), suggesting that underweight stimuli evoked a distinct emotional reaction in patients with AN and could be related to their body image perception. On the other hand, patients with AN experienced more negative feelings when processing images of normal-weight and overweight bodies, indicating that individuals with AN may

have heightened negative emotional responses to images of bodies within the normal or higher weight range (Clarke et al., 2016). These findings strongly support the distorted body image hallmark of patients with AN and suggest that the Val66Met polymorphism might play a role in mediating the heightened reward value associated with starvation imagery in AN.

In conclusion, these three aforementioned studies demonstrate that the BDNF gene, especially the Val66Met polymorphism, appears to be implicated in the personality traits, eating behaviors, and emotional responses associated with AN in different populations. Consistent with those findings, in a recent study conducted by Abou Al Hassan et al. (2021), a meta-analysis was performed to examine the influence of the BDNF gene on the progression of AN. Among various factors analyzed, the researchers found evidence suggesting a connection between the restrictive subtype of AN and the phenotypic distribution of the Val66Met gene polymorphism within the BDNF gene. Additionally, the presence of the Met66-allele was linked to typical clinical characteristics observed in individuals with AN (Abou Al Hassan et al., 2021). Animal studies on the same variant change were also shown to promote anorectic behavior in mice, when food restriction was paired with stress such as social isolation, but only in the peri-pubertal period (Madra and Zeltser, 2016).

Another gene studied in relation to AN is the OXTR gene, which codes for the oxytocin receptor protein. The role of the neuropeptide oxytocin (OT) in facilitating a range of social processes is well established (MacDonald and MacDonald, 2010). It was reported that OXTR polymorphisms are associated with social/emotional/behavioral functioning in children and adolescents (Kohlhoff et al., 2022). Sala et al. (2018), an included study in our systematic review, investigated two different SNPs in the OXTR gene, rs2254298 (G/A) and rs53576 (G/A), in patients with AN. They assessed the neural response to social stimuli using functional MRI in different brain regions. In contrast to previously reported data, no significant differences were found in the examined brain regions based on the rs53576 genotype. At the same time, carriers of the A allele for OXTR rs2254298 showed reduced neural activation in response to social stimuli in the medial prefrontal cortex, dorsal anterior cingulate, posterior cingulate cortex, and precuneus. Interestingly, the medial prefrontal cortex, dorsal anterior cingulate, posterior cingulate cortex, and precuneus are all areas associated with social cognition, emotional processing, and self-referential thinking (McAdams and Krawczyk, 2011, 2014; Schulte-Rüther et al., 2012; McAdams et al., 2015, 2016). Those processes are usually impaired in patients with AN (Oldershaw et al., 2011; Tchanturia et al., 2011; Lang et al., 2016). Consistent with this, another study showed that the A allele carriers of rs2254298 exhibited greater global social impairments (Parker et al., 2014). The study by Sala et al. (2018) further assessed its preliminary findings by the eating attitude test (EAT-26) as a psychological tool to assess the ED behaviors and ED symptomatology related to shape and weight concerns for significantly higher measures to be found for rs2254298A carriers compared to rs2244298GG carriers (Sala et al., 2018). That would suggest a potentially significant association between this genetic variation and disturbed body image and distorted perception of weight, which are central aspects of AN.

In a review of EDs and oxytocin receptor polymorphisms (Burmester et al., 2021), they observed that research on the OXTR SNPs rs53576 and rs2254298 has revealed distinct associations between genetic variations and eating behaviors. Specifically, the A allele of both SNPs is independently linked to restrictive eating

behaviors, while the G allele of rs53576 is associated with bingeing behaviors, a correlation reflected in neuroanatomical findings (Micali et al., 2017). Interestingly, one study discovered that the A allele of OXTR SNPs poses a risk for more severe symptoms related to ED, whereas the G allele provides some protective effects (Acevedo et al., 2015). Despite these associations, individual OXTR SNPs alone are unlikely to fully explain the complexity of EDs, suggesting that they may influence the expression and/or effectiveness of the OXTR.

TFAP2B and KCTD15 are two other genes investigated in an included study by Gamero-Villarroel et al. (2017). Transcription Factor AP-2 Beta (TFAP2B) and the Potassium Channel Tetramerization Domain Containing 15 (KCTD15) are two obesity-related genes that interact to regulate feeding behavior (Williams et al., 2014). TFAP2B is a crucial regulator of monoaminergic genes (Damberg, 2005), while KCTD15 is reported to be associated with putative regulation of body mass index (BMI) (Mei et al., 2012). In the prespective included cross-sectional study, ten clinically relevant and tag single-nucleotide polymorphisms (SNPs) in KCTD15 and TFAP2B were screened in the included participants in both AN and HC. The EDI-2 and the anxiety subscale of the Symptom Checklist 90 Revised (SCL90R) were utilized as psychological assessment tools to assess all of the drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation, and social insecurity. The results showed that the effect of the gene–gene interaction was more profound in scales such as perfectionism, maturity fears, or social insecurity for patients with AN. Moreover, in terms of the correlation with the studied SNPs, rs552393576 and rs2817420 in TFAP2B and rs4805059 and rs4239577 in KCTD15 showed significant relevant associations with the scores of several dimensions, including drive for thinness, ineffectiveness, and asceticism. In other words, the study suggests that genetic variability in TFAP2B and KCTD15 genes may influence personality dimensions related to AN, suggesting that the interaction of genetic variability in these loci could influence the risk for ED and/or psychological parameters.

Interestingly, both TFAP2B and KCTD15 genes were reported by multiple studies to be related to higher obesity risk (Bauer et al., 2009; Willer et al., 2009; Albuquerque et al., 2014; Lv et al., 2015) and there are many shared personality dimensions and risk factors between obesity and ED. These include body dissatisfaction, low self-esteem, anxiety, depression, substance abuse, dieting, binge-eating, and a history of sexual/physical abuse (Day et al., 2009). With that being said and given that both genes were found to alter personality dimensions, it is possible that genetic variations of both genes would not specifically predispose to more severe psychological manifestations of AN specifically, but rather in any eating disorder.

4 Conclusion

In conclusion, this comprehensive review highlights the intricate relationship between genetic polymorphisms and the psychological and neurobiological factors associated with AN. The serotonergic system, particularly the 5-HTTLPR polymorphism, has been consistently implicated in altered functional connectivity within the ventral attention network, impaired inhibitory control, and an increased predisposition to AN. The findings emphasize the impact of the 5-HTTLPR polymorphism on the ventral attention network, shedding light on the potential mechanisms underlying

altered reward processing, motivation, reasoning, working memory, inhibition, and outcome prediction in patients with AN. The dopaminergic system, encompassing genes such as *COMT*, *DRD2*, *DRD3*, and *DAT1*, plays a crucial role in regulating reward, motivation, and decision-making processes. Genetic variations in these dopaminergic genes have been linked to diverse psychological manifestations and clinical severity in AN patients.

The *BDNF* gene, specifically the Val66Met polymorphism, emerges as a significant player in influencing personality traits, eating behaviors, and emotional responses associated with AN across diverse populations. The *OXTR* gene, responsible for oxytocin receptor protein, and other genes like *TFAP2B* and *KCTD15*, reveal intriguing associations with social cognition, emotional processing, body image concerns, and personality dimensions in patients with AN. It is evident that genetic variations contribute to the complexity of AN, influencing not only the susceptibility to the disorder but also shaping its diverse clinical presentations. Future research should continue exploring the interplay between genetic factors and environmental influences to provide a more comprehensive understanding of the etiology and pathophysiology of AN. There is a need for further investigation to extend these findings to eating pathology. The use of Genome-Wide Association Studies (GWAS) could significantly contribute to expanding our knowledge in this area, shedding light on the intricate interplay between genetics and environmental factors in the development of EDs. This knowledge could pave the way for personalized therapeutic interventions that target specific genetic vulnerabilities, ultimately improving outcomes for individuals affected by this challenging and potentially life-threatening condition.

5 Strengths and limitations

This is the first systematic review to evaluate the genetic polymorphisms and their association with neurobiological and psychological factors in anorexia nervosa status and summarize almost all the available evidence regarding this association. In addition, a rigorous systematic approach was followed to develop this review, such as the PRISMA guidelines and the Rayyan application, which was used to perform initial screening and enabled the research team to conduct a blind review that would enhance the credibility of the findings. Additionally, the studies included were conducted on a large number of participants, who were relatively homogenous for their age (mainly adolescents) and health status (all cases were clinically diagnosed according to internationally established criteria). Additionally, the studies included in this systematic review were conducted in various countries, which allows us to see the influence of different genetic polymorphisms on neurobiological and psychological factors in individuals with various genetic backgrounds. Furthermore, the quality of the included studies was mainly high, and only two out of eleven studies were of stationary quality, which indicates that the evidence drawn from these studies is unlikely to be biased or the result of other uncontrolled confounding factors.

Despite the valuable insights provided by the reviewed studies on the association between genetic polymorphisms and psychological/neurobiological factors in AN, several limitations should be considered. Many studies exhibit small sample sizes, potentially compromising the generalizability of findings. Using cross-sectional designs might limit the ability to establish causation or determine the direction of relationships. Publication bias may skew the overall understanding, as positive results

are more likely to be published. Multiple testing and the lack of replication studies pose risks of false-positive results. Psychological assessment tools vary across studies, impacting the comparability of results. The complexity of gene–gene interactions and the functional implications of genetic variations require further exploration. Addressing these limitations in future research endeavors will contribute to a more nuanced understanding of the genetic factors influencing AN.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Author contributions

HA: Writing – original draft, Visualization, Methodology, Investigation, Data curation, Conceptualization. HB: Writing – review & editing, Validation, Supervision.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2024.1386233/full#supplementary-material>

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Overvaluation of weight and shape in obesity: a comparative study between people with and without binge eating disorder

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Introduction: The overvaluation of weight and shape is a diagnostic criterion in eating disorders, except in binge eating disorder (BED), where it has received less attention. This aspect is also not usually analyzed in people with overweight or obesity without an eating disorder. This research aims to identify the indicators of symptomatology, as well as those of self-construction and cognitive structure, that are associated with overvaluation in obesity, either alone or in conjunction with BED.

Method: A sample of 102 overweight or obese participants was accessed. The sample was divided into four groups: one without overvaluation or BED ($n = 33$); a second with overvaluation and without BED ($n = 21$); a third with BED, but without overvaluation ($n = 15$), and a fourth with BED and overvaluation ($n = 33$). The groups completed instruments regarding eating symptomatology, anxiety, depression, and stress. In addition, they were administered the Repertory Grid Technique, a semi-structured interview to evaluate the cognitive structure involved in the construal of the self and others.

Results: The factors of overvaluation and the presence of BED independently explained eating symptomatology, and the latter also showed a tendency to influence anxiety, depression, and stress. In terms of cognitive structure, weight polarization was explained by overvaluation, while BED was associated with a high presence of cognitive conflicts. In self-construction, BED was the factor that explained the differences, particularly in Self-Ideal discrepancy.

Discussion: The results highlight the importance of overvaluation in obesity, even in the absence of BED. Its evaluation and treatment are recommended. Furthermore, in the case of BED, it is also advisable to evaluate the overvaluation of weight and shape since it can be a severity specifier.

KEYWORDS

obesity, overweight, binge-eating disorder, overvaluation, psychopathology, repertory grid, internal conflict, personal construct

1 Introduction

Overvaluation of weight and shape is a concept that alludes to the great importance that some people attach to body weight and/or shape in assessing personal worth (Fairburn and Harrison, 2003). This is considered a central element in the development of eating disorders (EDs) (Fairburn et al., 2003). According to the DSM-5-TR, overvaluation is a diagnostic criterion for Bulimia Nervosa (BN) and Anorexia Nervosa, but not for Binge Eating Disorder (BED). However, different authors have investigated the role of overvaluation in BED, noting that this should be an element to be taken into account, either as a diagnostic criterion or as a specifier of severity in BED (e.g., Grilo, 2013; Harrison et al., 2015; Kenny and Carter, 2018; Mitchison et al., 2018; Coffino et al., 2019).

