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ORIGINAL ARTICLE

The relationship between body weight and dietary restraint is explained by body dissatisfaction and body image inflexibility among young adults in China

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Abstract

Objective Eating disorders and obesity are commonly recognized as key public health concerns worldwide. Although rates of obesity and disordered eating have traditionally been lower in China than Western countries, these rates are on the rise. As such, interest is growing in identifying mechanisms that may address these conditions. While associations between body weight and dissatisfaction are well established, burgeoning research aims to examine how these factors are related to dietary restraint and body image inflexibility. This study aimed to explore the possible mediation effect of body dissatisfaction and body image inflexibility between body weight (body mass index) and dietary restraint. Furthermore, we explored how these relationships differed across men and women.

Methods A sample of 1068 young adults (563 females and 505 males) in China participated in the study. Participants completed the Eating Disorder Inventory and Three-Factor Eating Questionnaire as well as the Body Image-Acceptance and Action Questionnaire.

Results Results showed that: (1) body dissatisfaction and body image inflexibility fully mediated the relationship between body mass index and dietary restraint; (2) this model fit both genders, although differences were found in the regression coefficients between the mediation model for men and women.

Conclusion These findings support body image dissatisfaction and inflexibility as mediators of the relationship between body weight and dietary restraint, highlighting these as potential mechanisms for treatment.

Level of evidence Level III, case-control analytic study.

Keywords Body dissatisfaction · Body image inflexibility · Body mass index · Body weight · Cognitive restraint · Disordered eating · Dietary restraint · Young adults

Introduction

Eating disorders and obesity are two important public health issues worldwide. Both eating disorders and obesity are associated with excess mortality and morbidity as well as high socioeconomic burden and poorer quality of life [1–3]. Historically, rates of obesity and eating disorders in China have been lower than in Western countries. However, recent epidemiological studies indicate that prevalence of eating disorders and obesity is rising in China [4–6], sparking interest in identifying modifiable targets for prevention and early intervention.

One factor closely related to the development and maintenance of both obesity and eating disorders is dietary restraint [7]. Dietary restraint refers to an individual's conscious effort to restrict their food intake, commonly for the purpose of controlling body weight/shape [7]. And while the intention to restrain eating does not equal "successful" restriction of dietary intake, laboratory-based studies have found that both healthy controls and individuals with an eating disorder who report greater dietary restraint are likely to consume a

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lower caloric intake at a normal meal [8]. Studies conducted in Western samples have generally described a positive relationship between body weight/body mass index (BMI), and dietary restraint [7, 9, 10]. To date, however, there has been little research into dietary restraint and its relationship with weight or disordered eating in Chinese populations.

Although the specific route is not clear, it has been suggested that dietary restraint may possess both direct and indirect associations with obesity, and disordered eating. One common explanation is that body dissatisfaction, or the negative subjective evaluations/experiences of one's physical appearance, including body size and shape [11], may mediate the relationship between BMI and dietary restraint [12–16]. From a sociocultural lens, Stice, Shaw [17] suggest that individuals with a higher BMI may be at greater risk for body dissatisfaction [18, 19] and, subsequently, are more likely to engage in dietary restraint. Additionally, as extensive literature supports the association between dietary restraint and binge eating, this provides an additional pathway with research suggesting that both BMI and body dissatisfaction are strong predictors of disorder eating behaviors [11, 16, 17]. However, as body dissatisfaction cannot fully explain this relationship, there are likely other constructs influencing the relationship between BMI, disordered eating, and dietary restraint.

Recently, the development of Body Image-Acceptance and Action Questionnaire has sparked interest in the construct of body image (in)flexibility. Body image inflexibility refers to the reluctance to experience negative appearance-related thoughts and emotions [15, 20], and has been preliminarily linked to BMI, body dissatisfaction, and eating disorder symptoms [15, 21–23]. While the specific nature of this relationship is currently unclear, several studies have suggested that body image inflexibility may serve as a mediator between body dissatisfaction and dietary restraint. Specifically, there have been studies showing that body dissatisfaction could predict body image inflexibility (e.g., [20, 23, 24]). For example, Webb (2015) [24] showed that body dissatisfaction significantly predicted body image inflexibility, and body image inflexibility mediated the association between body dissatisfaction and body appreciation; and Mancuso (2016) [20] found a mediation effect of body image inflexibility between body image evaluation and maladaptive body image coping strategies. Similarly, Ferreira and colleagues [25] found that body dissatisfaction leads to the adoption of inflexible eating rules, through the mechanisms of body image inflexibility. Despite these initial steps, further research is needed to understand the role of body image in mediating the relationship between BMI and dietary restraint, and particularly in non-Western samples.

