A Confirmation of the Eight Factor Structure of the Eating Disorders Inventory in a Non-Clinical Sample, with New Zealand Norms

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The Eating Disorders Inventory (EDI) is a widely used questionnaire for clinical assessment and for research with people who have eating disorders. It has eight subscales, providing information on eight separate dimensions of cognitive and behavioural aspects of eating disorders. While the existence of eight factors underlying these subscales is generally accepted for clinical samples, this has not always been the case when the EDI has been administered to non-clinical groups, a situation that has clear implications for its use as a screening device. In this study, the EDI was administered to a sample of 260 New Zealand female university students. An initial confirmatory factor analysis with five previously identified subscales supported a five factor structure, while successive analyses with each of the three remaining subscales included in turn, confirmed the eight factor structure. A single factor confirmatory analysis also provided strong support for the presence of an underlying general factor. As the EDI may therefore be a much more promising instrument for use with community samples than some critics have argued, summary statistics and norms were developed for all eight subscales and for the full EDI.

The Eating Disorders Inventory (EDI) is a 64 item, self-report questionnaire, designed to provide information on eight separate dimensions of cognitive and behavioural aspects of anorexia nervosa and bulimia (Garner, Olmsted, & Polivy, 1983, 1983a). The development and validation of this measure was first described by Garner, Olmsted, and Polivy (1983), who reported data on the internal consistency of its eight subscales, and also provided evidence for their convergent and discriminant validity. The eight subscales that comprise the EDI are called: Drive for Thinness (DT), Bulimia (B), Body Dissatisfaction (BD), Ineffectiveness (I), Perfectionism (P), Interpersonal Distrust (ID), Interoceptive Awareness (IA), and Maturity Fears (MF).

While the EDI has gained considerable popularity recently with both clinicians and researchers, controversy has surrounded the nature of its underlying factor structure. In particular, the failure to demonstrate an eight factor structure consistently among non-clinical samples, has been cited as evidence that the EDI is not a suitable instrument for screening for eating disorders in community samples (Schoemaker, van Strien, & van der Staak, 1994; Bennett & Stevens, 1997). By "non-clinical" we refer to samples, such as university students, where it is assumed that most of the participants have never been diagnosed with an eating disorder. That the eight factors are reliably observed with clinical samples of people with an eating disorder does not appear to be disputed.

Evidence for an eight factor structure among non-clinical groups

Klemchuk, Hutchinson and Frank (1990) examined the factor structure of the EDI for a sample of 1,506 North American, female undergraduates. They compared five, six, and eight factor solutions using both oblique (promax) and orthogonal (varimax) methods of rotation. While the six factor solution was considered to be the most easily interpretable these authors were quite positive about the eight factor model. They reported five robust factors which corresponded closely with the putative subscales of the EDI. The five factors were: Body Dissatisfaction, Ineffectiveness, Interpersonal Distrust, Maturity Fears and Perfectionism. The sixth factor reported by Klemchuk et al., loaded highly on items from three EDI subscales, which were Drive for Thinness, Bulimia and Interoceptive Awareness. Klemchuk et al. (1990, p.299) described this sixth factor as "the only significant departure from the clinically derived eight-scale structure of the EDI". Lee, Lee, Leung and Yu (1997), examined the factor structure of the EDI in a sample of 606 female Chinese undergraduates in Hong Kong.

Using a principal axis extraction with oblique rotation, they reported a robust eight factor solution, corresponding closely to the eight subscales originally proposed by Garner et al. (1983) when the measure was first developed.

Evidence against an eight factor structure

Welch, Hall and Walkey (1988) compared the factor structure of the EDI across three non-clinical samples using the FACTOREP technique devised by Walkey and McCormick (1985). They concluded that there were three clear and replicable factors but not eight. Later, Schoemaker, van Strien, and van der Staak (1994) administered the EDI to a Dutch sample of 735 adolescent girls. They compared four, five, and eight factor solutions using principal components analysis followed by varimax rotation. They concluded that the five factor solution was the "most meaningful" (p.390), but overall they were highly critical of the EDI. Schoemaker et al. criticised the EDI for its "lack of factorial integrity" (p.391) and cautioned against its use for screening among normal populations.