In the case of people with obesity without ED, little research has been conducted concerning the role of overvaluation of weight and shape in their mental health. Most research on the subject focuses on BED, and is based on comparisons between groups: people with obesity (without determining the presence or absence of overvaluation), people with BED, with or without overvaluation (e.g., Harrison et al., 2015; Kenny and Carter, 2018) and, in some cases, there is a group of people with BN (e.g., Grilo et al., 2010; Coffino et al., 2019). Despite the scarcity of research, there is evidence (e.g., Sonnevile et al., 2015) indicating that weight overvaluation in overweight/obesity is associated prospectively with the presence of binge eating and depressive symptoms, highlighting its clinical relevance in people with obesity without ED.

When comparisons have been made between people with BED, with and without overvaluation, it has been observed that those with overvaluation generally show more symptoms of EDs, as well as worse psychological functioning (Harrison et al., 2016; Kenny and Carter, 2018), providing further evidence of the relevance of assessing this aspect. These studies were conducted predominantly in adult women, with little participation of men. In this way, one of the few studies that have been carried out with a large sample of more than a thousand treatment-seeking patients with obesity included both male and female participants without an ED. This study showed that overvaluation is associated with greater eating and general psychopathology (Dalle Grave et al., 2020). Specifically, regarding food symptomatology, it has been observed that people with BED and overvaluation present more problems in emotional regulation than those who do not overvalue (Harrison et al., 2016). Thus, it is to be expected that such people tend to eat food to cope with unpleasant emotions, which is referred to by Ganley (1989) as emotional eating, which in turn is related to the manifestation of food craving (Verzijl et al., 2018; Dicker-Oren et al., 2022).

This study aims to analyze not only differences between people with and without weight/shape overvaluation of people with BED, as in previous research, but also explores this factor in people with overweight or obesity without BED, a less explored population. We present a secondary analysis of an investigation that compared the presence of cognitive conflicts, eating symptoms and anxious-depressive symptoms

in people with obesity, with and without BED, whose first results have been previously published (Escandón-Nagel et al., 2018). To gauge the relevance of cognitive processes involved in the construal of self and others, this line of research was based on Kelly's (1955) Personal Construct Theory. The central assumption of this theory is that each person develops a set of personal (largely implicit) hypotheses for both the self and the world, which are used for interpreting and anticipating events. Just as scientific hypotheses are made up of theoretical constructs, these are made up of personal constructs (Kelly, 1955; Botella and Feixas, 1998; Walker and Winter, 2007).

Each construct represents the grasping of a difference that a person has drawn from their experience. These distinctions are often shared with family members or friends, or incorporated from cultural narratives. For example, a person might express the construct "cares about oneself" (as opposed to "cares about others"), a distinction they use to categorize self and others. As a distinction reflecting a contrast in meaning, all personal constructs are represented by two opposite poles, and the person usually holds a preference one of the two. It is important to note that both these preferences and the constructs themselves are idiosyncratic (i.e., unique, different for each individual; see Walker and Winter, 2007). These constructs are the components of the system of meanings with which the person uniquely organizes their experience. The most common instrument used to elicit and analyze the constructs of a person is the Repertory Grid Technique (RGT; Feixas and Cornejo, 2002; Fransella et al., 2004).

One of the measures provided by the RGT is the self-ideal discrepancy (distance between current self and ideal self), which is regarded as an indicator of self-esteem because it provides information about how the person values the self on their terms. Similarly, the self-others discrepancy taps on self-perceived social isolation; and the ideal-others discrepancy alludes to the perceived adequacy of others, that is, how positive or negative is the view of others (Feixas and Cornejo, 2002). These three measures (self-esteem, perceived social isolation and adequacy of others) are important aspects of EDs and are associated with their severity (Bulik et al., 2002; Fairburn et al., 2003; Herbozo et al., 2015).

Few studies analyze the construal of the self and others in EDs. For example, Feixas et al. (2010) compared a group of women with BN with a control sample, both with an average age of 25 years, detecting a higher self-ideal discrepancy in the former. Another subsequent study with women with BN showed that they used more body-related constructs than the control sample (Dada et al., 2017).

One of the aspects of the cognitive structure (structural characteristics of the system of constructs) that can be assessed with the RGT is polarization. It reflects the extent to which the person employs extreme evaluations when judging the self and others. This measure has also been termed dichotomous interpersonal thinking and is considered to be an indicator of cognitive rigidity (García-Mieres et al., 2020). According to Alberts et al. (2012), dichotomous thinking is common in people with EDs. Another aspect of the cognitive structure refers to cognitive conflicts, distinguishing between two types: dilemmatic constructs and implicative dilemmas. The former are constructs that do not offer a clear course of action because the two poles are undesirable, so the person cannot choose one. If there are many dilemmatic constructs, the person can enter into a state of insecurity, doubt and inaction (Feixas and Saúl, 2004). On the other hand, implicative dilemmas occur when one construct in which the subject wishes to change (discrepant construct) is

Abbreviations: EDs, eating disorders; BED, binge eating disorder; group with binge eating disorder, without overvaluation of weight/shape; BEDOVE, group with binge eating disorder and overvaluation of weight/shape; OB, group with obesity, without overvaluation of weight/shape; OBOVE, group with obesity and overvaluation of weight/shape; RGT, repertory grid technique.

correlated with another in which the person is satisfied (congruent construct), so to acquire that desirable characteristic of the discrepant construct involves modifying another aspect of the congruent construct that the person wants to maintain. Thus, for some people, modifying a symptom, while desirable, may in turn mean a threat to personal identity (Feixas and Saúl, 2004). The presence of implicative dilemmas seems to distinguish, better than dilemmatic constructs, between clinical samples, such as people with depression and fibromyalgia, and control groups (Compañ et al., 2011; Feixas et al., 2014; Montesano et al., 2017). In EDs, implicative dilemmas are more prevalent in bulimia (Feixas et al., 2010) and in people with BED obesity than in those with obesity without BED (Escandón-Nagel et al., 2018). A study conducted by Dada (2014) comparing a group of people with different EDs with a control group also found that the group with EDs had more cognitive conflicts. Internal conflicts have been a recurrent topic of interest in psychology; however, they are not usually investigated, probably because there are few means of measuring them. Based on Personal Construct Theory, the RGT is offered as an instrument for this purpose (Feixas and Saúl, 2004).

Although several studies have found these measures of self-construal and cognitive structure to be associated with eating disorders, this is the first study to explore their relationship to the overvaluation of weight and shape in obesity and/or BED. Therefore, this research constitutes a novel study also because of the theoretical perspective adopted, which makes it possible to study how a person constructs their identity and the image of significant others (Feixas and Cornejo, 2002). In this way, it is possible to know the constructs a person uses to give meaning to their experience, and from this perspective, to analyze the role played by the symptoms concerning their meaning system. This focus on the vision of affected people contrasts with the bulk of research to date, which has been more focused on the researchers' constructs and their various categorization systems, which are alien to the patients' points of view.

Following these considerations, the objective of this study is to identify indicators of symptomatology as well as aspects of self-construction and cognitive structure that are associated with the overvaluation of weight and shape in people with overweight or obesity with and without BED. We expect the presence of overvaluation to be associated with psychopathological symptoms, discrepancies in self-construal, polarization, and presence of cognitive conflicts.

2 Materials and methods

2.1 Participants

After a non-probabilistic sampling for convenience, we divided a sample of 102 overweight and obese participants (9.8% with overweight; 90.2% with obesity) into four groups: one without overvaluation and BED (OB, $n = 33$); a second with overvaluation and without BED (OBOVE, $n = 21$); a third with BED and without overvaluation (BED, $n = 15$); and a fourth group with BED and overvaluation (BEDOVE, $n = 33$). Considering this sample size and the principle of maximum entropy ($\pi = 1 - \pi = 0.5$), the sample obtain a maximum error of 0,097 (95% confidence level) and a theoretical value of contrast power ($1 - \beta$) = 0.69.

The sample was recruited from different healthcare centers in Barcelona, as well as from notices located in public places and on social networks inviting people to participate in the study (Escandón-Nagel et al., 2018).

The inclusion criteria were to be over 18 years old with a BMI greater than or equal to 27 kg/m², the criteria for pre-obesity according to the Spanish Society for the Study of Obesity (Salas-Salvadó et al., 2007). Additionally, they had to have at least primary education and an adequate understanding of Spanish. People who had undergone bariatric surgery were excluded since they tend to have greater psychopathological severity, thus constituting a group with distinctive characteristics (Sarwer et al., 2019). We also excluded people who had any medical diagnosis that could be the basis of obesity, making weight loss difficult, such as hypothyroidism or diabetes.

In the OB group, 87.9% were women, with an average age of 46.39 ($SD = 10.85$, range 21–68) and a BMI of 36.82 Kg/m² ($SD = 5.16$, range 27.19–45.80); in the OBOVE group, 100% were women and the average age was 39.29 ($SD = 12.83$, range 18–66), with a BMI of 37.66 kg/m² ($SD = 7.70$, range 27.47–55.84). The BED group was also mainly comprised of women (93.3%), with an average age of 41.13 ($SD = 12.76$, range 19–57) and a BMI of 38.62 kg/m² ($SD = 4.86$, range 29.02–49.22). Finally, in the BEDOVE group, 90.9% were women and the average age was 38.70 ($SD = 11.65$, range 18–58), with a BMI of 38.46 kg/m² ($SD = 6.23$ range 27.40–50.26). In Table 1, data on marital status, educational level and employment status are presented. Analysis using chi-square was performed to test the equivalence of the groups in these categorical variables without statistically significant differences ($p > 0.05$). However, specific values are not reported because the application condition for chi-squared was not met since the expected frequencies were less than 5. Therefore, the interpretation of the equivalence of groups in these variables must be taken with caution.

Concerning BMI, the groups were equivalent: $F(3,98) = 0.52$; $p = 0.673$, $\eta^2 = 0.016$; Levene test $F(3,98) = 2.13$; $p = 0.101$. In relation to age, the analyses yielded differences, with a medium effect size [$F(3,98) = 2.75$, $p = 0.047$, $\eta^2 = 0.078$, Levene test $F(3,98) = 3.60$, $p = 0.782$], specifically between OB and BEDOVE ($p = 0.046$), the average age of the OB group being higher. For this reason, it became necessary to control this variable in subsequent analyses.

2.2 Instruments and measures

2.2.1 Semi-structured interview for the assessment of BED

A semi-structured interview was prepared for this study, based on the diagnostic criteria for BED of DSM-5 (American Psychiatric Association, 2013), to identify the participants with this disorder.

2.2.2 Eating disorder examination questionnaire

This instrument was initially developed by Fairburn and Beglin (1994) to assess eating habits and patterns over the past month. It consists of four subscales: Weight Concern, Eating Concern, Shape Concern and Restraint, together yielding an overall score. We used the Spanish version (Villarreal et al., 2011) consisting of 38 Likert scale items of 0–6 points. In our study, adequate reliability values were obtained (α weight concern = 0.727; α eating concern = 0.754; α shape concern = 0.871; α restraint = 0.714; α total = 0.898). Two

TABLE 1 Sociodemographic description of the sample: marital status, studies, employment situation.

