Zagaria *et al. BMC Psychology* (2024) 12:724
https://doi.org/10.1186/s40359-024-02179-6

BMC Psychology

RESEARCH Open Access

A psychometric examination of the cognitive flexibility scale and its association with Orthorexia Nervosa

Andrea Zagaria[1,2*], Monica D'Amico[1], Silvia Cerolini[1], Edoardo Mocini[3,4] and Caterina Lombardo[1]

Abstract

Background The Cognitive Flexibility Scale (CFS) is a 12-item self-report questionnaire designed to assess cognitive flexibility. Despite its widespread use, its psychometric properties have yet to be evaluated in the Italian context. Furthermore, while cognitive flexibility has emerged as a central correlate in Feeding and Eating Disorders, only a limited number of studies have investigated its association with Orthorexia Nervosa (ON), a clinical condition characterized by a pathological fixation with healthy eating. The present study aimed to fill these two knowledge gaps.

Methods A total of 803 participants (M_{age} = 33.89, SD = 9.44; 68.6% females) were enrolled in the investigation. The sample was randomly split into two subsamples: the first one for examining the psychometric properties of the CFS, and the second one for evaluating its association with ON symptoms. Participants completed self-report questionnaires assessing the constructs under investigation.

Results Confirmatory factor analysis revealed a global dimension of cognitive flexibility, alongside a method factor accounting for covariance arising by reverse-worded items. The CFS, which was factorially invariant across genders, yielded a reliable total score ($\omega = 0.834$) and provided evidence of convergent and criterion-related validity. Importantly, structural equation modelling showed that cognitive flexibility was negatively associated with emotional distress resulting from violations of orthorexic dietary rules (β = -0.279, $p < .001$).

Conclusions The CFS demonstrated to be a psychometrically robust instrument in the Italian context. Moreover, cognitive flexibility may be an important treatment target for mitigating the distress derived from ON symptoms, informing the development of future therapeutic approaches.

Keywords Orthorexia, Eating disorders, Psychometric properties, Cognitive flexibility, Risk factor, Protective factor

*Correspondence:
Andrea Zagaria
andrea.zagaria@uniroma2.it
[1]Department of Psychology, Sapienza University of Rome, Rome, Italy
[2]Department of Systems Medicine, Tor Vergata University of Rome, Rome, Italy
[3]Department of Experimental Medicine, Sapienza University of Rome, Rome, Italy
[4]Department of Theoretical and Applied Sciences, eCampus University, Novedrate, Italy

Introduction

Cognitive flexibility has been conceptualised and operationalised in several ways, primarily denoting the ability to adjust one's behaviour when confronting unpredicted situations, by choosing alternatives or changing plans (for an overview, refer to [1, 2]). More specifically, Martin and Rubin [3] operationalized cognitive flexibility as characterised by three components: (1) the ability to contemplate different available alternatives in various scenarios, (2) the willingness to act flexibly and adapt to the situation, and (3) one's self-efficacy in being flexible. These components have been synthesised in the Cognitive Flexibility Scale (CFS), a 12-item self-report questionnaire designed to measure cognitive flexibility under Martin and Rubin's [3] framework. The CFS has been widely employed in different cultural contexts, such as the USA [4], the United Kingdom [5], Australia [6], Japan [7], and Turkey [8]. However, despite its widespread use, there is currently no available psychometric evidence for the CFS within the Italian cultural context. Compared to other self-report measures available in the Italian context, such as the Cognitive Flexibility Inventory [9], the CFS offers a more focused assessment of cognitive flexibility, providing a single total score rather than multiple subscale scores that may not fully reflect a general dimension of cognitive flexibility. Additionally, the CFS, with its reduced number of items, presents the well-recognized advantages of brief scales, which are especially beneficial in community, clinical, and research settings where time or resources are constrained [10]. As suggested by Orgilès and colleagues [11], abbreviated versions of questionnaires are recommended for several reasons: (1) they eliminate repetitive and overlapping items, (2) reduce participant boredom from responding to similar questions, and (3) lessen participant fatigue.

Importantly, cognitive flexibility has been recognized as a fundamental aspect of mental health [2] and has been frequently conceived as the antithesis of rigidity [12]. Poor cognitive flexibility could lead to difficulties in different areas of functioning in everyday life [1], and it has been associated with different psychopathological conditions, including feeding and eating disorders (FED; e.g., [13]). FEDs are defined as pervasively impaired eating behaviours with consequent alterations of physical health and dysfunctions in psychosocial areas [14]. Individuals with FED such as Anorexia Nervosa (AN) or Bulimia Nervosa (BN) often apply (or attempt to apply) rigid rules about food and dieting and tend to resist change in therapy [15]. Numerous studies have investigated cognitive flexibility within the context of FED, with substantial evidence indicating significant impairment in cognitive flexibility among this population [13, 16, 17]. For instance, two recent studies by Miles and colleagues [18, 19] found that individuals with AN reported lower levels of cognitive flexibility and higher clinical perfectionism than the control group, and that eating disorder symptoms were significantly associated with self-reported cognitive flexibility. Additionally, cognitive flexibility has been shown to contribute to the maintenance of FED symptoms and treatment resistance [20, 21]. This suggests that deficits in cognitive flexibility may also play an active role in hindering therapeutic progress in individuals with dysfunctional eating behaviours.

Orthorexia Nervosa (ON), although not yet included in the Diagnostic and Statistical Manual of Mental Disorders Fifth ed. revised [14], has been defined as a clinical entity characterised by self-imposed rigid and inflexible rules about consuming healthy food, potentially leading to harmful consequences on both physical and mental health, as well as significant impairment in major life domains [22, 23]. According to a recent consensus conference involving 47 eating disorder researchers [22], ON could be considered a mental health disorder part of the FED spectrum. The consensus document corroborates previous meta-analytic evidence demonstrating a moderate overlap between ON and FED symptoms [24], which can be attributed to shared core features, including intense concerns about food, rigid dietary rules, the strong link between diet and self-esteem, and the social and health consequences (e.g., malnutrition, social isolation; [24, 25]). However, although some eating behaviours may overlap, ON appears to maintain its conceptual and empirical distinctiveness compared to other FEDs [22, 24]. The main difference lies in ON's emphasis on food quality rather than food quantity, along with its core preoccupations, which centre on avoiding foods perceived as unhealthy and overvaluing the effects of food quality on physical health [22, 24, 25]. In contrast, anorexia nervosa and bulimia nervosa primarily focus on concerns related to body shape and weight [22, 24, 25].

Given the central role of rigid and inflexible thinking patterns in ON and the broader FED cluster, it is plausible to hypothesise that cognitive inflexibility may be a core correlate of orthorexic symptoms. As an example, Coimbra and Ferreira [26] found that inflexible eating attitudes mediate the relationship between orthorexic behaviours and disordered eating. Expanding our understanding of the relationship between cognitive flexibility and ON could lay the groundwork for developing more specific and effective treatments, similar to those established for other FED. As a matter of fact, increasing cognitive flexibility in out-patients living with Anorexia Nervosa may improve eating and general symptomatology [27]. However, the research on this topic is still in its infancy and has yielded conflicting results (see [28] for a narrative review). For instance, Koven and Senbonmatsu [29] found a significant impairment in cognitive flexibility among students with a stronger interest in healthy eating, while a more recent investigation failed to replicate this association [30]. As such, additional studies are warranted to provide further clarification on this topic.

