

# Psychometric network analysis of the Intuitive Eating Scale-2 in Chinese general adults

Feng Ji<sup>1</sup>  | Hongyi Sun<sup>2</sup>  | Wesley R. Barnhart<sup>3</sup>  |  
Tianxiang Cui<sup>4</sup>  | Shuqi Cui<sup>5</sup>  | Jihong Zhang<sup>6</sup>  | Jinbo He<sup>5</sup> 

<sup>1</sup>Department of Applied Psychology and Human Development, University of Toronto, Toronto, Ontario, Canada

<sup>2</sup>School of Psychology, University of Southampton, Southampton, UK

<sup>3</sup>Department of Psychology, Bowling Green State University, Bowling Green, Ohio, USA

<sup>4</sup>Department of Psychology, University of Macau, Taipa, Macau, China

<sup>5</sup>Division of Applied Psychology, School of Humanities and Social Science, The Chinese University of Hong Kong, Shenzhen, Guangdong, China

<sup>6</sup>Department of Counseling, Leadership and Research Methods, University of Arkansas, Fayetteville, Arkansas, USA

## Correspondence

Jinbo He, School of Humanities and Social Science, The Chinese University of Hong Kong, Shenzhen, Shenzhen 518172, Guangdong, China.

Email: [anlfhe@gmail.com](mailto:anlfhe@gmail.com) and [hejinbo@cuhk.edu.cn](mailto:hejinbo@cuhk.edu.cn)

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## Abstract

The Intuitive Eating Scale-2 (IES-2) is a measure of intuitive eating behaviors that has been extensively validated, with traditional latent variable modeling approaches, in youth and adults from many different populations, including college students in China. However, there is still a lack of research on the psychometric properties of the IES-2 in adults from the Chinese general population. Moreover, psychometric network analysis, as a complement to traditional latent variable modeling approaches, has not been used for examining the psychometric properties of the IES-2. Thus, the present study used a psychometric network approach to evaluate the psychometric properties of the IES-2 in Chinese adults from the general population. A sample of 700 Chinese general adults (50% women;  $M_{\text{age}} = 31.13$  years,  $SD = 9.19$ ) recruited online were included in the present study. Psychometric network analysis was performed. Exploratory graph analysis (EGA) identified four dimensions, which were well separated in the estimated network. The network structure showed excellent stability and metric measurement invariance (i.e., network loadings) across men and women. Furthermore, several items on the IES-2 were identified as key nodes in the network of the IES-2 that may be important for the development and maintenance of intuitive eating. For example, two items (i.e., "I trust my body to tell me when

to eat,” and “I trust my body to tell me when to stop eating”) related to reliance on body cues were the most impactful nodes in the complete network. The findings of our study provide a greater understanding of the IES-2 from the perspective of network analysis and have implications for applications of intuitive eating interventions for general populations.

#### KEYWORDS

Chinese adults, IES-2, intuitive eating, network psychometric analysis

## 1 | INTRODUCTION

Intuitive eating includes an array of adaptive eating behaviors characterized by the reliance on body hunger and satiety cues rather than situational and emotional cues to eat (Tylka, 2006; Tylka & Kroon Van Diest, 2013). Empirical evidence shows that intuitive eating is related to better physical health, such as lower blood pressure, cholesterol levels (van Dyke & Drinkwater, 2014), and cardiovascular risk (Hawks et al., 2005). Also, intuitive eating is associated with better mental health, such as higher well-being (e.g., life satisfaction) and less disordered eating behaviors (Linardon et al., 2021; Markey et al., 2023).

### 1.1 | Intuitive Eating Scale-2

Intuitive eating is mostly measured by the Intuitive Eating Scale-2 (IES-2; Tylka & Kroon Van Diest, 2013). The IES-2 has 23 items and covers the core facets of intuitive eating. In the development study, the IES-2 showed four factors, including Unconditional Permission to Eat (UPE), Eating for Physical Rather Than Emotional Reasons (EPR), Reliance on Hunger and Satiety Cues (RHSC), and Body-Food Choice Congruence (BFCC). The psychometric properties of the IES-2 have been examined in several nonclinical samples from different countries and different gender, age, and ethnic groups (e.g., Bas et al., 2017; Ruzanska & Warschburger, 2017; Saunders et al., 2018; Swami et al., 2020), as well as clinical samples (e.g., breast cancer survivors with overweight or obesity; Nejati et al., 2021). Across these studies, even though the original four-factor structure of the IES-2 (Tylka & Kroon Van Diest, 2013) is frequently replicated (e.g., Bas et al., 2017; Ruzanska & Warschburger, 2017), there are also studies reporting different factor structures in different populations, such as a three-factor structure (Saunders et al., 2018; Swami et al., 2020) and a six-factor structure (Anastasiades et al., 2022; Khalsa et al., 2019). These findings suggest that the dimensionality of the IES-2 may vary in different populations.

### 1.2 | Intuitive eating in the Chinese context

China has a unique food culture (e.g., considers eating as an important activity in establishing and maintaining interpersonal relationships) that is linked to Chinese people's eating behaviors (Ma, 2015). For example, prior research suggests that better friendship quality was correlated with more intuitive eating behaviors in a sample of Chinese adolescents (Chen et al., 2020). Furthermore, higher family cohesion was found to be related to more

intuitive eating behaviors in a sample of Chinese college students (Yang et al., 2023). Currently, the IES-2 has been translated into Chinese Mandarin and its psychometric properties were examined in Chinese college students (Ma et al., 2019). Specifically, Ma et al. (2019) replicated the original four-factor structure of the IES-2 (i.e., UPE, EPR, RHSC, and BFCC) and showed good internal consistency reliability and construct validity in a sample of Chinese college students. However, intuitive eating in general Chinese adults may be different from that of Chinese college students. For example, general Chinese adults were found to have significantly higher hedonic hunger (i.e., food consumption for pleasure in the absence of physical hunger; Lowe & Butryn, 2007) than Chinese college students (Xiao et al., 2023). Also, compared to college students, general adults usually have jobs and more social connections which may correspond to increased eating-related social activities (e.g., social dinners) for establishing and maintaining interpersonal relationships in the Chinese context (Luo, 2000). Thus, given the conceptual overlap between hedonic hunger and intuitive eating, and given socioeconomic status differences between college students and general adults, the psychometric properties of the IES-2 should be further explored in Chinese general adults.