		Group			
		OB (<i>n</i> = 33)	OBOVE (<i>n</i> = 21)	BED (<i>n</i> = 15)	BEDOVE (<i>n</i> = 33)
Marital status	Single	24.2%	19.0%	26.7%	39.4%
	Married	60.6%	66.7%	46.7%	51.5%
	Divorced/separated/ widowed	15.2%	14.3%	26.7%	9.1%
Education	Primary education	39.4%	38.1%	26.7%	27.3%
Level	Vocational/Professional Training	36.4%	52.4%	53.3%	30.3%
	University studies	24.2%	9.5%	20.0%	42.4%
Employment	Employed	45.5%	52.4%	53.3%	39.4%
Status	Unemployed	15.2%	23.8%	13.13%	15.2%
	Other	39.4%	23.8%	33.3%	45.5%

OB, group without BED and without overvaluation; OBOVE, group without BED and with overvaluation; BED, group with BED without overvaluation; BEDOVE, group with BED and overvaluation.

items from this instrument were utilized to assess the presence of overvaluation (“Has your weight influenced how you think about yourself as a person?” and “Has your shape influenced how you think about yourself as a person?”) These items explore whether weight and/or shape significantly impact self-perception, with a score of 5 or higher on either question indicating overvaluation. This measurement strategy has been used in several previous studies (e.g., Grilo et al., 2010; Harrison et al., 2015; Mitchison et al., 2017; Kenny and Carter, 2018). Because one of these items belongs to the Weight Concern scale and the other to Shape Concern, we corrected the scores belonging to these subscales, omitting those items. Based on the aforementioned, the following scores were utilized in this study: Overvaluation of Weight/Shape, Eating Concern, Restraint, and three scores that were adjusted due to the exclusion of two items used for the calculation of overvaluation (Corrected Weight Concern, Corrected Shape Concern and corrected overall score). Thus, the reliability of the corrected scores was α weight concern corrected = 0.641; α shape concern corrected = 0.856. In addition, a corrected overall score was also obtained, which yielded a Cronbach alpha of α total corrected = 0.884.

2.2.3 Short form of the depression anxiety stress scales

This is a 21-item scale derived from the depression, anxiety and stress scale (DASS-21) (Lovibond and Lovibond, 1995). It was adapted to Spanish by Bados et al. (2005) and evaluates items on 0–3 Likert scale investigating symptoms of anxiety, depression, and stress in the previous 7 days. In this investigation, adequate reliability values were obtained (α depression = 0.819; α anxiety = 0.797; α stress = 0.822; α global = 0.902).

2.2.4 The emotional eater questionnaire

This is a self-report questionnaire of 10 items on a 4-points Likert scale, developed in Spain by Garaulet et al. (2012) to evaluate emotional eating in people who are overweight or obese. It measures the influence of emotions on eating behavior. In this research, a Cronbach alpha was obtained of α = 0.863.

2.2.5 The food craving inventory (FCI-SP)

This self-report questionnaire was created by White et al. (2002) to assess food craving by exploring how often in the previous month the respondent experienced craving regarding a list of 28 foods. For each item, the evaluated must respond on a 0–4 Likert scale. We used the Spanish version of the instrument developed by Jáuregui et al. (2010) which yielded a Cronbach alpha of α = 0.881.

2.2.6 The repertory grid technique

The RGT is a semi-structured interview designed to evaluate the system of constructs of the person from which a matrix with three components is obtained. In the columns, at the top, elements (“present self,” “ideal self” and significant others of the evaluated person, such as partner and friends) are recorded (in this study, from 10 to 20 elements, depending on the participant). In the rows, the constructs provided by the person are annotated, having been elicited from the comparison, in terms of similarities and differences, between these elements taken in rotative pairs. The number of constructs elicited with this procedure varied across participants, ranging from 10 to 37. In the cells, formed by the intersection between elements and constructs, participants are asked to score each element in each construct, using a 7-point Likert scale. The whole process lasted between 50 and 70 min depending on the participant (see these manuals for more detail: Feixas and Cornejo, 2002; Fransella et al., 2004).

With this instrument, the self-construction indices were obtained, such as the self-ideal discrepancy (Euclidian distance between the scores of the “current self” and those of the “ideal self”), self-others discrepancy (Euclidian distance between the scores of the “current self” and the average of the scores attributed to others), and others-ideal discrepancy (Euclidian distance between the scores of the average of the scores attributed to others and those of the “ideal self”). In each of them, the higher the score obtained, the greater the discrepancy. It was decided to include “fat-thin” as a provided construct. This allowed for an evaluation of the perception of the current weight and the ideal weight according to the score rated for the current “self” element (1 very fat; 7 very thin). The difference between the score on the current self and the ideal self in this construct

was considered a measure of body dissatisfaction. In addition, cognitive structure indices such as total polarization, polarization on the “fat-thin” construct, percentage of implicative dilemmas, and percentage of dilemmatic constructs were obtained. The higher the scores obtained in these indices, the higher the level at which the target characteristic is presented.

2.2.7 Sociodemographic questionnaire

A sociodemographic questionnaire was also used to collect data to describe the sample in terms of age, sex, educational level, employment situation and marital status while collecting information on weight and size, to obtain BMI.

2.3 Procedure

The research was approved by the Bioethics Commission of the *Universitat de Barcelona*. We invited different health centers in Barcelona to participate in the study. Professionals of these centers informed potential participants and, if they agreed, contacted the coordinator of the study (first author). We also used posters on public sites and on social networks to invite more participants. Potential participants were informed about the study and a signature of informed consent was requested, guaranteeing the confidentiality of the data, to subsequently administer the different instruments listed above.

The psychological evaluation was carried out individually in a single session of approximately 2 h. First, the evaluator administered the sociodemographic questionnaire and conducted the semi-structured interview to assess BED. Next, the other questionnaires were applied, and finally, the RGT was administered.

After inclusion in the study, the four groups mentioned above were formed based on the information collected with the semi-structured interview to evaluate BED and on the two items of the eating disorder examination questionnaire (EDE-Q) with which overvaluation was measured.

2.4 Data analysis

ANCOVA was used to compare the symptomatology between the different groups, considering two factors: the presence of overvaluation and the presence of BED. Age was included as a covariate since the groups were not equivalent in this regard. Homoscedasticity was evaluated with Levene's test. When the assumption of homoscedasticity was not met, the nonparametric statistic of Kruskal Wallis was used and, if significant values were obtained, Mann–Whitney's *U* was used as a *post hoc*.

Self-construction and cognitive structure were compared using MANCOVA. If Box M confirmed homoscedasticity compliance for multivariate analyses, Wilks' Lambda was used. If not, we used Pillai's trace to interpret the results.

As for statistical programs, for the analysis of grid data, we used GRIDCOR 6.0 (García-Gutiérrez and Feixas, 2018) and results of the variables from RGT were introduced to the overall analysis of the data that was performed with IBM SPSS 22. The value of the type I error or global alpha risk was set to $\alpha < 0.05$; however, when multiple comparisons were used in ANCOVA, MANOVA and Kruskal Wallis

post-hoc, we applied the Bonferroni correction for groups of variables (the corresponding corrected value is indicated in the Results section). In addition to the *p*-value, we reported the effect size of the different analyses.

3 Results

3.1 Symptoms of depression, anxiety, stress, and eating behavior

In Table 2, descriptive statistics obtained by the different subgroups in the symptomatology of depression, anxiety, and stress, as well as in symptoms of food behavior are presented.

Regarding ANCOVA, Table 3 emphasizes that, considering the correction of Bonferroni ($\alpha < 0.013$), no differences in depression, anxiety, or stress were detected.

As shown in Table 4, concerning the corrected total EDE-Q, differences in scores explained by both factors were independently detected. That is, on the one hand, people with overvaluation had higher scores than those who did not overvalue weight and shape (with a large effect size), and those with BED scored higher than those who did not (with a medium effect size). Something similar happened with Corrected Weight Concern and Eating Concern, as in both cases, the scores were explained by the two factors independently.

A trend (without reaching statistical significance according to the corrected alpha value, but with a value of less than $p < 0.05$) can be seen in Table 4 for the Restriction scale relative to the weight and shape overvaluation factor, regardless of BED. With a medium effect size, the group's scores with overvaluation were higher. Something similar happened with body dissatisfaction, although in this case, the magnitude of the difference was small.

Regarding the emotional eater questionnaire (EEQ), differences were identified between the groups given by both factors independently, with higher scores on those with BED, as well as in the overvaluation group. As shown in Tables 3, 4, in none of the analyses did the age covariate turn out to be statistically significant.

In the variables Corrected Shape Concern [$F(3,98) = 6.17$; $p = 0.001$] and Food Craving [$F(3,98) = 2.91$; $p = 0.038$] the homoscedasticity condition was not met and the Kruskal Wallis analysis was used. For Mann–Whitney's *U post-hoc* analyses, the corrected alpha was 0.008. In Corrected Shape Concern, differences were found between the groups [$\chi^2(3) = 36.7$, $p < 0.001$]. The post-hoc analyses are presented in Table 5, which shows that specifically there are differences, with a large effect size, between the OB group and BEDOVE; between the OB and OBSOB group, with a medium effect size; and between OB and BED, with a small effect size. Differences were also identified in the Food Craving variable between the groups [$\chi^2(3) = 21.50$, $p < 0.001$]. As shown in Table 5, the main differences were between OB and BED and OB and OBSOB, in both cases with a medium effect size.

3.2 Self-construction and cognitive structure

Table 6 presents the descriptive statistics referring to self-construction and cognitive structure.

TABLE 2 Descriptive statistics of symptoms of depression, anxiety, stress and eating behavior.

Variable	With overvaluation		Without overvaluation	
	Presence of BED		Presence of BED	
	Yes (<i>n</i> = 33) <i>M</i> (<i>SD</i>)	No (<i>n</i> = 21) <i>M</i> (<i>SD</i>)	Yes (<i>n</i> = 15) <i>M</i> (<i>SD</i>)	No (<i>n</i> = 33) <i>M</i> (<i>SD</i>)
DASS-21 depression	20.61 (12.95)	14.76 (13.09)	16.93 (8.81)	12.73 (10.80)
DASS-21 anxiety	15.09 (8.90)	13.52 (11.04)	15.73 (9.47)	8.42 (9.27)
DASS-21 stress	20.18 (9.64)	20.00 (8.34)	22.13 (7.39)	15.15 (11.10)
EDE-Q corrected total	3.75 (0.93)	3.33 (0.66)	3.03 (0.93)	2.06 (1.02)
EDE-Q restriction	2.49 (1.53)	2.64 (1.23)	1.69 (1.43)	2.06 (1.42)
EDE-Q corrected weight	4.13 (1.06)	3.92 (1.07)	3.37 (1.31)	2.27 (1.16)
EDE-Q corrected shape	5.04 (0.82)	4.73 (0.81)	4.29 (1.38)	2.89 (1.47)
EDE-Q eating concern	3.35 (1.46)	2.02 (1.07)	2.76 (0.91)	1.00 (1.11)
EEQ	22.33 (4.13)	15.00 (3.87)	19.73 (4.48)	10.70 (5.58)
FCI-SP	44.45 (15.25)	33.76 (9.49)	43.27 (12.74)	27.27 (19.28)
Body dissatisfaction	3.94 (1.48)	3.90 (1.61)	3.13 (1.41)	3.33 (1.57)

BED, Binge Eating Disorder; DASS-21, Short form of the Depression Anxiety Stress Scales; EDE-Q, Eating Disorder Examination Questionnaire; EEQ, Emotional Eater Questionnaire; FCI-SP, Food Craving Inventory.

TABLE 3 Comparative analysis of symptoms of depression, anxiety, and stress.

