Abstract

The Body Image Concern Inventory (BICI) was developed to assess dysmorphic appearance concern and has been found to be a reliable and valid instrument in Western societies. To examine the psychometric properties of a new Chinese BICI, the BICI was administered to 1,231 Chinese young adults (Study 1) and 47 female patients with eating disorders and 56 matched controls (ED; Study 2). In study 1, Cronbach's alpha of .92 and test-retest reliability of .73 over a 6-month interval was observed for the total scale. Confirmatory factor analysis supported a 3-factor model for the BICI: avoidant behaviors (AB), safety behaviors against perceived flaws (SB), and negative appearance evaluation (NE). In study 2, ED patients scored significantly higher on the BICI total and three subscale scores than the controls. In addition, AB best differentiated ED patients and matched controls (Cohen's $d = 1.52$); SB best differentiated between the non-clinical female and male groups (Cohen's $d = 0.75$); NE was most closely associated with level of negative affect and subjective well-being (inverse relationship) in both clinical and non-clinical groups. In conclusion, the Chinese BICI is a reliable and valid tool for evaluating dysmorphic appearance concern in Chinese settings.

Keywords: body image; eating disorders; Body Image Concern Inventory (BICI); reliability; validity

Body image concern exists on a continuum (Callaghan, Lopez, Wong, Northcross, & Anderson, 2011). Individuals with high levels of body image concern (also labeled dysmorphic appearance concern) are dissatisfied with various aspects of their appearance as well as engage in checking behaviors, including weighing and measuring themselves and examining their bodies. They may also try to camouflage their perceived flaws, engage in frequent comparisons of their appearance to others, seek reassurance from others about their appearance, and avoid social activities due to fears that others will notice their perceived appearance defect (s) (Littleton & Breitkopf, 2008). Thus, body image concern is a much broader construct than body (dis)satisfaction, encompassing evaluative, cognitive, behavioral, and social components.

Among patient groups, experiencing high levels of body image concern has been linked to eating disorders and body dysmorphic disorder (American Psychiatric Association, 2013). However, recent studies have suggested that high levels of body image concern is also frequently observed among those with other psychological disorders a well as physical health conditions, including breast cancer, schizophrenia and social anxiety (Lewer, Bauer, Hartmann, & Vocks, 2017; van de Grift, Cohen-Kettenis, de Vries, & Kreukels, 2018; Zhou et al., 2018). Thus, body image concern may be an important area of clinical concern among a greater number of individuals than previously considered.

In the general population, there is clear evidence that many individuals, particularly women, demonstrate some level of body image concern. Body image concern has been observed among postpartum women (Lovering, Rodgers, George, & Franko, 2018), as well as among adolescent and young adult women and men. For example, a survey of

Australian youth between the ages of 15 and 19 found that approximately 30%

experienced major concerns about their body image (Mission Australia, 2017). Similarly,

35% of female college students in the United Kingdom reported elevated body image

concern (Ansari, Dibba, Labeeb, & Stock, 2014). Body image concern is also an issue in

China (Xu, Mellor, Kiehne, Ricciardelli, McCabe & Xu). For example, in a survey of

college students in Beijing, China, 73% of women and 46% of men endorsed that they

wished to have a slimmer figure (Wang et al., 2018). Similar results were found in

another recent study of Chinese college students (Wang et al., 2020). As expected, body

dissatisfaction was negatively associated with self-esteem and positively with negative

affect and disordered eating among Chinese adults (Wang et al., 2018; Wang et al., 2020;

Yu et al., 2020). Among a sample of Chinese medical students, one-third endorsed body

image concern not related to their current weight (Liao et al., 2009). Additionally,

Chinese adolescents endorsed experiencing pressure from peers, family, and the media to

maintain a certain weight/appearance, and the perception of pressure from these sources

was associated with greater body dissatisfaction (Xu et al., 2010). Finally, eating disorder

pathology is increasingly common in China, and is associated with high levels of

dysmorphic appearance concern, as has been found in Western samples (Jackson & Chen,

2007).Thus, body image concern may be an ignored but important facet of public health

risk in China, and as such, measures to assess this construct in Chinese populations are

necessary.

There is some existing research seeking to develop body image concern measures

for Chinese samples. One promising recently developed measure is the 24 item Body

Image Concern Scale (He et al., 2017). This measure, with six subscales, demonstrated

adequate to good internal consistency among a sample of Chinese college students (He et al., 2017). Its clinical utility has also been supported in patients with body dysmorphic disorder (He et al., 2018). However, the reliability, validity, and cross-cultural utility of this instrument is not yet available. In addition, Chinese versions of body image concern measures for breast cancer patients and patients with symptomatic pelvic organ prolapse have also been developed (Zhou et al., 2018; Zhu et al., 2015). While results supported reliability and validity of these scales, the items are likely not be relevant to the experiences of individuals without these conditions, and thus, the measures are unlikely to be useful in assessing body image concern more broadly.