To fill the gaps above, the present study had a twofold aim: (1) to provide the first psychometric evidence for the CFS within the Italian cultural context by examining its dimensionality, measurement invariance across genders, internal consistency, and convergent and criterion-related validity; (2) to contribute to the ongoing debate on the correlates, risk and protective factors of ON by examining the relationship between cognitive flexibility, as indexed by the CFS, and orthorexic symptoms.

Methods

Procedure

Participants were recruited voluntarily through advertisements on social networks and within the university community, as well as by word of mouth. To be eligible for inclusion, participants had to be at least 18 years old and electronically provided an informed consent. Before completing the online survey hosted on the Qualtrics platform (www.qualtrics.com), participants were explicitly informed that there would be no form of compensation, that there were no right or wrong answers to the questions, and that all data would be treated confidentially and used exclusively for research purposes. The online survey required approximately fifteen minutes to complete. This study was funded by Sapienza University of Rome and was part of larger research projects focused on the assessment and correlates of orthorexic symptoms approved by the Institutional Review Board of the Department of Psychology and the Ethics Committee of Sapienza University of Rome.

Table 1 Socio-demographic characteristics of the sample

Variable	M (SD) / *N* (%)
Age	33.89 (9.44)
BMI	25.21 (5.71)
Gender	
Female	551 (68.6%)
Male	252 (31.4%)
Marital Status	
Single	246 (30.6%)
In a committed relationship	378 (47.1%)
Married	162 (20.2%)
Divorced	16 (2%)
Widowed	1 (0.1%)
Education	
Middle school diploma	14 (1.7%)
High school diploma	255 (31.8%)
Bachelor's degree	160 (19.9%)
Master's degree	271 (33.7%)
Postgraduate specialization	103 (12.8%)
Self-reported diagnosis of psychiatric disorders	
No	574 (71.5%)
Yes	229 (28.5%)

Participants

A total of 803 participants, aged 18–70 (M_{age} = 33.89, SD=9.44; 68.6% females), were enrolled in the present investigation. Demographic characteristics of the sample are summarised in Table 1. The total sample was randomly split into two halves through IBM SPSS facilities. The resulting subgroups did not differ in terms of demographics, including age (t=1.472, df=800, p=.142), gender (χ2=1.185, df=1, p=.276), and education (χ2=5.562, df=4, p=.234). The first subsample was employed to evaluate the psychometric properties of the CFS within the Italian context (Study 1). The second subsample was employed to examine the relationship between cognitive flexibility, as measured by the CFS, and orthorexic symptoms (Study 2). The random split was performed after data collection, with all participants having completed the same battery of self-report scales. Sample size calculations were based on three criteria: (a) to test dimensionality and internal consistency of the CFS, 10 participants for each item of the scale were guaranteed (n_{min} = 120; [31]) (b) to detect a practically significant effect size in correlation analyses (ρ=0.2; [32]), 193 subjects were required (power=0.80, α=0.05); (c) to detect the same effect size in SEM analysis assessing the structural relationship between cognitive flexibility and ON, according to the procedure described in Westland [33], a minimum of 342 subjects were required (power=0.80, α=0.05).

Study 1

Participants

A total of 402 participants randomly selected from the overall sample were included in the first investigation (see Table 1). Of these, 70.4% (n=283) were females, while 29.6% (n=119) were males. The mean age of the sample was 34.38 years (SD=9.70), ranging from 19 to 67 years.

Measures

Cognitive flexibility scale (CFS)

The Cognitive Flexibility Scale (CFS), developed by Martin and Rubin [3], assesses cognitive flexibility in the form of individuals' awareness of different options and choices for behaving, willingness to be flexible and adapt to different scenarios, and self-efficacy in being flexible. The CFS comprises 12 items rated on a 6-point Likert scale, ranging from 1 (strongly disagree) to 6 (strongly agree). After reversing four items, a total score can be computed, ranging from 12 to 72, with higher scores indicating higher cognitive flexibility.

The CFS was adapted into Italian following a forward and back-translation procedure [34]. First, two independent researchers translated the original English version of the CFS into Italian, and discrepancies in the translation process were resolved by discussion. Second, the Italian version of the CFS was back-translated into English by a researcher blinded to the original version to resolve conceptual inconsistencies. Third, the revised Italian version was administered in a pilot study to 20 participants to verify the clarity and comprehensibility of the contents. The participants rated the clarity and comprehensibility of each item on a 5-point scale (1=do not understand at all; 5=understand completely), and since all items received a satisfactory average rating (i.e., higher than 4), no further revisions were applied.

Cognitive flexibility inventory (CFI)

The Cognitive Flexibility Inventory (CFI; [35]) is a 20-item self-report questionnaire designed to evaluate two dimensions of cognitive flexibility: (a) the ability to generate multiple solutions and explanations for challenging situations (the "alternative" subscale); (b) the inclination to perceive challenging situations as controllable (the "control" subscale). Items are rated on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). Higher subscale scores indicate higher cognitive flexibility. The Italian version of the CFI was administered [9], and satisfactory omega coefficients for both the alternative and the control subscales were found in the present investigation (0.919 and 0.898, respectively).

Obsessive-compulsive inventory-revised (OCI-R)

The Obsessive-Compulsive Inventory-Revised (OCI-R; [36]) is an 18-item self-report questionnaire designed to evaluate the presence and severity of obsessive-compulsive symptomatology in the past month. Participants rated each item on a 5-point scale, ranging from 0 (not at all) to 4 (extremely). The scale yielded a total score of 0–72, where higher scores denote higher severity of obsessive-compulsive symptoms. The Italian version of the OCI-R was administered [37], with an excellent omega coefficient of 0.886 found in the present sample. The OCI-R was administered in order to assess the criterion-related validity of the CFS, consistent with a large body of evidence highlighting a pattern of cognitive inflexibility in OCD patients with effect sizes generally in the medium range [38].

Data analysis

Data were analysed using IBM SPSS v.25 (IBM Corporation, Armonk NY; USA) and Mplus v.8.6 [39].

Preliminarily, item-level descriptive statistics including mean, standard deviation, skewness and kurtosis, were calculated. Moreover, Mardia's [40] tests for multivariate normality were computed. To examine the dimensionality of the CFS, in line with previous studies [7, 8], a one-factor structure was examined through confirmatory factor analysis (CFA). Moreover, to account for method effects stemming from reverse-worded items [41, 42], a general dimension of cognitive flexibility with an additional, orthogonal, wording factor saturated by the four reverse items was specified (see [43] for an empirical application). The two nested models were compared through a chi-square difference test using a more conservative alpha level of 0.01 [44, 45]. According to a multifaceted approach to the assessment of model fit [46], several indices were employed to evaluate the fit of the proposed model to the empirical data [47, 48]: the root mean square error of approximation (RMSEA; ≤ 0.08 indicates a reasonable fit), the comparative fit index and Tucker-Lewis index (CFI and TLI, respectively; ≥ 0.90 indicates acceptable fit), and the standardized root mean squared residual (SRMR; ≤ 0.08 indicates acceptable fit). As specified later, model parameters were estimated using robust maximum likelihood (MLM; [39]) to compensate for the non-normality of the observed indicators.