Variable	Comparison	<i>F</i>	d.f.	<i>p</i>	η^2
DASS-21	Overvaluation	1.37	1, 97	0.203	0.017
Depression	Presence of BED	4.46	1, 97	0.037*	0.044
	Overvaluation \times BED	0.07	1, 97	0.797	0.001
	Age	0.59	1, 97	0.446	0.006
	Levene's test	1.26	3, 98	0.294	
DASS-21	Overvaluation	1.36	1, 97	0.246	0.014
Anxiety	Presence of BED	5.02	1, 97	0.027*	0.049
	Overvaluation \times BED	2.14	1, 97	0.147	0.022
	Age	0.17	1, 97	0.679	0.002
	Levene's test	0.74	3, 98	0.532	
DASS-21	Overvaluation	0.85	1, 97	0.360	0.009
Stress	Presence of BED	3.62	1, 97	0.060	0.036
	Overvaluation \times BED	3.21	1, 97	0.077	0.032
	Age	1.24	1, 97	0.269	0.013
	Levene's test	1.40	3, 98	0.248	

*Significant to the level 0.05.

Concerning the self-construction variables, to compare the samples using MANCOVA, the homogeneity of the variance-covariance matrixes was checked with the Box's *M* test, confirming compliance with this assumption [$F(45,11454.02) = 1.00, p = 0.468$]. In addition, as shown in Table 7, the Levene test found homoscedasticity in all the variables involved. The source of variation presence of BED was statistically significant for the explanation of the variability of self-construction [$F(5,93) = 3.74, p = 0.004$; Wilks' Lambda = 0.833; $\eta^2 = 0.167$], with a large effect size. This is explained, specifically, by the self-ideal discrepancy (Table 7), which was higher in the BED group, regardless of overvaluation. The other sources of variation do not explain the variability of self-construction [Overvaluation

$F(5,93) = 1.03, p = 0.402$; Wilks' Lambda = 0.947; $\eta^2 = 0.053$; the presence of BED \times Overvaluation ($F(5,93) = 0.07, p = 0.996$; Wilks' Lambda = 0.996; $\eta^2 = 0.004$]. In addition, the age covariate also did not prove statistically significant [$F(5,93) = 0.38, p = 0.863$; Wilks' Lambda = 0.980; $\eta^2 = 0.020$].

Regarding the cognitive structure, Box's *M* test indicates that the homogeneity of the matrixes of variance-covariance is not met [$F(30, 12491.41) = 2.17, p < 0.001$]. Nevertheless, with the Levene test, the homoscedasticity was stated in almost all the implied variables, as seen in Table 8, except in the percentage of implicative dilemmas [$F(3,98) = 4.35; p = 0.006$].

The source of overvaluation variation is statistically significant for the explanation of the variability of cognitive structure [$F(4,94) = 4.03, p = 0.005$; Pillai trace = 0.146; $\eta^2 = 0.146$], with a large effect size. Specifically, as shown in Table 7, the weight polarization is more marked in the group with overvaluation. In addition, the presence of BED also explains the variability of cognitive structure [$F(4,94) = 3.63, p = 0.009$; Pillai trace = 0.134; $\eta^2 = 0.134$], with a large effect size.

The interaction of BED and overvaluation does not explain the variability in cognitive structure [$F(4,94) = 1.62, p = 0.176$; Pillai trace = 0.064; $\eta^2 = 0.064$]. The age covariate also did not prove statistically significant [$F(4,94) = 0.82, p = 0.516$; Pillai trace = 0.034; $\eta^2 = 0.034$].

In implicative dilemmas, Kruskal Wallis was used to identify differences between the groups [$\chi^2(3) = 9.45, p = 0.024$]. Although, as shown in Table 9, Mann-Whitney's *U* post-hoc-based analyses did not yield statistically significant differences when considering the corrected alpha value of 0.008.

4 Discussion

This study sought to identify which indicators of symptomatology, self-construction, and cognitive structure, are associated with overvaluation of weight and shape in people with obesity (or overweight), either alone or in conjunction with BED. The main

TABLE 4 Comparative analysis of symptoms of eating behavior.

Variable	Comparison	F	d.f.	p	η ²
EDE-Q	Overvaluation	25.91	1, 97	<0.001**	0.211
Total	Presence of BED	12.90	1, 97	<0.001**	0.117
Corrected	Overvaluation × BED	1.96	1, 97	0.165	0.020
	Age	0.00	1, 97	0.955	0.000
	Levene's test	0.95	3, 98	0.421	
EDE-Q	Overvaluation	6.00	1, 97	0.016*	0.058
Restriction	Presence of BED	0.58	1, 97	0.450	0.006
	Overvaluation × BED	0.85	1, 97	0.771	0.001
	Age	0.84	1, 97	0.361	0.009
	Levene's test	0.70	3, 98	0.557	
EDE-Q	Overvaluation	22.94	1, 97	<0.001**	0.191
Corrected weight	Presence of BED	6.84	1, 97	0.010**	0.066
Concern	Overvaluation × BED	3.08	1, 97	0.082	0.031
	Age	1.07	1, 97	0.303	0.011
	Levene's test	0.56	3, 98	0.643	
EDE-Q	Overvaluation	9.18	1, 97	0.003**	0.086
Eating	Presence of BED	36.16	1, 97	<0.001**	0.272
Concern	Overvaluation × BED	0.63	1, 97	0.429	0.006
	Age	0.25	1, 97	0.615	0.003
	Levene's test	2.57	3, 98	0.059	
EEQ	Overvaluation	13.52	1, 97	<0.001**	0.122
	Presence of BED	71.84	1, 97	<0.001**	0.425
	Overvaluation × BED	0.94	1, 97	0.335	0.010
	Age	1.03	1, 97	0.312	0.011
	Levene's test	2.45	3, 98	0.068	
Body dissatisfaction	Overvaluation	4.72	1, 97	0.032*	0.046
	Presence of BED	0.05	1, 97	0.830	0.000
	Overvaluation × BED	0.11	1, 97	0.741	0.001
	Age	0.12	1, 97	0.733	0.001
	Levene's test	0.80	3, 98	0.497	

*Significant to the level 0.05. **Significant to the level 0.013.

results indicate that global eating symptomatology, as well as specific concerns about weight, eating and emotional eating, are explained by overvaluation and by BED independently. On the one hand, this confirms previous findings regarding the increased psychopathological severity of people with BED and overvaluation, compared to those with BED but who do not exhibit overvaluation (Harrison et al., 2016; Kenny and Carter, 2018). In addition, this study has provided evidence of the importance of assessing the overvaluation of weight and shape in people with obesity without BED since even in these cases, it is associated with a risk of experiencing symptoms of EDs (Sonnevile et al., 2015).

In addition, we found a trend regarding food restriction which appeared to be higher in the groups that overvalued weight and shape, regardless of the presence of BED. This is important since, as Fairburn

et al. (2003) pointed out, restriction is a relevant factor in the emergence of binge eating, and being part of the core psychopathology of EDs. In other words, restriction is associated with EDs, regardless of the specific diagnosis, and is also associated with overvaluation of weight and shape, even in obese patients without eating disorders. At this point, it is important to highlight that although restriction is not a diagnostic criterion for BED, and is even an aspect to consider in the differential diagnosis with BN, there is evidence that people with BED engage in constant attempts at dieting, behavior based on food restriction. In a recent study based on interviews with experts, a consensus was reached that food restriction is a common behavior in BED, whether voluntary or imposed by a third party (such as a health professional) (Bray et al., 2023).

Regarding emotional eating and food craving, these variables were higher in those who overvalued weight and shape, as well as in those who presented BED, which coincides with previous findings (Harrison et al., 2016; Verzijl et al., 2018), thus corroborating the importance of considering these variables in the presence of overvaluation.

As for the symptomatology of anxiety, depression, and stress, they are not explained by overvaluation, although a trend in depression and anxiety regarding the presence of BED is detected, being greater in those with the eating disorder, as found by Klatzkin et al. (2015).

On the other hand, in the cognitive structure, the polarization of weight was explained by overvaluation and not by BED. This implies that people with obesity or overweight and who overestimate the importance of their weight and shape have a more dichotomous way of thinking concerning their weight and that of others compared to those who do not overestimate. So, for such people, there are only two extreme positions: being “fat” or “thin.” Therefore, it can be hypothesized that when they are in the “fat” pole, the “thin” pole is perceived as distant, an unattainable goal for them. This result goes in line with the contributions of Alberts et al. (2012) pointing out that dichotomous thinking is important in EDs. However, the findings of this study indicate that in the case of people with obesity (or overweight), dichotomous thinking is important only with a particular type of content of thought, the weight, which is linked to the presence of an overestimation of the importance of weight and shape. This finding is aligned with the contributions of Palascha et al. (2015) indicating that dichotomous thinking about food and diet is associated with diet stiffness behaviors, making it difficult to maintain adequate body weight.

The results of this study suggest that cognitive structure in obesity is also explained by the presence of BED, but in this case, it seems to be the implicative dilemmas that take on importance since they occur in greater numbers in those who have BED, regardless of overvaluation. That is, those who have BED tend to present more conflicted cognitive systems, which coincides with what is observed in samples with different psychopathological profiles (Montesano et al., 2015; Escandón-Nagel et al., 2018). However, more studies are needed to confirm this finding regarding BED.

As for the construction of self, it was also the presence of BED that best explained the differences. Specifically, the variable self-ideal discrepancy was higher in those who presented BED than those who did not present BED, regardless of overvaluation. This indicates that those who have obesity and BED show more damaged self-esteem than those who have only obesity, which is in line with previous literature (Bulik et al., 2002; Herbozo et al., 2015).

TABLE 5 Nonparametric group comparison analysis in EDE-Q corrected shape concern and FCI-SP.

Variable	Groups		<i>U</i>	<i>Z</i>	<i>p</i>	<i>r</i>
EDE-Q corrected shape concern	OB	BED	116.50	−2.92	0.004**	0.29
		BEDOVE	117.00	−5.49	<0.001**	0.54
		OBOVE	95.50	−4.46	<0.001**	0.44
	BED	BEDOVE	165.5	−1.83	0.067	0.18
		OBOVE	130.00	−0.89	0.375	0.09
	BEDOVE	OBOVE	283.00	−1.13	0.257	0.11
FCI-SP	OB	BED	107.00	−3.13	0.002**	0.31
		BEDOVE	245.00	−3.84	<0.001**	0.38
		OBOVE	244.00	−1.82	0.069	0.18
	BED	BEDOVE	242.00	−0.12	0.903	0.01
		OBOVE	82.00	−2.43	0.015*	0.24
	BEDOVE	OBOVE	198.00	−2.64	0.008**	0.26

OB, group without BED and without overvaluation; OBOVE, group without BED and with overvaluation; BED, group with BED without overvaluation; BEDOVE, group with BED and overvaluation. *Significant to the level 0.05; **Significant to the level 0.008.

TABLE 6 Descriptive statistics for measures of self-construction and cognitive structure.

	With overvaluation		Without overvaluation	
	Presence of BED		Presence of BED	
	Yes (<i>n</i> = 33)	No (<i>n</i> = 21)	Yes (<i>n</i> = 15)	No (<i>n</i> = 33)
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
Self-ideal discrepancy	0.39 (0.11)	0.31 (0.11)	0.35 (0.10)	0.28 (0.10)
Self perceived social isolation	0.29 (0.07)	0.26 (0.06)	0.28 (0.06)	0.25 (0.06)
Perceived adequacy in others	0.25 (0.07)	0.23 (0.06)	0.24 (0.06)	0.22 (0.05)
Actual weight perception	1.33 (0.60)	1.61 (0.80)	1.53 (0.83)	1.79 (0.78)
Ideal weight perception	5.27 (1.28)	5.52 (1.25)	4.67 (1.40)	5.12 (1.08)
Total polarization	29.35 (12.72)	35.05 (16.09)	33.41 (16.72)	34.44 (19.30)
Weight polarization	30.83 (18.07)	27.48 (18.97)	20.34 (12.00)	17.30 (15.35)
Implicative dilemmas	11.25 (15.08)	7.94 (17.98)	22.81 (29.83)	5.51 (10.11)
Dilemmatic constructs	22.28 (16.32)	15.39 (17.55)	13.04 (12.23)	13.73 (11.55)

The measures employed in this study, based on Personal Construct Theory, have allowed the recognition of important aspects of personal identity, which have distinguished individuals with obesity with and without BED. Regarding weight polarization, it complements the existing literature on polarized or dichotomous thinking in EDs, recognizing the importance of dichotomous thinking regarding one’s own weight and/or that of others.