### 1.3 | Psychometric network analysis

To our knowledge, previous validation studies of the IES-2 have focused on traditional latent variable modeling approaches (e.g., exploratory and confirmatory factor analyses; Fekih-Romdhane et al., 2023; Saunders et al., 2018; Swami et al., 2020; Tylka & Kroon Van Diest, 2013). However, traditional latent variable modeling approaches often rely on many parametric and distributional assumptions (e.g., the often unrealistic assumption of local independence between symptoms; Borsboom & Cramer, 2013). In recent years, network psychometrics, as a complement to traditional latent variable modeling approaches, has been increasingly applied in the fields of psychopathology and psychometrics (e.g., Epskamp, Maris, et al., 2018; Smith et al., 2018). Despite the underlying connections between psychometric network analysis and latent variable modeling (Kruis & Maris, 2016), the use of network psychometrics may have certain advantages, such as identifying the network structure of variables (i.e., nodes) and allowing the visualization of the strength of the (partial) correlations between variables (i.e., edges; Hevey, 2018). Thus, psychometric network analysis may provide new perspectives to evaluate the structure and dynamics of psychological tools in mental health settings, including tools for assessing eating behaviors (e.g., Laskowski et al., 2023; Punzi et al., 2023). For example, using psychometric network analysis, Laskowski et al. (2023) revealed that the original factor model of the Eating Disorder Examination-Questionnaire (EDE-Q) might not be optimal for women with EDs; thus, they suggested using different scorings of the EDE-Q in women with EDs for screening purposes or for evaluating the effects of interventions. Similarly, the use of the psychometric network model may be a novel method for providing a better understanding of the dimensionality of the IES-2 and to provide insights for future research on intuitive eating, including the design and improvement of intuitive eating interventions.

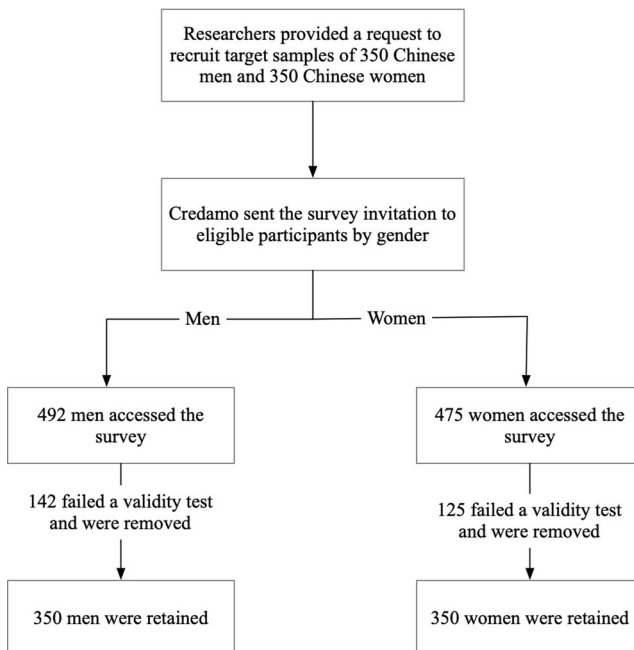
### 1.4 | The present study

To this end, the present study used a psychometric network approach to evaluate the psychometric properties of the IES-2 in Chinese adults from the general adult population. Given the inconsistent evidence regarding the factor structure of the IES-2 in different populations and no prior studies that have explored the factor structure of the IES-2 with psychometric network analysis, we did not make hypotheses about the psychometric properties of the IES-2 in a sample of Chinese general adults. In other words, the present psychometric network analysis was exploratory.

## 2 | METHOD

### 2.1 | Participants and procedure

The data used in the present study were from a project approved by the Institutional Review Board of the Chinese University of Hong Kong, Shenzhen. Participation was restricted to Chinese adults, aged 18 years or above. We used Credamo (<https://www.credamo.com/>), a popular Chinese online survey platform, to recruit a target sample of 700 adults (350 men and 350 women). Previous research demonstrated the validity of data collected on Credamo (Wang et al., 2022). Sample pool registrants received invitations to participate randomly, and all individuals who completed the online survey provided their informed consent. Consistent with previous studies using this platform (e.g., He et al., 2023), we adopted multiple validity tests to ensure data quality, including a voice recording question, a “CAPTCHA” question, two attention checks, and the manual inspection of participants' responses. Specifically, the voice recording question required participants to record the phrase “I agree with all contents in the informed consent and voluntarily participate in the survey,” which was easy for humans but difficult for bots or scripts. The recordings were carefully checked by research assistants and surveys with non-clear recordings or without recordings were removed. The two attention checks (e.g., please choose “strongly agree” for this item) were used to ensure participants provided high-quality and attentive responses. Participants who failed either of the attention checks were removed. Furthermore, research assistants also manually inspected the completed surveys and excluded those with typical careless response patterns (e.g., zig-zag and straight-line patterns). Participants meeting the inclusion criteria and passing the validity tests (i.e., providing clear voice recordings, completing the “CAPTCHA” question, passing the attention checks, and manual inspection) were compensated ¥14. Finally, 492 men and 475 women accessed our survey. After removing those failing the validity tests, 700 adult participants (350 men and 350 women) were retained. Figure 1 describes the sampling process on Credamo. Note that the survey platform only pays participants who completed the survey with valid responses, and users of the survey platform are only



**FIGURE 1** Flowchart of the sampling process on Credamo.

allowed to use data from the participants who get paid. Therefore, there were no missing data in the present data analyses.