While not yet evaluated among Chinese samples, the Body Image Concern Inventory (BICI) is a free, widely available, brief measure of dysmorphic appearance concern that has demonstrated good cross-cultural validity and may represent a potentially useful measure for assessing body image concern in Chinese samples. First developed by Littleton and colleagues (2005), the 19-item BICI is a brief self-report measure designed to capture the multiple facets of dysmorphic appearance concern, including appearance dissatisfaction, checking and camouflaging of a perceived appearance defect(s), reassurance seeking related to one's perceived appearance flaws/defects, and avoidance behaviors due to appearance concerns. This measure has been translated and validated in Japan (Tanaka, Arimura, & Tayama, 2011), among Spanish speaking Mexican and Mexican American women in the United States (Littleton & Breitkopf, 2008), in the Netherlands (Maaren et al., 2014), and in Italy (Luca, Giannini, Gori, & Littleton, 2011). BICI scores have been found to correlate with measures of eating disorder symptomology (Littleton, Axsom, & Pury, 2005; Luca et al.,

2011) and general distress (Littleton & Breitkopf, 2008). BICI scores also differentiated individuals with bulimia or body dysmorphic disorder (BDD) from those with subclinical levels of BDD or eating disorders (Littleton et al., 2005) and patients with BDD from healthy controls (Maaren et al., 2014). Regarding internal consistency of the BICI, Cronbach's alphas of .90 or above for overall scores have been consistently found across samples (Littleton et al., 2005; Littleton & Breitkopf, 2008; Luca et al., 2011; Maaren et al., 2014; Tanaka et al., 2011; Tanaka & Tayama, 2013). Additionally, a test-retest reliability of .88 for the total score was found among university students in Japan over a three-week interval (Tanaka et al., 2011). Previous studies generally found that women score higher on the BICI than men (Luca et al., 2011; Maaren et al., 2014; Tanaka et al., 2011), consistent with research supporting that women are more likely to endorse body image concern.

The factor structure of the BICI, nevertheless, was found to be inconsistent across cultures. Based on the results of exploratory factor structure analyses (EFA), a one-factor structure of the BICI measuring "general body image concern" was suggested by Littleton and colleagues (2005). A two-factor structure, with a primary 12-item "dysmorphic symptoms" and a much smaller 7-item "symptom interference" factor was later found using the Italian and Spanish versions (Littleton et al., 2008, Luca et al., 2011). For the Japanese version of the BICI (Tanaka et al., 2011), a unique three-factor structure was reported consisting of "safety behaviors against perceived flaws (SB)", "avoidant behaviors (AB)", and "negative evaluation of appearance (NE)." Of note, all items loading on AB in the three-factor model were the same as those loading on the "symptom interference" factor in the two-factor model (with the exception of item 3).

The other two factors, SB and NE, can be viewed as two types of behaviors that can be part of the "dysmorphic symptoms" factor in the two-factor models. Thus, the different structures should not be viewed as a limitation of the tool, but instead they may represent cultural sensitivity of this measure. Indeed, body dissatisfaction has been found to vary cross ethnic groups and cultures (Jung & Lee, 2006), with cultural factors such as collectivism-individualism influencing the nature of body image concerns (Cordero, 2011). It is also possible that the underlying structure of body image concern in different cultures may show subtle variations. For example, a three-factor structure including social avoidance, social distress and negative affect, instead of a general main factor of self-consciousness of appearance was revealed in the Derriford Appearance Scale validated in Taiwan (Moss, Lawson & Liu, 2015).

The primary aim of the current study was to investigate the psychometric properties and clinical utility of a newly developed Chinese BICI. In Study 1, the factor structure of the Chinese BICI was first examined with confirmatory factor analyses (CFA) within a large online sample. Second, the internal consistency and six-month test-retest reliability of subscales of the CFA-suggested model and total scale score were examined. Body image can be conceptualized at state and trait levels (Moffitt, Neumann, & Williamson, 2020). BICI, which was developed to assess the symptomatology of body image concern observed at clinical (patients with body dysmorphic disorder and with eating disorders) and subclinical levels (Littleton, Axsom, & Pury, 2005), taps more trait than state of body image. Stability of body dysmorphic symptoms over 1 year or even longer has been reported in longitudinal studies (Phillip, Pagano, Menard, Fay, & Stout, 2005; Tignol, Biraben-Gotzamanis, Martin-Guehl, Grabot & Aouizerate, 2007). Therefore, a six-month

interval was chosen to evaluate the measure's test-retest reliability. Third, the convergent validity of the Chinese BICI was assessed through examining its relationship with body dissatisfaction as well as weight dissatisfaction. In Study 2, the clinical utility of the Chinese BICI was evaluated among a group of eating disorder patients with a diagnosis of either anorexia nervosa or bulimia nervosa and a healthy control group, matched on age and education.

We hypothesized that the three-factor Japanese BICI structure would fit the Chinese BICI, because of the shared collectivist cultures (Markus & Kitayama, 1991) and similar aesthetic facial criteria in Japan and China (Gao, Niddam, Noel, Hersant, & Meningaud, 2018). Because the BICI was developed to assess body image concern, we hypothesized that scores on the BICI would correlate more strongly with overall body dissatisfaction (as assessed using the body dissatisfaction scale of the Eating Disorders Inventory) than weight dissatisfaction (as assessed by the gap between an individual's current and ideal body weight). Given that body image concern, particularly with regards to weight and shape, is a key symptom among patients with anorexia nervosa and bulimia nervosa (American Psychiatric Association, 2013), we also hypothesized that the eating disorders (ED) group would score higher on the BICI than matched healthy controls.