After achieving an optimal model fit, reliability was estimated in the form of internal consistency by calculating model-based omega coefficients. To account for correlated errors, the ratio was calculated using the model-implied variance of the total score in the denominator [49]. Omega was preferred to Cronbach's alpha since the latter relied on frequently untenable assumptions, including uncorrelated residuals and true-score equivalence [50]. Furthermore, convergent and criterion-related validity evidence were gathered through zero-order correlations with the CFS and the OCI-R, respectively. Correlation coefficients were interpreted following Cohen's guidelines [51]: an r between 0.10 and 0.29 is considered a small effect, between 0.30 and 0.49 a medium effect, and above 0.50 a large effect.

To examine the generalisability of the measurement model across genders, factorial invariance tests were conducted through multi-group CFA. Following the stepwise framework proposed by Meredith [52], three levels of invariance were tested: configural invariance (i.e., the same pattern of free and fixed loadings), metric invariance (i.e., equality of factor loadings), and scalar invariance (i.e., equality of items' intercepts). To compare these nested models and assess the feasibility of the invariance constraints, $\chi2$ difference tests were integrated with changes in goodness-of-fit indices, where $\Delta CFI \geq 0.010$ accompanied by $\Delta RMSEA \geq 0.015$ suggest a significant worsening in model fit [48, 53].

Results

Descriptive statistics

Descriptive statistics with means, standard deviations, skewness and kurtosis for each CFS item are reported in Table 2. Skewness and kurtosis for the majority of items fell between −1.00 and +1.00, except for two indicators

Table 2 Item-level descriptive statistics. Note: items marked with "R" were reverse scored

Item	Mean (SD)	Skewness	Kurtosis
1. I can communicate an idea in many different ways.	4.74 (1.01)	-1.37	2.59
2. I avoid new and unusual situations. (R)	3.81 (1.39)	-0.08	-0.90
3. I feel like I never get to make decisions. (R)	4.22 (1.39)	-0.52	-0.68
4. I can find workable solutions to seemingly unsolvable problems.	4.09 (1.18)	-0.54	0.02
5. I seldom have choices when deciding how to behave. (R)	3.91 (1.26)	-0.15	-0.83
6. I am willing to work at creative solutions to problems.	4.64 (1.08)	-0.90	0.82
7. In any given situation, I am able to act appropriately.	3.89 (1.17)	-0.58	-0.18
8. My behavior is a result of conscious decisions that I make.	4.29 (1.09)	-0.70	0.20
9. I have many possible ways of behaving in any given situation.	4.16 (1.06)	-0.55	0.07
10. I have difficulty using my knowledge on a given topic in real life situations. (R)	3.94 (1.26)	-0.27	-0.68
11. I am willing to listen and consider alternatives for handling a problem.	4.86 (0.87)	-1.13	2.39
12. I have the self-confidence necessary to try different ways of behaving.	3.88 (1.24)	-0.38	-0.55

Table 3 Factorial solution of the CFS. Note: parameters are reported in a completely standardized metric. All factor loadings are statistically significant ($p < .001$)

	Standardized factor loading	
Item	**Cognitive flexibility**	**Method factor**
CFS#1	0.415	
CFS#2	0.522	0.390
CFS#3	0.571	0.543
CFS#4	0.682	
CFS#5	0.397	0.408
CFS#6	0.666	
CFS#7	0.767	
CFS#8	0.723	
CFS#9	0.676	
CFS#10	0.504	0.258
CFS#11	0.569	
CFS#12	0.767	

which showed slight deviations from univariate normality (e.g [54]. , . Relatedly, Mardia's skewness ($\chi2=1002.331$, df=364, $p<.001$) and kurtosis ($z=21.832$, $p<.001$) coefficients suggested significant departures from a multivariate normal distribution. To this end, parameters were estimated using maximum likelihood with Satorra-Bentler scaled χ^2 statistics and robust standard errors to account for non-normal distributions (MLM estimator; [39]).

Dimensionality

Two alternative models were tested: Model (1) a one-factor structure; Model (2) a general dimension of cognitive flexibility, plus a method factor to account for the additional covariance arising by the four reverse-worded items (i.e., wording effect; [41, 42]). This latter solution fitted better when compared to the more parsimonious one-factor model: $\Delta\chi2$ (4)=57.002, $p<.001$. However, Model 2 exhibited a borderline-to-unacceptable fit to the data: $\chi2(50)=164.759$, $p<.001$; RMSEA=0.076 (90% CI 0.063–0.089); CFI=0.922, TLI=0.897, SRMR=0.046. To identify sources of misfit, modifications indices were analysed, uncovering theoretically plausible error covariance between Item #9 and Item #5, which may be attributed to content overlap (i.e., both items examine the awareness of different options and choices for behaving). After freely estimating the parameter, the goodness-of-fit of the revised model was acceptable: $\chi2(49)=133.223$, $p<.001$; RMSEA=0.065 (90% CI 0.052–0.079); CFI=0.943, TLI=0.923, SRMR=0.041. All the items loaded significantly on the cognitive flexibility factor ($p<.001$), with standardized loadings ranging from 0.397 to 0.767 (M_λ = 0.604, SD=0.127). Moreover, the four reverse-worded items loaded significantly onto the method factor ($p<.001$; M_λ = 0.399, SD=0.116), suggesting that meaningful covariance among these items may reflect a methodological artefact stemming from the negative wording (see [42]). The factorial solution is summarised in Table 3.

Reliability and validity

The omega estimate corresponding to the general cognitive flexibility construct, over and above extraneous influences captured by the method factor, was excellent ($\omega_h=0.834$), thus supporting the use of a total score for reliably assessing cognitive flexibility. Moreover, CFS scores were positively and strongly correlated with the Alternative ($r = .583$, $p < .001$) and Control ($r = .792$, $p < .001$) subscales of the CFI, as well as negatively and moderately correlated with the OCI-R scores ($r = -.416$, $p < .001$), providing evidence of convergent and criterion-related validity, respectively.

Measurement invariance

The generalisability of the measurement model across genders was examined through factorial invariance tests within a multi-group framework. In order to examine configural invariance, the revised model was tested simultaneously on males and females without imposing any equality constraints, showing a reasonable fit to the data: $\chi2(98) = 180.303$, $p < .001$; RMSEA = 0.065 (90% CI 0.050–0.079); CFI = 0.945, TLI = 0.926, SRMR = 0.047. Thereafter, equality constraints on factor loadings were imposed, supporting the metric invariance model ($\Delta\chi2 = 13.561$, df = 14, $p = .482$; ΔCFI = 0.001, ΔRMSEA = -0.005). Similarly, imposing equality constraints on items' intercepts resulted in negligible changes in fit ($\Delta\chi2 = 17.791$, df = 10, $p = .058$; ΔCFI = -0.005, ΔRMSEA = 0), supporting the scalar invariance model. Results are summarised in Table 4. Furthermore, latent mean comparisons revealed no significant differences in cognitive flexibility levels between males and females (Cohen's d = 0.060, $p = .599$).

