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Measures of body image: Confirmatory factor analysis and association with disordered eating

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Abstract

The current study aimed to examine the factor structure, reliability, and validity of three measures of body image disturbance (body image flexibility, body avoidance, and body checking) considered to be relevant to eating disorder psychopathology, with the aim of determining the optimal structure of each for use in treatment planning and outcome monitoring. Additionally, the study aimed to identify which factors had the strongest association with disordered eating. Participants were 328 female undergraduate university students aged 17-25 years. Confirmatory factor analyses were conducted followed by correlational, regression, and t-test analyses. The original proposed models were retained for the body image flexibility and body checking measures, while an alternative model was supported for the body image avoidance measure. All three solutions were found to have acceptable validity and reliability. Scores on each measure differed significantly between normal and disordered eaters. The body image flexibility measure and selected subscales of the body image avoidance and checking measures had unique associations with eating disorder psychopathology and psychosocial impairment. Results of this study indicate how the assessment of body image can be achieved in treatment of eating disorders in such a way as to reduce participant burden while adequately assessing the body image disturbance that is characteristic of eating disorders.

Keywords: Body image; eating disorders; body image flexibility; body image avoidance; body checking; confirmatory factor analysis.

Public Significance Statement

The present study advances knowledge in the assessment of body image relevant to eating disorder psychopathology. Suggestions are provided for brief, yet effective measurement that can be applied to research and clinical settings.

Body image is a multi-faceted construct (Cash, 2004) which can be measured in multiple ways. Cognitive behavioural treatments for eating disorders consider both cognitions and behaviours associated with body image disturbance to be important targets for intervention (Fairburn, 2008). Cognitions typically focus on the over-evaluation of control over shape and weight as it is considered central to the maintenance of core eating disorder psychopathology, while other features such as dieting restraint, bingeing and purging are considered secondary (Fairburn, 2008). Furthermore, as acceptance and mindfulness based approaches are increasingly investigated with respect to the treatment of eating disorders, interest has turned more recently to the role of body image flexibility.

The two main behavioural manifestations of body image disturbance targeted in treatment are body avoidance and body checking. The former includes avoidance of mirrors, weighing, wearing tight clothing, and being photographed. The latter includes behaviours such as obsessive weighing and shape checking, including pinching or touching body parts of concern, looking at mirrors and reflective surfaces, measuring body parts, and assessing the tightness of clothes or accessories (Fairburn, 2008; Menzel, Krawczyk, & Thompson, 2011). Both behaviours are elevated in clinical eating disorder samples and thus are considered to be both risk and maintenance factors for eating disorders (Amin, Strauss, & Waller, 2012; Calugi, Grave, Ghisi, & Sanavio, 2006; Campana, Swami, Onodera, da Silva, & Tavares, 2013; Grilo et al., 2005; Menzel et al., 2011; Reas, Grilo, Masheb, & Wilson, 2005; Reas, Whisenhunt, Netemeyer, & Williamson, 2002; Rosen, Srebnik, Saltzberg, & Wendt, 1991; Shafran, Fairburn, Robinson, & Lask, 2003). Hence the effective measurement of body avoidance and body checking is required to assess and intervene those at risk of developing an eating disorder in addition to treating body image disturbance in clinical eating disorder samples.

Valid measurement of these three elements – flexibility, avoidance, and checking – requires further improvement. The Body Image Acceptance and Action Questionnaire (BI-AAQ; Sandoz, Wilson, Merwin, & Kellum, 2013) has been developed to assess body image flexibility, defined as the ability to accept and experience thoughts, beliefs, perceptions, and feelings about one's body. The BI-AAQ is considered to be an affective measure for positive body image and a protective factor for physical and psychological wellbeing (Tylka & Wood-Barcalow, 2015; Webb, Wood-Barcalow, & Tylka, 2015). Notably, a recent treatment study used the body image flexibility measure as part of their outcome monitoring, and found that improvements in body image flexibility at end of treatment were associated with reduced eating disorder psychopathology (Butryn et al., 2013). It has a well-replicated unidimensional structure, consistently good reliability, and has demonstrated concurrent and convergent validity with eating disorder samples, including key risk and maintenance factors such as body dissatisfaction and negative affect (Ferreira, Pinto-Gouveia, & Duarte, 2011; Kurz, Flynn, & Bordieri, 2016; Sandoz et al., 2013; Timko, Juarascio, Martin, Faherty, & Kalodner, 2014). While early investigations find the BI-AAQ to be psychometrically sound, to date the measure has not been widely used in eating disorders and remains novel. Furthermore, it is unclear whether body image flexibility is a unique predictor of eating disorder psychopathology when considered alongside other body image measures of relevance to eating disorders such as body avoidance and body checking. Thus further investigation is warranted.

The Body Image Avoidance Questionnaire (BIAQ; Rosen et al., 1991) and the Body Checking Questionnaire (BCQ; Reas et al., 2002) have been developed to assess these respective behavioural components. Behavioural measures, such as the BIAQ and BCQ, have been subject to considerably less psychometric evaluation compared to affective and cognitive measures of body image (Menzel et al., 2011). To date, psychometric studies have

found contradictory evidence with respect to factor structure and reliability. However, both measures have demonstrated convergent and concurrent validity with respect to eating disorder samples, including body dissatisfaction and negative affect (Calugi et al., 2006; Campana et al., 2013; Reas et al., 2002; Reas, White, & Grilo, 2006; Rosen et al., 1991), suggesting their potential value in assessment of relevant targets in eating disorder intervention.

In sum, the body image flexibility measure has the potential to assess an important protective factor, while the body avoidance and checking measures assess risk factors. The reliable and valid measurement of each construct is important in informing treatment planning and monitoring outcome, given the prevalence of each construct in eating disorders. However, collectively they include a large number of items and scales, and it is unclear which of them have the most clinical utility. Increased understanding of which items or subscales are most relevant will aid parsimonious but adequate assessment of these key constructs. By considering all three measures together and using a large sample size, this should help resolve the contradictory findings to date regarding item number and factor structure for the body avoidance and checking measures.