As well as the American and Eurocentric bias in eating disorder literature, the majority of research examining eating disorder symptomology and body dissatisfaction has been conducted in female samples. While body image dissatisfaction and disordered eating are more common in women than men cross-culturally [4, 19], this has contributed to limitations in our understanding of these constructs and their relationships in male populations. As males are more commonly prone to a muscular, athletic ideal [26], in comparison to females who typically idealize a thin ideal, they may be more likely to engage in a more diverse range of disordered eating and exercise behaviors to achieve this ideal. Furthermore, having a lower BMI, which combines low adiposity and low muscularity, is further away from this large, muscular ideal, meaning that it is unlikely the relationship between BMI and body dissatisfaction is straightforward. Indeed, Austin and colleagues [27], report that while a linear positive relationship between BMI and body dissatisfaction is present in adolescent girls, boys in the sample exhibited a U-shape positive relationship between BMI and body dissatisfaction. Subsequently, research examining body dissatisfaction and eating disorder psychopathology with BMI, must consider the relevance of both ethnicity and culture, as well as gender in these relationships.

Considering the high mortality of both obesity-related illness and eating disorders [28], understanding factors contributing to the development and maintenance of these conditions is an urgent public health concern. While previous research has linked dietary restraint to BMI and disordered eating behaviors, it is not yet evident which factors may mediators of this relationship. As body image dissatisfaction is highly associated with high BMI and body image inflexibility, we propose examining these factors along with dietary restraint in a mediation model, as shown in Fig. 1. Additionally, due to the confounding influence on gender in the relationship between BMI and body dissatisfaction, we will examine indirect effects of gender on the model. Specifically, we aim to investigate:

What are the relationship patterns among four research variables (i.e., BMI, body dissatisfaction, body image inflexibility, dietary restraint) in a sample of young adults in China?

Whether and to what extent body dissatisfaction and body image inflexibility can mediate the relationship between BMI and dietary restraint?

Do males have the same patterns of relationships among the four research variables as females?

Methods

Participants and procedure

The current sample comprised 1068 undergraduate students (M_{age} = 20.11 years, SD = 1.01) and included 563 females and 505 males. Mean BMI, as derived from participants' self-reported height and weight, ranged between 14.30 and

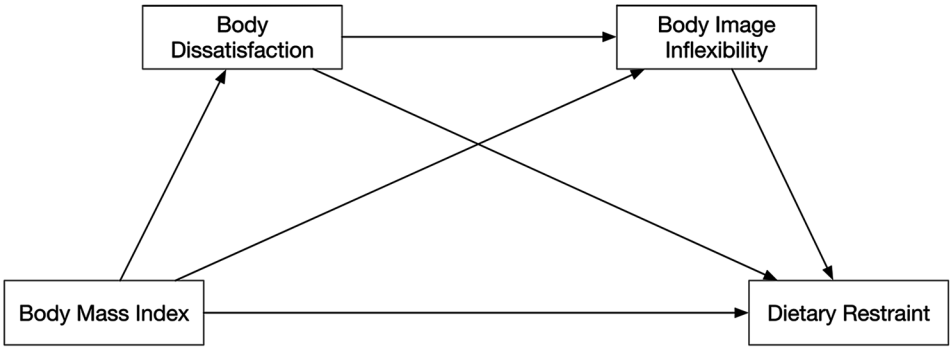

Fig. 1 Conceptual model of the mediation analysis

36.89 kg/m^2 and the sample mean was 21.11 kg/m^2 (3.10). Based on the cutoff values of BMI for Chinese adults [i.e., < 18.5 for underweight, 18.5–23.9 for normal weight, 24–27.9 for overweight, and > 28 for obese; 29], 19.8% of this sample would be categorized as underweight, 63.3% as normal weight, 12.7% as overweight, and 3.3% as obese.

The participants of the current study were recruited from two Chinese universities in Zhejiang province (Southern China) and Liaoning province (Northern China). Before conducting the survey, the study protocol was approved by the Research and Development Administration Office of Hunan University (the corresponding author's previous affiliation). The survey was conducted in a paper-and-pencil format in classroom settings. All participants provided informed consent during the survey. Further details regarding recruitment and sample characteristics can be found in our previous publications [e.g., 30–32].