Study 2

Participants

A total of 401 participants randomly selected from the overall sample were included in the second investigation (see Table 1). Of these, 66.8% ($n = 268$) were females, while 33.2% ($n = 133$) were males. The mean age of the sample was 33.40 years (SD = 9.16), ranging from 18 to 70 years.

Measures

Diagnosis of psychiatric disorders

Participants were asked whether they formally received a recent diagnosis of psychiatric disorders (e.g., feeding and eating disorders, obsessive-compulsive disorders, major depression disorders, generalised anxiety, personality disorders, etc.) by healthcare professionals using a dichotomous question (i.e., yes/no options).

Cognitive flexibility scale (CFS)

See the measures section of Study 1.

Orthorexia nervosa inventory (ONI)

The Orthorexia Nervosa Inventory (ONI; [55]), administered in its Italian version adapted by Zagaria and colleagues [56], is a 24 self-report scale designed to evaluate orthorexic symptoms. The questionnaire is composed of three subscales assessing behaviours and preoccupation with healthy eating (i.e., *behaviours*), physical and psychosocial impairments due to nutritional deficiencies and dietary restrictions (i.e., *impairments*), and emotional distress stemming from violations of orthorexic dietary rules (i.e., *emotional distress*). The ONI demonstrated a well-defined factorial structure, good internal consistency, evidence of convergent validity with alternative measures of ON (i.e., the Italian Düsseldorf Orthorexia Scale; [57]), as well as concurrent validity with eating and obsessive-compulsive symptomatology [56].

Data analysis

Data were analysed using IBM SPSS v.25 (IBM Corporation, Armonk NY; USA) and Mplus v.8.6 [39].

The relationship between cognitive flexibility and orthorexia was examined within the structural equation modelling framework (SEM; [44]). Specifically, a full SEM was employed, which can be decomposed into two parts: a measurement model, which specifies the relationship between the latent and the observed variables, and a structural model, which specifies the relationship between the latent variables [58].

In the first step, the measurement model was examined through a confirmatory factorial approach. A parcelling strategy was applied to define each latent dimension of ON and cognitive flexibility, which has several advantages over using single indicators, including fewer parameter estimates and reduced sources of sampling error [59]. Moreover, when the main aim is to examine the structural relationships among multiple constructs, parcelling contributes to removing theoretically unimportant noises attributable to method factors, such as negative wording [60, 61]. Such an approach is warranted and justifiable when error covariances are due to theoretically trivial reasons and do not reflect conceptually meaningful factors [60, 61]. This is particularly applicable in the case of the Italian version of the CFS, where a method factor accounted for additional covariance stemming from reverse-wording items. Hence, three parcels per latent dimension under investigation were constructed via the *balancing approach* based on the highest-to-lowest

Table 4 Factorial invariance tests across gender. Note: parameters were estimated using maximum likelihood with Satorra-Bentler χ2 and robust standard errors (MLM estimator)

Model	SBχ2 (df)	CFI	TLI	SRMR	RMSEA	Model comparison	ΔSBχ2 (df)	ΔRMSEA	ΔCFI
1.Configural invariance	180.303 (98)	0.945	0.926	0.047	0.065				
2.Metric invariance	192.824 (112)	0.946	0.936	0.064	0.060	2 vs. 1	13.561 (14)	-0.005	0.001
3.Scalar invariance	210.533 (122)	0.941	0.936	0.067	0.060	3 vs. 2	17.791 (10)	0	-0.005

item-total correlations [59]. Composite reliability coefficients, as well as average variance extracted (AVE) values, were calculated for each construct following Bagozzi & Yi [62]. Moreover, a competing one-factor model (i.e., Harman's single-factor test) was estimated to provide evidence regarding the discriminant validity of the study variables (e.g., [23, 63]). As a second step, the structural part of the SEM was specified positing a direct effect between cognitive flexibility and the three ON dimensions (see Fig. 1). Concomitant diagnoses of psychiatric disorders and gender were included as covariates through the semipartial control approach [64]. The same goodness-of-fit indices with their respective cutoffs, as specified for Study 1, were employed to assess the fit of the CFA and full SEM to the observed data [47, 48]. Moreover, as for Study 1, robust maximum likelihood was employed as the parameter estimation method for dealing with non-normal indicators [39].

Results

Measurement model

In the measurement part of the SEM, four factors were specified, each measured by three parcels serving as manifest indicators: Cognitive Flexibility, ON Emotional distress, ON Behaviours, and ON Impairments. All cross-loadings and residual covariances were fixed to 0. The hypothesised CFA exhibited an acceptable fit to the observed data: $\chi2(48)=120.806$, $p<.001$; RMSEA = 0.062 (90% CI 0.048–0.075); CFI = 0.960, TLI = 0.945, SRMR = 0.050. Each latent factor was well-defined, with standardized loadings ranging from 0.731 to 0.873 (M_λ = 0.793, SD = 0.05). Composite reliability estimates were 0.849 for Cognitive Flexibility, 0.878 for ON Emotional Distress, 0.833 for ON Behaviours, and 0.784 for ON Impairments. Additionally, AVE values indicated a high degree of convergence among the indicators (> 0.50; [65]). The results of the measurement model are summarised in Table 5. Importantly, the alternative one-factor model (i.e., Harman's single-factor test) yielded a very poor fit to the data, supporting the discriminant