Thus, the primary aim of the current study is to examine the factor structure of each of the three measures of body image by testing models supported by prior research, with a view to determining the optimal structure to inform treatment planning and monitor outcomes related to body image disturbances observed in disordered eating and its associated psychological impairment. We achieve this using a female university sample who reported a full range of disordered eating. A second aim is to determine which factors have the strongest association with disordered eating, as well as with issues commonly associated with disordered eating, including perfectionism, depression, anxiety, and body dissatisfaction. Negative affect (i.e. depression and anxiety) and body dissatisfaction are classified as two of

the most potent risk factors for developing disordered eating in large longitudinal study focused on university-age women (Jacobi & Fittig, 2010). Additionally, clinical perfectionism has been considered as a risk and maintenance factor for eating disorders in addition to depression and anxiety disorders (Egan, Wade, & Shafran, 2011). Given the problems with assessment burden in a clinical population who are undergoing treatment, the findings will allow clinicians to select the most relevant subscales, rather than using each measure in its entirety.

Method

Participants

A total of 346 female university students from Flinders University, South Australia, were recruited from two separate studies. The majority of participants ($N = 234$) were recruited to address the aims outlined in this paper and completed an online questionnaire entitled “Body image and eating behaviours”. A subgroup ($N = 112$, 34%) participated in a separate study entitled “Thinking styles in young women” where the primary aims focused on attention bias related to body dissatisfaction. Data from this second study were amalgamated with the first to increase power and allow for a greater variety of variables to be considered in validity analyses. All participants received either course credit or payment for their participation. Participants who did not meet inclusion criteria for either study (aged 17 to 25 years and female) were excluded from the analyses ($N = 18$). Therefore, the final number of participants included in analyses was 328. The mean age was 19.74 years ($SD = 2.13$) and the majority identified as being Caucasian (74.7 %). Participants also identified as being Aboriginal or Torres Strait Islander (0.3%), Asian (17.1%), African (0.6%), or of other descent (7.3%). The mean body mass index (BMI) was 23.00 ($SD = 4.77$), with a range of 14.69 to 59.99.

Measures

Participants completed the following measures:

Body Image-Acceptance and Action Questionnaire (BI-AAQ). The BI-AAQ (Sandoz et al., 2013) is a 12-item affective measure of body image designed to measure body image flexibility, the ability to accept and experience thoughts, beliefs, perceptions, and feelings about one's body. Items (e.g. "To control my life, I need to control my weight") are rated on a 7-point Likert scale (1 = never true, 7 = always true) and are reverse scored and summed such that higher scores indicate greater body image flexibility. It has good reliability related to internal consistency (Cronbach's $\alpha = .91 - .95$), item-total ($r = .50 - .82$), and test-retest ($r = .80 - .82$) (Ferreira et al., 2011; Kurz et al., 2016; Sandoz et al., 2013; Timko et al., 2014). It is correlated with measures of eating disorder psychopathology, general psychopathology, self-compassion, self-esteem, social comparison, body dissatisfaction, body appreciation, BMI, intuitive eating, distress tolerance, internalisation of the thin ideal, psychological flexibility, body checking and body image avoidance (Ferreira et al., 2011; Kelly, Vimalakanthan, & Miller, 2014; Sandoz et al., 2013; Schoenefeld & Webb, 2013; Timko et al., 2014; Wendell, Masuda, & Le, 2012). Eating disorder and dieting samples, in addition to those classified 'at risk' for eating disorders, have significantly lower BI-AAQ scores compared to controls (Ferreira et al., 2011; Masuda, Hill, Tully, & Garcia, 2015; Sandoz et al., 2013; Timko et al., 2014).

Body Image Avoidance Questionnaire (BIAQ). The BIAQ (Rosen et al., 1991) is a 19-item behavioural measure of body image that assesses the avoidance of body image related situations. Items (e.g. "I avoid going clothes shopping") were originally rated on a 6-point Likert scale (0 = never, 5 = always). However, the response format has been changed in the present study to match that of the BI-AAQ to enable factor analysis. Items 12, 14, and 19 are reverse scored. Scores are summed such that higher scores indicated greater body image

avoidance. The original questionnaire contained four factors: clothing, social activities, eating restraint, and grooming and weighing (Maïano, Morin, Monthuy-Blanc, & Garbarino, 2009; Rosen et al., 1991). Other studies have found two or three factor models (Campana, Tavares, da Silva, & Diogo, 2009; Legenbauer, Vocks, & Schütt-Strömel, 2007; Lydecker, Cotter, & Mazzeo, 2014; Riva & Molinari, 1998). Internal consistency reliability (Cronbach's $\alpha = .64 - .89$) and test-retest reliability ($r = .64 - .87$) vary across studies (Legenbauer et al., 2007; Lydecker et al., 2014; Maïano et al., 2009; Riva & Molinari, 1998; Rosen et al., 1991). The BIAQ is correlated with measures of eating disorder psychopathology, body shape and size, social physique anxiety, and self-esteem, and participants with bulimia nervosa had greater scores compared to controls (Maïano et al., 2009; Rosen et al., 1991).

Body Checking Questionnaire (BCQ). The BCQ (Reas et al., 2002) is a 23-item behavioural measure of body image that assesses body checking behaviours. Items (e.g. "I check to see if my thighs spread when I'm sitting down") were originally rated on a 5-point Likert scale (1 = never, 5 = very often). However, the response format has been changed in the present study to match that of the BI-AAQ to enable factor analysis. Scores are summed such that higher scores indicate greater body checking. The original questionnaire contained three factors: overall appearance, specific body parts, and idiosyncratic checking, (Calugi et al., 2006; Campana et al., 2013; Reas, von Soest, & Lask, 2009; Reas et al., 2006) however other studies have found a one, two, or three factor model with subscales varying from the original model (Lydecker et al., 2014; Menzel et al., 2011; Vocks, Moswald, & Legenbauer, 2008; White, Claudat, Jones, Barchard, & Warren, 2015). Internal consistency reliability (Cronbach's $\alpha = .66 - .95$) and test-retest reliability ($r = .83 - .94$) vary across studies (Calugi et al., 2006; Campana et al., 2013; Lydecker et al., 2014; Reas et al., 2009; Reas et al., 2002; Reas et al., 2006; White et al., 2015). Scores are correlated with measures of body dissatisfaction, body image avoidance, eating disorder psychopathology, BMI, depression,

self-esteem, social anxiety, exercise intensity, and body surveillance, and scores are higher in clinical and dieting samples (Calugi et al., 2006; Campana et al., 2013; Reas et al., 2009; Reas et al., 2002; Reas et al., 2006; White et al., 2015).