Study 1

The goal of Study 1 was to evaluate the factor structure, internal consistency, 6-month test-retest reliability, and convergent validity of the Chinese BICI among a large sample of women recruited to participate in an online study.

Method

Participants

A total of 1,231 participants (910 women, M = 21.12 years, SD = 2.40 years,

$range$ = 16-31 years) recruited via snowball sampling using social media provided valid

online survey data. The sample size met the requirements for CFA (Muthén & Muthén,

2002). Five pairs of validity check items were administered to detect non-valid response

patterns. An example pair is (a) When I am with others, I seldom talk; and (b) I talk a lot

when I am with others. Participants providing inconsistent answers to two or more item

pairs were excluded from the analyses. Participants identified themselves as from 16

different ethnicities, but the majority were Han Chinese (92.4%). On average they had

received 15.09 years of education (SD = 2.03 years, $range$ = 10-23 years). All

participants self-reported as free from a history of or current diagnosis of a mental

disorders. Those participants excluded from analyses due to validity concerns had a

similar demographic profile (mean age = 21.02 years, mean years of education = 14.70

years) as those included.

Measures

As part of a larger study, the "Mental Health Project among Young Adults",

participants completed a battery of self-report questionnaires and a demographics form

with their smartphone. For the purpose of this study, demographic information and data

from the BICI, Depression Anxiety and Stress Scale, Eating Disorder Inventory, and

Satisfaction with Life Scale were examined and analyzed.

All participants completed items regarding their age, sex, years of formal education, ethnicity, as well as current and ideal height and weight (for computing current and ideal BMI).

Body image concern was assessed with the Chinese BICI, originally developed by Littleton et al. (2005). For each of the 19 items, individuals respond with regards to how often they experience the described feelings or perform the described behaviors on a 5-point rating scale bounded by 1 (*never*) and 5 (*always*). A sample item is, "I feel others are speaking negatively of my appearance." Summing the scores of all items generates a dysmorphic appearance concern score, with higher scores indicating greater dysmorphic concern.

Following the World Health Organization (WHO) Process of Translation and Adaptation of Instruments guidelines (WHO, 2020), the English version of the BICI was initially translated to Chinese by a native Chinese speaker who was also a proficient English translator. This translated scale was then reviewed by the first author and four additional researchers. After minor revisions in wording, the measure was back-translated by a bilingual researcher to identify potential translation problems. This resulted in minor revisions to some of the translated items. Next, a group of graduate students completed the Chinese BICI and were debriefed afterward. They reported no problems in understanding the items. A copy of the Chinese version of the BICI is available in the supplemental material.

The 64-item Eating Disorder Inventory-I (EDI-I) was used to measure disordered eating symptomology (Garner, 1983). Each item utilizes a 6-point rating scale bounded by 1 (*never*) and 6 (*always*). Good reliability and validity have been obtained from its

Chinese version (Lee, Lee, & Leung, 1998; Zhang & Kong, 2004). Only the body dissatisfaction scale of this inventory was used in the current study. This scale consists of nine items assessing frequency of dissatisfaction with one's body shape and several body parts, such as stomach, thighs, and hips. Summing the score of subscale items generates a body dissatisfaction score, with higher scores indicating greater body dissatisfaction. The internal consistency for this subscale was .87 in the current sample.

The Depression Anxiety Stress Scale-21 (DASS-21) is a 21-item self-report scale measuring three domains of negative emotional experiences (depression, anxiety, and stress) over the last week (e.g., "I felt that life was meaningless": Lovibond & Lovibond, 1995). Participants respond to each item on a 4-point rating scale bounded by 0 (*never*) and 3 (*always*). Good reliability and validity for the measure has been obtained for the Chinese version of the measure (Wang et al., 2016). Summing the scores of all items generates a total score ranging from 0 to 63, with higher scores indicating more negative emotional experiences. The internal consistency for DASS-21 was .92 in the current sample.

The Satisfaction with Life Scale (SWLS) is a five-item measure of life satisfaction (e.g., "If I could live my life over, I would change almost nothing;" Diener, Emmons, Larsen, & Griffin, 1985). Participants respond to each item on a 7-point Likert scale bounded by 1 (*strongly disagree*) and 7 (*strongly agree*). The potential scores range from 5 to 35, with a higher total score indicating greater life satisfaction. The Cronbach's alpha of the Chinese version was .81 in a Chinese college student sample (Wang et al., 2018), and was .91 in the current sample.

Procedures

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The confidential on-line survey, advertised as a study on mental health among young Chinese adults, was posted to Questionnaire Star web (https://www.wjx.cn/), an on-line survey creation platform in October, 2017. A snowballing procedure was used for sampling. The survey link was promoted to individuals who previously participated in studies, colleagues, and college students by WeChat (a popular social media platform in China). The participants were encouraged to promote the link further to their friends.

To compute test-retest reliability, the BICI was administered to a subsample of participants 6 months (T2) after completing the initial online survey, who were contacted with a message sending by a research assistant to complete a second online survey. We stopped data collection after a total of 563 participants completed T2.