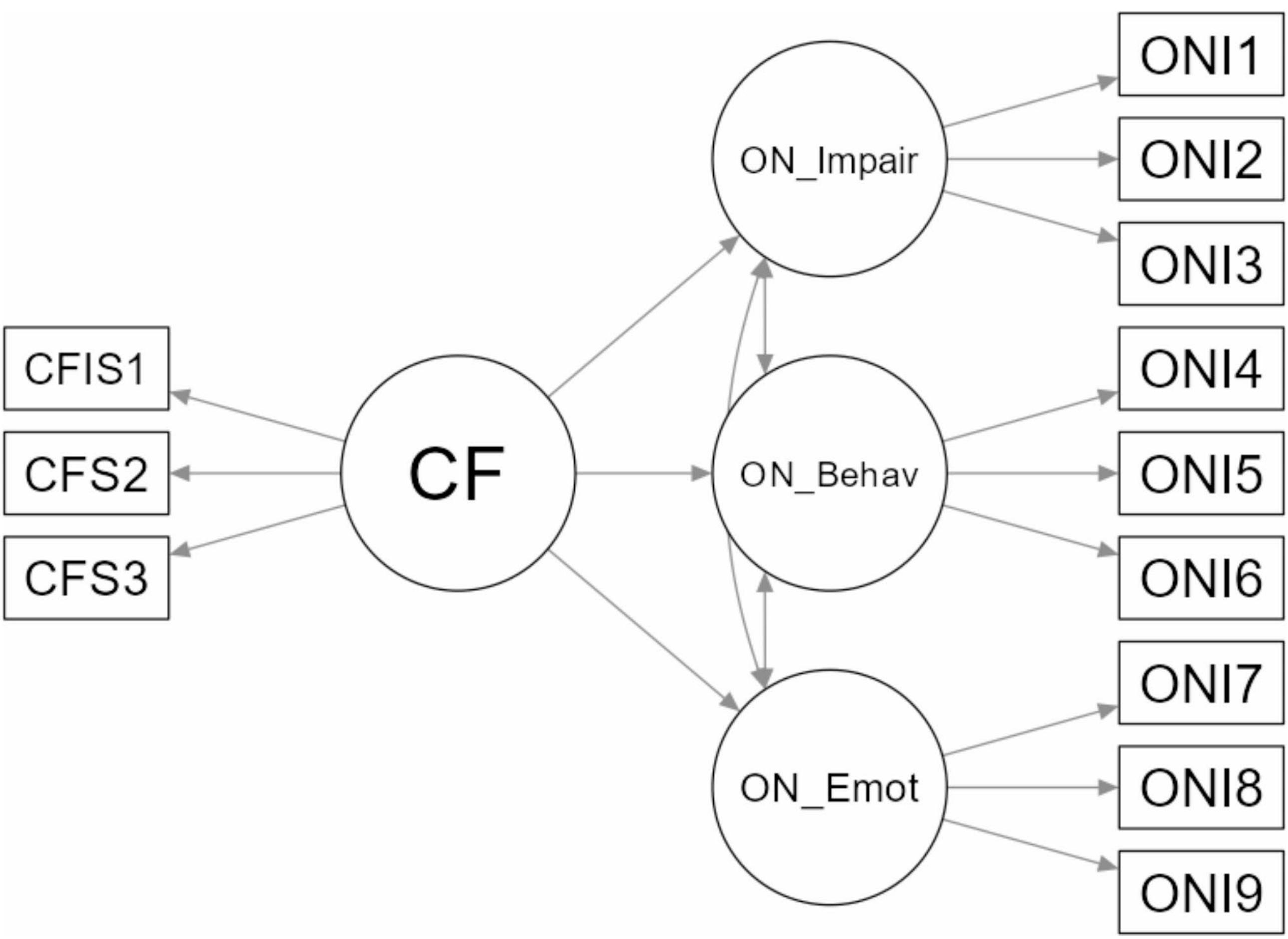

Fig. 1 The proposed full SEM. Note: All latent dimensions were reflected by parcels as manifest indicators. To maintain visual clarity, variance terms are not shown. Abbreviations: CF, cognitive flexibility; ON, orthorexia nervosa; Impair, impairment; Behav, behaviours; Emot, emotional distress

Table 5 Measurement model results

Construct	Standardized factor loadings	Composite reliability	Average variance extracted
Cognitive Flexibility		0.849	0.652
Parcel#1	0.834		
Parcel#2	0.794		
Parcel#3	0.794		
ON Emotional distress		0.878	0.706
Parcel#1	0.784		
Parcel#2	0.873		
Parcel#3	0.861		
ON Behaviours		0.833	0.625
Parcel#1	0.850		
Parcel#2	0.743		
Parcel#3	0.775		
ON Impairments		0.784	0.547
Parcel#1	0.731		
Parcel#2	0.755		
Parcel#3	0.732		

validity of the constructs: $\chi 2(54)=677.851$, $p<.001$; RMSEA = 0.170 (90% CI 0.158–0.181); CFI = 0.619, TLI = 0.534, SRMR = 0.126.

Structural model

Afterwards, we examined the structural model depicted in Fig. 1, positing the latent variable of Cognitive Flexibility as a predictor of the three latent dimensions of ON, namely Impairment, Behaviours, and Emotional Distress. Concomitant diagnoses of psychiatric disorders (coded as 0 = no and 1 = yes) and gender (coded as 0 = males and 1 = females) were considered as covariates. The goodness-of-fit indices were satisfactory: $\chi 2(64)=137.619$, $p<.001$; RMSEA = 0.054 (90% CI 0.041–0.066); CFI = 0.963, TLI = 0.948, SRMR = 0.044. The structural coefficients revealed that Cognitive Flexibility was significantly and negatively associated with ON Emotional Distress (β = -0.279, $p<.001$), whilst it was unrelated to ON Behaviours ($\beta=0.044$, $p=.509$) and ON Impairments (β = -0.124, $p=.083$). That is, participants with higher scores of cognitive flexibility reported lower emotional distress stemming from violations of orthorexic dietary rules. Following Ferguson [32], the structural coefficient can be interpreted as practically significant (>|0.20|). Concerning covariates, a concomitant diagnosis of psychiatric disorders was consistently associated with ON Emotional Distress (B = 0.257, $p<.001$), Behaviours (B = 0.225, $p=.001$) and Impairments (B = 0.237, $p<.001$), whilst gender did not exert any statistically significant effect ($p>.05$). Overall, according to Cohen's benchmarks [51], the SEM explained a moderate proportion of the variance in ON Emotional Distress (18%) and ON Impairments (17%), and a small proportion of the variance in ON Behaviours (5%).

Discussion

The present study aimed to provide the first psychometric evidence for the Cognitive Flexibility Scale (CFS) within the Italian cultural context, as well as testing its relationship with orthorexic symptoms, thus contributing to the ongoing debate on the correlates, risk and protective factors for ON (see [22, 66].

More specifically, the first study aimed to test the factorial structure, internal consistency, and convergent and criterion-related validity of the CFS among an Italian community sample. To examine the dimensionality of the scale, two competitive CFA models were compared: (1) a one-factor structure; and (2) a model comprising a global dimension of cognitive flexibility, plus a method factor to account for the additional covariance arising by reverse-worded items. Findings supported the second model as the more plausible in reproducing the observed-covariance matrix. Specifically, the 10 items constituting the CFS exhibited significant loadings on the global dimension of cognitive flexibility, supporting their factorial validity. Additionally, the four reverse-worded items of the scale significantly loaded on the intended method factor, explaining a substantial amount of variance above and beyond the global dimension of cognitive flexibility. As noted by Brown ([42] p.141), "*method effect exists when some of the differential covariance among items is due to the measurement approach rather than the substantive latent variables*". In the context of our investigation, method effects occurred due to the differential covariance arising from reverse-worded assessments (e.g., [41, 42, 67, 68]). To address method effects, the factorial solution was specified appropriately by incorporating a latent factor reflecting these reverse-worded items. Failing to model method variance may otherwise end in a poor-fitting solution, leading to biased factor loading and scale reliability estimates [42, 69, 70].

Importantly, factorial invariance tests indicated that the hypothesised measurement model could be generalized across males and females. That is, configural invariance (i.e., the same pattern of free and fixed loadings), metric invariance (i.e., the equivalence of factor loadings), and scalar invariance (i.e., the equivalence of items' intercepts) models held across the two groups. Overall, findings suggest that males and females used a similar framework to conceptualize cognitive flexibility and that all items contribute similarly to represent this latent dimension, thus supporting meaningful score comparisons across genders (i.e., latent mean comparisons; [71]).

The omega coefficient for the general dimension of cognitive flexibility was excellent, supporting the use of a composite score for reliably measuring the construct. This result is consistent with previous studies conducted on the American [3], Turkish [8] and Japanese [7] contexts, which highlighted a satisfactory internal reliability of the scale. In terms of validity analyses, CFS scores exhibited a large and positive correlation with an alternative measure of cognitive flexibility (i.e., the CFI), as well as a negative and moderate correlation with obsessive-compulsive symptomatology, providing evidence of convergent and criterion-related validity, respectively. The latter result corroborates recent meta-analytic evidence highlighting deficits in cognitive flexibility in OCD with medium to large effect sizes [72]. Indeed, as noted by Jalal and colleagues [73], poor cognitive flexibility may predispose individuals to OCD and contribute to the persistence of such symptomatology, representing a potential endophenotype.