Eating Disorder Examination – Questionnaire (EDE-Q). The EDE-Q (Fairburn & Beglin, 1994) is a 22-item measure of eating disorder psychopathology over the previous 28 days. Subscales include Restraint, Eating Concern, Shape Concern, and Weight Concern and a global score is calculated by summing and averaging the four subscales (Fairburn & Beglin, 1994). The EDE-Q is routinely used in most evaluations of treatment to assess the over-evaluation of weight and shape. Higher scores indicating greater eating disorder psychopathology. The EDE-Q Restraint subscale is correlated with other measures of restraint and bulimic symptoms, and food records, and all subscales are strongly correlated with the interview version of the EDE (Berg, Peterson, Frazier, & Crow, 2012; Fairburn & Beglin, 1994). Internal consistency (Cronbach's $\alpha = .70 - .93$), test-retest reliability (short-term, over 1-14 days, $r = .66 - .94$), and temporal stability (long term test-retest reliability, over 5-15 months, $r = .57 - .82$) for the four subscales are adequate (Berg et al., 2012).

Clinical Impairment Assessment (CIA). The CIA (Bohn et al., 2008; Bohn & Fairburn, 2008) is a 16-item measure of psychosocial impairment due to eating disorder psychopathology. 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 it difficult to concentrate?") are rated on a 4-point Likert scale (0 = not at all, 3 = a lot) and are summed to calculate a global CIA impairment score (Bohn et al., 2008; Bohn & Fairburn, 2008). Higher scores indicate greater psychosocial impairment. The CIA correlates well with the global EDE-Q score and clinician ratings of impairment, and discriminated between those with and without an eating disorder (Bohn et al., 2008). Internal consistency (Cronbach's $\alpha = .97$) and test-retest reliability ($r = .86$) are adequate (Bohn et al., 2008).

Depression Anxiety and Stress Scales 21 (DASS21). The DASS short form (Lovibond & Lovibond, 1995), a 21 item measure of general psychopathology, was administered to participants in the second study (N=112). Items (e.g. “I felt down-hearted and blue”) are rated on a 4-point Likert scale (0 = did not apply to me at all, 4 = applied to me very much, or most of the time) and Depression, Anxiety, and Stress subscales are summed to calculate a total score where higher scores indicate greater psychopathology (Lovibond & Lovibond, 1995). Subscale scores can be categorised as normal, mild, moderate, severe, or extremely severe. The scale has good internal consistency ($\alpha = .87-.94$), is correlated with other measures of depression and anxiety, and discriminates well between clinical and non-clinical samples (Antony, Bieling, Cox, Enns, & Swinson, 1998).

Multidimensional Perfectionism Scale (MPS): Personal Standards (PS) and Concern Over Mistakes (CM) Subscale. The 7-item PS subscale and 9-item CM subscale from the MPS (Frost, Marten, Lahart, & Rosenblate, 1990) were administered to participants in the second study (N=112) to assess clinical perfectionism. Items (e.g. “I set higher goals than most people”) are rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) and are summed and averaged such that higher scores indicate greater perfectionism (Frost et al., 1990). The PS and CM subscales have good internal consistency ($\alpha = .81-.91$) and are correlated with other measures of perfectionism, self-evaluation, general psychopathology, procrastination, and compulsivity (Frost et al., 1990).

Eating Disorder Inventory (EDI): Body Dissatisfaction Subscale. The 9-item body dissatisfaction subscale of the EDI was administered to participants in the second study (N=112). Items (e.g. “I think my stomach is too large”) are rated on a 6-point Likert scale (1 = always, 6 = never). Items 3, 5, 6, 7, and 9 are reverse scored and all items are summed and averaged, with lower scores indicating a greater level of body dissatisfaction. The body

dissatisfaction subscale of the EDI has good internal consistency ($\alpha \geq .80$) and internal validity (Garner, 1991).

Procedure

Following approval by the Institutional Research Ethics Committee, participants were recruited online via the psychology registration system. All participants completed the three body image measures and the measures of eating disorder psychopathology and psychosocial impairment related to eating (EDE-Q and CIA). In addition, the subgroup completed measures of depression and anxiety, body dissatisfaction, and perfectionism. Height and weight were self-reported.

Statistical Analyses

Confirmatory factor analysis (CFA), the best analysis to test models suggested by prior research, was conducted using Mplus7.1 (Muthén & Muthén, 1998-2015) separately for each body image measure. For the BI-AAQ, the original and well-replicated Sandoz et al. (2013) model was examined. For the BIAQ, the original Rosen et al. (1991) model was examined in addition to the Campana et al. (2009) and Lydecker et al. (2014) solutions. For the BCQ the original Reas et al. (2002) model was examined, in addition to the White et al. (2015) and Lydecker et al. (2014) solutions. In order to examine how these three measures related to each other, a CFA were performed using the best solution for each of the three body image measures. Weighted least squares with mean and variance adjustment (WLSMV) was used for all analyses as per recommendations for categorical data (Brown, 2006).

Prior to running each CFA, missing values were replaced using the expectation maximisation method. The overall model of fit for each CFA performed was judged using the following fit indices: Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and the Tucker Lewis Index. As per previous recommendations, a good fit is indicated by $RMSEA < 0.05$, CFI and TLI ≥ 0.9 , while an excellent fit is indicated by

RMSEA < .01, CFI and TLI \geq 0.95 (Bentler, 1990; Bentler & Bonett, 1980; Dehon, Weems, Stickle, Costa, & Berman, 2005; MacCallum, Browne, & Sugawara, 1996; Schreiber, Nora, Stage, Barlow, & King, 2006; Williams, Dalglish, Karl, & Kuyken, 2014). However, it is noted that RMSEA can be artificially large in models with small degrees of freedom and sample size (Kenny & McCoach, 2003). Composite reliability was assessed for the BI-AAQ, BIAQ, and BCQ using standardised loadings and error variances obtained from Mplus (Raykov, 1997). A composite reliability of 0.8 indicates good internal consistency (Cicchetti, 1994). The internal consistency of all other scales was assessed by Cronbach's alpha.