Participants consented online to participate in the study and were reimbursed 20 RMB (about 3 US dollars) for completing each online survey. Participants used their smartphone to complete survey measures. Each WeChat account, linked to a single cellphone number, was allowed to complete each survey once. Survey responses were linked using cellphone numbers with all surveys successfully linked across administrations.

The project (Studies 1 and 2) was reviewed and approved by the Institute of Psychology, Chinese Academy of Sciences, and Shanghai Mental Health Center. Research procedures conformed fully with the ethical criteria proposed by the Code of Ethics of the World Medical Association (Declaration of Helsinki) for research involving human participants.

Data analyses

The three previous BICI factor structures (one factor model, two factor model and three factor model) were assessed via confirmatory factor analyses (CFAs) using LISREL 8.7 (Jöreskog & Sörbom, 2005). A maximum likelihood estimation procedure was used. The fit of the CFA models was assessed using chi-square, root mean square error of approximation (RMSEA), comparative fit index (CFI), and the non-normed fit index (NNFI). The evaluation criteria for good model fit include CFI and NNFI larger than .95 and RMSEA less than .05 (Hu & Bentler, 1999). However, RMSEA less than 0.10 are also considered to reflect acceptable fit (MacCallum, Browne, & Sugawara, 1996). As model chi-square is influenced by sample size, it is less useful for model-fitting judgment with a large sample size, but changes in model chi-square offer a method to compare the fit of different models. Accordingly, model chi-square is only reported when comparing different models.

Six-month test-retest reliability and internal consistency were calculated to assess the reliability of BICI subscales and total scale. To evaluate convergent validity, correlations between BICI, EDI-I body dissatisfaction scale, and weight dissatisfaction (body mass index (BMI) difference between current and ideal value) were calculated. BMI was calculated as weight in kilogram divided by the square of height in meter. The *Z* test introduced by Meng, Rosenthal, and Rubin (1992) was used to compare the size of correlation coefficients (Meng, 1992). Additionally, Pearson's correlation coefficients between BICI subscale scores, DASS-21 scores, and SWLS score were computed to evaluate the relationship between BICI domains and measures of well-being.

Results

Profile of participants

The demographics of participants are presented in Table 1. The range for BMI was 14.66-33.20 kg/m^2 for women and 15.89-38.61 kg/m^2 for men. According to the World Health Organization recommended BMI for Asian populations (Barba, Cavalli-Sforza, Cutter, & Darnton-Hill, 2004), 24.83% of female and 8.41% of male participants were underweight (< 18.49 kg/m^2); 70.36% of female participants and 79.11% of male participants were in the normal range of BMI (18.5-22.9 kg/m^2); 4.73% of female participants and 12.46% of male participants were overweight (> 23.0 kg/m^2). As shown in Table 1, the demographic profile of T2 data was quite similar to that of T1.

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Factor structure and reliability of BICI

Fit indices for each of the tested factor models of the BICI are presented in Table 2. As compared to the one-factor and two-factor models, the three-factor model fit the data better. The CFI and NNFIs were both larger than .95, and the RMSEA was less than .10. All items loaded positively on each factor, with values between .52 and .97. The inter-factor correlation was .80 between negative evaluation and safety behaviors, .74 between negative evaluation and avoidant behaviors, and .70 between safety behaviors and avoidant behaviors. Therefore, we retained the three-factor model suggested by Tanaka, Arimura, and Tayama (2011) in their Japanese sample. A graphic representation of the three-factor model is shown in Figure 1.

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The internal consistency as measured by Cronbach's *α* was .83, .84, and .86 for the safety behavior, avoidant behavior, and negative evaluation subscales, and was .92 for the BICI total score. The correlation between item scores and total scale score ranged between .48-.79. The six-month test-retest reliability was .71, .65, .71, and .73 for SB, AB, NE, and total scale.

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Convergent validity

As summarized in Table 3, Chinese BICI total scale scores correlated significantly with weight dissatisfaction as assessed by BMI difference in women ($r = -.23$), but not in men ($r = -.10$). As hypothesized, the correlations were weaker than with EDI_BD (body dissatisfaction; men: $r = .39$; women: $r = .41$). The difference between the two correlation coefficients were significant for each gender (for men: $n = 321$, $r_{\text{BMI difference-EDI-BD}} = -.61$, $Z = 6.08$, $p < .01$; for women: $n = 910$, $r_{\text{BMI difference-EDI-BD}} = -.65$, $Z = 6.91$, $p < .01$).

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Gender difference and correlations between BICI and other measures.

Among participants, women had significantly higher total BICI scores than men, t (1229) = 7.90, $p < .01$, $d = 0.50$. Women and men also differed significantly on BICI subscale scores, $V = .12$, F (3, 1227) = 57.79, $p < .01$. Women scored significantly higher on each of the three BICI subscales, SB, t (1229) = 11.91, $p < .01$, $d = 0.75$; AB, t (1229) = 2.98, $p < .01$, $d = 0.20$; NE, t (1229) = 4.96, $p < .01$, $d = 0.31$).