Of the 700 participants, the age range of participants was from 18 to 60 years old ( $M = 31.13$  years,  $SD = 9.19$ ). In terms of ethnicity, the majority of participants ( $n = 681$ , 97.3%) were Han, and 2.7% ( $n = 19$ ) were ethnic minorities. For educational levels, 95.1% ( $n = 666$ ) had a college degree or above, and 4.9% ( $n = 34$ ) had a high school education or below. For monthly income, 53.1% ( $n = 372$ ) had monthly income  $< ¥8000$ , and 46.9% ( $n = 328$ ) had monthly income  $\geq ¥8000$ . For marital status, 38.7% ( $n = 271$ ) were unmarried, 60.9% ( $n = 426$ ) were married, and 0.4% ( $n = 3$ ) were divorced or other.

## 2.2 | Measures

### 2.2.1 | Intuitive eating

The Chinese version of the IES-2 was used in the present study (Ma et al., 2019). The IES-2 has four subscales, including UPE, EPR, RHSC, and BFCC. The IES-2 contains 23 items (e.g., "I allow myself to eat what food I desire at the moment") that are rated from 1 (*strongly disagree*) to 5 (*strongly agree*). Seven items are reverse-coded. Except for the subscale scores, a total scale score can also be calculated by averaging the item responses, with higher total scores corresponding to higher levels of intuitive eating. The Chinese version of the IES-2 showed good internal consistency reliability, test-retest reliability, and good construct validity in Chinese young adult women and men (Ma et al., 2019).

### 2.2.2 | Disordered eating

The Chinese version of the short version of the Eating Disorder Examination-Questionnaire (EDE-QS; He et al., 2021) contains 12 items (e.g., "Have you had a sense of having lost control over your eating (at the time that you were eating)?") rated on a four-point Likert scale from 0 (*0 days/not at all*) to 3 (*6-7 days/markedly*). A higher total score represents a higher level of disordered eating. The good internal consistency reliability and construct validity of the EDE-QS were shown in Chinese young adult women and men (He et al., 2021). In the present study, the EDE-QS showed a Cronbach's  $\alpha$  value of .89.

### 2.2.3 | Psychosocial impairment

The Chinese version of the Clinical Impairment Assessment (CIA 3.0; He et al., 2022) was used to measure psychosocial impairment due to eating disorder symptomatology. The CIA 3.0 contains 16 self-report items (e.g., "Over the past 28 days, to what extent have your eating habits, exercising, or feelings about your eating, shape or weight made you upset?") rated from 0 (*not at all*) to 3 (*a lot*). Higher total scores represent higher levels of psychosocial impairment. Adequate internal consistency reliability, test-retest reliability, and construct validity of the CIA 3.0 were reported in Chinese adult women and men (He et al., 2022). In the present study, the CIA 3.0 showed a Cronbach's  $\alpha$  value of .93.

## 2.3 | Statistical analysis

We conducted data analyses using *EGAnet* (Christensen & Golino, 2021; Golino & Christensen, 2019) and *psychonetrics* (Epskamp, 2021) in the R computing environment. For each item in the scale, we examined if there was an observed ceiling/floor effect following the criterion discussed (Terwee et al., 2007). Specifically, floor/ceiling

effects are present when 15 percentage points more than the expected percentage points based on a uniform distribution of participants are seen to select a certain category. For example, it means that for a five-point Likert scale, if there are more than 35% (20% + 15%) of participants selecting the first and last category, then it indicates that there is a potential floor/ceiling effect.

We evaluated the psychometric properties of the current scale using a series of techniques from the network psychometrics literature (Epskamp, Borsboom, et al., 2018). First, according to prior literature (Christensen & Golino, 2021; Mazumder & Hastie, 2012), we fitted a Graphical Least Absolute Shrinkage and Selection Operator based on our sample polychoric correlation matrix. We plotted the psychometric network of all nodes with the Fruchterman-Reingold algorithm, which helps indicate how strong the associations are among nodes via the spatial distance between nodes. Measurement invariance is important to ensure generalizability and comparability across different groups. To this end, we followed the procedure documented by Jamison et al. (2022) to test measurement invariance in the framework of network psychometrics. To provide more evidence for construct validity, we examined the associations of the scores on the IES-2 with psychosocial impairment as measured by the CIA 3.0 and disordered eating as measured by the EDE-QS. Disordered eating and psychosocial impairment were selected given their theoretical relevance to intuitive eating via negative associations (Linardon et al., 2021; Martin-Wagar & Heppner, 2023). Additionally, we conducted another network analysis incorporating the individual items of the IES-2 and the total scores of the CIA 3.0 (psychosocial impairment) and EDE-QS (disordered eating) to explore the network connections between items of the IES-2 and the constructs of psychosocial impairment and disordered eating.