All other analyses were conducted with IBM Statistical Package for the Social Sciences, Version 22 (IBM Corp, 2013). Pearson correlations were performed to evaluate the relationship between the subscales of each body image measure, eating disorder psychopathology, psychosocial impairment related to eating, depression and anxiety, perfectionism and body dissatisfaction. Hierarchical multiple regressions were conducted to assess the unique contribution of each body image measure with respect to eating disorder psychopathology and psychosocial impairment after controlling for BMI.

Results

Preliminary Analyses

After combining data from the two groups of participants, data were first checked for normality to ensure the suitability of parametric tests. As recommended by Tabachnick and Fidell (2012) visual inspection of distributions and formal inference tests were carried out, and indicated all variables were normally distributed. Little's missing completely at random test was nonsignificant $\chi^2(11) = 5.328, p = .914$, indicating that data were missing at random.

Confirmatory Factor Analysis of each measure

Indices for all models are presented in **Table 1**. A CFA of the unidimensional 12-item BI-AAQ (Sandoz et al., 2013) produced CFI and TLI indices that indicated that the model is an excellent fit. The items, standardised factor loadings, and variance explained for the BI-AAQ are summarised in **Table 2**.

The three CFAs of the BIAQ (Rosen et al., 1991), summarised in **Table 1**, show that the 2-factor Lydecker et al. (2014) solution was considered an excellent fit by CFI and TLI indices, while the 4-factor model (Rosen et al., 1991) was considered only to be a good fit by CFI and TLI and the Campana et al. (2009) 3-factor solution was considered a poor fit by all three indices. Thus, the Lydecker et al. (2014) model was selected as the most appropriate solution. Item 13 of the Lydecker et al. (2014) solution was found to have a lower factor loading (0.20) and R^2 (0.04), and thus the CFA was run a second time after omitting the item. As seen in the footnote of **Table 1** omitting the item did not improve the fit indices. **Table 3** summarises the items, standardised factor loadings, and variance explained.

For the BCQ, all three models were similar across all three indices (see **Table 1**). Specifically, the CFI and TLI for each model indicated all were a good fit. Given the similarity across models, the original model (Reas et al., 2002) was selected as the most appropriate. **Table 4** summarises the items, standardised factor loadings, and variance explained.

Confirmatory factor analysis of all measures together

A CFA was performed to examine the six factor model using the items from the best fitting models (Campana et al., 2009; Lydecker et al., 2014; Rosen et al., 1991; White et al., 2015). The three chosen models (6 subscales) were then combined into a six-factor CFA. The six-factor solution was indicated by the CFI and TLI to be an excellent fit (see **Table 1**), demonstrating that each subscale represents a unique factor. While a hierarchical CFA including a higher order factor showed a good fit to excellent fit (see **Table 1**), the

comparison of the two models ($\chi^2 = 499.426$, $df = 9$, $p < 0.001$) suggests that the structure is best described as six-factor model without a higher order factor. Therefore, the six subscales were considered as separate dimensions in the analyses reported below. It is noted that across all analyses the RMSEA fit index was considered neither good nor excellent.

An Exploratory Factor Analysis (EFA) was conducted as a supplementary analysis to examine the replicability of the 6-factor CFA solution. Geomin oblique rotation was applied in Mplus to allow for correlated factors. Model comparisons showed the 6-factor solution to be the best fitting model, with a good RMSEA, and excellent CFI and TLI; the factor structure demonstrated variable replicability¹.

Descriptives and Internal Consistency

Table 5 presents the means, standard deviations, minima, and maxima for all variables, and the internal consistency (as measured by composite reliability) for the body acceptance (BI-AAQ) scale, body avoidance (BIAQ) total and subscales, and the body checking (BCQ) total and subscales. Good internal consistency was observed across all total scores and subscales.

Convergent Validity

Table 6 presents the Pearson correlations between the six body image subscales and their cumulative total, eating disorder psychopathology, and psychosocial impairment related to eating i.e., depression and anxiety, perfectionism and body dissatisfaction. Overall, adequate convergent validity is demonstrated across all measures. The two body avoidance subscales were strongly inter-correlated, as were the three body checking subscales. There were significant, strong positive relationships between eating disorder psychopathology and the body avoidance and checking total scores and subscales. For body acceptance there was a significant, strong negative relationship with eating disorder psychopathology. BMI had

¹ See Supplementary tables.

significant moderate positive relationships with the body avoidance total and subscales, significant weak positive relationships with the body checking total and subscales, and a significant, moderate negative relationship with the body acceptance measure.

Multicollinearity

Given that there were 3 correlations > 0.80 between body image measure subscales, the presence of multicollinearity was examined. Multicollinearity was examined in the context of the hierarchical multiple regressions testing concurrent validity, with eating disorder psychopathology (EDE-Q) and psychosocial impairment (CIA) as the dependent variables respectively (**Table 7**). BMI was included as a covariate given its significant associations with the body image measures. We examined the Condition Index (CI) and Variance Proportions (VP) described by Tabachnick and Fidell (2012). It is recommended that a $CI > 30$ in addition to a $VP > 0.50$ for at least two different variables is indicative of multicollinearity (Tabachnick & Fidell, 2012). In both regression analyses there was one $CI > 30$ (36.89 and 36.97 respectively), but in both cases no more than one $VP > 0.50$. Thus, multicollinearity is not indicated.

Concurrent Validity

As shown in **Table 7**, BMI explained 10.1% of the variance of eating disorder psychopathology, and the body image measures explained an additional 63.4% of the variance. Significant independent predictors were the body acceptance measure, the social discomfort subscale of the body avoidance measure, and the specific body parts and idiosyncratic subscales of the body checking measure. With respect to psychosocial impairment, BMI explained 12.2% of the variance, with the body image measures explaining an additional 61.9% of the variance. The significant independent predictors were the body acceptance measure and the social discomfort subscale of the body avoidance measure.

A series of t-tests were performed to compare participants who had high levels of disordered eating, defined as an EDE-Q global score more than one standard deviation above the community mean (≥ 2.77) using Australian norms (Mond, Hay, Rodgers, & Owen, 2006), with those who did not on each body image measure. The disordered eating group and healthy group were comparable in age however the disordered eating group had a significantly higher BMI (see **Table 8**). All tests demonstrated significant differences between groups on each body image measure (see **Table 8**). The disordered eating group had a significantly lower BI-AAQ score and higher BIAQ and BCQ scores than the healthy comparison group. This difference was also present for each of the BIAQ and BCQ subscales. All differences were associated with large between group effect sizes.

