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The Irrational Food Beliefs Scale: Validation of the Italian Version in Patients with Obesity

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Abstract

The Irrational Food Beliefs Scale (IFBS) is a self-report questionnaire comprising 57 items, 41 of which in the irrational food beliefs subscale, assessing cognitive distortions and inappropriate attitudes and beliefs about food. This study aimed to propose the Italian version of the IFBS and examine its psychometric properties. The tool was translated into Italian and administered to 503 Italian-speaking patients with obesity and 45 healthy controls. The clinical group also completed the Eating Disorder Examination (EDE) interview, and the Symptom Checklist-90 (SCL-90). Principal factor analysis identified that 51.6% of the variance was accounted for by six factors, which we termed 'self-deception on eating and weight control', 'beliefs about eating and emotion regulation', 'low tolerance for eating control', 'beliefs about eating and hedonic pleasure', 'beliefs about dieting', and 'all-or-nothing thinking about eating.' The IFBS global and subscale scores were partially correlated with eating-disorder and general psychopathology. Significantly higher scores were found in patients with obesity and binge-eating disorder than in those with obesity without binge-eating disorder. Overall, the study demonstrated the good psychometric properties of the Italian version of the IFBS and validated its use in Italian-speaking patients with obesity.

Keywords Obesity · Validity · Psychometric characteristics · Factor structure · Cognitive mechanisms

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Introduction

The growing prevalence of obesity is a serious health problem for adults, children, and adolescents alike (Engin, 2017). Indeed, it negatively affects the quality of life, and is associated with several noncommunicable diseases (Malnick & Knobler, 2006), particularly cardiovascular diseases (Ortega et al., 2016), type 2 diabetes mellitus (Duclos, 2016), obstructive sleep apnoea (Lee & Cho, 2022), osteoarthritis (Duclos, 2016) and certain types of cancers (Renehan et al., 2008).

Obesity treatment via lifestyle modification is effective in producing a healthy weight loss in the short term, with completers achieving a mean weight loss of 8–10% of their initial body weight within roughly 30 weeks (Wadden & Butryn, 2003). However, by 5 years post-treatment, 50% or more patients are likely to have returned to their baseline weight (Wadden et al., 1989).

It is widely accepted that the driving force behind weight regain is the biological pressure on individuals to overeat to restore their original weight (Keesey & Hirvonen, 1997). However, data from the Look AHEAD study showed that a large number of individuals with obesity overcome the biological pressures to regain weight, maintaining a significant weight loss in the long-term through lifestyle modification (Look AHEAD Research Group, 2014). If biological pressures are not entirely to blame, therefore, it is conceivable that some cognitive mechanisms interacting with specific changes in diet and physical activity may play a pivotal role in the success or failure of weight management. Nevertheless, cognitive factors have largely been overlooked in traditional weight-loss lifestyle modification programmes, which could be one of the main reasons for their limited effectiveness in promoting long-term weight loss (Cooper & Fairburn, 2001).

A large Italian study, including a total of 1944 treatment-seeking patients with obesity in "real-world" settings, represented by 25 medical centres authorized to treat obesity by the Italian National Health Service, has assessed the role of some cognitive factors in the obesity treatment response (Melchionda et al., 2003). It identified several cognitive factors associated with treatment discontinuation, namely higher weight-loss expectations, appearance-based primary motivation for weight loss, and unsatisfactory progress. Other cognitive factors have been associated with either the amount of weight lost, i.e., increased dietary restraint and reduced disinhibition, or long-term weight-loss maintenance in patients who discontinued treatment, specifically, satisfaction with results achieved, and confidence in being able to lose weight without professional help (Dalle Grave et al., 2014). However, many other specific dysfunctional cognitive factors remain to be investigated, as they may play a key role in maintaining poor eating habits and creating an obstacle to obesity treatment.

To this end, the Irrational Food Beliefs Scale (IFBS) (Osberg et al., 2008) was developed. It is designed to analyse cognitive distortions and inappropriate attitudes and beliefs about food. The authors postulated that individuals who endorse many irrational food beliefs could be more likely to fail at weight control efforts when compared to individuals not prone to such beliefs. This construct was extrapolated from Ellis's more general construct of irrational beliefs (Ellis, 1962, 1993), posited to underlie people's dysfunctional emotions—the crux of his widely practiced Rational Emotive Behavior Therapy.