Bennett and Stevens (1997) examined the factor structure of the EDI with a sample of 310 women volunteers from a variety of different community settings, using principal component analysis with varimax rotation. They reported a seven factor structure. However, they also noted that some 35 of the total number of 64 items, loaded high (>.40) on the first rotated factor. Moreover, these 34 items were drawn from all but one of the eight subscales, suggesting the presence of a significant general factor underlying responses to the EDI as a whole. If such a pervasive general factor does underlie the EDI, it might well account for the difficulty in replicating the eight factor structure, when conventional exploratory factor analysis is employed using the 64 individual items with their inherent single-item unreliability.

In summary, the EDI is a popular instrument for the assessment of eating disorders, for clinical and research purposes. It has eight subscales providing information on what appear to be the most salient dimensions of eating disorders. However, while the eight factors thought to underlie its subscales have been consistently observed among clinical samples, results have been more variable with non-clinical samples. This has important implications for the value of the EDI as both a screening instrument and a research instrument with community samples. It also has theoretical significance as noted by Bennett and Stevens (1997). They comment that the debate over the factor structure of the EDI is closely connected with the "continuum hypothesis debate". This refers to the question of whether or not eating disorders occur on a continuum, with full-blown eating disorders representing extreme levels of characteristics observable in women without such disorders. Thus the issue of the factor structure of the EDI has both practical implications for researchers who might use this measure, and theoretical importance as well.

In the present study we report a confirmatory factor analytic evaluation of the eight factor structure of the EDI in the responses of a substantial sample of New Zealand female university students - and provide summary statistics and norms derived from these responses.

The confirmatory factor analyses were undertaken using the AMOS 4 Structural Equation Modelling procedure in SPSS (Arbuckle & Wothke, 1999). Four indices of the fit between the data and the various alternative models were examined. These included chi-square, the ratio of chi-square to the degrees of freedom, the Goodness of Fit Index, (GFI) and the Root Mean Square of Approximation (RMSEA). These indices are described in detail in many texts on Structural Equation Modeling, including Arbuckle and Wothke (1999), and Tabachnick and Fidell (1996), and only a brief description will be given here.

The only index for which a test of significance is available is chi-square, and paradoxically, in testing the fit to the model a non-significant chi-square is sought, indicating that in this instance there is no significant difference between the observed data and the model under scrutiny. Experience has also shown that the chi-square value obtained is highly vulnerable to increases in the degrees of freedom, and that it is virtually impossible to achieve a non-significant value when single item data are used. Two strategies have been employed to counter this.

The first strategy, is to reduce both the degrees of freedom, and the impact of single item unreliability, by combining the items into a relatively small number of more reliable, multiple item parcels. The parceling procedure, which was utilised in a confirmatory factor analytic context by Kishton and Widaman (1994), was constrained in the present study by the need for at least four parcels of observed variables to give a minimum number of degrees of freedom, and for at least two of these observed variables to be related to each latent variable. By using 16 factor parcels rather than the 64 individual items (with two parcels derived from each of the eight subscales), the degrees of freedom for the eight-factor confirmatory analysis were reduced from 1924 to just 76. Using four parcels for the single-factor analysis, with each parcel representing all aspects of the eating disorders domain covered by the EDI, that is, with each of the eight subscales represented in all four parcels, the degrees of freedom are reduced to two.

The second strategy employed in the analyses, was to use the ratio of chi-square to degrees of freedom as an alternative indicator of goodness of fit. As a rule of thumb, it has been suggested that for an acceptable fit the value of the ratio should be less than 2.00. (There is no test for the significance of this value.)

Of the two remaining indices, the Goodness of Fit Index (GFI) is a measure of the adequacy of the model in relation to the observed data. The fourth index, the Root Mean Square of Approximation (RMSEA) is a measure of badness of fit. While there are no tests of significance for these indices either, it is generally accepted that the GFI should be >0.90, and preferably >0.95, with 1.00 as the ideal value. The RMSEA on the other hand, as a measure of badness of fit, should be as small as possible, approaching 0.00, with values <0.10 being acceptable, and <0.05 regarded as good.