The main limitation of this study is the difference in the sample size of the subgroups since the BED and OBOVE groups are smaller in comparison to the rest. In addition, there is generally a low representation of men in the sample.

The methodological limitations of this study should be taken into account when analyzing the results, since it is a cross-sectional study that, by its nature, does not allow establishing causal relationships. This implies that it is not possible to determine from these data whether the overvaluation of weight and shape is at the basis of the symptomatology studied or whether it is a consequence of it.

For future research, it would be important to analyze whether these findings apply to men with overweight or obesity. Also, considering that BED can occur in people with normal weight, it would be interesting to investigate the role of overvaluation of weight and shape in such cases.

Previous research has shown that overvaluation of weight and shape acts as a moderator of the relationship between self-esteem and internalization of weight stigma in people with obesity and BED (Pearl et al., 2014). This relationship is associated with negative health outcomes, such as a significant presence of obesogenic behaviors (Puhl and Lessard, 2020). Therefore, it would be interesting for future research to analyze in depth the role of overvaluation in terms of weight stigma, not only in people with obesity and binge eating but also in those who do not present BED.

The results of this study also provide evidence of the overlap between obesity and eating disorders. Although they are different phenomena, the evidence shows that there are some elements that are common to both. As observed in the present study, there is a subgroup

TABLE 7 Comparative analysis of self-construction.

Variable	Comparison	<i>F</i>	d.f	<i>p</i>	η^2
Discrepancy ideal-self	Overvaluation	1.46	1, 97	0.230	0.015
	Presence of BED	10.52	1, 97	0.002**	0.098
	Overvaluation × BED	0.01	1, 97	0.911	0.000
	Age	0.73	1, 97	0.394	0.008
	Levene's test	0.08	3, 98	0.969	
Self perceived social isolation	Overvaluation	0.31	1, 97	0.581	0.003
	Presence of BED	3.89	1, 97	0.051	0.039
	Overvaluation × BED	0.03	1, 97	0.860	0.000
	Age	0.47	1, 97	0.494	0.004
	Levene's test	0.30	3, 98	0.826	
Perceived adequacy in others	Overvaluation	1.25	1, 97	0.267	0.013
	Presence of BED	1.75	1, 97	0.189	0.018
	Sobrevaloración × BED	0.16	1, 97	0.686	0.002
	Age	0.00	1, 97	0.999	0.000
	Levene's test	0.34	3, 98	0.796	
Actual weight perception	Overvaluation	1.70	1, 97	0.195	0.017
	Presence of BED	3.30	1, 97	0.073	0.033
	Overvaluation × BED	0.00	1, 97	0.974	0.000
	Age	0.51	1, 97	0.478	0.005
	Levene's test	1.22	3, 98	0.307	
Ideal weight perception	Overvaluation	3.66	1, 97	0.059	0.036
	Presence of BED	1.83	1, 97	0.179	0.019
	Overvaluation × BED	0.15	1, 97	0.696	0.002
	Age	0.00	1, 97	0.998	0.000
	Levene's test	1.14	3, 98	0.336	

*Significant to the level.05. **Significant to the level 0.013.

TABLE 8 Comparative analysis of cognitive structure.

Variable	Comparison	<i>F</i>	d.f	<i>p</i>	η^2
Polarization	Overvaluation	0.00	1, 97	0.999	0.000
	Presence of BED	1.30	1, 97	0.257	0.013
	Overvaluation × BED	1.16	1, 97	0.285	0.012
	Age	1.17	1, 97	0.283	0.012
	Levene's test	1.90	3, 98	0.135	
Weight polarization	Overvaluation	8.87	1, 97	0.004**	0.084
	Presence of BED	0.91	1, 97	0.343	0.009
	Overvaluation × BED	0.00	1, 97	0.996	0.000
	Age	0.18	1, 97	0.676	0.002
	Levene's test	2.00	3, 98	0.119	
Percentage of dilemmatic constructs	Overvaluation	2.24	1, 97	0.138	0.023
	Presence of BED	0.73	1, 97	0.396	0.007
	Overvaluation × BED	1.86	1, 97	0.176	0.011
	Age	1.80	1, 97	0.183	0.018
	Levine's test	1.26	3, 98	0.292	

*Significant at the level 0.05. **Significant at the level 0.013.

TABLE 9 Nonparametric group comparison analysis in implicative dilemmas.

Variable	Groups		U	Z	p	r
Implicative dilemmas	OB	BED	143.50	−2.55	0.011*	0.252
		BEDOVE	395.00	−2.07	0.038*	0.204
		OBOVE	335.50	−0.23	0.819	0.023
	BED	BEDOVE	197.5	−1.14	0.253	0.113
		OBOVE	96.50	−2.09	0.036*	0.207
	BEDOVE	OBOVE	260.50	−1.62	0.105	0.160

OB, group without BED and without overvaluation; OBOVE, group without BED and with overvaluation; BED, group with BED without overvaluation; BEDOVE, group with BED and overvaluation. *Significant at the level 0.05; **Significant at the level 0.008.

of individuals with obesity who also exhibit an overvaluation of weight and shape. Along the same lines, research such as that of [Breton et al. \(2022\)](#) emphasizes that an interdisciplinary approach is essential to achieve a better understanding of these phenomena and the elements that are common to both.

We expected that the presence of overvaluation of weight and shape would be associated with more psychopathological symptoms, as well higher discrepancies in self-construction, higher polarization, and a higher percentage of implicative dilemmas and dilemmatic constructs. This hypothesis was partially confirmed, since the overvaluation was indeed associated with eating psychopathology, but not with anxiety, depression, or stress. Regarding cognitive structure, overvaluation was associated with a greater polarization of weight, while self-construction did not explain the presence of overvaluation, although it was linked to the presence of BED, as it was found for other EDs (e.g., [Feixas et al., 2010](#); [Dada, 2014](#)).

The results of this study highlight the importance of weight and shape overvaluation in the evaluation and treatment not only of people with BED but also of those with overweight-obesity without an ED. The interest in this variable is justified not only by its influence on symptomatology but also by the cognitive structure that underpins personal identity.

This study recognizes the importance of weight polarization, dietary restriction, and emotional eating, concerning overvaluation. In future research, it would be relevant, then, to investigate the role that these variables have regarding the development of an ED such as BED.

All this provides possible focuses of action in terms of intervention, suggesting investigation and targeting of the overvaluation of weight and shape be conducted as early as possible, particularly in patients with obesity or overweight who do not manifest a diagnosis of BED.

5 Conclusion

Overvaluation of weight and shape is considered an important part of EDs like anorexia and bulimia, but not of BED. Also, there has been little research on what role this variable plays in people with overweight or obesity. In our sample of people with overweight or obesity we studied the role of the presence of BED and/or overvaluation, finding that the latter was associated with higher eating symptomatology not only in people with BED but also in obesity in general. Overvaluation of weight and shape seems to be a factor related to the severity of BED. In addition, overvaluation in people with obesity or overweight (not the presence of BED) was associated with higher polarization of ratings of weight for the self and others. For future research, it would be interesting to evaluate whether, in the long

term, people with obesity and without BED, who at some point present overvaluation of weight and shape, will eventually develop an ED.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by The Bioethics Commission of the University of Barcelona (IRB00003099). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

NE-N: Writing – original draft, Project administration, Methodology, Formal analysis, Conceptualization. MP: Writing – review & editing, Project administration, Methodology, Formal analysis. AG: Writing – review & editing, Resources, Investigation. JS: Writing – review & editing, Resources, Investigation. GF: Writing – review & editing, Project administration, Methodology, Conceptualization.

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Conflict of interest

AG was employed by ITA Salud Mental, Clariane. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Metacognition as a transdiagnostic factor across eating disorders: a latent profile analysis study

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Background: Metacognition is a crucial aspect of understanding and attributing mental states, playing a key role in the psychopathology of eating disorders (EDs). This study aims to explore the diverse clinical profiles of metacognition among patients with EDs using latent profile analysis (LPA).

Method: A total of 395 patients with a DSM-5 diagnosis of ED (116 AN-R, 30 AN/BP, 100 BN, 149 BED) participated in this study. They completed self-report measures assessing metacognition, eating psychopathology, depression, emotional dysregulation, personality traits, and childhood adversities. LPA and Welch ANOVAs were conducted to identify profiles based on metacognition scores and examine psychological differences between them. Logistic regression models were employed to explore associations between personal characteristics and different profiles.

Results: A 3-class solution had a good fit to the data, revealing profiles of high functioning (HF), intermediate functioning (IF), and low functioning (LF) based on levels of metacognitive impairments. Participants in the IF group were older and had a higher BMI than those in the HF and LF groups. Individuals with BN were largely categorized into HF and LF profiles, whereas participants with BED were mainly included in the IF profile. Participants in the LF group reported an impaired psychological profile, with high levels of depression, emotional dysregulation, childhood adversity, and personality dysfunction. Multinomial logistic regression analyses showed significant associations between metacognitive profiles and emotional and neglect abuse, emotion dysregulation, and detachment.

Conclusion: This exploratory study unveils distinct metacognitive profiles in EDs, providing a foundation for future research and targeted interventions. In this light, metacognitive interpersonal therapy could be a valid and effective treatment for EDs, as suggested by the initial promising results for these patients.

KEYWORDS

eating disorders, metacognition, latent profile analysis, targeted intervention, childhood maltreatment, personality traits, emotional dysregulation, depression

1 Introduction

Metacognition is a psychological construct that significantly contributes to recognizing and attributing mental states to oneself and others. It involves reflecting and analyzing mental states, ultimately utilizing this awareness to navigate interpersonal conflicts (Semerari et al., 2003). According to this framework, metacognition consists of five distinct sub-functions that interact and can be compromised individually: monitoring, integration, differentiation, understanding others' mind/decentration, and mastery.

Monitoring involves identifying and defining our mental states, encompassing thoughts, emotions, desires, and motivations. Integration pertains to the general ability to reflect on various mental states, identifying internal conflicts and contradictions. Poor differentiation prevents individuals from maintaining a critical distance from their subjective mental representations. Understanding others' minds refers to the ability to formulate plausible hypotheses about their mental states, and decentration is the use of that ability to adopt a non-egocentric perspective. Lastly, mastery involves employing psychological information about mental states to address problems of escalating complexity and is connected to activities focused on regulation and control (Semerari et al., 2007, 2012; Carcione et al., 2011).

Researchers and clinicians have theoretically suggested the presence of specific metacognitive failures in patients with eating disorders (EDs) (Olstad et al., 2015; Simonsen et al., 2020). Eating disorders are challenging to treat, and there is still a need to identify psychological mechanisms associated with disordered eating patterns that may serve as important targets for therapeutic interventions. The capacity to monitor, interpret, and regulate mental states is a crucial factor influencing emotion regulation processes related to eating behaviors (Vann et al., 2014; Leppanen et al., 2022). Moreover, research has shown that individuals with adverse childhood experiences are at increased risk for developing emotion dysregulation and eating problems (Michopoulos et al., 2015). While emotion dysregulation has been identified as a mediator between childhood trauma and eating psychopathology (Moulton et al., 2015), it remains unclear whether various patterns of metacognitive functioning are associated with emotional dysregulation and childhood trauma experiences in patients with EDs (Martin and Strodl, 2023).