The IFBS has demonstrated adequate psychometric properties, and factor analysis highlighted two factors, corresponding to the irrational food beliefs subscale (Cronbach's alpha 0.89) and the rational food beliefs subscale (Cronbach's alpha 0.70), respectively. Of the 57 items on the IFBS, 41 are on the irrational food beliefs subscale and 16 on the rational food beliefs subscale.

The original study found no differences between men and women in terms of subscale scores. A Spanish version was validated in a non-clinical sample, demonstrating adequate internal consistency and construct validity (Jáuregui Lobera & Bolaños, 2010). However, in Italy, an instrument investigating specific irrational food beliefs is lacking. Therefore, our study aimed to evaluate the psychometric properties of the Italian version of the IFBS in a sample of patients seeking obesity treatment in a real-world clinical setting.

We hypothesized that this instrument had good internal consistency in its Italian version, in patients with obesity. We also postulated that the factor analysis could aggregate items describing specific dysfunctional cognitive factors about eating. Finally, we did not expect differences between patients with or without obesity on IFBS scores.

Methods

Participants and Procedure

The clinical sample comprised all patients consecutively admitted between January 2021 and May 2022 to the Villa Garda Hospital Department of Eating and Weight Disorders who met the following criteria: (i) body mass index (BMI) ≥ 30 kg/m^2; and (ii) residential treatment, a choice dictated by a global score >25 on the Comprehensive Appropriateness Scale for the Care of Obesity in Rehabilitation (CASCO-R) scale (Donini et al., 2014). The inclusion criteria to be eligible for the study were (i) age ≥ 18 and ≤ 75 years; (ii) signed informed consent. Patients were excluded from the study if they had medical comorbidities and/or were taking drugs influencing body weight. Patients with more than 20% of missing IFBS data were also excluded from the final sample (n = 7).

A healthy control group was recruited from various settings in the general population. Subjects were excluded from the control group if they scored ≥ 20 on the Eating Attitudes Test-26 (EAT-26) and/or if there was a suspicion or diagnosis of an eating disorder, i.e., an affirmative answer to one or both of the following two questions: "Do you currently have an eating disorder?" and/or "Are you attending a treatment for eating disorders?" and/or "Are you currently on a weight loss diet?" (n = 6).

This observational study design was reviewed and approved by the Verona and Rovigo Ethics Committee (project identification code 8571). All participants gave informed written consent for the use of their anonymized personal information.

Assessment and Measures

Measured body weight and height, appropriateness of residential treatment, eating disorder psychopathology and behaviours, and general psychiatric features were recorded on a case report form on the first day of admission to the intensive residential treatment unit.

Body Weight and Height

Body weight was measured on a calibrated scale (Seca digital wheelchair scale Model 664, Hamburg, Germany) at baseline, with patients wearing no shoes and only lightweight clothing. Height was measured at baseline using a stadiometer (Wunder wall-mounted mechanical height rod Model 00051 A, Milan, Italy). BMI was calculated via the standard formula, i.e., bodyweight in kilograms divided by height in metres squared.

Appropriateness of Residential Treatment

The appropriateness of residential treatment was assessed using the CASCO-R scale, which was jointly developed by the Italian Society of Obesity (SIO) and the Italian Society for the Study of Eating Disorders (SISDCA) to assess the suitability of different settings of care in Italy (i.e., residential rehabilitation, intensive outpatient rehabilitation, or outpatient treatment). The scale comprises four sections: (i) body mass index (BMI) and waist circumference; (ii) comorbidities associated with obesity; (iii) risk factors potentially increasing obesity-related morbidity; and (iv) previous hospitalization for metabolic/nutritional rehabilitation. Each item is assigned a score (with negative scores for one or more hospital stays in nutritional rehabilitation units), and a global score of >25 indicates a condition of severe obesity that would benefit from residential treatment. The global CASCO-R score is significantly correlated with both overall workload and adverse clinical event measures and has excellent internal validity and test–retest reliability (Donini et al., 2014).