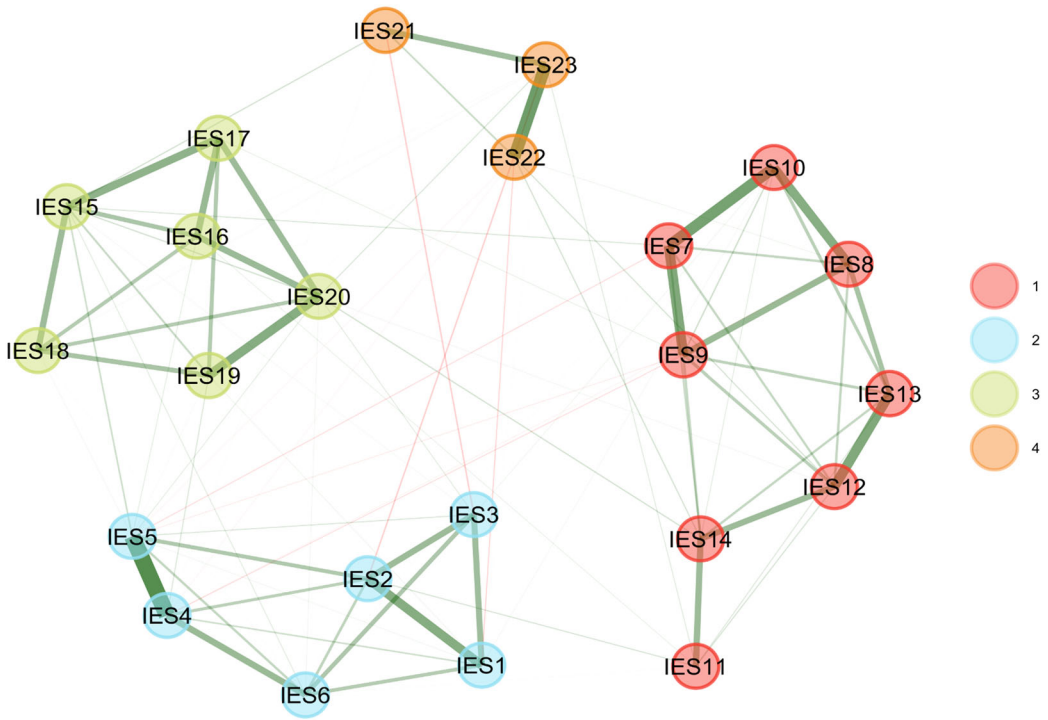
### 3 | RESULTS

#### 3.1 | Response categories

We checked each item and did not observe any ceiling/floor effects using the criterion defined in Section 2.3, which also fulfilled the partial requirement of psychometric network analysis.

#### 3.2 | Network psychometrics and EGA

As shown in Figure 2, EGA identified four dimensions that were well separated in the estimated network and this factor structure was also consistent with the original development of the scale (Tylka & Kroon Van Diest, 2013). The network properties of each node are summarized in Figure 3. Specifically, we summarized normalized Bridge Betweenness, Bridge Strength, and Bridge Closeness (referred to as Betweenness, Strength, and Closeness for simplicity below), where Strength is denoted as the aggregate of the absolute values of all edges that occur between a certain node A and all other nodes that are not part of the same cluster as node A. Betweenness refers to the count of instances where a node B falls on the shortest route between nodes A and C, where A and C belong to separate clusters. Closeness is represented as the reciprocal of the mean length of the route from a particular node A to all other nodes that do not share the same cluster as node A. All three dimensions quantify how important one node is in a given network. We reported items that are above 80 quantiles for all three dimensions as potentially important items. For both Strength (denoted as  $s$ ) and Betweenness (denoted as  $b$ ), we identified the same set of items: Item 5 ("I allow myself to eat what food I desire at the moment";  $s = 0.18$ ,  $b = 0.06$ ), Item 4 ("If I am craving a certain food, I allow myself to have it";  $s = 0.17$ ,  $b = 0.17$ ), Item 15 ("I trust my body to tell me when to eat";  $s = 0.16$ ,  $b = 0.16$ ), and Item 20 ("I trust my body to tell me when to stop eating";  $s = 0.16$ ,  $b = 0.16$ ). For Closeness (denoted as  $c$ ), we identified Item 15 ( $c = 0.15$ ), Item 20 ( $c = 0.15$ ), Item 16 ("I trust my body to tell me what to eat";  $c = 0.13$ ), and Item 17 ("I trust my body to tell me how much to eat";  $c = 0.13$ ), for which both Items 15 and 20 were also revealed in the other two network metrics. Therefore, Items 15 and 20 were the most impactful nodes in the



**FIGURE 2** A psychometric network of all items in the scale. Positive edges are displayed as green, while negative edges are in red; thicker lines represent a larger magnitude of connections; Intuitive Eating Scale 1, 2, 3, 7, 8, 9, and 10 were reverse-coded.

complete network, and Items 4, 5, 16, and 17 were also important nodes. The estimates of Strength, Betweenness, and Closeness for all items are shown in Table 1.

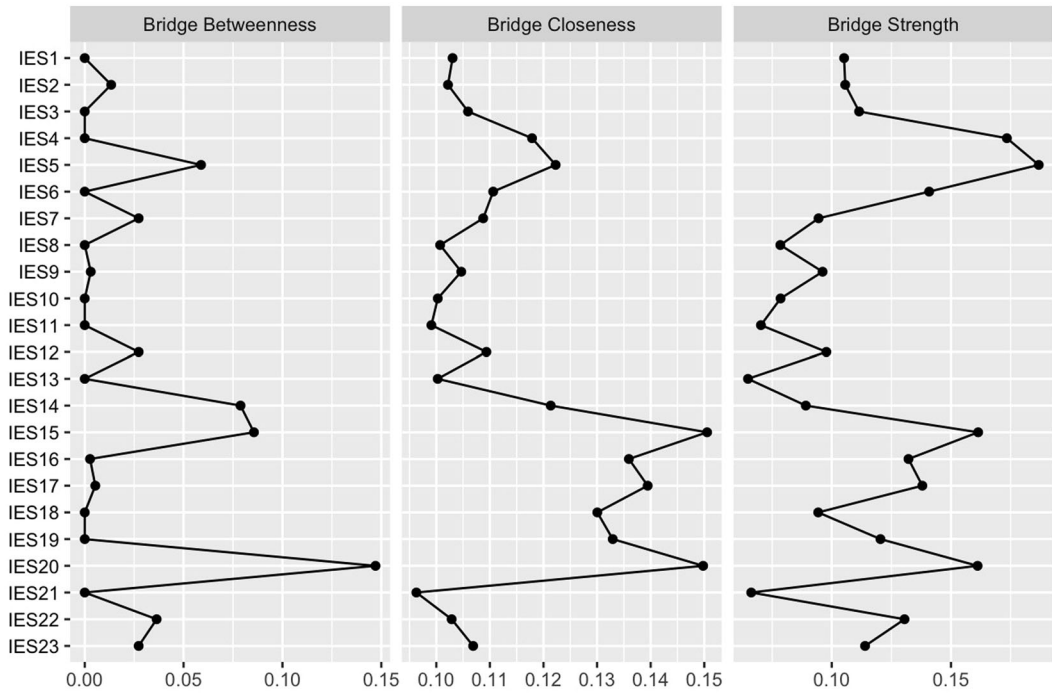
A bootstrap resampling process and corresponding item stability analysis were also performed to assess the stability of these results, with all items showing excellent stability, ranging from 0.99 to 1, as shown in Figure 4. The stability of this structure also shows evidence for configural invariance across men and women (Jamison et al., 2022), which means the same set of nodes have been partitioned into the same communities across different groups in network psychometrics.