Discussion

Cognitions and behaviours related to body image disturbance are considered to be central to core eating disorder psychopathology and important targets for intervention (Fairburn, 2008). Promotion of positive body image is increasingly considered to be a desirable outcome in the treatment of eating disorders (Sandoz et al., 2013), and body avoidance and body checking are specific behaviours that are a key focus of treatment (Fairburn, 2008; Waller et al., 2007). Thus their reliable and valid measurement is important in informing treatment planning and monitoring outcome. Therefore, this study sought to investigate the factor structure, reliability, and validity of measures of body image flexibility, body image avoidance, and body checking in order to inform their parsimonious use in eating disorder research and treatment.

The first aim of this study was to determine the optimal structure of each body image questionnaire by examining models supported by prior research. The unidimensional 12-item structure for the body image flexibility measure was found to be a good to excellent fit to the

data, consistent with the original model and subsequent replications (Ferreira et al., 2011; Sandoz et al., 2013; Timko et al., 2014). The 2-factor 14-item structure for the body image avoidance reported by Lydecker et al. (2014) was considered an excellent fit, with one factor representing social discomfort and the other representing exposure discomfort. Lydecker et al. (2014) postulated that affective discomfort is a key driver of body image avoidance behaviours, but the present study showed the social discomfort rather than the exposure discomfort scale to be a significant predictor of eating disorder psychopathology. This is perhaps indicative of the high comorbidity of social anxiety and eating disorders and highlights the importance of assessing body image concerns in a social context (Hinrichsen, Wright, Waller, & Meyer, 2003). As all three solutions investigated for the body checking questionnaire were found to be a good fit (Lydecker et al., 2014; White et al., 2015), the original 3-factor model (Reas et al., 2002) was retained. All measures evidenced good internal consistency, and convergent validity was demonstrated with moderate to strong negative relationships with eating disorder psychopathology, BMI, depression and anxiety, perfectionism, and body dissatisfaction. However, for all solutions, the RMSEA fit index was neither good nor excellent. This may have been due to the smaller sample size and degrees of freedom (Kenny & McCoach, 2003). Regardless, the optimal structure for each measure requires further exploration.

The second aim was to determine the factors that have the strongest association with disordered eating. The results suggest that the 12-item body image flexibility questionnaire and the 5-item social discomfort sub-scale of the body avoidance questionnaire are the most pertinent when considering outcomes related to both disordered eating psychopathology and quality of life related to disordered eating. If assessment of body checking is also required, then the specific body parts and idiosyncratic sub-scales of the body checking questionnaire are also indicated, given that they predict unique variance in disordered eating

psychopathology. Use of this subset of body image measures involves a total of 30 items (as opposed to the original 54 items), providing a more manageable burden on respondents.

The strongest predictor of both disordered eating and quality of life was the body image flexibility measure. This is consistent with the idea that the measure assesses a broader aspect of positive body image. It was noted in a recent review by Webb et al. (2015) that positive body image assessment has largely been neglected in eating disorder prevention and intervention work. Notably, positive body image is defined as distinct from negative body image, and attaining positive body image is a desirable outcome, rather than simply the absence of negative body image (Tylka & Wood-Barcalow, 2015). Given that positive body image is conceptualised as a protective factor, ongoing assessment in eating disorder treatment is of particular relevance.

However, current outcome monitoring in eating disorder treatment focuses on the assessment of negative body image only, typically through the use of measures such as the EDE-Q. This is an important indicator of outcome, with one study identifying that changes to negative body image during treatment were the strongest predictor of eating pathology outcome in an inpatient treatment of a transdiagnostic sample of patients with eating disorders (Danielsen & Rø, 2012). In the absence of the assessment of positive body image, it is unknown whether treatment decreases negative body image alone or additionally encourages improved positive body image. Given the consistent findings across eating disorder treatment studies that early decrease in symptoms (including binge/purge symptoms and disordered eating) is one of the most robust predictors of good outcome (Vall & Wade, 2015), it would be of interest to further examine the predictive outcome of early changes to positive body image.

This study has several limitations. The cross-sectional design does not enable causal conclusions regarding the contribution of body image disturbance to disordered eating. Future

research investigating the measures over multiple time points is warranted, as is examination of test-retest reliability and responsiveness of these questionnaires to change. Further, this study did not utilise a clinical eating disorder sample. Rather, all participants were female undergraduate university students, which might limit the generalisation of results, although it should be noted that the rate of disordered eating is typically high in such samples.

Nonetheless, all results should be interpreted cautiously when applying the results to males.

The sample size, while sufficient to run the confirmatory factor analyses presented, is not sufficient to assess cross-validation with confirmatory or exploratory factor analysis to ensure the stability and precision of the solution. Thus further research may seek to replicate the findings of this study using a different and independent sample. The individual measures investigated have their own set of limitations. Specifically, while the psychometric properties of the body image flexibility measure have been consistently replicated across studies, it has been noted that, because of the use of negatively worded items, conceptually the measure may also be assessing the experiential avoidance of body image (Timko et al., 2014; Webb et al., 2015). Additionally, the measure may be more relevant to body image concerns of women than those of men (Sandoz et al., 2013; Webb et al., 2015). While the BI-AQQ was studied in an exclusively male sample which supported prior findings with women, psychometric properties including factor structure and validity were not conducted (Masuda et al., 2015). Thus, further research might investigate the use of more positively worded items and modifying the scale for use with men. Further research is also needed to establish whether items such as mirror gazing and weighing, which were omitted from the Lydecker et al. (2014) solution for body image avoidance, can be included in the valid assessment of body-related maintenance behaviours, given the focus of interventions for eating disorders on these behaviours (Fairburn, 2008; Waller et al., 2007). Finally, the response format of the

BIAQ and BCQ measures were modified in the present study to match the BI-AAQ to aid in factor analysis. Therefore, results for both measures must be interpreted with this in mind.