It is noteworthy that the few existing studies on metacognition in patients with EDs mainly focused on individuals with anorexia nervosa (AN) and bulimia nervosa (BN) (Rothschild-Yakar et al., 2018, 2019; Sacchetti et al., 2019; Kjaersdam Tell us et al., 2023), whereas patients with binge eating disorder (BED) received little attention from researchers (Simonsen et al., 2020). Recently, two studies have investigated the role of metacognition in the severity of binge eating and as a possible treatment target in this population. The first study supported the idea that low self-monitoring metacognition and high negative urgency lead to a worsening of binge severity through the mediation of emotional dysregulation (Aloi et al., 2020); a network analysis study, on the other hand, reported that impaired self-monitoring metacognition and difficulties in impulse control were central nodes in the psychopathological network of BED, while eating symptoms appearing marginal (Aloi et al., 2021).

Although the link between metacognition and EDs has received some empirical support, there is still a need for a greater understanding of heterogeneity in their presentations. In this framework, latent profile

analysis (LPA) may represent a suitable approach to better identify and describe the profile of individuals characterized by specific patterns of metacognition (Gibson, 1959; Lazarsfeld and Henry, 1968). LPA serves as a useful technique for conducting person-centered analyses, distinct from variable-centered approaches. Specifically, LPA is a statistical method involving continuous variables (i.e., indicators) to identify hidden subgroups within a population (i.e., latent profiles) using specific variables. This approach operates on the assumption that individuals can be categorized with differing probabilities into various profiles or groups (Williams and Kibowski, 2016).

To the best of our knowledge, LPA has been employed in only a study with patients with EDs to investigate metacognition patterns (Gagliardini et al., 2020). However, the authors used the Mentalization Imbalances Scale (MIS) (Gagliardini et al., 2018), a measure of mentalizing imbalances based on six subscales according to the model proposed by Fonagy and colleagues (Bateman and Fonagy, 2004, 2016; Luyten et al., 2012). In this study, four different profiles of impairments in the dimension of mentalizing were identified. These profiles were heterogeneous in EDs represented in each group and showed notable distinctions across multiple factors such as attachment style, emotion dysregulation, empathy, interpersonal reactivity, and reflective function (Gagliardini et al., 2020).

Metacognition and mentalization are two constructs with some overlap, both referring to the ability of human beings to reflect and reason about their own and others' mental states, and both attributing a multidimensional nature to these functions (Semerari et al., 2003; Bateman and Fonagy, 2016). Some differences emerge in the definition of metacognition, which includes the ability to use psychological information to cope with distress and interpersonal problems (i.e., metacognitive mastery), with dysfunctions in this area correlated with specific psychopathology profiles (Carcione et al., 2011). Furthermore, unlike mentalization, metacognition does not presuppose activation of the attachment system as the main source of disorders (Dimaggio et al., 2007). In this framework, the DSM-5 emphasizes the importance of reflective abilities. According to the alternative model of personality disorder (AMPD) of Section III, diagnosing a personality disorder requires assessing an individual's personality functioning, which includes their ability to (1) self-reflect, thereby fostering a stable sense of self and self-direction, and (2) understand others' perspectives to establish and maintain empathetic and healthy relationships (American Psychiatric Association, 2013).

Building on these previous findings, the present study specifically investigates the role of metacognition according to the model proposed by Semerari and colleagues (Semerari et al., 2007; Carcione et al., 2021). This model suggests that the measurement of this construct includes different and relatively independent sub-functions that could be impaired in several psychiatric disorders (Semerari et al., 2015; Carcione et al., 2019; Aloi et al., 2023).

The primary objective of this study was to explore the metacognition profiles that can be detected in patients with EDs, based on the metacognition sub-functions. The secondary aim was to investigate how these empirically derived metacognitive profiles are associated with some clinical, personality, and ED-related factors. Specifically, we examined whether patients belonging to the different metacognition profiles differ in the levels of childhood maltreatment (CM), negative affectivity, and emotion dysregulation, given the previous evidence that supported their interplay with metacognition

and dysfunctional eating (Moulton et al., 2015; Martin and Strodl, 2023). Finally, we investigated which psychological characteristics are associated with the different profiles. Due to the exploratory nature of the present study and the limited existing literature, no specific hypotheses about these metacognitive profiles were formulated.

2 Methods

2.1 Participants

Participants eligible for inclusion were selected among those seeking care in the Outpatient Unit for Clinical Research and Treatment of Eating Disorders at the University Hospital “Renato Dulbecco” of Catanzaro (Italy) between June 2018 and June 2023. They were consecutively recruited during their initial visit for participation in this cross-sectional study and the aim and the description of the research were presented by the research team. To be included, patients needed to be aged between 14 and 65, diagnosed with an ED according to DSM-5 criteria (American Psychiatric Association, 2013), willing to take part, and able to provide valid informed consent. Exclusion criteria included comorbidity with severe psychiatric diagnoses (e.g., neurodevelopmental, schizophrenia spectrum, bipolar disorders, neurocognitive disorders), neurological or medical conditions (e.g., diabetes), active substance dependence or abuse (within ≤ 6 months), and other medical comorbidities or treatments that could influence eating behaviors.

Each participant underwent a diagnostic interview conducted by experienced psychiatrists through the Structured Clinical Interview for the DSM-5 (SCID-5-CV) (First, 2016) and the Eating Disorder Examination (EDE 17.0D) (Calugi et al., 2015). Afterward, participants were asked to complete self-report questionnaires aimed at assessing psychological aspects such as metacognition, depression, emotional dysregulation, childhood trauma, and personality traits.

Out of the 413 patients initially approached for the study, 18 were excluded during the screening or enrollment phase for the following reasons: five patients (1.2%) were not eligible due to active substance use disorder; five (1.2%) dropped out before the end of the assessment and were thus excluded from the study; four (1.0%) met the exclusion criteria for intellectual disability, and four (1.0%) were not eligible due to psychotic symptoms. Consequently, the final sample consisted of 395 patients ($N = 116$ AN-R, $N = 30$ AN/BP, $N = 100$ BN, $N = 149$ BED) with a dropout rate of 4.4%.

Only the patients who accepted to participate in the research protocol, provided informed consent, and completed the evaluation were included in the analysis. No missing data were reported in the participants' socio-demographic information or in the assessment. This study adhered to the ethical principles outlined in the updated Helsinki Declaration (World Medical Association, 2013) and received approval from the Ethical Committee of “Regione Calabria, Sezione Area Centro” (identifier: Prot. 66/15.03.2018). Before completing the questionnaires, participants provided written informed consent. For minors, consent was acquired from their parents or legal tutors after providing detailed information.

2.2 Measures

- **Eating Disorder Examination (EDE):** This clinical interview assesses eating psychopathology's presence and severity across four subscales using 28 items: Eating Restraint, Eating Concern, Weight Concern, and Shape Concern, contributing to a global EDE score (Calugi et al., 2015). This semi-structured interview delves into ED-related behaviors and psychopathology within the preceding 3 months. It examines behavioral symptoms associated with EDs, such as binge eating, self-induced vomiting, diuretic and laxative misuse, excessive exercise, and food restriction. Elevated scores signify a heightened severity of psychopathology. For this study, we only took into consideration the EDE total score; the total McDonald's ω was 0.88.
- **Beck Depression Inventory-II (BDI-II):** This instrument measures the severity of depression through 21 items (Ghisi et al., 2006). Higher scores indicate more severe symptoms. Scores fall into these standardized categories: 0–13: minimal depression; 14–19: mild depression; 20–28: moderate depression; 29–63: severe depression. The reliability index, measured by McDonald's ω , was 0.90.
- **Metacognition Self-Assessment Scale (MSAS):** This self-report questionnaire (Pedone et al., 2017) evaluates metacognitive functioning through 18 Likert-type response format items. Lower scores indicate impaired self-evaluation of metacognitive abilities across four domains: self-monitoring, critical distance (differentiation/decentration), mastery, and understanding others' minds. McDonald's ω internal consistency ranged from 0.83 (Mastery) to 0.92 (Self-monitoring) in this study.
- **Difficulties in Emotion Regulation Scale (DERS):** Comprising 36 items, the DERS (Giromini et al., 2012) evaluates emotion dysregulation across six subscales. The total score reflects overall problems in emotional regulation. In this study, the McDonald's ω internal consistency coefficient for the total score was 0.88.
- **Personality Inventory for DSM-5 (PID-5):** This 220-item self-administered scale (Fossati et al., 2013) measures 25 personality traits grouped into five domains: negative affectivity, detachment, antagonism, disinhibition, and psychoticism. Participants rate items on a Likert scale. Higher scores are indicative of higher dysfunction in specific personality facets or domains. Internal consistency in this sample for the domains ranged from McDonald's ω 0.84 (Negative affectivity) to 0.91 (Detachment).
- **Childhood Trauma Questionnaire Short-Form (CTQ-SF):** It is a self-administered test comprising 28 Likert-scale items measuring CM across five subscales (Innamorati et al., 2016). In the present study, internal consistency measured through McDonald's omega ranged as follows: physical abuse 0.83; emotional abuse 0.89; sexual abuse 0.85; emotional neglect 0.92 and physical neglect 0.83.

2.3 Statistical analyses

Analyses were carried out with SPSS Version 26.0 and R Version 4.0.0 using the *tidyLPA* package (Rosenberg et al., 2018).

To establish the number of profiles within the sample, various models ranging from one to five profiles were assessed using

information statistical criteria such as Consistent Akaike's Information Criteria (cAIC), Bayesian Information Criteria (BIC), sample size-adjusted BIC (saBIC), and approximate weight of evidence criterion (AWE). Lower values of these indices indicate better predictive accuracy.

The accuracy of participant classification was evaluated using standardized entropy (ranging from 0 to 1), where values exceeding 0.80 suggest strong group differentiation (Ramaswamy et al., 1993).

Regarding sample size, there is no definitive recommendation for the minimum sample size in LPA. However, previous research suggests that a range of $N \sim 300$ –1,000 tends to offer reliable fit indices for mixture models (Nylund-Gibson and Choi, 2018). The sample size in this study ($N = 395$) was considered adequate for the exploratory latent profile.

To empirically distinguish profiles linked to metacognition impairments in individuals with EDs, we conducted an LPA based on their scores across the four subscales of the MSAS.

Following the identification of an LPA solution, individuals were assigned to a class based on their most likely class membership. In case of departure from the homoscedasticity assumption, Welch ANOVA, followed by Dunnett T3 *post hoc* tests, was employed to identify differences among the empirically derived profiles in the self-reported measures. We also reported the eta-squared (η^2), as a measure of the effect size of ANOVA.

Finally, scores were transformed into z-scores and a series of univariate multinomial logistic regressions were employed to explore relationships between profile memberships and the variables of interest (i.e., ED psychopathology, depression, childhood adversities, personality traits, emotion dysregulation).

Statistical significance was defined at $p < 0.05$.

3 Results

3.1 Latent profile analysis

The 3-class solution emerged as the most balanced option, considering the statistics used for evaluating model fit comparisons.

Notably, the elbow plot showed a more pronounced change in information criteria between the 2-profile and 3-profile models (Figure 1). Overall, the three-class model seemed to fit the data best. This model exhibited the lowest AIC, cAIC, BIC, saBIC, and AWE values. Furthermore, the three-class model displayed the highest entropy (0.80), signifying a strong distinction between profiles (Ramaswamy et al., 1993).