### 3.3 | Network loadings

Figure 5 shows the estimated network loadings. It is easy to see and also consistent with the above dimensionality analysis that the items have high edge weights on the corresponding dimension and low edge weights on other dimensions, except for Item 11, whose edge weight on dimension 1 is moderate in size (0.11), although much higher than the other three dimensions.

### 3.4 | Network measurement invariance across women and men

Currently, only the approach of metric invariance is available in the framework of psychometric network analysis, so we applied the newly proposed procedure (Jamison et al., 2022) based on running the permutation test on network loadings



**FIGURE 3** Summary of network properties of each node. Intuitive Eating Scale 1, 2, 3, 7, 8, 9, and 10 were reverse-coded.

to test metric variance and summarized the results in Table 2. In following the original methodological paper, we also conducted a Benjamin–Hochberg correction for adjusting the multiple testing to ensure a nominal false-positive rate. Results showed that there were no gender differences in terms of network loadings on the items of the IES-2.

### 3.5 | Construct validity

We examined the construct validity of the IES-2 with other theoretically-related constructs of disordered eating and psychosocial impairment (i.e., the EDE-QS and CIA 3.0) that are believed to display negative associations with intuitive eating (see Table 3). Both Pearson's correlation and psychometric network analysis yielded similar results: both the IES-2 total and subscale scores were significantly and negatively correlated with the EDE-QS and the CIA 3.0, providing evidence for the construct validity of this measure in the Chinese general adults.

### 3.6 | Network analysis of items on the IES-2 with disordered eating and psychosocial impairment

To investigate the item-level correlations, Figure 6 shows the psychometric network analysis results, including the items on the IES-2 and total scores of the CIA 3.0 (ciat) and the EDE-QS (edeqst). Item 1 (“I try to avoid certain foods high in fat, carbohydrates, or calories”; reverse-coded) and Item 3 (“I get mad at myself for eating something unhealthy”; reverse-coded) were found to be strongly and negatively associated with the total scores of the CIA 3.0 and the EDE-QS. Furthermore, the two total scores are clustered into the same dimension as Items 1–6, which constitute the subscale of EPR.



**TABLE 1** Normalized network property metrics for every node (item).

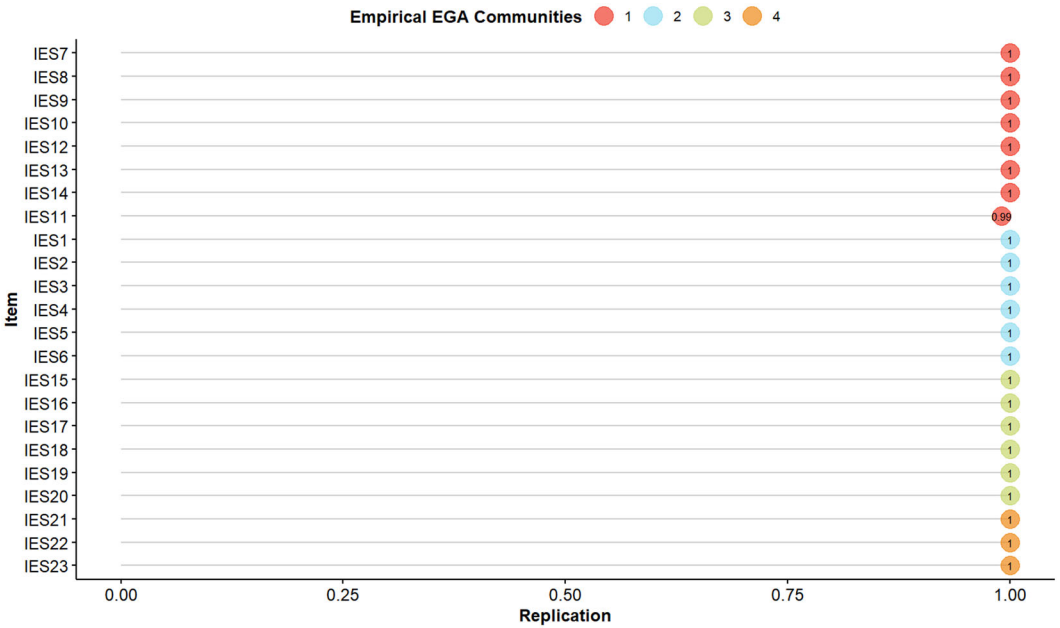
Node	Strength	Betweenness	Closeness
IES1. I try to avoid certain foods high in fat, carbohydrates, or calories. <sup>a</sup>	0.11	0	0.10
IES2. I have forbidden foods that I don't allow myself to eat. <sup>a</sup>	0.11	0.01	0.10
IES3. I get mad at myself for eating something unhealthy. <sup>a</sup>	0.11	0	0.11
IES4. If I am craving a certain food, I allow myself to have it.	0.17	0	0.12
IES5. I allow myself to eat what food I desire at the moment.	0.19	0.06	0.12
IES6. I do NOT follow eating rules or dieting plans that dictate what, when, and/or how much to eat.	0.14	0	0.11
IES7. I find myself eating when I'm feeling emotional (e.g., anxious, depressed, sad), even when I'm not physically hungry. <sup>a</sup>	0.09	0.03	0.11
IES8. I find myself eating when I am lonely, even when I'm not physically hungry. <sup>a</sup>	0.08	0	0.10
IES9. I use food to help me soothe my negative emotions. <sup>a</sup>	0.10	0	0.10
IES10. I find myself eating when I am stressed out, even when I'm not physically hungry. <sup>a</sup>	0.08	0	0.10
IES11. I am able to cope with my negative emotions (e.g., anxiety, sadness) without turning to food for comfort.	0.07	0	0.10
IES12. When I am bored, I do NOT eat just for something to do.	0.10	0.03	0.11
IES13. When I am lonely, I do NOT turn to food for comfort.	0.06	0	0.10
IES14. I find other ways to cope with stress and anxiety than by eating.	0.09	0.08	0.12
IES15. I trust my body to tell me when to eat.	0.16	0.09	0.15
IES16. I trust my body to tell me what to eat.	0.13	0	0.14
IES17. I trust my body to tell me how much to eat.	0.14	0.01	0.14
IES18. I rely on my hunger signals to tell me when to eat.	0.09	0	0.13
IES19. I rely on my fullness (satiety) signals to tell me when to stop eating.	0.12	0	0.13
IES20. I trust my body to tell me when to stop eating.	0.16	0.15	0.15
IES21. Most of the time, I desire to eat nutritious foods.	0.07	0	0.10
IES22. I mostly eat foods that make my body perform efficiently (well).	0.13	0.04	0.10
IES23. I mostly eat foods that give my body energy and stamina.	0.11	0.03	0.11