Table 3 also shows that BICI subscale scores and total scores correlated negatively with subjective wellbeing as assessed by the SWLS, $r_s = -.18 - -.36$, and positively with psychological distress as assessed by the DASS-21 $r_s = .33 - .48$.

Discussion

Using data from a large online sample, we found that the 3-factor structure previously obtained in a Japanese sample was the best fit for the Chinese BICI. The three subscales and total scale showed good internal consistency and test-retest reliability over a 6-month period. Supporting convergent validity of the Chinese BICI, scores were correlated in the expected manner with body dissatisfaction and weight dissatisfaction, as well as well-being and psychological distress. Further, supporting that the BICI assesses broader body image concerns, BICI scores were significantly more strongly correlated with a measure of overall body dissatisfaction than weight dissatisfaction. Thus, our hypotheses regarding the factor structure, reliability, and validity of the Chinese BICI were supported.

As in many previous studies (Hoffmann & Warschburger, 2017; Varnado-Sullivan, Horton, & Savoy, 2006), we found that women had greater body image concern than

men. However, findings from the current study also suggested that body image concern among Chinese men should not be ignored, as men and women had negligible difference on NE, which is most strongly related to psychological wellbeing among the three BICI dimensions. In fact, prior research has supported that there are no gender differences in the prevalence of body dysmorphic disorder among Chinese college students (Zheng & Zhang, 2012; Zhu & Deng, 2010).

Study 2

The goal of Study 2 was to further evaluate the validity and potential clinical utility of the Chinese BICI through administration of the measure to a sample of women receiving eating disorder treatment, and through comparison of their scores to a sample of matched control individuals.

Method

Participants

To calculate the reasonable sample size for Study 2, we conservatively set the effect size as .30 in the G*power software (Faul, Erdfelder, Buchner, & Lang, 2009). With an α of .05 (two tailed) and β of .80, the computed total sample size was 82. The ED group was comprised of 47 female eating disorder patients recruited from the Shanghai Mental Health Center (26 anorexia nervosa, AN; 21 bulimia nervosa, BN). Their diagnosis was made by a senior psychiatrist (Dr. Jue Chen) based on Diagnostic and Statistical Manual of Mental Disorders, fifth edition criteria (DSM-5; American Psychiatric Association, 2013). Participants' mean age was 20.76 years ($SD = 4.58$, *range* = 13-34 years, one missing data). On average, they had received 14.02 years of education ($SD = 3.16$, *range*

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= 7-20 years, one missing data). The duration of illness had large variabilities (M = 41.80 months, SD = 41.76 months, *range* = 4-240 months, two missing data). Nine patients met the criteria for additional Axis I mental disorders. Major depressive disorder (MDD) was the most common comorbidity among these patients, with six patients meeting the diagnostic criteria for MDD. Two patients met the diagnostic criteria for bipolar disorder. One patient met criteria for obsessive-compulsive disorder and alcohol dependence. Among the six patients with comorbid MDD, two also met the diagnostic criteria for an anxiety disorder.

The matched control group included 56 female students from Beijing, with a mean age of 20.63 years (SD = 3.16, *range* = 15-27 years). On average, they had received 14.55 years of education (SD = 3.0, *range* = 10-20 years, one missing data). The two groups were matched on age, t (100) <1, and years of education, t (99) < 1.

Measures and procedures

The patient group were recruited from the Shanghai Mental Health Center. The matched control group were recruited by advertisements posted in universities and high schools in Beijing. Participants were informed that this project was about individuals' body image and mental health. All participants completed survey measures individually in a private test room. They also completed other questionnaires and an experimental task unrelated to current study. Each participant received about 100 RMB (about 14 US dollars) as reimbursement, depending on length of test session. Formal written consent was received from each participant and one of her guardians (for patients and for matched controls younger than 18 years of age).

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The internal consistency of the total and subscale scores of the Chinese BICI was also tested in the ED group. As in Study 1, convergent validity was evaluated by comparing the correlations between BICI total score and EDI-I body dissatisfaction subscale score and BMI difference (as a measure of weight dissatisfaction). The *Z* test introduced by Meng, Rosenthal, and Rubin (1992) was used to compare correlation coefficients.

Clinical utility was evaluated by comparing BICI total and subscale scores between ED patients and matched controls. Independent *t*-tests were used to compare the scores. To control for Type I error, MANOVA was used to compare BICI subscale scores. Whenever a significant between group difference was detected by MANOVA, MANCOVA was used to test whether the between group difference still existed after controlling for current BMI.

In the ED group, Pearson's correlation coefficients among BICI subscale scores, BMI, DASS-21 scores, and SWLS score were computed to evaluate the associations of BICI domains with other measures. Independent *t*-tests were conducted to compare the two groups on BICI total scores. MANOVA was used to compare the groups on BICI subscale scores.

Results

Demographics of participants

The demographics of participants in Study 2 are presented in Table 1. The range for BMI was 13.36-27.34 for patients (2 missing data) and 15.79-26.57 for matched controls.