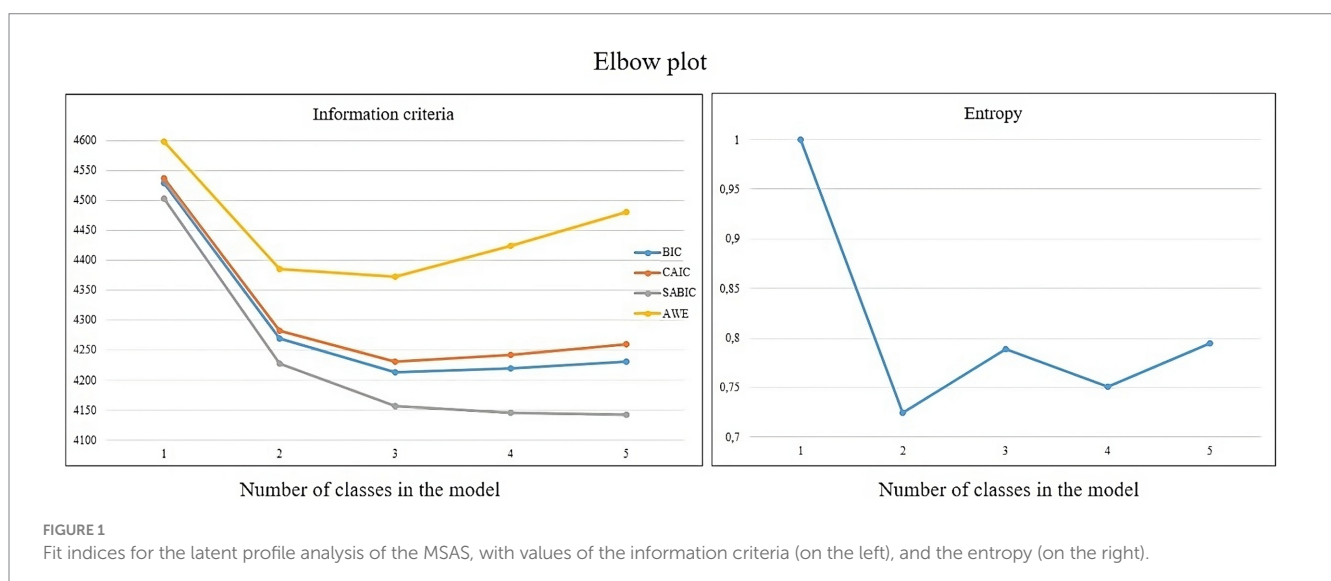
This solution yielded a baseline class with high functioning (HF) according to the MSAS scores, including 191 (48.3%) participants. Members of this HF class reported high scores on each metacognition MSAS domain. A second class including 176 (44.5%) participants showed an intermediate functioning (IF) profile, characterized by moderate levels of understanding of others' mind domain, which was close to those of the HF class. In contrast, the self-monitoring was different from the HF group. A third profile including 28 participants (7.2%) showed a low MSAS functioning (LF), characterized by the worst scores in MSAS domains. Figure 2 illustrates the standardized group averages on MSAS subscales for the three-profile solution.

Table 1 reassumes the characteristics of the total sample and each MSAS profile, including demographic features. Most participants were females, had completed middle and high school, and were single. Differences were found in age and BMI, with those in the IF profile reporting higher scores than those in the HF and LF profiles. Regarding BMI, the mean and SD for each diagnosis are as follows: AN-R ($M = 17.5 \pm 2.5$ SD), AN-BP ($M = 19.1 \pm 2.5$ SD), BN ($M = 23.8 \pm 5.3$ SD) and BED ($M = 38.8 \pm 8.2$ SD).

Table 2 displays the distribution of participants within the three profiles. Based on the LPA analyses, individuals with BN mainly belonged to the LF and HF profiles. Nearly half of the participants with BED were included in the IF profile.

3.2 Comparison of psychopathological variables between the three profiles

Table 3 shows the mean scores and comparisons between the three profiles on the EDE, BDI-II, DERS, PID-5, and CTQ-SF. Both the LF and IF profiles reported greater depressive



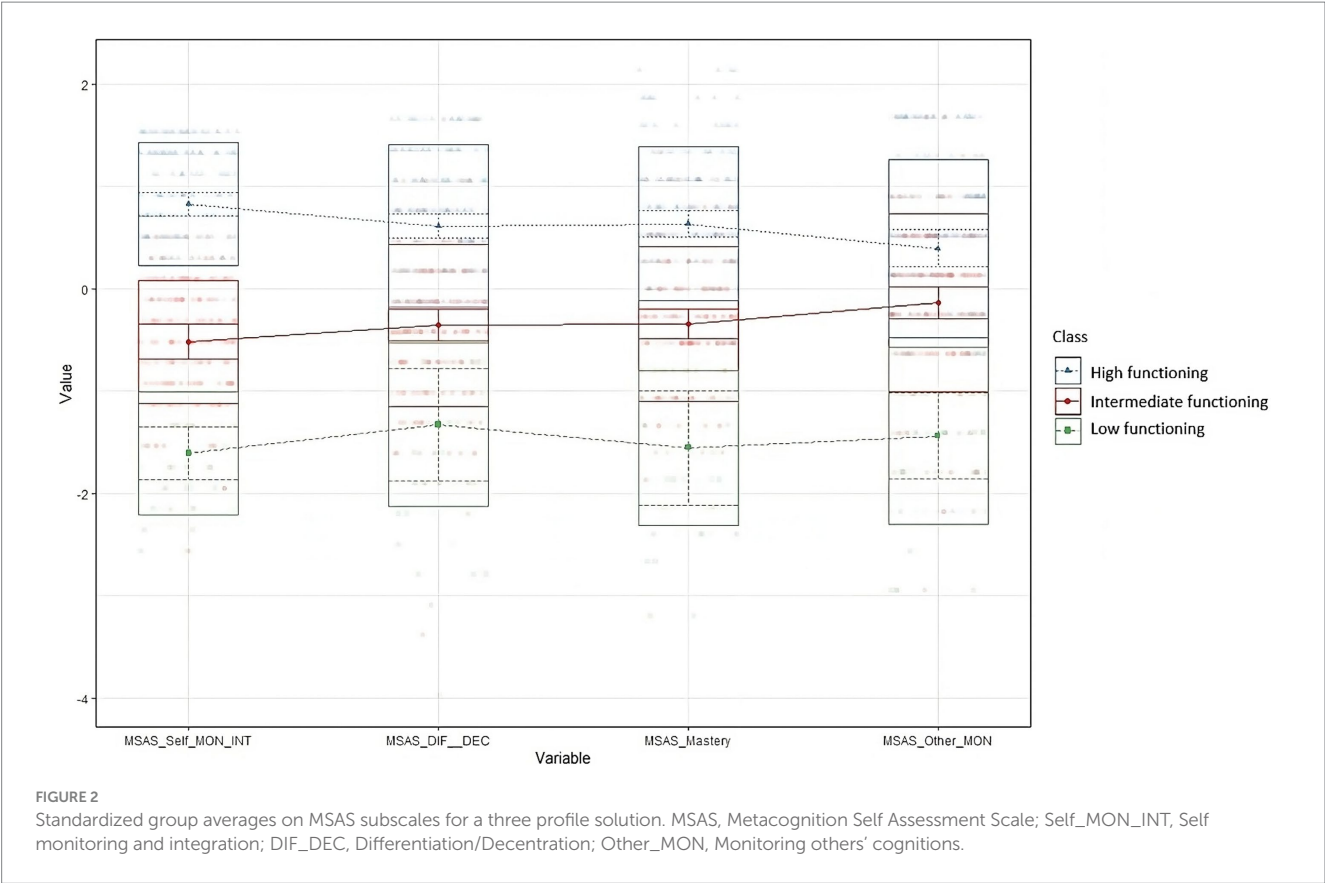


TABLE 1 Characteristics of the total sample and by latent profiles.

		Total sample	Low-functioning (LF)	Intermediate functioning (IF)	High-functioning (HF)			
		<i>N</i> = 395	<i>n</i> = 28	<i>n</i> = 176	<i>n</i> = 191	χ^2/df	<i>p</i>	Post hoc
Age ^a		27.5 (13.6)	23.5 (13.2)	31.1 (14.3)	24.7 (12.3)	11.185	<0.001	IF > HF, LF
Sex	Female	366 (92.7)	27 (92.7)	164 (93.2)	175 (91.6)	0.957	0.620	
	Male	29 (7.3)	1 (3.6)	12 (6.8)	16 (8.4)			
Body mass index ^a		27.4 (11.1)	23.2 (6.6)	30.2 (12.5)	25.1 (9.3)	10.691	<0.001	IF > HF, LF
Civil status	Married	102 (25.8)	4 (14.3)	52 (29.5)	46 (24.1)	7.094	0.131	
	Single	283 (71.6)	24 (85.7)	117 (66.5)	142 (74.3)			
	Divorced	10 (2.5)	0 (0.0)	7 (4.0)	3 (1.6)			
Education	Elementary	6 (1.5)	2 (7.1)	1 (0.6)	3 (1.6)	34.847	<0.001	
	Middle school	170 (43.0)	15 (53.6)	55 (31.3)	100 (52.4)			
	High school	171 (43.3)	10 (35.7)	85 (48.3)	76 (39.8)			
	Master	48 (12.2)	1 (3.6)	35 (19.9)	12 (6.3)			

^aData are expressed as means and standard deviation.

symptoms and higher scores on four domains of PID-5 (i.e., negative affectivity, antagonism, disinhibition, and psychoticism) compared to the HF profile. The LF group reported the most severe scores on CM (i.e., emotional abuse and neglect, and physical neglect), emotion dysregulation, and the detachment domains of PID-5.

TABLE 2 The frequencies of eating disorder diagnosis across the three profiles.

	Low-functioning	Intermediate-functioning	High-functioning	Frequencies
AN-R	6 (21.4)	53 (30.1)	57 (29.8)	116
AN-BP	4 (14.3)	11 (6.3)	15 (7.9)	30
BN	11 (39.3)	25 (14.2)	64 (33.5)	100
BED	7 (25)	87 (49.4)	55 (28.8)	149
Total	28 (100)	176 (100)	191 (100)	395

Data are presented as frequencies (%) AN-R, Anorexia nervosa – restricting type; AN-BP, Anorexia nervosa – binge/purge type; BN, Bulimia nervosa; BED, Binge eating disorder.

TABLE 3 Clinical characteristics of the total sample and by latent profiles.

		High-functioning (HF)		Intermediate-functioning (IF)		Low-functioning (LF)		<i>F</i>	Sig.	η^{2a}	Dunnett T3
		Mean	SD	Mean	SD	Mean	SD				
EDE	Total score	3.5	1.4	4.2	1.1	4.0	1.8	11.203	<0.001	0.06	IF > HF
BDI-II	Total score	23.8	12.5	31.8	13.2	38.0	11.8	17.935	<0.001	0.12	LF, IF > HF
DERS	Total score	91.2	26.0	119.9	25.0	142.0	27.8	74.710	<0.001	0.30	LF > IF, HF; IF > HF
PID-5	Negative affectivity	1.2	0.4	1.7	0.4	1.9	0.4	49.713	<0.001	0.23	LF, IF > HF
	Detachment	1.1	0.5	1.5	0.5	1.9	0.5	47.008	<0.001	0.23	LF > IF, HF; IF > HF
	Antagonism	0.7	0.4	0.9	0.5	1.1	0.5	16.412	<0.001	0.10	LF, IF > HF
	Disinhibition	0.9	0.4	1.3	0.4	1.6	0.5	40.874	<0.001	0.22	LF, IF > HF
	Psychoticism	0.7	0.5	1.2	0.6	1.5	0.7	37.284	<0.001	0.20	LF, IF > HF
CTQ-SF	Emotional abuse	8.9	4.0	9.7	4.8	13.3	5.7	7.045	0.002	0.06	LF > IF, HF
	Physical abuse	5.9	2.1	6.2	2.6	6.8	3.3	1.368	0.262		
	Sexual abuse	6.7	4.0	6.2	3.4	7.0	4.6	0.616	0.543		
	Emotional neglect	9.4	4.6	11.0	4.6	14.8	5.4	13.472	<0.001	0.10	LF > IF, HF; IF > HF
	Physical neglect	6.2	2.3	6.4	1.9	7.9	3.2	3.219	0.047	0.04	LF > HF

*Only effect sizes of significant differences are displayed. Results in bold are statistically significant.
EDE, Eating disorder examination; BDI-II, Beck depression inventory – II; DERS, Difficulties in emotion regulation scale; PID-5, Personality inventory for DSM-5; CTQ-SF, Childhood trauma questionnaire – short form.