Abbreviation: IES, Intuitive Eating Scale.

<sup>a</sup>indicates an item with reverse scoring.

## 4 | DISCUSSION

The present study, to our knowledge, represents the first effort to use psychometric network analysis to evaluate the measurement of the IES-2. With an adult sample from the general population in China, we explored the network structure of the IES-2. The estimated network showed good separation between the four dimensions (i.e., EPR, BFCC, UPE, and RHSC). Furthermore, the stability of the network psychometrics and EGA result was tested and showed stability in all the items. Findings regarding the construct validity of the IES-2 were supported via negative



**FIGURE 4** Item stability of the Intuitive Eating Scale-2 (IES-2) items. IES1, 2, 3, 7, 8, 9, and 10 were reverse-coded. EGA, Exploratory graph analysis.

Item	Dimension 1	Dimension 2	Dimension 3	Dimension 4
IES1	0.01	0.32	0.01	-0.04
IES2	0.01	0.38	0.00	-0.04
IES3	0.01	0.27	0.02	-0.04
IES4	-0.02	0.42	0.02	0.00
IES5	-0.02	0.37	0.06	-0.01
IES6	0.00	0.30	0.03	0.00
IES7	0.37	-0.02	0.01	0.00
IES8	0.35	0.00	0.00	0.01
IES9	0.36	-0.02	0.01	0.00
IES10	0.35	0.02	0.00	0.00
IES12	0.34	0.00	0.01	0.03
IES13	0.33	0.00	0.01	0.00
IES14	0.27	0.00	0.02	0.03
IES11	0.11	0.02	0.01	0.03
IES15	0.02	0.05	0.34	0.04
IES16	0.01	0.01	0.33	0.02
IES17	0.01	0.00	0.38	0.01
IES18	0.00	0.01	0.29	0.02
IES19	0.00	0.03	0.31	0.02
IES20	0.03	0.03	0.41	0.02
IES21	0.00	-0.01	0.03	0.20
IES22	0.04	-0.03	0.01	0.36
IES23	0.01	-0.03	0.04	0.46

**FIGURE 5** Network loadings. Intuitive Eating Scale 1, 2, 3, 7, 8, 9, and 10 were reverse-coded.

correlations between the scores of the IES-2 and psychosocial impairment related to eating disorder symptomatology and disordered eating.

The four-dimensional structure of the Chinese IES-2 identified by EGA in the present study was consistent with the four-factor structure identified in Chinese college students with the traditional latent variable modeling

**TABLE 2** Metric invariance analysis regarding gender differences in the psychometric network analysis framework, *p*-value adjusted for multiple testing.

Node	Dimension	Difference	Adjusted <i>p</i> -values
IES1 <sup>a</sup>	1	0.07	.345
IES2 <sup>a</sup>	1	0.00	.993
IES3 <sup>a</sup>	1	0.06	.352
IES4	1	-0.00	.998
IES5	1	-0.02	.993
IES6	1	0.01	.993
IES7 <sup>a</sup>	2	-0.01	.993
IES8 <sup>a</sup>	2	0.07	.345
IES9 <sup>a</sup>	2	0.01	.993
IES10 <sup>a</sup>	2	0.02	.993
IES11	2	-0.06	.345
IES12	2	0.01	.993
IES13	2	-0.04	.993
IES14	2	-0.07	.345
IES15	3	-0.06	.345
IES16	3	-0.07	.345
IES17	3	-0.09	.345
IES18	3	0.03	.953
IES19	3	-0.01	.993
IES20	3	0.01	.993
IES21	4	0.00	.993
IES22	4	-0.11	.352
IES23	4	0.00	.993

Abbreviation: IES, Intuitive Eating Scale.