Measures

Body dissatisfaction

Participants completed the nine-item body dissatisfaction subscale of Eating Disorder Inventory-II (EDI-II) [33]. This scale has previously demonstrated good reliability and validity in empirical studies [13, 16, 34], and has been validated in both female and male samples [35]. Items are rated on the 6-point Likert scale from never to always with higher scores reflect higher levels of body dissatisfaction. In this sample, the scale showed an excellent Cronbach's α of 0.91.

Body image inflexibility

The 12-item Body Image-Acceptance and Action Questionnaire (BI-AAQ) [15] was used to assess body image inflexibility applied in this study. BI-AAQ scores have previously demonstrated exhibited good internal consistency and test–retest reliability [15, 36]. Items are rated on a 7-point Likert scale ranging from 1 (never true) to 7 (always true), with higher scores imply higher levels of body image inflexibility. We found excellent internal consistency for the BI-AAQ with Cronbach's α of 0.94.

Dietary restraint

We used the cognitive restraint (CR) subscale of the Three-Factor Eating Questionnaire-R18 [37] to measure dietary restraint. The TFEQ-R18 has exhibited good construct validity in a sample of young Finnish females [9] and acceptable internal consistency in French adults and teenagers [38]. The subscale asks participants to rate items on a 4-point Likert scale with higher scores reflex higher levels of restrained eating. We found a Cronbach's α of 0.83 in the present study sample, indicating good internal consistency of the scale.

Statistical analyses

Data analyses were carried out on R console 3.6.1 (R Core Team, 2019) using the lavaan [39] and psych [40] packages. As missing data in the sample were generally less than 5% [41], we did not impute missing data. Relationships between variables were examined using Pearson's bivariate correlations. We obtained standardized regression coefficients, by standardizing all variables prior to entering into the mediation analyses. Mediation effects were calculated with 10,000 bootstrapped 95% bias corrected and accelerated (BcA) confidence interval. According to Hayes (2017), if the CI does not include zero, then indirect effects are statistically significant. We also examined differences in the regression coefficients between the mediation model for men and women using multigroup analyses, as described by Lefcheck [42]. Specifically, we set all regression coefficients to be equal between the mediation model of men and women (i.e., restrained model M1), and then we freely estimated all the regression coefficients for the mediation model of men and women (freely estimated model M2). Lastly, we released constraints of the regression coefficients step by step (partial constrained model M3), to freely estimate the regression coefficients for "body dissatisfaction → body image inflexibility" and "body

dissatisfaction → dietary restraint. Fit of each model was compared using Chi-square difference test.

Results

Descriptive and correlational analysis

Descriptive data including means, standard deviations (SD) of the participants' scores of BMI, body dissatisfaction, body image inflexibility, and dietary restraint can be seen in Table 1. While BMI was higher in male participants than female participants, mean ratings of body dissatisfaction, body image inflexibility, and dietary restraint was higher in female respondents. All variables were significantly correlated across both genders, with small to large effects.

Mediation analyses by gender

As shown in Fig. 2, for both men and women, body dissatisfaction and body image inflexibility could fully mediate the relationship between BMI and dietary restraint. Furthermore, results further showed that the mediation model explained 41.4% of the variance in dietary restraint in male participants, compared to 17.4% in female participants.

Indirect effects by gender

Regarding the mediation analysis, we analyzed the indirect effects between BMI and dietary restraint through different paths for both genders. As shown in Table 2, the indirect effects from BMI to dietary restraint via body dissatisfaction and body image inflexibility were statistically significant, with the total indirect effect of 0.277 (95% CI 0.217, 0.339) and 0.151 (95% CI 0.088, 0.220) for men and women, respectively (Table 3).

Model comparisons by gender

Chi-square difference test indicated that that M2 (freely estimated model) had a significant better fit with χ^2 (9) = 259.493 ($p < 0.001$) than M1 (restrained model) indicating that some regression coefficients must vary across gender. M3 (partial constrained mode) freely estimating the regression coefficients for "body dissatisfaction → body image inflexibility" and "body dissatisfaction → dietary

Table 1 Means and standard deviations of key variables by gender

Variable	1	2	3	4
1. BMI	–	.493*** (*n* = 514)	0.287*** (n = 518)	0.229*** (n = 538)
2. Body dissatisfaction	0.519*** (*n* = 464)	–	0.367*** (*n* = 486)	0.256*** (*n* = 503)
3. Body image inflexibility	0.359*** (*n* = 488)	0.514*** (*n* = 461)	–	0.392*** (*n* = 507)
4. Dietary restraint	0.370*** (*n* = 489)	0.513*** (*n* = 468)	0.599*** (*n* = 487)	–
Men (*Mean*)	21.570	29.732	34.812	1.903
Men (*SD*)	3.138	10.518	14.912	0.701
Women (*Mean*)	20.699	36.346	39.382	2.352
Women (*SD*)	3.008	9.350	15.085	0.681