Concerning Study 2, SEM analyses unveiled a significant association between Cognitive Flexibility—defined as one's perceived ability, willingness, and self-efficacy to be flexible and adapt to different situations—and the Emotional Distress component of the Orthorexia Nervosa Inventory (ONI). Emotional Distress, as operationalized by ONI, assesses the psychological consequences (e.g. guilt, a sense of failure, anxiety) arising from violations of self-imposed inflexible rules about healthy eating [56], which are core aspects of ON [22]. The negative association found in this study suggests that Cognitive Flexibility may serve as a potential buffer against the distress caused by orthorexic symptoms. These findings align with a recent network analysis that identified a relationship between psychological distress and cognitive flexibility in a clinical sample of 185 patients with AN [74]. Moreover, these findings are in line with extensive evidence supporting cognitive inflexibility as a transdiagnostic factor across different psychopathological conditions. A systematic review conducted by Morris and Mansell [12] investigated its association with other well-established transdiagnostic factors of psychopathology, such as perfectionism and rumination, highlighting that inflexibility/rigidity and transdiagnostic cognitive and behavioural maintenance processes were correlated, co-occurred, and predictive of each other. Consistently, a more recent study found deficits in Cognitive Flexibility across different psychiatric disorders, including FED, Major Depression, Generalized Anxiety Disorder, and Post-Traumatic Stress Disorder [75]. However, it is important to note that some experimental studies conducted in laboratory settings (e.g., [76, 77]) have failed to find significant impairments in cognitive flexibility among participants reporting binge eating symptoms. These discrepancies may be attributed to differences in measurement methods (e.g., self-report/subjective vs. experimental/objective assessment; [19]) or may underlie differences related to the specificity of eating behaviour difficulties (e.g., restrictive/selective behaviours vs. dysregulated behaviours). Recognizing these potential differences, our results contribute to the growing body of evidence suggesting a potential role for cognitive flexibility as a buffering factor against the distress associated with ON [28].

Limitations and conclusions

Several limitations of the present study should be mentioned. Firstly, the cross-sectional design precluded examining the causal direction between ON and cognitive flexibility, as well as the stability of the CFS scores over time. Future longitudinal studies are warranted to address these gaps and capture dynamic and reciprocal influences between the variables under investigation. Moreover, relying solely on self-report questionnaires may introduce biases, such as recall and social desirability. Future research could benefit from assessing orthorexic symptoms using semi-structured clinical interviews and cognitive flexibility through experimental tasks (e.g., Wisconsin Card Sorting Test; [29]). Eventually, it is worth noting that the sample was recruited from the Italian general population, and findings cannot be generalised to clinical populations (e.g., patients with formal diagnoses of FED). Relatedly, we enrolled a convenience sample, which may be subject to biases such as self-selection, leading to an unbalanced gender distribution. Future studies are needed to assess the psychometric properties of the CFS in a more representative sample of the Italian population, as well as to explore the relationship between ON and cognitive flexibility in samples with clinically significant orthorexic symptomatology.

Despite these limitations, the present study offers valuable insights into the ongoing debate on the correlates, risks, and protective factors of ON, showcasing several strengths. Firstly, it provides a novel contribution to understanding the relationship between cognitive flexibility and orthorexic symptoms, encouraging further longitudinal and experimental studies. Secondly, the use of psychometrically robust and culturally adapted tools addresses criticisms regarding the validity of research on ON, which largely relied on psychometrically invalid self-report scales (e.g., [78]). Thirdly, these findings have important clinical implications for the treatment of FED and specifically ON symptoms, suggesting that cognitive flexibility may play a protective role against the emotional distress derived from psychopathological symptoms, such as ON attitudes and behaviours. Some therapeutic approaches,including protocols based on Acceptance and Commitment Therapy [79], use strategies to increase cognitive flexibility. Hence, based on these considerations, enhancing cognitive flexibility within treatments for ON and FED could be effective. A recent systematic review [80] suggests that this class of interventions demonstrate efficacy in reducing FED symptoms, despite the detection of a lack of methodological rigour in many studies. To sum up, cognitive (in)flexibility may be an important treatment target for FED and ON symptoms, and therapeutic approaches addressing this factor may be prioritized and fostered.

Abbreviations

AN	Anorexia Nervosa
AVE	Average Variance Extracted
BM	Bulimia Nervosa
BMI	Body Mass Index
CFA	Confirmatory Factor Analysis
CFI	Cognitive Flexibility Inventory
CFI	Comparative Fit Index
CFS	Cognitive Flexibility Scale
FED	Feeding and Eating Disorders
OCD	Obsessive-Compulsive Disorder
OCI-R	Obsessive-Compulsive Inventory-Revised
ON	Orthorexia Nervosa
ONI	Orthorexia Nervosa Inventory
RMSEA	Root Mean Square Error of Approximation
SD	Standard deviation
SEM	Structural Equation Modelling
SRMR	Standardized Root Mean Squared Residual
TLI	Tucker-Lewis Index

Acknowledgements
Not applicable.

Author contributions
AZ projected the study. AZ and EM collected the data. AZ analysed the data. AZ, MD, and SC wrote the first draft of the manuscript. All authors reviewed and commented on subsequent drafts of the manuscript. CL supervised the entire process.

Funding
The APC was funded by Sapienza University of Rome ("*Avvio alla Ricerca*" grant, secured by A.Z.).

Data availability
The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
Informed consent was obtained from all individual participants included in the study. The research was conducted in accordance with the 1964 Helsinki Declaration and its later amendments. This study was part of larger research projects focused on the assessment and correlates of orthorexic symptoms, approved by the Institutional Review Board of the Department of Psychology and the Ethics Committee of Sapienza University of Rome.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 20 February 2024 / Accepted: 8 November 2024
Published online: 04 December 2024