Eating Disorder Examination Interview (EDE 17.0D)

The EDE (Calugi et al., 2015; Fairburn et al., 2008) is a semi-structured interview for assessing eating-disorder psychopathology and behaviours in the 28 days prior. It comprises 22 items across four subscales ('restraint', 'eating concern', 'shape concern', and 'weight concern'), all rated on a 7-point Likert scale. The EDE was also used to generate operational eating disorder diagnoses, with reference to the Diagnostic and Statistical Manual of mental disorders 5 (DSM-5) criteria and employing a 3-month timeframe. The EDE was administered by assessors trained and supervised by RDG, an expert on the instrument. For the purposes of this study, specific EDE items were also used to assess for the presence of binge-eating disorder (BED) and the overvaluation of shape and weight. Overvaluation of shape and weight was measured using the following two specific items from the EDE: "Over the past four weeks, has your shape influenced how you feel about (judge/think/evaluate) yourself

as a person?“, and “Over the past four weeks, has your weight influenced how you feel about (judge/think/evaluate) yourself as a person?“. In line with indications by Fairburn and Cooper (1993), the clinical overvaluation group comprised individuals who reported a score ≥ 4 on either or both overvaluation items.

Symptom Checklist-90 (SCL-90-R)

The SCL-90-R (Derogatis, 1994; Prunas et al., 2012) is a self-report questionnaire that evaluates general psychopathology over the preceding week. The questionnaire comprises 90 items, and each item is rated on a 5-point Likert scale (0–4), ranging from “not at all” to “extremely”. Nine subscales are also calculated: somatization, obsessive compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism.

Eating Attitudes Test-26 (EAT-26)

The EAT-26 (Dotti & Lazzari, 1998; Garner et al., 1982) is a questionnaire that investigates eating disorder symptoms and related concerns. The questionnaire comprises 26 items, each rated on a 6-point Likert scale ranging from “always” to “never”. A score ≥ 20 indicates a situation to be carefully assessed by a therapist and was used a cut-off for inclusion/exclusion in the control group.

Irrational Food Beliefs Scale (IFBS)

The IFBS (Osberg et al., 2008) was developed to assess cognitive distortions and inappropriate attitudes or beliefs about food. Subjects respond on a 4-point Likert scale ranging from “strongly disagree” to “strongly agree”. The IFBS consists of two subscales, one comprising 41 items that investigate irrational beliefs associated with food (Irrational Subscale), while the other 16 items investigate. rational beliefs (Rational Subscale), making a total of 57 items. For the purposes of this study, however, only the irrational food beliefs subscale was administered, as the rational food beliefs subscale includes items that, although consistent with the recommendations in Dietary Guidelines for Americans 2005 (U.S. Department of Health and Human Services and U.S. Department of Agriculture, January 2005), differ substantially from the recent Italian Dietary Guidelines (Rossi et al., 2022).

This scale was originally constructed in English and has previously been validated in Spanish. This study involved the construction of an Italian version of the IFBS, which was developed by conducting a translation and back-translation procedure from the original English version. Specifically, the translation process unfolded as follows: (1) initial translation into Italian by a bilingual person; (2) back translation into English by a bilingual person; (3) discussion by investigator team members to identify any discrepancies and settle any inconsistencies; and (4) final approval by investigators.

Statistical Analysis

Statistical analysis was conducted using IBM SPSS Statistics 27.0 (SPSS, Chicago, USA). Specifically, baseline demographic and clinical characteristics of the sample and control groups were calculated, and are presented as mean and standard deviation, while gender is expressed in terms of frequency and percentage. Then, construct validity was assessed by applying principal axis factoring (PAF) with oblique rotation (hypothesizing that identified factors would be correlated) and Kaiser normalization (Tabachnick & Fidell, 2013) to the responses of patients with obesity to the 41 IFBS items, rated along the Likert scale. In line with the recommendations on factor analysis (Gorsuch, 1983), the total number of questionnaires to administer was calculated in advance to ensure a satisfactory subject-to-item ratio (10:1). Moreover, sampling adequacy was assessed via Kaiser-Meier-Olkin (KMO) analysis and Bartlett's test of sphericity (KMO > 0.60) (Kaiser, 1974). Specifically, the number of factors to be extracted was determined by: (i) examining the scree plot; (ii) using components with an eigenvalue > 1; and (iii) assessing their interpretability and consistency with the hypotheses used to develop the tool. Items with factor loadings lower than 0.30 were eliminated so that only items related to the factor were included (Stevens, 1992, 1996). Item–total correlations were also examined for each factor.