3.3 Association between group membership and psychopathological variables

Finally, a series of univariate multinomial logistic regressions were run to evaluate the associations between group membership and the variables of interest (Table 4), while controlling for their shared variance. High emotional abuse, low emotion dysregulation, and low emotional neglect were associated with the HF profile of metacognition. Moreover, individuals with greater negative affectivity, emotional neglect, and physical abuse, had higher odds of reporting an IF profile of metacognition. Lastly, for those with high emotion dysregulation and detachment, the odds of reporting an LF profile of metacognition were higher.

4 Discussion

The current research aimed to explore different profiles of metacognition across the EDs spectrum using LPA. For this purpose, we conducted a study where various models were assessed using goodness-of-fit statistics, and participant classification accuracy was evaluated using standardized entropy. Subsequently, differences among the derived profiles were examined using Welch ANOVA, followed by *post hoc* tests, and logistic regression models were employed to explore relationships between profile memberships and relevant variables.

A 3-class model emerged for the metacognition domains: “low,” “intermediate,” and “high” functioning. Nearly half of the participants showed high metacognitive functioning, whereas 44.5% of participants showed intermediate metacognitive functioning.

TABLE 4 Associations between group membership and psychopathological variables.

		High-functioning	Intermediate-functioning	Low-functioning
		OR (95% CI)	OR (95% CI)	OR (95% CI)
zEDE	Total	0.758 (0.470–1.222)	1.404 (0.892–2.210)	0.810 (0.308–2.128)
zBDI-II	Total	1.227 (0.699–2.151)	0.957 (0.581–1.577)	0.661 (0.226–1.937)
zDERS	Total	0.410 (0.206–0.818)*	1.358 (0.737–2.503)	9.227 (2.022–42.111)**
zPID-5	Negative affectivity	0.518 (0.235–1.142)	2.781 (1.370–5.647)**	0.523 (0.135–2.024)
	Detachment	1.353 (0.690–2.651)	458 (0.251–0.837)*	4.569 (1.348–15.488)*
	Antagonism	1.084 (0.650–1.808)	0.971 (0.634–1.485)	1.238 (0.627–2.444)
	Disinhibition	0.744 (0.357–1.552)	1.192 (0.635–2.236)	0.706 (0.241–2.067)
	Psychoticism	0.653 (0.338–1.261)	1.385 (0.786–2.438)	0.997 (0.407–2.445)
zCTQ	Emotional abuse	2.275 (1.210–4.278)*	0.367 (0.208–0.645)***	1.109 (0.928–1.325)
	Emotional neglect	0.453 (0.245–0.837)*	1.923 (1.104–3.348)*	0.995 (0.839–1.181)
	Physical neglect	1.494 (0.940–2.375)	0.632 (0.407–0.983)*	1.200 (0.879–1.637)
	Physical abuse	0.639 (0.346–1.180)	1.754 (1.030–2.985)*	0.790 (0.550–1.134)
	Sexual abuse	1.185 (0.761–1.846)	0.283 (0.802–0.535)	1.116 (0.925–1.347)
R ² di Nagelkerke		0.445	0.305	0.491

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Results in bold are statistically significant.

z, Standardized scores; EDE, Eating disorder examination; BDI-II, Beck depression inventory – II; DERS, Difficulties in emotion regulation scale; PID-5, Personality inventory for DSM-5; CTQ-SF, Childhood trauma questionnaire – short form; OR, odds ratio.

Only 7.2% of patients reported low metacognitive functioning. Overall, the present findings support the detection of group heterogeneity in metacognitive functioning among patients with EDs (Rothschild-Yakar et al., 2019; Aloi et al., 2021; Kjaersdam Telléus et al., 2023). Moreover, our findings suggest that the different metacognition profiles are heterogeneous concerning EDs, consistent with previous research (Gagliardini et al., 2020). Specifically, the LF class comprised mostly patients with BN (39%), whereas the IF class included mostly patients with BED (49%). The HF class was the most heterogeneous in terms of diagnostic categories (30% AN-R, 33% BN, and 29% BED). It is worth noting that a trend of increasing severity in all the psychopathological variables (i.e., eating psychopathology, depressive symptoms, emotional dysregulation, dysfunctional personality traits, and CM) was consistently reported across the different profiles of metacognition (LF > IF > HF). Thus, the current findings support the study hypothesis that metacognition may be a transdiagnostic feature across the ED spectrum.

The most striking result of the current study was the association between group membership and psychopathological variables according to the three latent profiles. Interestingly, when partialling out the variance shared by the other CTQ variables, emotional neglect was more strongly associated with the IF profile, while emotional abuse was more strongly associated with the HF profile. There is increasing evidence that childhood emotional abuse is the trauma most associated with disordered eating in adulthood (Michopoulos et al., 2015; Strodl and Wylie, 2020). Our findings add that patients who experienced emotional abuse had higher odds of high metacognitive functioning compared to other groups, when controlling for other forms of abuse and neglect. Therefore, it appears that emotional abuse has the least impact on the metacognitive functioning of individuals with EDs. Further research is necessary to examine whether abusive behaviors, such as constant swearing,

yelling, criticism, unrealistic expectations, or unreasonable demands on the child, contribute to the development of mature metacognition among patients with EDs. On the other hand, emotional neglect, characterized by a failure to attend to the child's emotional needs, may represent a risk factor for developing moderate metacognitive function, especially among patients with BED. Prior research suggested higher levels of emotional neglect than obese patients without BED (Amianto et al., 2018). Thus, further research is needed to examine the link between adverse life experiences during childhood and metacognitive functioning in patients with BED. Interestingly, sexual abuse was not associated with any of the three classes. This result is in contrast with previous literature reporting a high prevalence of sexual abuse among EDs (Afifi et al., 2017) and that a history of sexual abuse could predict poor long-term outcomes (Eielsen et al., 2024). However, the relationship between childhood sexual abuse and eating disorder among adults still requires clarification of the pathways and examination of maladaptive coping responses, with consideration for metacognition patterns. A possible explanation for these mixed findings could be related to the nature of the classes, as the three empirically derived groups were categorized on metacognition features and not according to eating psychopathology. Prior research has also highlighted that the large time gap between childhood sexual trauma and present eating behaviors can convolute total effects (Becker and Grilo, 2011).

Another important finding highlighted in this investigation was the association between detachment PID-5 domain and emotional dysregulation with membership in the LF group. The detachment domain refers to the individual tendency to withdraw emotionally and avoid close interpersonal relations. This result is not surprising, given that few studies have investigated personality traits according to the PID-5 in EDs. Additionally, a recent study found that the facets of anhedonia and depression (traits of the Detachment domain) were strongly associated with all three dimensions of well-being (i.e.,

emotional, psychological, and social) in patients with EDs (de Vos et al., 2022). In this vein, several studies have demonstrated that patients with EDs reported a pattern of distancing themselves from others, often driven by a desire to protect themselves from potential emotional distress or interpersonal conflicts (Lo Coco et al., 2012; Segura-García et al., 2013; Brugnera et al., 2018; Sivyer et al., 2020; Cassioli et al., 2022; Harris et al., 2023). This interpersonal issue could stem from an impaired metacognition function, specifically the deceleration/differentiation subfunction. In fact, this subfunction, which involves the ability to understand others' thoughts, generate plausible hypotheses about their mental states, and adopt a perspective that is not centered on oneself, is often impaired in several clinical conditions (Semerari et al., 2015; MacBeth et al., 2016; Riccardi et al., 2020; Aloi et al., 2023).

Finally, theoretical frameworks on metacognition have proposed a strong connection between the capacity for metacognitive function and the regulation of emotional states (Euler et al., 2021). Metacognition is considered a crucial process in influencing and adjusting emotional regulation (Rossi et al., 2023), with the roots of this connection believed to be established in early attachment relationships. However, from a psychological perspective, some important differences exist between them. In particular, prior research provided backing for the idea that the capacity for metacognitive functioning might serve as a prerequisite for emotion regulation. This association has been previously linked to increased utilization of adaptive strategies and a reduction in the application of maladaptive emotion regulation strategies (Schwarzer et al., 2021).

4.1 Strengths and limitations

The present study is the first attempt to verify whether metacognition, according to the model of Semerari and colleagues (Semerari et al., 2007), can represent a transdiagnostic construct in patients with EDs. It is essential to highlight the inclusion of a large clinical sample comprising both males and females. Notably, the sample exhibits homogeneous frequencies of the main psychopathological diagnoses (i.e., AN, BN, BED), in contrast to previous literature that primarily focuses on female patients with AN and BN. Nonetheless, this work is not without limitations. First, we recognize that this study is exploratory, indicating that certain classes may have a limited number of participants (e.g., the LF group, constituting 7.2% of the total sample). Consequently, it is essential for future studies to cross-validate these findings. However, a rule of thumb is that if the profile includes <1.0% of the total sample size or fewer than 25 cases, the profile should be rejected (Lubke and Neale, 2006; Spurk et al., 2020).

Additionally, this study did not explore diagnoses of personality disorders, which could have offered valuable insights into clinically significant distinctions between the profiles. Hence, the absence of such an investigation may constrain the generalizability of the findings.

Another limitation was the reliance on self-reported data, which may have introduced biases. Furthermore, this research does not include any information about gender identity and sexual orientation, which may hinder the generalizability of the findings to patients with EDs who fall within these sexual minoritized groups. Finally, the cross-sectional design of the study hinders our ability to establish causality and examine the relationships between metacognition and psychopathological variables. With this in mind, further investigation regarding the stability of these latent profiles over time is warranted.

5 Conclusion

Present results underscore the significance of considering a metacognitive function in the spectrum of eating disorders. The current data appear helpful both for diagnostic purposes and also for clinicians who deliver psychological interventions. Evaluating metacognition could aid clinicians and researchers in tailoring psychological interventions more precisely. This method allows for active involvement with patients who have a shared mental disorder, but varying levels of metacognitive skills. On the opposite, it also facilitates communication with patients who have different diagnoses, but who share similar challenges in their metacognitive abilities. Our study suggests that patients with EDs can be classified based on impairments in various dimensions of metacognition, regardless of their specific ED diagnosis. Further, it also recommends that clinicians should consider a multidimensional approach to metacognition when treating ED patients. Future studies should investigate whether the three different identified profiles also correspond to different treatment outcomes, given the initial promising results that metacognitive interpersonal therapy seems to show in the treatment of EDs (Fioravanti et al., 2023).

Data availability statement

Raw data supporting the results of the present study will be made available upon reasonable request from the corresponding author.

Ethics statement

The studies involving humans were approved by Ethical Committee of "Regione Calabria, Sezione Area Centro" (identifier: Prot. 66/15.03.2018). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

MA: Conceptualization, Data curation, Methodology, Writing – original draft, Writing – review & editing. AC: Writing – original draft, Writing – review & editing. GL: Writing – original draft, Writing – review & editing. MR: Data curation, Writing – review & editing. EC: Data curation, Writing – review & editing. RF: Data curation, Writing – review & editing. CS-G: Supervision, Writing – review & editing. ML: Methodology, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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