References
1. Howlett CA, Miles S, Berryman C, Phillipou A, Moseley GL. Conflation between self-report and neurocognitive assessments of cognitive flexibility: a critical review of the Jingle Fallacy. Australian J Psychol. 2023;75:2174684.
2. Kashdan TB, Rottenberg J. Psychological flexibility as a fundamental aspect of health. Clin Psychol Rev. 2010;30:865–78.
3. Martin MM, Rubin RB. A New measure of cognitive flexibility. Psychol Rep. 1995;76:623–6.
4. Martin MM, Staggers SM, Anderson CM. The relationships between Cognitive Flexibility with Dogmatism, Intellectual Flexibility, preference for consistency, and Self-Compassion. Communication Res Rep. 2011;28:275–80.
5. Murphy-Beiner A, Soar K. Ayahuasca's 'afterglow': improved mindfulness and cognitive flexibility in Ayahuasca drinkers. Psychopharmacology. 2020;237:1161–9.
6. Johnco C, Wuthrich VM, Rapee RM. The influence of cognitive flexibility on treatment outcome and cognitive restructuring skill acquisition during cognitive behavioural treatment for anxiety and depression in older adults: results of a pilot study. Behav Res Ther. 2014;57:55–64.
7. Oshiro K, Nagaoka S, Shimizu E. Development and validation of the Japanese version of cognitive flexibility scale. BMC Res Notes. 2016;9:275.
8. Çeľikkaleľi Ö. The validity and reliability of the cognitive flexibility scale. Educ Sci. 2014;39.
9. Portoghese I, Lasio M, Conti R, Mascia ML, Hitchcott P, Agus M, et al. Cognitive flexibility inventory: factor structure, invariance, reliability, convergent, and discriminant validity among Italian university students. PsyCh J. 2020;9:934–41.
10. Cerolini S, Zagaria A, Vacca M, Spinhoven P, Violani C, Lombardo C. Cognitive emotion Regulation Questionnaire—Short: reliability, validity, and Measurement Invariance of the Italian version. Behav Sci. 2022;12:474.
11. Orgilés M, Morales A, Fernández-Martínez I, Melero S, Espada JP. Validation of the short version of the cognitive emotion regulation questionnaire for Spanish children. J Child Health Care. 2019;23:87–101.
12. Morris L, Mansell W. A systematic review of the relationship between rigidity/flexibility and transdiagnostic cognitive and behavioral processes that maintain psychopathology. J Experimental Psychopathol. 2018;9:204380871877943.
13. Miles S, Gnatt I, Phillipou A, Nedeljkovic M. Cognitive flexibility in acute anorexia nervosa and after recovery: a systematic review. Clin Psychol Rev. 2020;81:101905.
14. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. DSM-5-TR. American Psychiatric Association Publishing; 2022.
15. Fairburn CG. Cognitive behavior therapy and eating disorders. Guilford Press; 2008.
16. Iceta S, Rodrigue C, Legendre M, Daoust J, Flaudias V, Michaud A, et al. Cognitive function in binge eating disorder and food addiction: a systematic review and three-level meta-analysis. Prog Neuropsychopharmacol Biol Psychiatry. 2021;111:110400.
17. Westwood H, Stahl D, Mandy W, Tchanturia K. The set-shifting profiles of anorexia nervosa and autism spectrum disorder using the Wisconsin Card sorting test: a systematic review and meta-analysis. Psychol Med. 2016;46:1809–27.