Internal consistency was assessed via Cronbach's alpha, and convergent and discriminant validity via Pearson's correlation, comparing IFBS with SCL-90-R and EDE global and subscale scores. Criterion validity was then tested using a t-test for independent samples, comparing IFBS scores for the sample with obesity with those of healthy controls. Furthermore, we compared IFBS scores in patients with obesity with and without binge-eating disorders and with and without overvaluation of shape and weight. Finally, the same comparison was performed controlling for age and gender.

Results

The clinical sample (n = 503) comprised 63.8% females, the mean age was 53.9 (SD = 13.8) years, and the mean BMI was 41.7 (SD = 9.1) kg/m^2. The control group comprised 45 subjects, 61.4% of whom were female, with mean age 48.9 (SD = 12.3) years and a mean BMI of 24.1 (SD = 2.7) kg/m^2. Patients with obesity had significantly higher age and BMI than the control group (age: $t = 2.36$, $p = 0.018$; BMI: $t = 32.43$, $p < 0.001$); however, the difference in the proportion of females between the two groups was not significant.

Construct Validity

A correlation between factors potentially obtainable from factor analysis was assumed, and a PAF with oblique rotation was performed. The KMO was 0.92, and Bartlett's sphericity test yielded a significant result ($p < 0.001$), indicating that the data was suitable for factor analysis. The best solution was obtained using Promax rotation, and six factors were extracted that, together, accounted for 51.6% of the

items' variance. As shown in Tables 1, the first factor identified was that which we termed 'self-deception on eating and weight control,' which comprised 14 items; the second was 'beliefs about eating and emotion regulation', with 8 items; the third was 'low tolerance for eating control', with 7 items; the fourth 'beliefs about eating and hedonic pleasure', with 4 items; the fifth 'beliefs about dieting' with 3 items; and the sixth 'all-or-nothing thinking about eating', with 5 items. All items showed a moderate to high item–factor correlation (ranging from 0.25 to 0.61). The global score for each subscale was obtained by adding the items.

Reliability

Cronbach's alpha for the global score was 0.93, and for the six factors it was, respectively: 0.88 for 'self-deception on eating and weight control', 0.87 for 'beliefs about eating and emotion regulation', 0.82 for 'low tolerance for eating control', 0.75 for 'beliefs about eating and hedonic pleasure', 0.67 for 'beliefs about dieting', and 0.60 for 'all-or-nothing thinking about eating'. Intraclass correlation indicated a coefficient of 0.90 for the global score, 0.87 for 'self-deception on eating and weight control', 0.85 for 'beliefs about eating and emotion regulation', 0.79 for 'low tolerance for eating control', 0.73 for 'beliefs about eating and hedonic pleasure', 0.65 for 'beliefs about dieting', and 0.58 for 'all-or-nothing thinking'.

Relationship Between IFBS and Eating-Disorder and General Psychopathology

As shown in Table 2, IFBS global and 'beliefs about eating and emotion regulation' and 'low tolerance for eating control' scores were highly correlated with EDE and SCL-90-R global and subscale scores, except for EDE 'restraint', which was not correlated with either global or subscale IFBS scores. Weak, modest associations were found between the remaining IFBS factors, namely 'self-deception on eating and weight control', 'beliefs about eating and hedonic pleasure', 'beliefs about dieting', and 'all-or-nothing thinking about eating', and both EDE and SCL-90 global and subscale scores. There was no relationship found between IFBS global or subscale scores and BMI.

Group Mean Comparison

The t-test for independent samples was used to compare IFBS global and subscale scores in patients with obesity versus healthy controls. Data indicated that patients with obesity had higher scores on IFBS 'low tolerance for eating control' and 'all-or-nothing thinking about eating', and lower scores on IFBS ' beliefs about eating and hedonic pleasure' than healthy controls (Table 3). No significant differences were found between the two groups for the other three IFBS factors and the global score. Controlling the data for age and gender did not significantly alter the results.