In summary, the structure of the original body image flexibility and body checking measures were replicated and deemed to be reliable and valid measures. The Lydecker et al. (2014) solution for the body image avoidance measure was considered to be the best fitting model and adequate reliability and validity were demonstrated. The significant predictors of eating disorder psychopathology and psychosocial impairment included the body image flexibility measure and select subscales from the body image avoidance and body checking measures. It is suggested that researchers and clinicians focus on the subscales identified, in order to reduce participant burden while adequately assessing body image disturbance as related to eating disorders.

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Table 1

Confirmatory Factor Analyses Model Fit Statistics (N=212) for the BI-AAQ, BIAQ, and BCQ (best fitting model is shaded)

	RMSEA [90% CI]	CFI	TLI	χ^2 test of model fit (df)
BI-AAQ 1-factor, 12-item (Original; Sandoz et al., 2013)	0.115 [0.102, 0.128]	0.982	0.977	288.169 (54)
BIAQ 4-factor, 19-item (Original; Rosen et al., 1991)	0.088 [0.080, 0.096]	0.922	0.909	515.965 (146)
BIAQ 3-factor, 13-item (Campana et al., 2009)	0.121 [0.109, 0.133]	0.879	0.848	358.803 (62)
BIAQ 2-factor, 14-item (Lydecker et al., 2014) ^a	0.060 [0.047, 0.072]	0.979	0.975	165.326 (76)
BCQ 3-factor, 23-item (Original; Reas et al., 2002)	0.096 [0.089, 0.102]	0.925	0.916	910.376 (227)
BCQ 2-factor, 23-item (White et al., 2015)	0.090 [0.083, 0.097]	0.933	0.926	837.214 (229)
BCQ 3-factor, 23-item (Lydecker et al., 2014)	0.092 [0.085, 0.098]	0.931	0.932	852.681 (227)
6 factors (BI-AAQ, BIAQ 2 subscales, & BCQ 3 subscales)	0.055 [0.052, 0.058]	0.953	0.951	2211.836 (1112)
6 factors (BI-AAQ, BIAQ 2 subscales, & BCQ 3 subscales) loading onto one higher order factor	0.066 [0.063, 0.069]	0.933	0.929	2711.262 (1121)

Note. BI-AAQ = Body Image Acceptance and Action Questionnaire; BIAQ = Body Image Avoidance Questionnaire; BCQ = Body Checking Questionnaire; RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker Lewis Index

^aThe CFA was run again after omitting item 13 ($R^2 = .04$, loading = .20). RMSEA [90% CI] = 0.067 [0.054, 0.080], CFI = 0.977, TLI = 0.972, χ^2 test of model fit (df) = 157.698 (64)

Table 2.

Items, standardised CFA squared multiple correlations and factor loadings on the 12 item one factor Body Image Acceptance and Action Questionnaire

Item	R ²	Loading
1. Worrying about my weight makes it difficult for me to live a life that I value	0.69	0.83
2. I care too much about my weight and body shape	0.64	0.80
3. I shut down when I feel bad about my body shape or weight	0.65	0.80
4. My thoughts and feelings about my body weight and shape must change before I can take important steps in my life	0.78	0.89
5. Worrying about my body takes up too much of my time	0.73	0.86
6. If I start to feel fat, I try to think about something else	0.19	0.43
7. Before I can make any serious plans, I have to feel better about my body	0.74	0.86
8. I will have better control over my life if I can control my negative thoughts about my body	0.66	0.81
9. To control my life, I need to control my weight	0.64	0.80
10. Feeling fat causes problems in my life	0.79	0.89
11. When I start thinking about the size and shape of my body, it's hard to do anything else	0.79	0.89
12. My relationships would be better if my body weight and/or shape did not bother me	0.70	0.84

Table 3.

Items, standardised CFA squared multiple correlations and factor loadings on the 14 item two factor Body Image Avoidance Questionnaire

Factor	Item	R ²	Loading
1. Exposure Discomfort	1. I wear baggy clothes	0.32	0.57
	2. I wear clothes I do not like	0.44	0.67
	3. I wear darker colour clothing	0.24	0.49
	4. I wear a special set of clothing e.g. my “fat clothes”	0.55	0.74
	13. I am inactive	0.04	0.20
	15. I avoid physical intimacy	0.44	0.66
	16. I wear clothes that will divert attention from my weight	0.61	0.78
	17. I avoid going clothes shopping	0.61	0.78
	18. I don’t wear “revealing” clothes (e.g. bathing suits, tank tops, or shorts)	0.50	0.71
2. Social Discomfort	7. I fast for a day or longer	0.51	0.71
	8. I do not go out socially if I will be “checked out”	0.70	0.84
	9. I do not go out socially if the people I am with will discuss weight	0.74	0.86
	10. I do not go out socially if the people I am with are thinner than me	0.74	0.86
	11. I do not go out socially if it involves eating	0.63	0.79

Note. Composite Reliability (CR) for the 14-item two factor Body Image Avoidance Questionnaire is 0.920. After omitting item 13 CR= 0.926.

Table 4.

Items, standardised CFA squared multiple correlations and factor loadings on the 23 item three factor Body Checking Questionnaire

Factor	Item	R ²	Loading
1. Overall Appearance	3. I have special clothes which I try on to make sure they still fit	0.45	0.67
	5. I check my reflection in glass doors or car windows to see how I look	0.29	0.54
	8. I look at others to see how my body size compares to their body size	0.59	0.77
	11. I ask others about their weight or clothing size so I can compare my own weight/size	0.50	0.71
	12. I check to see how my bottom looks in the mirror	0.42	0.65
	13. I practice sitting and standing in various positions to see how I would look in each position	0.40	0.64
	15. I try to elicit comments from others about how fat I am	0.46	0.68
	17. I suck in my gut to see what it is like when my stomach is completely flat	0.60	0.77
	21. I pull my clothes as tightly as possible around myself to see how I look	0.35	0.59
	22. I compare myself to models on TV or in magazines	0.29	0.54
2. Specific Body Parts	1. I check to see if my thighs spread when I'm sitting down	0.63	0.80
	2. I pinch my stomach to measure fatness	0.73	0.85
	6. I pinch my upper arms to measure fatness	0.68	0.83
	9. I rub (or touch) my thighs while sitting to check for fatness	0.79	0.89
	10. I check the diameter of my legs to make sure they're the same size as before	0.69	0.83
	14. I check to see if my thighs rub together	0.66	0.81
	16. I check to see if my fat jiggles	0.69	0.83
19. I look to see if I have cellulite on my thighs when I'm sitting	0.51	0.71	
3. Idiosyncratic Checking	4. I check the diameter of my wrist to make sure it's the same size as before	0.54	0.73
	7. I touch underneath my chin to make sure I don't have a "double chin"	0.65	0.80
	18. I check to make sure my rings fit the same way as before	0.28	0.53
	20. I lie down on the floor to see if I can feel my bones touch the floor	0.32	0.56
	23. I pinch my cheeks to measure fatness	0.30	0.54