According to the World Health Organization recommended BMI for Asian populations

(Barba et al., 2004), 51.1% of patients and 19.6% of matched controls were underweight

(< 18.49 kg/m^2), 44.4% of patients and 76.8% of matched controls were in the normal

range of BMI (18.5-22.9 kg/m^2), and 4.4% of patients and 3.6% of matched controls were

overweight (> 23.0 kg/m^2). On average, the ED group had slightly lower current BMI

than the matched controls, t (99) = 2.08, p = .04, d = -0.14, but the patients had much

smaller ideal BMI than the matched controls, t(99) = 4.01, $p < .01$, d = -0.77. As

expected, the BN group (M = 21.03, SD = 2.60) had significantly larger current BMI than

AN (M = 17.28, SD = 1.96). In addition, the BN group (M = 23.19, SD = 4.73) were

significantly older than the AN group (M = 18.72, SD = 3.34), and had significantly more

years of education as well (BN: M = 15.43, SD = 2.56; AN: M = 12.84, SD = 3.17).

Reliabilities

In the ED group, the internal consistency was .92, .89, and .92 for the SB, AB, and

NE subscales, and was .96 for the BICI total score.

Clinical utility

The ED patients had significantly higher BICI total score than controls, t (101) =

6.33, $p < .01$, d = 1.28. Patients and controls differed significantly on BICI subscale

scores, V = .39, F (3, 99) = 21.13, $p < .01$. This group difference still existed after

controlling for current BMI. Patients scored higher on each of the BICI subscales, SB: t

(101) = 5.06, $p < .01$, d = 0.99; AB: t (101) = 7.43, $p < .01$, d = 1.52; NE: t (101) = 4.80,

p = .01 d = 0.96. The ED group tended to have a higher EDI-I body dissatisfaction score

than controls with a small effect size, t (100) = 1.89, p = .06, d = 0.37.

Convergent validity

BICI total scores in the ED group correlated more strongly with EDI-I body dissatisfaction subscale score ($r = .78$) than weight dissatisfaction ($r = -.56$). The difference between the two correlation coefficients was significant ($n = 103$, $r_{\text{BMI difference-EDI-BD}} = -.60$, $Z = 2.47$).

Correlation analyses and group differences

Table 3 also shows that BICI subscale scores and total score correlated negatively with subjective wellbeing, as assessed by SWLS, $r_s = -.37 - -.56$, and positively with DASS-21, $r_s = .41 - .61$ in the ED group. The correlation coefficients with the NE subscale was larger than with the AB and SB subscales. As compared to Study 1, the correlations were generally larger in the ED group. Among ED patients, BICI scores were moderately correlated with current weight and current BMI, $r_s = .42 - .64$.

Among the ED patients, BN patients ($M = 65.19$, $SD = 13.72$) had significantly higher BICI total scores than AN patients ($M = 54.91$, $SD = 18.78$), $F (1, 45) = 4.39$, $p < .05$, $d = 0.63$. However, the group difference on BICI total score was no longer significant after controlling for current BMI, $F (1, 42) < 1$. As for the subscale scores, MANOVA suggested no group differences, $V = .13$, $F (3, 43) = 2.16$, $p > .05$.

Discussion

In Study 2, the ED group and controls were well matched with regards to age and years of education. The BMI of the two groups was significantly different with a small effect size ($d = -0.14$), but the ED patients reported a significantly lower ideal BMI than

the controls with a large effect size (d = -0.77), which is likely to be a reflection of one of their key symptoms, namely "fear of fatness" (American Psychiatric Association, 2013).

Among the ED patients, the AN participants were younger than the BN participants. This difference may represent a normal profile of ED patients rather than a biased sample, since it has been suggested that AN has an earlier age of onset than BN (Stice, Marti, Shaw, & Jaconis, 2009; Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011). We also found that BN participants had higher BICI total score than AN participants, indicating a higher level of body image concern among BN. This finding is consistent with previous literature indicating that individuals with BN had greater body image disturbance and body dissatisfaction than individuals with AN (Cash & Deagle, 1997; Molbert et al., 2017; Ruuska, Kaltiala-Heino, Rantanen, & Koivisto, 2005). BN participants had a larger BMI than AN participants in the current study, thus the higher level of body image concern may also relate to their larger BMI. Indeed, between group differences in BICI scores were no longer significant when BMI was included as a covariate.

Importantly, the ED group scored higher than the matched controls on each of the three BICI subscales and total score, supporting the clinical sensitivity and utility of the Chinese version of the BICI. Further, the Chinese version of the BICI demonstrated excellent internal consistency in the ED sample (Cronbach's α greater than .89 for all subscales and of .96 for total scale). Thus, our hypotheses regarding reliability and validity of the BICI were supported. As in our online sample, BICI total score correlated more strongly with body dissatisfaction than weight dissatisfaction. Finally, it should be noted that the difference in BICI scores between ED patients and controls (d = 1.28) was

larger than the differences in scores on the EDI-I body dissatisfaction subscale between these two groups ($d = 0.37$), suggesting that the BICI was better capturing the full nature of body image related symptoms experienced by patients with ED, as compared to measures of body dissatisfaction alone.