Breaking the obesity group down, patients with obesity and binge-eating disorder displayed higher scores for global IFBS and 'beliefs about eating and emotion regulation', 'low tolerance for eating control', 'beliefs about eating and hedonic pleasure' and 'beliefs about dieting' subscales than patients with obesity but without binge-

eating disorder. Furthermore, patients with obesity and overvaluation of shape and weight displayed higher scores on the IFBS 'self-deception on eating and weight control', 'beliefs about eating and emotion regulation', and 'low tolerance for eating control' than patients with obesity without overvaluation of shape and weight scores. No other differences were found between the above subgroups. (Table 3).

Discussion

This study, which aimed to evaluate the psychometric proprieties of the Italian version of the IFBS in a large sample of patients with obesity, and to compare their scores with those of a healthy control sample, had four main findings. First, as regards IFBS construct validity, PAF indicated that the six-factor solution, accounting for 51.6% of the variance, was the best for patients with obesity. The six factors identified were those we termed 'self-deception on eating and weight control', 'beliefs about eating and emotion regulation', 'low tolerance for eating control', 'beliefs about eating and hedonic pleasure', 'beliefs about dieting', and 'all-or-nothing thinking about eating.' These factors have never previously been assessed, as previous studies investigating the psychometric proprieties of IFBS used rational and irrational food belief items as the only two factors in the instrument (Jáuregui Lobera & Bolaños, 2010; Osberg et al., 2008), whereas the "rational" items were omitted from this study as explained in the Methods.

Second, the six IFBS subscale and global scores demonstrated excellent internal consistency. This indicates that both IFBS global and subscale scores measure well-identified constructs. Moreover, these data confirm the original validation of the IFBS in both the college sample and the community sample with obesity (Osberg et al., 2008), as well as its Spanish version (Jáuregui Lobera & Bolaños, 2010).

Third, the convergent and discriminant validity of the tool indicated that IFBS global score and 'beliefs about eating and emotion regulation' and 'low tolerance for eating control' factor scores were highly correlated with both eating-disorder (except EDE 'restraint' subscale) and general psychopathology scores, indicating a relationship between some irrational thoughts about food, in particular those associated with emotions, with eating-disorder and general psychopathology. This is in line with the finding by Osberg and colleagues (Osberg et al., 2008) that in a sample of 96 participants with obesity and a history of weight control problems there was a positive correlation between IFBS global score and SCl-90 global and 'somatization', 'interpersonal sensitivity', 'depression', 'anxiety', 'phobic anxiety', and 'psychoticism' subscale scores, as well as self-reported symptoms of bulimia nervosa and anorexia nervosa.

Our data indicated that IFBS scores were unrelated to EDE 'restraint' subscale score and BMI. This finding contrasts with that by Osberg and colleagues (2008), who found that higher scores on the IFBS score were associated with greater current weight and higher dieting restraint scores in participants with obesity. We speculate that the discrepancy could be due to the different characteristics of the two samples; our sample comprised patients seeking obesity treatment, whereas Osberg and col-

Table 1 Results of principal component analysis with oblique rotation on responses from patients with obesity. Extraction method: principal axis factoring. Rotation method: promax with Kaiser normalization. Factor loadings lower than 0.30 were eliminated

Items	Factor 1 'Self-deception on eating and weight control'	Factor 2 'Beliefs about eating and emotion regulation'	Factor 3 'Low tolerance for eating control'	Factor 4 'Beliefs about eating and hedonic pleasure'	Factor 5 'Beliefs about dieting'	Factor 6 'All-or-nothing thinking about eating'
1. Food is a substitute source of comfort		**0.740**				
2. Some foods are able to relax you.		**0.792**				
4. I can't possibly live without my favorite food.		0.385	**0.415**			
6. My greatest pleasure in life is eating.		**0.541**			0.363	
7. Eating is a good way to overcome boredom.		**0.707**				
8. Exercise can undo the effects of a poor diet.					0.322	**0.348**
10. Food is a good way to lift depression.		**0.626**				
11. Social events are not as fun without food.				**0.334**		
13. If no one sees me eating something, the calories don't count.					**0.767**	
14. Only high fat foods taste good.					**0.596**	
15. The only way to diet is to crash diet.					**0.684**	
16. A good means of stress reduction is to eat.		**0.624**				
18. Some foods are irresistible.			**0.612**			
19. If something is fat free, you can eat as much as you want of it.					0.301	**0.486**
22. If you eat something you shouldn't, you should feel guilty.						**0.631**
23. There are some foods you can have in an unlimited amount and not gain weight.						**0.433**
25. I simply cannot control my weight because I love to eat.			**0.554**			
26. There are some foods over which I cannot control my intake.			**0.730**			
27. I must have sweets to exist.	0.360		**0.506**			
30. All social gatherings must be centered on food.	**0.680**					
31. Some foods are addictive.			**0.649**			
32. Food is my one pleasure, and I should not have to regulate my intake of it.	**0.529**					