18. Miles S, Nedeljkovic M, Phillipou A. Can cognitive flexibility and clinical perfectionism be used to identify people with Anorexia Nervosa? JCM. 2022;11:1954.
19. Miles S, Nedeljkovic M, Sumner P, Phillipou A. Understanding self-report and neurocognitive assessments of cognitive flexibility in people with and without lifetime anorexia nervosa. Cogn Neuropsychiatry. 2022;27:325–41.
20. Treasure J, Schmidt U. The cognitive-interpersonal maintenance model of anorexia nervosa revisited: a summary of the evidence for cognitive, socio-emotional and interpersonal predisposing and perpetuating factors. J Eat Disord. 2013;1:13.
21. Tchanturia K, Lloyd S, Lang K. Cognitive remediation therapy for anorexia nervosa: current evidence and future research directions. Intl J Eat Disorders. 2013;46:492–5.
22. Donini LM, Barrada JR, Barthels F, Dunn TM, Babeau C, Brytek-Matera A, et al. A consensus document on definition and diagnostic criteria for orthorexia nervosa. Eat Weight Disord. 2022;27:3695–711.
23. Zagaria A, Vacca M, Cerolini S, Barbaranelli C, Lombardo C. Orthorexia nervosa and psychosocial impairment from a multidimensional perspective: a structural equation modelling approach. Curr Psychol. 2023. https://doi.org/10.1007/s12144-023-05513-0.
24. Zagaria A, Vacca M, Cerolini S, Ballesio A, Lombardo C. Associations between Orthorexia, disordered eating, and obsessive–compulsive symptoms: a systematic review and meta-analysis. Intl J Eat Disorders. 2022;55:295–312.
25. Cena H, Barthels F, Cuzzolaro M, Bratman S, Brytek-Matera A, Dunn T, et al. Definition and diagnostic criteria for orthorexia nervosa: a narrative review of the literature. Eat Weight Disord. 2019;24:209–46.
26. Coimbra M, Ferreira C. Making the leap from healthy to disordered eating: the role of intuitive and inflexible eating attitudes in orthorexic behaviours among women. Eat Weight Disord. 2021;26:1793–800.
27. Duriez P, Kaya Lefèvre H, Di Lodovico L, Viltart O, Gorwood P. Increased cognitive flexibility mediates the improvement of eating disorders symptoms, depressive symptoms and level of daily life functioning in patients with anorexia nervosa treated in specialised centres. Euro Eat Disorders Rev. 2021;29:600–10.
28. Strahler J, Stark R, Perspective. Classifying Orthorexia Nervosa as a New Mental Illness—much discussion, little evidence. Adv Nutr. 2020;11:784–9.
29. Koven NS, Senbonmatsu R. A neuropsychological evaluation of orthorexia nervosa. OJPsych. 2013;03:214–22.
30. Hayatbini N, Oberle CD. Are orthorexia nervosa symptoms associated with cognitive inflexibility? Psychiatry Res. 2019;271:464–8.
31. De Vet HCW, Terwee CB, Mokkink LB, Knol DL. Measurement in Medicine: A Practical Guide. 1st edition. Cambridge University Press; 2011.
32. Ferguson CJ. An effect size primer: a guide for clinicians and researchers. Prof Psychology: Res Pract. 2009;40:532–8.
33. Christopher Westland J. Lower bounds on sample size in structural equation modeling. Electron Commer Res Appl. 2010;9:476–87.
34. Kuliś D, Arnott M, Greimel ER, Bottomley A, Koller M. Trends in translation requests and arising issues regarding cultural adaptation. Expert Rev PharmacoEcon Outcomes Res. 2011;11:307–14.
35. Dennis JP, Vander Wal JS. The cognitive flexibility inventory: Instrument Development and estimates of reliability and validity. Cogn Ther Res. 2010;34:241–53.
36. Foa EB, Huppert JD, Leiberg S, Langner R, Kichic R, Hajcak G, et al. The obsessive-compulsive inventory: development and validation of a short version. Psychol Assess. 2002;14:485–96.
37. Marchetti I, Chiri L, Ghisi M, Sica C. Obsessive-compulsive inventory-revised (OCI-R): presentazione e indicazioni di utilizzo nel contest italiano. Psicoterapia Cognitiva E Comportamentale. 2010;16:69–84.
38. Gruner P, Pittenger C. Cognitive inflexibility in obsessive-compulsive disorder. Neuroscience. 2017;345:243–55.
39. Muthén LK, Muthén BO. Mplus user's guide, 8th ed. LosAngeles: Muthén & Muthén; 1998–2017.
40. Mardia KV. Measures of multivariate skewness and kurtosis with applications. Biometrika. 1970;57:519–30.
41. Brown TA. Confirmatory factor analysis of the Penn state worry questionnaire: multiple factors or method effects? Behav Res Ther. 2003;41:1411–26.
42. Brown TA. Confirmatory factor analysis for applied research. Second edition. New York; London: The Guilford Press; 2015.
43. Tsai M-C, Strong C, Latner JD, Lin Y-C, Pakpour AH, Lin C-Y, et al. Attitudes toward and beliefs about obese persons across Hong Kong and Taiwan: wording effects and measurement invariance. Health Qual Life Outcomes. 2019;17:134.
44. Bollen KA. Structural Equations with Latent Variables. 1st edition. Wiley; 1989.
45. Scott-Lennox JA, Scott-Lennox RD. Sex—race differences in social support and depression in older low-income adults. In: Hoyle RH, editor. Structural equation modeling: concepts, issues, and applications. Sage; 1995. pp. 199–216.
46. Tanaka JS. Multifaceted conceptions of fit in structural equation models. In: Bollen KA, Long JS, editors. Testing structural equation models. Newbury Park, CA: Sage; 1993. pp. 10–39.
47. Browne MW, Cudeck R. Alternative ways of assessing model fit. In: Bollen KA, Long JS, editors. Testing structural equation models. Newbury Park, CA: Sage; 1993. pp. 136–62.
48. Wang J, Wang X. Structural Equation Modeling: Applications Using Mplus. 2nd edition. Wiley; 2019.
49. Flora DB. Your coefficient alpha is probably wrong, but which Coefficient omega is right? A tutorial on using R to obtain better reliability estimates. Adv Methods Practices Psychol Sci. 2020;3:484–501.
50. Kelley K, Pornprasertmanit S. Confidence intervals for population reliability coefficients: evaluation of methods, recommendations, and software for composite measures. Psychol Methods. 2016;21:69–92.
51. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, N.J: L. Erlbaum Associates; 1988.
52. Meredith W. Measurement invariance, factor analysis and factorial invariance. Psychometrika. 1993;58:525–43.
53. Chen FF. Sensitivity of goodness of fit indexes to lack of Measurement Invariance. Struct Equation Modeling: Multidisciplinary J. 2007;14:464–504.
54. Marcoulides GA, Hershberger SL. Multivariate statistical methods: a first course. Mahwah, N.J: Lawrence Erlbaum Associates; 1997.
55. Oberle CD, De Nadai AS, Madrid AL. Orthorexia Nervosa Inventory (ONI): development and validation of a new measure of orthorexic symptomatology. Eat Weight Disord. 2021;26:609–22.
56. Zagaria A, Barbaranelli C, Mocini E, Lombardo C. Cross-cultural adaptation and psychometric properties of the Italian version of the Orthorexia Nervosa Inventory (ONI). J Eat Disord. 2023;11:144.
57. Cerolini S, Vacca M, Zagaria A, Donini LM, Barbaranelli C, Lombardo C. Italian adaptation of the Düsseldorf Orthorexia Scale (I-DOS): psychometric properties and prevalence of orthorexia nervosa among an Italian sample. Eat Weight Disord. 2022;27:1405–13.
58. Schreiber JB. Core reporting practices in structural equation modeling. Res Social Administrative Pharm. 2008;4:83–97.
59. Little TD, Rhemtulla M, Gibson K, Schoemann AM. Why the items versus parcels controversy needn't be one. Psychol Methods. 2013;18:285–300.
60. Matsunaga M. Item parceling in Structural equation modeling: a primer. Communication Methods Measures. 2008;2:260–93.
61. Little TD, Cunningham WA, Shahar G, Widaman KF. To Parcel or not to Parcel: exploring the question, weighing the merits. Struct Equation Modeling: Multidisciplinary J. 2002;9:151–73.
62. Bagozzi RP, Yi Y. Specification, evaluation, and interpretation of structural equation models. J Acad Mark Sci. 2012;40:8–34.
63. Zagaria A, Cerolini S, Mocini E, Lombardo C. The relationship between internalized weight stigma and physical and mental health-related quality of life in a large sample of women: a structural equation modeling analysis. Eat Weight Disord. 2023;28:52.
64. Little TD. Longitudinal structural equation modeling. New York: Guilford Press; 2013.
65. Hair JF, Babin BJ, Anderson RE, Black WC. Multivariate data analysis. Eighth edition. Andover, Hampshire: Cengage; 2019.
66. McComb SE, Mills JS. Orthorexia nervosa: a review of psychosocial risk factors. Appetite. 2019;140:50–75.
67. Zagaria A, Mocini E, Cerolini S, Donini LM, Castelnuovo G, Manzoni GM, et al. A validation study of the Italian version of the attitudes toward obese persons (I-ATOP) questionnaire. Obes Res Clin Pract. 2022;16:262–8.
68. Marsh HW. Positive and negative global self-esteem: a substantively meaningful distinction or artifactors? J Personal Soc Psychol. 1996;70:810–9.
69. Green SB, Hershberger SL. Correlated errors in true score models and their effect on Coefficient Alpha. Struct Equation Modeling: Multidisciplinary J. 2000;7:251–70.
70. Raykov T. Estimation of congeneric scale reliability using covariance structure analysis with nonlinear constraints. Brit J Math Statis. 2001;54:315–23.
71. Yu DS, De Maria M, Barbaranelli C, Vellone E, Matarese M, Ausili D, et al. Cross-cultural applicability of the Self-Care Self-Efficacy Scale in a multi-national study. J Adv Nurs. 2021;77:681–92.

72. Chamberlain SR, Solly JE, Hook RW, Vaghi MM, Robbins TW. Cognitive inflexibility in OCD and Related disorders. In: Fineberg NA, Robbins TW, editors. The Neurobiology and Treatment of OCD: accelerating Progress. Cham: Springer International Publishing; 2021. pp. 125–45.
73. Jalal B, Chamberlain SR, Sahakian BJ. Obsessive-compulsive disorder: etiology, neuropathology, and cognitive dysfunction. Brain Behav. 2023;13:e3000.
74. Giles S, Hughes EK, Castle D, Jenkins Z, Phillipou A, Rossell S, et al. A new network analysis model in anorexia nervosa patients based on self-reported eating disorder symptoms, psychological distress, and cognitive flexibility. Br J Clin Psychol. 2024;63:118–34.
75. Grant JE, Chamberlain SR. Impaired cognitive flexibility across psychiatric disorders. CNS Spectr. 2023;28:688–92.
76. Cerolini S, Ballesio A, Ferlazzo F, Lucidi F, Lombardo C. Decreased inhibitory control after partial sleep deprivation in individuals reporting binge eating: preliminary findings. PeerJ. 2020;8:e9252.
77. Kittel R, Schmidt R, Hilbert A. Executive functions in adolescents with binge-eating disorder and obesity. Intl J Eat Disorders. 2017;50:933–41.
78. Barrada JR, Meule A. Orthorexia nervosa: Research based on invalid measures is invalid. J Glob Health. 2024;14:03007.
79. Dindo L, Van Liew JR, Arch JJ. Acceptance and Commitment Therapy: a Transdiagnostic Behavioral Intervention for Mental Health and Medical conditions. Neurotherapeutics. 2017;14:546–53.
80. Onnink CM, Konstantinidou Y, Moskovich AA, Karekla MK, Merwin RM. Acceptance and commitment therapy (ACT) for eating disorders: a systematic review of intervention studies and call to action. J Context Behav Sci. 2022;26:11–28.

Publisher's note