Table 5

Minima, Maxima, Means, Standard Deviations, and Internal Consistency (Composite Reliability) for all variables

	N	Range	Min	Max	M	SD	CR	Cronbach's Alpha
BI-AAQ	328	12 - 84	12	84	53.61	16.92	0.959	-
Two Factor 14 Item BIAQ Total	328	14 - 98	14	86	37.79	13.52	0.920	-
Two Factor 14 Item BIAQ Exposure Discomfort Subscale	328	9 - 63	9	60	28.62	9.55	0.857	-
Two Factor 14 Item BIAQ Social Discomfort Subscale	328	5 - 35	5	34	9.17	5.22	0.907	-
Three Factor 23 Item BCQ Total	328	23 - 161	24	156	74.09	28.46	0.957	-
Three Factor 23 Item BCQ Overall Appearance Subscale	328	10 - 70	11	68	34.50	11.73	0.883	-
Three Factor 23 Item BCQ Specific Body Parts Subscale	328	8 - 56	8	56	26.10	12.21	0.942	-
Three Factor 23 Item BCQ Idiosyncratic Checking Subscale	328	5 - 35	5	35	15.29	6.52	0.775	-
EDE-Q Total	216	0 - 6	0	5.80	2.02	1.45	-	0.76-0.92
CIA Total	217	0 - 48	0	42	12.08	10.53	-	0.95
DASS21 Depression Subscale	111	0 - 21	0	21	4.75	4.63	-	0.92
DASS21 Anxiety Subscale	111	0 - 21	0	21	4.39	4.18	-	0.85
MPS PS and CM Subscales	111	1 - 5	1.50	5	3.06	0.69	-	0.77 (PS), 0.88 (CM)
EDI Body Dissatisfaction Subscale	111	1 - 6	1.00	5.44	3.17	0.92	-	0.84
BMI	328		14.69	59.99	23.00	4.77	-	-

Note: BI-AAQ = Body Image Acceptance and Action Questionnaire; BIAQ = Body Image Avoidance Questionnaire; BCQ = Body Checking Questionnaire; EDE-Q = Eating Disorder Examination Questionnaire; CIA = Clinical Impairment Assessment; DASS21 = Depression Anxiety and Stress Scales 21 item version; MPS = Multidimensional Perfectionism Scale; PS = Personal Standards; CM = Concern over Mistakes; EDI = Eating Disorder Inventory; BMI = Body Mass Index; CR=Composite Reliability Cronbach's alpha provided as a range across the 4 subscales for the EDE-Q.

Table 6

Pearson Correlations between the BI-AAQ, Two Factor BIAQ Subscales and Total Scores, Three Factor BCQ Subscales and Total Scores, EDE-Q Global Scores, CIA, and BMI.

	BIAQT (N=328)	BIAQED (N=328)	BIAQSD (N=328)	BCQT (N=328)	BCQO (N=328)	BCQS (N=328)	BCQI (N=328)	EDE-Q (N=216)	CIA (N=217)	BMI (N=328)	DASS-D (N=111)	DASS-A (N=111)	MPS (N=111)	EDI-BD (N=111)
BI-AAQ	-.66	-.60	-.63	-.73	-.70	-.68	-.69	-.81	-.81	-.34	-.45	-.40	-.33	.50
BIAQT	-	.96	.84	.60	.55	.54	.60	.63	.72	.42	.42	.40	.26	-.53
BIAQED	-	-	.64	.54	.49	.49	.54	.56	.64	.42	.37	.34	.27	-.53
BIAQSD	-	-	-	.57	.52	.52	.56	.63	.71	.32	.39	.40	.17 ^a	-.41
BCQT	-	-	-	-	.95	.96	.90	.78	.72	.18	.33	.28	.42	-.61
BCQO	-	-	-	-	-	.87	.80	.73	.68	.16	.28	.24	.40	-.58
BCQS	-	-	-	-	-	-	.81	.74	.68	.16	.33	.29	.41	-.61
BCQI	-	-	-	-	-	-	-	.74	.69	.18	.36	.31	.38	-.54

Note. BI-AAQ = Body Image Acceptance and Action Questionnaire; BIAQ = Body Image Avoidance Questionnaire; BCQ = Body Checking Questionnaire; BIAQT = BIAQ Total; BIAQED = BIAQ Exposure Discomfort; BIAQSD = BIAQ Social Discomfort; BCQT = BCQ Total; BCQO = BCQ Overall Appearance; BCQS = BCQ Specific Body Parts; BCQI = BCQ Idiosyncratic checking; DASS21 = Depression Anxiety and Stress Scales 21 item version; DASS-D = DASS21 depression subscale; DASS-A = DASS21 anxiety subscale; MPS = Multidimensional Perfectionism Scale; EDI-BD = Eating Disorder Inventory body dissatisfaction subscale. All correlations are significant ($p < .001$) unless denoted by ^a

Table 7

Summary of Regression Analyses with the six Body Image Subscales, controlling for BMI, with Global EDE-Q and CIA Scores as the Dependent Variables (significant subscales bolded).