Table 1 (continued)

Items	Factor 1 'Self-deception on eating and weight control'	Factor 2 'Beliefs about eating and emotion regulation'	Factor 3 'Low tolerance for eating control'	Factor 4 'Beliefs about eating and hedonic pleasure'	Factor 5 'Beliefs about dieting'	Factor 6 'All-or-nothing thinking about eating'
33. Food is a good substitute for sex.	**0.403**					
34. To hell with what's healthy, let me eat what I want.	**0.348**				0.333	
36. You won't gain weight for anything you eat before 8 p.m.	**0.827**					
37. If I exercise first, I can eat whatever I want.	**0.628**					
38. Being overweight is genetic, so why bother trying to lose weight?	**0.743**					
39. Foods like fruits and vegetables have no calories.	**0.540**					0.343
40. There are times when I NEED certain foods.			**0.712**			
42. You can drink as much fluid as you want and not gain weight.	**0.584**					
44. Happiness can be achieved through eating.		**0.368**				
45. You can eat as much as you want as long as it's low fat.	**0.372**					0.368
46. Once you eat something bad, you've blown your diet.						**0.603**
48. Because alcohol has no fat, it can't make you gain weight.	**0.704**		-0.300			
49. What a person eats really has no effect on their health.	**0.734**		-0.327			
50. It is punishment to have to eat certain foods like fruits and vegetables.	**0.436**		0.395			
51. To diet is to give up the pleasure of eating.				**0.791**		
52. Diet food is boring.				**0.905**		
54. Not being able to eat what you want will make you sad.				**0.639**		
55. Eating can help overcome loneliness.		**0.451**				
57. If you exercise, it doesn't matter what you eat.	**0.480**					

Table 3 Irrational Food Beliefs Scale global score and subscales in patients with obesity and healthy controls

Irrational Food Beliefs Scale (IFBS), mean (SD)	Patients with obesity (n=503)	Healthy controls (n=45)	t-test (*df*, p-value)	*ef*	Patients with obesity and BED (n=125)	Patients with obesity without BED (n=409)	t-test (*df*, p-value)	*ef*	Patients with obesity and OSW (n=154)	Patients with obesity without OSW (n=335)	t-test (*df*, p-value)	*ef*
Global score	81.5 (16.7)	79.7 (13.6)	0.73 (546; 0.468)	0.03	85.8 (16.5)	80.2 (16.1)	3.38 (532; <0.001)	0.14	83.1 (16.3)	81.1 (16.8)	1.29 (487; 0.199)	0.06
Factor 1 'Self-deception on eating and weight control'	21.9 (6.0)	22.8 (5.4)	0.94 (546; 0.346)	0.04	22.4 (5.4)	21.9 (6.1)	0.74 (232; 0.230)	0.05	21.1 (5.3)	22.4 (6.3)	2.31 (345; 0.022)	0.12
Factor 2 'Beliefs about eating and emotion regulation'	19.1 (5.1)	17.6 (4.9)	1.96 (546; 0.051)	0.08	20.6 (5.5)	18.6 (4.9)	3.94 (532; <0.001)	0.17	20.6 (5.4)	18.5 (4.9)	4.24 (487; <0.001)	0.19
Factor 3 'Low tolerance for eating control'	17.2 (4.4)	15.7 (4.0)	2.14 (546; 0.033)	0.09	18.1 (4.7)	16.8 (4.2)	2.98 (532; 0.001)	0.13	17.9 (4.4)	16.9 (4.3)	2.38 (487; 0.018)	0.11
Factor 4 'Beliefs about eating and hedonic pleasure'	8.4 (2.5)	9.3 (2.4)	2.28 (546; 0.023)	0.10	9.4 (2.7)	8.2 (2.4)	4.52 (532; <0.001)	0.19	8.6 (2.5)	8.3 (2.5)	0.96 (487; 0.336)	0.04
Factor 5 'Beliefs about dieting'	4.7 (1.7)	4.9 (1.2)	0.62 (546; 0.533)	0.03	5.1 (1.8)	4.6 (1.6)	2.98 (532; 0.003)	0.13	4.8 (1.8)	4.7 (1.7)	0.30 (487; 0.767)	0.03
Factor 6 'All-or-nothing thinking about eating'	10.2 (2.6)	9.4 (2.1)	1.98 (546; 0.048)	0.08	10.2 (2.5)	10.1 (2.6)	0.65; (532; 0.517)	0.03	10.2 (2.8)	10.2 (2.5)	0.14 (487; 0.891)	0.03