<sup>a</sup>indicates an item with reverse scoring.

approach (Ma et al., 2019). As discussed in Section 1, there could be differences in intuitive eating between Chinese college students and general adults in the context of Chinese food culture (Ma, 2015). A potential explanation is that the differences in intuitive eating between Chinese college students and general adults may not be at the factor structure level of the IES-2, but at the factor-score level of the IES-2. Indeed, Xiao et al. (2023) found that the Power of Food Scale (PFS; Lowe et al., 2009) for assessing hedonic hunger (a construct closely related to intuitive eating) showed consistent factor structures across Chinese college students and general adults, but college students had significantly lower factor means on the PFS than general adults. Thus, future studies are needed to include both Chinese college students and general adults to test this postulation.

The result of the bootstrap resampling process and corresponding item stability analysis showed excellent stability and configural invariance in the present study. Moreover, only a few studies have examined the gender invariance of the IES-2 (e.g., Fekih-Romdhane et al., 2023; Swami et al., 2021; Tylka & Kroon Van Diest, 2013) and

**TABLE 3** Correlation tables of subscales and total scores of the IES-2 with the total scores on the CIA 3.0 and the EDE-QS.

Variables	1	2	3	4	5	6
1. CIA 3.0						
2. EDE-QS	0.74*** [0.70, 0.77]					
3. IES_Total	-0.49*** [-0.54, -0.43]	-0.55*** [-0.60, -0.49]				
4. IES_EPR	-0.28*** [-0.34, -0.21]	-0.30*** [-0.36, -0.23]	0.66*** [0.62, 0.70]			
5. IES_B-FCC	0.07 [-0.00, 0.14]	0.08* [0.00, 0.15]	0.25*** [0.18, 0.32]	0.15*** [0.08, 0.22]		
6. IES_UPE	-0.43*** [-0.49, -0.37]	-0.49*** [-0.54, -0.43]	0.54*** [0.48, 0.59]	-0.09* [-0.16, -0.02]	-0.18*** [-0.25, -0.11]	
7. IES_RHSC	-0.29*** [-0.36, -0.22]	-0.33*** [-0.40, -0.26]	0.69*** [0.65, 0.73]	0.13*** [0.05, 0.20]	0.16*** [0.09, 0.23]	0.35*** [0.28, 0.41]

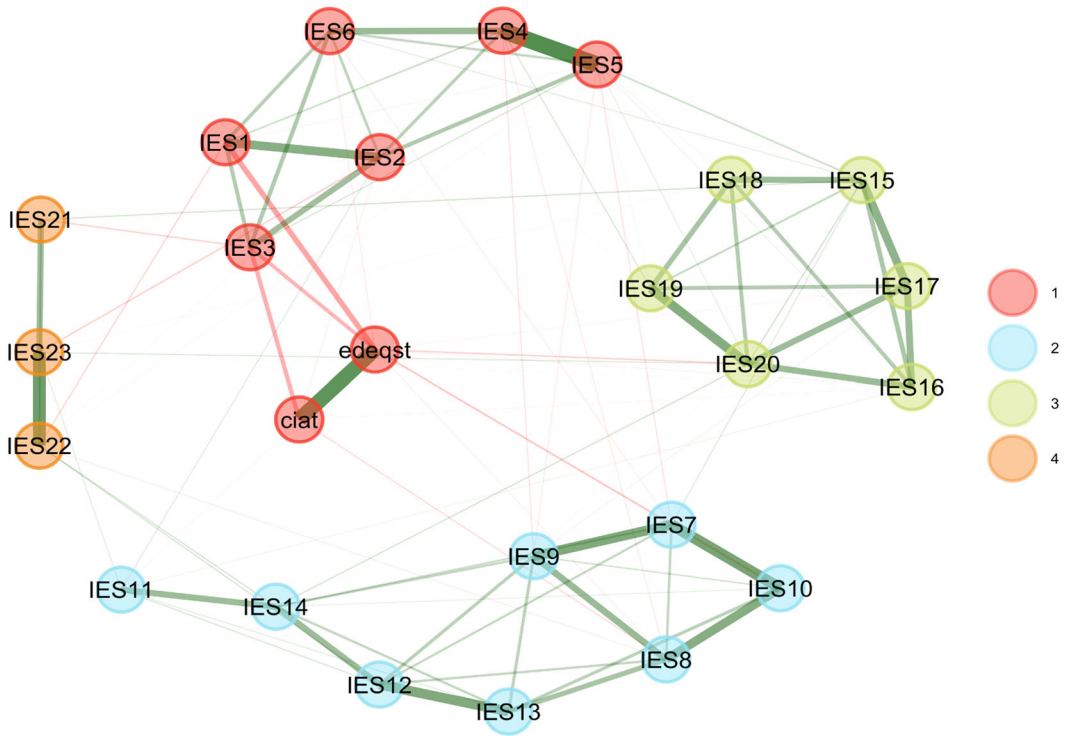
Note: Values in square brackets indicate the 95% confidence intervals for each correlation.

Abbreviations: CIA 3.0, Clinical Impairment Assessment 3.0, EDE-QS, 12-item Short Form of the Eating Disorder Examination-Questionnaire; IES\_B-FCC, Intuitive Eating Scale\_Body-Food Choice Congruence; IES\_EPR, Intuitive Eating Scale\_Eating for Physical Rather Than Emotional Reasons; IES\_RHSC, Intuitive Eating Scale\_Reliance on Hunger and Satiety Cues; IES\_UPE, Intuitive Eating Scale\_Unconditional Permission to Eat.

\* $p < .05$ ; \*\*\* $p < .001$ .

no previous study has presented the measurement invariance of the IES-2 in Chinese populations. There were no gender differences in terms of metric invariance found in the present study, which indicates the network loadings of the IES-2 are invariant across Chinese women and men. Put another way, these findings suggest that intuitive eating as assessed by the IES-2 is a viable tool to capture gender differences in this adaptive eating behavior in China. However, it should be noted that different from traditional latent variable modeling approaches (e.g., factor analyses), only metric invariance in network loadings is currently available for testing measurement invariance in the network psychometrics framework (Jamison et al., 2022). This is important considering the philosophical and underlying methodological differences in how measurement invariance is defined and conceptualized (e.g., Kruis & Maris, 2016). Thus, when stricter invariance in psychometric network analysis becomes methodologically available and philosophically clear, future research can be conducted to test stricter invariance (e.g., scalar invariance) of the IES-2 via psychometric network analysis to replicate and expand on the present study.