General Discussion

Our goal in the current study was to evaluate the psychometric properties and clinical utility of the new Chinese BICI. Results from Study 1 supported the cross-cultural stability of the BICI as a measure of body image concern across cultures. First, the 95th percentile from our online sample (71) was very close to the suggested cut-off score of 72 in its English version (Littleton et al., 2005). Second, the mean total score in the current online sample (women: 50.47, men: 43.90) was almost identical to that obtained in a Japanese sample (women: 51.05, men: 43.14; Tanaka & Tayama, 2013). Third, the measure had a Cronbach's α of .92 and a 6-month test-retest reliability of .73. Additionally, the findings of Study 2 supported the use of BICI in clinical settings. The group difference on subscales and BICI total scores between ED patients and matched controls (ds ≥ 0.96) was much larger than that for EDI-I body dissatisfaction ($d = 0.37$), suggesting that the BICI better captures body image symptoms of ED patients than a measure of body dissatisfaction.

Notably, the factor structure of the BICI seems to vary across cultures. Consistent with our hypothesis, the CFA parameters suggested a three-factor structure first obtained in a Japanese sample (Tanaka et al., 2011) as best fitting, namely avoidant behaviors, safety behaviors against perceived flaws, and negative appearance evaluation. Each of the three subscales of the BICI had good reliability across items. Cronbach's αs of .83-.86 for

subscales were obtained, which were comparable to those in the previous Japanese study (.84- .86 for subscales; Tanaka et al., 2011; Tanaka & Tayama, 2013). The three subscales also showed good 6-month test-retest reliability ranging from .65- .71. While this was lower than found in the prior Japanese study (.79- .88), that study examined 3-week test-retest reliability (Tanaka et al., 2011). Additionally, the subscale scores of the BICI in each gender in our online sample were very close to those obtained in the Japanese sample (Tanaka & Tayama, 2013). The similar factor structure and similar factor scores of Chinese and Japanese BICI indicated that dysmorphic symptoms could be clearly separated into safety behaviors and negative evaluation in the Chinese and Japanese samples. It is not clear, however, whether this three-factor structure is a unique feature of Eastern Asian culture or cuts across collectivist cultures, and more research is needed to answer this question.

Importantly, the three-factor structure of the Chinese BICI assessed important facets of body image concern in both the general sample and the clinical sample. ED patients frequently experience deficits in social functioning related to their symptomology (Bentz et al., 2017), which are tied to avoidant behaviors. It is thus logical that the largest difference between ED patients and the matched controls was on the avoidant behaviors scale. Safety behaviors best captured between-gender differences in dysmorphic appearance concerns in the online sample. This finding was consistent with prior findings, such as research supporting that female college students are more willing to have cosmetic surgery to address a perceived appearance defect than their male counterparts (Qiu et al., 2018; Zou & Gao, 2012).

Of note, NE was most strongly associated with psychological distress and decreased subjective wellbeing in both the clinical and non-clinical samples. Relatedly, patients with ED also had higher levels of negative affect and lower levels of life satisfaction in our study, as has been found in prior work (Agras, 2001; Ulfvebrand, Birgegård, Norring, Högdahl, & von Hausswolff-Juhlin, 2015). Just as in our ED sample, the highest comorbidity was with affective disorders (Carrot et al., 2017). Thus, negative evaluations of one's own appearance should be targeted when treating body image concern among ED patients.

The picture regarding the relationship between body image concern and weight is illustrative among ED patients, with body image concern correlated with current weight ($r = -.58$) and BMI ($r = -.56$). The correlational results preclude us from drawing any causal conclusions. However, findings of the current study may provide some suggestions for the treatment of ED, especially AN. Successful treatment will often increase the weight of participants to the normal range of BMI, which may also increase body image concern. It is likely that with improved physical health, some of the key eating disorder symptoms may be in fact be aggravated. We speculate that this observation may be related to the high relapse rate of AN (Berends, Boonstra, & Elburg, 2018; Herzog et al., 1999; Olmstead, Kaplan, & Rockert, 1994; Richard, Bauer, & Kordy, 2005). In fact, it has been suggested that addressing dysmorphic appearance concern should be taken as a central psychotherapeutic intervention target for ED treatment (Junne et al., 2019). At the very least, findings suggest a need to assess and treat high levels of dysmorphic appearance concerns among ED patients as part of a comprehensive treatment plan.

Limitations of the current findings should be noted. First, we used a convenience sample of volunteers recruited via social media to test the factor structure, validity, and reliability of the Chinese BICI. Thus, it is possible that findings may not generalize to other groups, including lower income samples. Second, most of the participants in the current study were Han Chinese. Thus, the findings may not generalize to other ethnic minority groups in China. Third, the majority of participants were university students. As such, it is unclear whether the Chinese BICI is a reliable and valid measure of body image concern for adolescents and older adults. Bearing these limitations in mind, results of this study indicated that the Chinese BICI had good reliability and validity and would be useful for assessing body image concern in clinical and non-clinical research. The Chinese BICI was related to psychological distress and subjective well-being in clinical and non-clinical samples, as well as body and weight dissatisfaction. Additionally, Chinese BICI scores successfully discriminated ED patients from matched controls. Use of the BICI in future research can help advance our understanding of dysmorphic appearance concern among Chinese speaking populations.

Conflict of Interest

All authors declare that they have no conflict of interest.