BED=binge-eating disorder; OSW=overvaluation of shape and weight; *df*=degree of freedom; *ef*=effect size (Cohen's *d*: Small=0.20; Medium=0.50; Large=0.80; Very large=1.20)

leagues' (2008) included individuals with a history of weight control problems but not in treatment for obesity.

Fourth, IFBS 'low tolerance for eating control', 'beliefs about eating and hedonic pleasure', and 'all-or-nothing thinking about eating' factors distinguished between patients with obesity and healthy controls, while global score and the other three factors identified did not. However, IFBS global and the other factor scores did distinguish between patients with obesity with or without binge-eating disorder, and partially so between patients with obesity with or without overvaluation of shape and weight.

The absence of significant differences in the IFBS global scores between patients with obesity and controls is not surprising because it would be simplistic to associate obesity with specific irrational thoughts about food. Indeed, there is growing evidence suggesting that obesity is a chronic, relapsing, progressive disease process that may arise from different causes, including altered environments, personal situations, and psychosocial factors, medications, diseases, trauma, iatrogenic procedures, as well as genetic and epigenetic variations (Bray et al., 2017). Our findings suggest that irrational food beliefs are more pronounced in the subgroup of patients with obesity and binge-eating disorder and are more related to some eating-disorder psychopathological features and overvaluation of shape and weight than body weight. In contrast, as found in our previous studies (Dalle Grave et al., 2014), cognitive factors may play a specific role in influencing the outcome of obesity treatment, although this link will need to be investigated further.

The present study has two main strengths. First, the large sample of patients with clinically severe obesity means that our results may be generalized to patients seeking obesity treatment. Second, the use of other assessment tools allowed us to investigate the relationship between IFBS and other baseline psychopathological features. However, the study itself does have some limitations. First, the results cannot be generalized to all individuals with obesity not seeking obesity treatment. Second, the low number of healthy controls could limit our conclusions. Third, the IFBS factor structure was determined via an exploratory method. Future studies should assess the performance of IFBS items via confirmatory factor analysis or item–response theory analysis. Finally, the relatively low internal consistency for Factors 5 and 6 could limit their interpretability.

That being said, the Italian version of the IFBS showed good internal consistency, construct validity, and convergent and discriminant validity in treatment-seeking patients with obesity.

Author Contribution All authors contributed to the study conception and design. Materials preparation, data collection and analysis were performed by Laura Dametti, Elena Bani, Chiara Tomasi, Anna Dalle Grave, Rossella Derrigo and Mirko Chimini. The first draft of the manuscript was written by Simona Calugi and Riccardo Dalle Grave, and all authors' comments were taken into account in the final version, which was read and approved by all authors.

Data Availability The datasets generated during and/or analysed during the current study are not available for public consultation, due the fact that they constitute an excerpt of research in progress. However, they are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest On behalf of all the authors, the corresponding author states that there is no conflict of interest.

Ethics Approval The protocol was approved by the Verona and Rovigo Ethics Committee (project identification code 8571). The study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments, or comparable ethical standards.

Consent to participate All participants provided informed written consent for the anonymous use of their data for research purposes.

Consent for publication Patients signed informed consent regarding publishing their data.

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