Note: $N = 1068$, 563 women, 505 men; correlations for women are above the diagonal; correlations for men are below the diagonal. ***$p < .001$

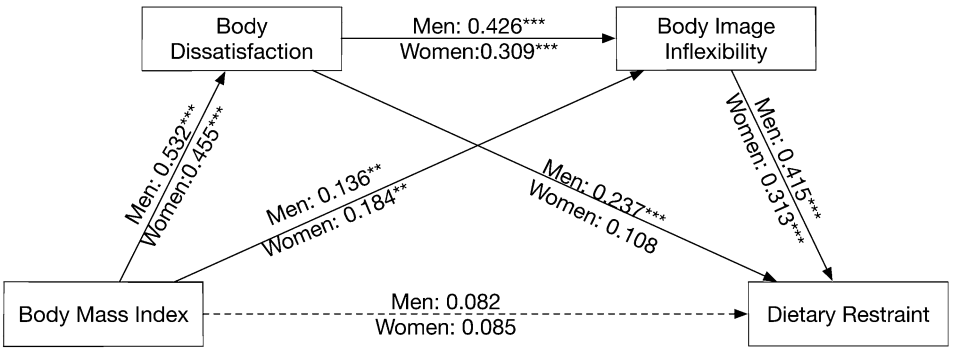

Fig. 2 Regression models of the mediation analysis by gender ($R^2_{male} = 0.414$ and $R^2_{female} = 0.174$)

Table 2 Three pathways of indirect effects for men ($N=453$)

	Point estimates	*SE*	Bootstrapping 95% CI	
			Lower	Upper
Total indirect effect	0.277***	0.032	0.217	0.339
Path 1:				
BMI ↓ Body dissatisfaction ↓ Dietary restraint	0.126***	0.026	0.075	0.179
Path 2:				
BMI ↓ Body image inflexibility ↓ Dietary restraint	0.057*	0.022	0.015	0.102
Path 3:				
BMI ↓ Body dissatisfaction ↓ Body image inflexibility ↓ Dietary restraint	0.094***	0.018	0.062	0.131

Note: $*p<.05$, $**p<.01$, $***p<.001$; *SE* = standardized error; *CI* = confidence interval

Table 3 Three pathways of indirect effects for women ($N=471$)

	Point estimates	*SE*	Bootstrapping 95% CI	
			Lower	Upper
Total indirect effect	0.151***	0.034	0.088	0.220
Path 1:				
BMI ↓ Body dissatisfaction ↓ Dietary restraint	0.049	0.027	−0.002	0.105
Path 2:				
BMI ↓ Body image inflexibility ↓ Dietary restraint	0.057**	0.021	0.021	0.104
Path 3:				
BMI ↓ Body dissatisfaction ↓ Body image inflexibility ↓ Dietary restraint	0.044***	0.012	0.024	0.072

Note: *SE* standardized error; *CI* confidence interval

$p<.05$, $**p<.01$, $***p<.001$;

restraint" showed no significant Chi-square difference to M1, with χ^2 (4) = 5.601 ($p=0.231$). The regression coefficients for the two paths vary by gender. Specifically, as shown in Fig. 2, the regression coefficients for both paths of men were larger than those of women [30].

Discussion

Despite established links between body image inflexibility, dietary restraint, body weight and body dissatisfaction, these relationships have not yet been examined together. Considering the risks of disordered eating behavior as well as obesity-related illness, we investigated whether body image inflexibility and body dissatisfaction mediated the relationship between BMI and dietary restraint in a sample of young Chinese adults. Results of our mediation analyses indicated that body dissatisfaction and body image inflexibility, indeed, could fully mediate the relationship between BMI and dietary restraint.

These results extend on previous literature which has individually supported these relationships [21, 22, 43]. There are many reasons why an individual with a higher BMI may be more prone to feel body dissatisfaction and body image inflexibility, such as weight stigma and health inequities. However, experiencing both of these states appears to be important in motivating a strong weight loss intention [44] and, thus, dietary restraint. As explained by Mancuso [20], body dissatisfaction appears to contribute to an individual feeling reluctant to experience their negative body image (body image inflexibility), and, with this, contributing to an increased likelihood of engaging in dietary restraint or disordered eating behaviors.