Importantly, the results of network analysis of the IES-2 identified two key nodes (i.e., Items 15 and 20) in the whole network structure, and both nodes are from the same domain (i.e., RHSC). Furthermore, another two items (i.e., Items 16 and 17) from the RHSC also showed high levels of strength and closeness in the structure. Taken together, though speculative, these findings may suggest the potential importance of RHSC to develop and maintain intuitive eating in the Chinese general adult population, which is also consistent with the core feature of intuitive eating that emphasizes the central role of focusing on physical hunger and satiety cues to guide eating behaviors (Tylka, 2006). Future research adopting experimental and longitudinal designs will be needed to further investigate the causative and temporal order of RHSC in the development and maintenance of intuitive eating. Furthermore, Items 4 and 5 from the UPE domain not only showed high levels of strength and closeness but also had the largest negative associations with the total scores of



**FIGURE 6** Psychometric network analysis of the Intuitive Eating Scale-2 (IES-2) and the total scores of the 12-item Short Form of the Eating Disorder Examination-Questionnaire and the Clinical Impairment Assessment 3.0. IES1, 2, 3, 7, 8, 9, and 10 were reverse-coded.

the CIA 3.0 and the EDE-QS. Moreover, the items of the UPE and the total scores of the CIA 3.0 and the EDE-QS were grouped into one group, indicating UPE as a potential facet of intuitive eating related to less disordered eating behaviors and lower psychosocial impairment due to eating disorder symptomatology.

The findings of the present study have several implications. First, the validity and reliability of the Chinese version of the IES-2 have been further extended to the general population, providing a theoretical basis for future studies focusing on intuitive eating and its health correlates in the Chinese general adult population. Second, the gender invariance further ensures the certainty of using the IES-2 in the assessment of gender differences in the Chinese general adult population. Finally, we identified key nodes and bridges in the network structure that can potentially inform future intuitive eating interventions. For example, regarding the most impactful nodes of Item 15 and Item 20 from the RHSC, interventions for intuitive eating in Chinese populations (e.g., Cheng et al., 2022) may consider attending to participants' awareness and reliance on physical hunger and satiety cues in the service of supporting the development and/or maintenance of intuitive eating. Still, as noted above, findings should be considered tentative and call for future replication studies using experimental and longitudinal designs to validate these theoretical pathways between hunger and satiety cues and intuitive eating.

#### 4.1 | Strengths, limitations, and future research directions

The present work has significant strengths, including being the first study to explore the psychometric properties (e.g., construct validity) of the IES-2 with psychometric network analysis, identification of influential nodes on the

IES-2, and the inclusion of adults from the general Chinese population. Strengths aside, there are limitations and future research directions. First, data reflected participants' self-reports, which may suffer from subjective biases. Thus, future studies could use more objective data collection methods such as clinical measurements to get more unbiased results. Second, because Credamo does not allow users to access data from unpaid participants, we were unable to examine if there were any demographic differences between the included participants and those who were excluded due to failure on the validity tests (e.g., attention checks). Thus, future studies may consider testing these differences. Third, due to the current methodological development of psychometric network analysis, we only tested the metric invariance of the IES-2 defined in the psychometric network analysis framework. Fourth, the present study used a cross-sectional design, which prevents detecting directional or causal relations. Thus, carefully designed longitudinal studies and randomized controlled trials about intuitive eating should be conducted to determine the directionality and causality (e.g., the link between the UPE domain and disordered eating behaviors) in the service of improving and refining existing prevention and treatment designs. Finally, the sample in the present study collected from Credamo might not be representative of the entire Chinese general population (e.g., 95.1% of the participants had a college degree or above). Thus, the study needs to be replicated in samples with better representativeness of the Chinese general adult population.

## 5 | CONCLUSION

In conclusion, this study provided evidence for the good psychometric properties of the IES-2 in the Chinese general adult population. Moreover, we found that the network structure of the IES-2 was consistent with the classification of the original scale and identified key bridging nodes in the IES-2 network structure that may inform future intuitive eating interventions in the Chinese general adult population.

### AUTHOR CONTRIBUTIONS

**Feng Ji:** Conceptualization; formal analysis; writing—original draft; writing—review and editing. **Hongyi Sun:** Writing—original draft; writing—review and editing. **Wesley R. Barnhart:** Writing—review and editing. **Tianxiang Cui:** Writing—original draft; writing—review and editing. **Suiqi Cui:** Writing—review and editing. **Jihong Zhang:** Writing—review and editing. **Jinbo He:** Conceptualization; supervision; funding acquisition; project administration; investigation; writing—original draft; writing—review and editing.

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### CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### ETHICS STATEMENT

The ethical approval was obtained from the Institutional Review Board of the Chinese University of Hong Kong, Shenzhen (No. EF20220509002). Informed consent was obtained from all the participants.

## ORCID

- Feng Ji  <http://orcid.org/0000-0002-2051-5453>
- Hongyi Sun  <http://orcid.org/0000-0002-7229-9019>
- Wesley R. Barnhart  <http://orcid.org/0000-0002-9809-5225>
- Tianxiang Cui  <http://orcid.org/0000-0003-2826-1109>
- Shuqi Cui  <http://orcid.org/0000-0002-4929-5167>
- Jihong Zhang  <http://orcid.org/0000-0003-2820-3734>
- Jinbo He  <http://orcid.org/0000-0002-2785-9371>

## PEER REVIEW

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