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Table 1 Descriptive Statistics for current and ideal height, weight, and BMI, Body Image Concern Inventory (BICI), Eating Disorder Inventory (EDI), Satisfaction with Life Scale (SWLS), and the Depression Anxiety Stress Scales (DASS).

Group	BMI		BICI				EDI_BD	SWLS
	current	Ideal	Total	AB	SB	NE		
Online T1 (***n* = 1231**)	20.79 (3.04)	18.74 (2.20)	48.76 (13.12)	11.43 (4.49)	19.53 (5.70)	17.80 (4.80)	32.23 (10.57)	20.91 (6.16)
Women (*n* = 910)	20.22 (2.50)	17.88 (1.38)	50.47 (12.58)	11.65 (4.48)	20.62 (5.29)	18.20 (4.65)	33.23 (10.32)	20.94 (6.12)
Men (*n* = 321)	22.10 (3.22)	20.92 (1.76)	43.90 (13.44)	10.78 (4.47)	16.45 (5.72)	16.66 (5.04)	29.43 (10.76)	20.80 (6.28)
Online T2 (***n* = 563**)	20.82 (2.84)	18.67 (2.07)	50.00 (13.09)	12.32 (4.81)	19.80 (5.51)	17.88 (4.62)	32.44 (9.81)	21.43 (6.31)
Women (*n* = 418)	20.44 (2.55)	17.91 (1.38)	51.29 (12.62)	12.42 (4.69)	20.68 (5.25)	18.18 (4.54)	33.42 (9.66)	21.70 (6.14)
Men (*n* = 145)	22.15 (3.06)	20.97 (1.87)	46.28 (13.75)	12.03 (5.11)	17.26 (5.48)	17.00 (4.76)	29.61 (9.71)	20.66 (6.72)
Patients (***n* = 47**)	19.03 (2.94)	16.78 (1.57)	59.50 (17.32)	15.57 (6.23)	23.82 (6.89)	20.11 (6.00)	36.62 (11.74)	16.21 (8.03)
Controls (***n* = 56**)	20.12 (2.34)	17.97 (1.45)	41.32 (10.22)	8.37 (2.50)	17.64 (5.51)	15.31 (3.63)	32.58 (9.90)	21.75 (5.94)

Note: AB, avoidant behaviors subscale; NE, negative evaluation subscale; SB, safety behaviors subscale; BICI, Body Image Concern Inventory; DASS, Depression, Anxiety, and Stress Scale; EDI_BD, body dissatisfaction Scale of Eating Disorder Inventory; SWLS, Satisfaction with Life Scale.

Table 2 Fit indices of the one-factor, two-factor, and the three-factor CFA models

	$\chi2$	df	CFI	NNFI	RMSEA	$\Delta\chi^2$
One factor model	2,811.57	152	0.925	0.915	0.141	---
Two factor model	2,335.91	151	0.938	0.930	0.121	475.66
Three factor model	1,576.21	149	0.960	0.954	0.094	759.70

Note: CFI, comparative fit index; df, degree of freedom; NNFI, non-normed fit index;

RMSEA, root mean square error of approximation

Table 3 Correlations between BICI scores and other measures (Study 1 On-line female participants/Study 1 on-line male participants / Study 2 ED patients).

BICI	SWLS	DASS	EDI_BD	Current weight	Current BMI	BMI difference
Safety behaviors	-.22/-.18/-.37	.33/.34/54	.31/.27/.66	.05/.10/.47	.05/.02/.42	-.16/-.04/-.39
Avoidant behaviors	-.24/-.24/-.44	.43/.48/41	.30/.30/.70	.09/.03/.60	.09/.03/.64	-.17/-.06/-.67
Negative evaluation	-.36/-.30/-.56	.46/.41/.61	.48/.47/.78	.15/.09/.42	.18/.11/.43	-.28/-.16/-.49
Total score	-.31/-.27/-.50	.46/.46/.57	.41/.39/.78	.11/.05/.55	.12/.06/.55	-.23/-.10/-.56

Note: BMI, body mass index; DASS, Depression, Anxiety, and Stress Scale; EDI_BD, body dissatisfaction Scale of Eating Disorder Inventory; SWLS, Satisfaction with Life Scale.

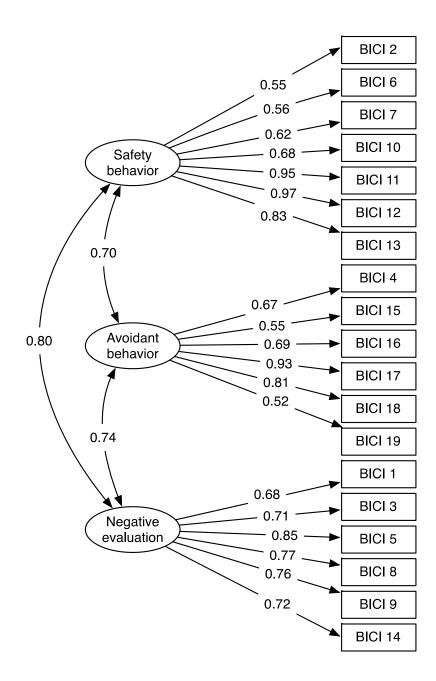Significant values presented in bold.

Figure 1. Graphical representation of three-factor model with factor loadings.