Despite good fit for the mediation model in both genders, we did find significant differences in the regression coefficients for men and women. More specifically, while the model explained 41.4% of the variance in dietary restraint in men, it explained only 17.4% of the variance in dietary restraint of women. These findings are consistent with a sample of U.S. college students, where the relationship between disordered eating cognitions and overall disordered eating psychopathology was mediated by body image inflexibility, where gender was controlled [21]. Greater unexplained variance for dietary restraint in females may reflect that the factors leading to dietary restrain in females are more complex than those for males, that is, the potential three factors included in the current study (BMI, body dissatisfaction, and body image inflexibility) are likely for the main reasons for males to restrain their diet, but not for females. This is in line with the previous literature, as there have been numerous studies supporting that the risk factors for disordered eating and body image issues differed by gender (e.g., [45–47]). Therefore, it is very likely that there are a greater range of

influences on dietary restraint in women such as psychological distress [48], body size misperception [49], internalization of the thin ideal [50, 51], and impulsivity [52].

Clinically, findings from this study provide initial support that dietary restraint may be attenuated by addressing body dissatisfaction and body image inflexibility. This is consistent with the use of interventions such as self-compassion and acceptance-based approaches for patients with dietary restraint. For example, Juarascio et al. [53] propose Acceptance and Commitment Therapy for Eating Disorders to build tolerance of distressing cognitions and emotions, such as is difficult for individuals with high body image inflexibility. While Kelly and colleagues (2014) recommend that body image and inflexibility may be improved by learning to practice kindness to one's body and related distress [22]. Further, in this study, Kelly et al. (2014) reported that higher levels of self-compassion were linked to weaker associations between BMI and eating disorder pathology, as well as body image inflexibility [22].

Limitations and strengths

There are several limitations to this study. First, our sample was a homogenous sample of young undergraduate students. While BMI varied highly within our sample, it will be important to replicate results in both older and more diverse samples. Moreover, self-reported height and weight was used to obtain BMI, which has been found to be different from BMI derived from directly measured height and weight [54]; thus, future studies are needed to confirm our findings with BMI based on directly measured height and weight. Additionally, as the data used in the current study was cross sectional, we were unable to test the causal relationships among the variables, and future research should use a longitudinal design or experiments to examine how body image inflexibility and body dissatisfaction interact with dietary restraint and body weight over time.

However, our study did include significant strengths, for example, a large sample of Chinese young adults, a group who has often been overlooked in eating disorder research previously [6]. An additional strength includes our recruitment of both male and female participants to better examine how gender impacts these variables. We hope that this study and its findings will encourage future researchers to examine eating disorder symptomatology and body image in Chinese populations.

Conclusion

This study was aimed to find the relationship patterns among body mass index, body dissatisfaction, body image inflexibility, and dietary restraint in a sample of young adults in China and explore the gender differences. The final results revealed body dissatisfaction and body image inflexibility as mediators of the relationship between body mass index and dietary restraint, and such pattern fit both genders. However, the model predicted greater variance in men, which indicated that other factors may also contribute to dietary restraint in women. These results provide initial support for the development of interventions to address body image dissatisfaction and inflexibility which is consistent with the use of interventions such as self-compassion and acceptance-based approaches for patients with dietary restraint.

What is already known on this subject?

A close relationship has been found between body mass index and dietary restraint. However, the mechanisms of how BMI may relate to dietary restraint still remains largely unknown, especially in Asian countries (e.g., China). Body dissatisfaction and body image inflexibility are two factors that are associated with both BMI and disordered eating behaviors and they could be potential mediators to explain the relationship between BMI and dietary restraint.

What does this study add?

This study revealed that body dissatisfaction and body image inflexibility were mediators of the relationship between body mass index and dietary restraint in a large Chinese young adult sample. Our findings suggest that dietary restraint may be attenuated by addressing body dissatisfaction and body image inflexibility and future interventions target at reducing dietary restraint or other dietary restraint-related disordered eating behaviors may benefit by taking body dissatisfaction and body image inflexibility into consideration to have better intervention outcomes.

Author contributions C. T. led the result interpretation, drafted and revised the manuscript. M.C. helped draft and revise the manuscript. S. W. helped collect the data. J. S. helped revise the manuscript. J. H. performed the statistical analysis and helped draft and revise the manuscript. All authors read and approved the final manuscript.

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

Compliance with ethical standards

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

Ethical approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the research committee of Hunan University (the corresponding author's previous affiliation) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Written informed consent was obtained from all the surveyed participants.

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