		Global EDE-Q (N = 216 ^a)				CIA (N = 217)				
Step	Predictors & Order of Entry	B	SE	β	p	Predictors & Order of Entry	B	SE	β	p
1	BMI	0.09	0.02	0.32	< .001	BMI	0.75	0.14	0.35	< .001
		$R^2 = .101, F(1, 214) = 24.057, p < .001$				$R^2 = .122, F(1, 215) = 30.008, p < .001$				
2	BI-AAQ	-0.04	0.01	-0.45	< .001	BI-AAQ	-0.28	0.04	-0.46	< .001
	BIAQ Exposure Discomfort	0.00	0.01	-0.02	.724	BIAQ Exposure Discomfort	0.11	0.06	0.10	.051
	BIAQ Social Discomfort	0.03	0.02	0.12	.032	BIAQ Social Discomfort	0.47	0.11	0.23	< .001
	BCQ Overall Appearance	0.01	0.01	0.05	.564	BCQ Overall Appearance	0.03	0.07	0.03	.681
	BCQ Specific Body Parts	0.02	0.01	0.20	.009	BCQ Specific Body Parts	0.08	0.06	0.10	.212
	BCQ Idiosyncratic Checking	0.03	0.02	0.16	.033	BCQ Idiosyncratic Checking	0.11	0.11	0.07	.325
		$R^2\text{change} = 0.634, F\text{change}(6, 208) = 82.830, p < .001$				$R^2\text{change} = .619, F\text{change}(6, 209) = 83.297, p < .001$				

Note. BI-AAQ = Body Image Acceptance and Action Questionnaire; BIAQ = Body Image Avoidance Questionnaire; BCQ = Body Checking Questionnaire; EDE-Q = Eating Disorder Examination Questionnaire; CIA = Clinical Impairment Assessment; BMI = Body Mass Index; SE = Standard Error

^a 1 participant did not complete enough items to derive a global EDE-Q score

Table 8

Summary of independent samples t-tests comparing disordered eating and healthy groups on the best fitting BI-AAQ, BIAQ, and BCQ

Measure	Disordered Eating Group N = 69 M(SD)	Healthy Group N = 147 M(SD)	t	df	p	Cohen's d
Age	19.69 (2.18)	19.49 (1.89)	0.68	211	0.50	0.10
BMI	25.10 (5.17)	21.97 (4.54)	4.52	214	<.001	0.66
BI-AAQ	38.07 (12.38)	61.14 (14.18)	12.18	150.91	<.001	1.69
BIAQ Total	48.99 (13.80)	32.25 (9.83)	9.06	101.57	<.001	1.49
BIAQ Exposure Discomfort	35.78 (9.52)	25.25 (7.97)	8.49	214	<.001	1.24
BIAQ Social Discomfort	13.21 (6.08)	7.00 (2.87)	8.08	85.53	<.001	1.49
BCQ Total	101.48 (27.43)	62.77 (20.73)	10.41	105.79	<.001	1.68
BCQ Overall Appearance	45.62 (10.75)	31.04 (9.15)	10.32	214	<.001	1.51
BCQ Specific Body Parts	38.44 (11.72)	22.20 (9.66)	10.74	214	<.001	1.57
BCQ Idiosyncratic Checking	20.39 (6.61)	12.07 (4.62)	9.42	100.23	<.001	1.56

Note. BI-AAQ = Body Image Acceptance and Action Questionnaire; BIAQ = Body Image Avoidance Questionnaire; BCQ = Body Checking Questionnaire.

Supplementary Table 1

Exploratory factor analyses – summary of model fit information

	Number of parameters	χ^2	df	RMSEA [90% CI]	CFI	TLI	Models compared	χ^2^a	df
1-factor	49	1788.351**	1127	0.080 [0.073, 0.087]	0.916	0.913			
2-factor	97	1445.432**	1079	0.061 [0.052, 0.069]	0.954	0.949	1-factor against 2-factor	281.617**	48
3-factor	144	1288.627**	1032	0.052 [0.042, 0.061]	0.968	0.963	2-factor against 3-factor	149.944**	47
4-factor	190	1182.183**	986	0.047 [0.035, 0.056]	0.975	0.970	3-factor against 4-factor	110.828**	46
5-factor	235	1074.390*	941	0.039 [0.026, 0.050]	0.983	0.979	4-factor against 5-factor	126.993**	45
6-factor	279	1009.712*	897	0.037 [0.022, 0.049]	0.986	0.981	5-factor against 6-factor	74.812*	44

Note. RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker Lewis Index

** p < .001 * p < .05

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Supplementary Table 2

Exploratory factor analysis – *factor loadings on the 6 factor model* $\geq .4$

Item	F1	F2	F3	F4	F5	F6	POVE
BI-AAQ 1	0.82						0.75
BI-AAQ 2	0.69						0.75
BI-AAQ 3	0.65						0.68
BI-AAQ 4	0.97		-0.54				0.87
BI-AAQ 5	0.83						0.78
BI-AAQ 6							0.30
BI-AAQ 7	1.03						0.85
BI-AAQ 8	0.88						0.77
BI-AAQ 9	0.63						0.71
BI-AAQ 10	0.66						0.79
BI-AAQ 11	0.85						0.86
BI-AAQ 12	0.67						0.77
BIAQ 1		0.68					0.58
BIAQ 2						0.40	0.47
BIAQ 3		0.63					0.53
BIAQ 4						0.45	0.57
BIAQ 7			0.40	-0.51			0.70
BIAQ 8				-0.71			0.57
BIAQ 9							0.60
BIAQ 10						0.68	0.70
BIAQ 11	0.56					0.42	0.83
BIAQ 13	0.40					0.40	0.73
BIAQ 15						0.51	0.65
BIAQ 16							0.14
BIAQ 17				0.51	0.44		0.46
BIAQ 18			0.41	0.53			0.48
BCQ 1		0.53					0.64
BCQ 2	0.40						0.67
BCQ 3		0.59					0.71
BCQ 4		0.56					0.61
BCQ 5		-0.61					0.46
BCQ 6			0.50				0.60
BCQ 7			0.78				0.81
BCQ 8							0.60
BCQ 9					0.68		0.65
BCQ 10			0.51	0.44			0.36
BCQ 11			0.44		0.46		0.79
BCQ 12			0.47		0.42		0.73
BCQ 13			0.56				0.67
BCQ 14			0.59				0.82
BCQ 15					0.57		0.71
BCQ 16					0.76		0.62
BCQ 17			0.65				0.41
BCQ 18			0.48		0.44		0.50
BCQ 19			0.53				0.80
BCQ 20					0.73		0.70
BCQ 21			0.50				0.77
BCQ 22			0.67				0.73
BCQ 23					0.78		0.75

Note. All factor loadings significant $p < .05$
 POVE = Proportion of variance explained