The adequacy of the five-factor structure suggested by Klemchuk et al. (1990) and the original eight-factor structure proposed by Garner et al. (1983) were examined using two parcels of items derived from each of the relevant subscales. To test the hypothesis that a single underlying general factor would provide an adequate model for the data, analyses were undertaken using just four parcels of items drawn from all factors, to optimise their reliability and to minimise the degrees of freedom. In every case, all the relevant items were included in the parcels.

Summary statistics and reliabilities (Cronbach's Alpha and corrected split-half) were calculated for the individual subscales and for the full EDI.

As the participants included a significant sample of New Zealand women within the higher risk age range for eating disorders, a table of norms was drawn up, reflecting their responses to the eight factors identified by Garner et al. (1983) and to the overall EDI scale.

Method

Measure

The Eating Disorders Inventory (EDI) is a 64 item, self-report questionnaire, designed to provide information on eight separate dimensions (see above for details) of cognitive and behavioural aspects of anorexia nervosa and bulimia (Garner, Olmsted, & Polivy, 1983, 1983a). Respondents are asked to rate themselves for each item (e.g. "I am terrified of gaining weight", "I think that my hips are too large") on a six point Likert scale from *Always* to *Never*.

Participants

Participants were 266 female university students at Victoria University of Wellington, New Zealand. Their ages ranged from 18 to 28 years with a mean age of 19.90. Participants completed the EDI as one part of a booklet of three questionnaires which were part of a broader research programme. All participants completed the EDI anonymously and on a voluntary basis. The project had previously been approved by the Human Ethics Committee of Victoria University.

Confirmatory Factor Analyses

An initial confirmatory factor analysis was undertaken to test the conclusion of Klemchuk et al. (1990) that the Body Dissatisfaction, Ineffectiveness, Interpersonal Distrust, Maturity Fears and Perfectionism subscales would provide an adequate five factor structure. When this was supported the remaining subscales were added one at a time to confirm their contributions to the factor structure of the EDI. The pattern of correlations between the eight factors of the EDI was also examined to identify further support for the eight factor structure. In this instance it was assumed that support for the eight factor structure would be shown by a pattern of intercorrelations between .15 and .80. Finally the relationship between the items of the EDI and a single underlying general factor was examined to assess the suggestion of such a factor based on the observations of Bennett and Stevens (1997).

Results

The results of the various confirmatory factor analyses are summarised in Table 1.

Confirmation of the Eight Factor Structure

The five factors identified by Klemchuk et al. (1990) and related to the Body Dissatisfaction, Ineffectiveness, Interpersonal Distrust, Maturity Fears, and Perfectionism subscales were examined in the first confirmatory factor analysis. As is commonly found the chi-square was significant, casting some doubt on the adequacy of the model. However, at 1.64, the chi-square to df ratio was well below the criterion level of 2.00, which with the GFI at 0.96 and the RMSEA at 0.06 provide clear support for the model.

As the three remaining scales were added, one at a time, the level of support for the developing model remained constant. While the chi-square value and the degrees of freedom escalated with the addition of further observed variables, the chi-square to df ratio, the GFI, and the RMSEA, all remained relatively stable, and at levels that provided consistent support for the model, and thereby for the proposed factor and subscale structure. Examination of the pattern of correlations between the factors given in Table 2, shows that all but two of the 28 correlations lay within the .15-.80 criterion span used. The outliers included one at just .14 and one at .86. Examination of the pattern of correlations therefore, may be seen as supporting the expected eight factor structure already identified by the outcome of the confirmatory factor analysis.

Confirmation of the Underlying General Factor

The presence of a general factor was confirmed by the analysis of four parcels, each drawn from across all the scales of the EDI. With four observed variables and two degrees of freedom, the Chi-square is not significant, thereby providing support for the one factor model. This support is strengthened by the chi-square to degrees of freedom ratio, which is only 1.01, (well below the criterion level of 2.00) by the GFI which achieves its ideal maximum of 1.00, and by the RMSEA which is just 0.01 above its ideal minimum of 0.00.

Table 1. Results of the Confirmatory Factor Analyses of the Eating Disorders Inventory

Number of Factors	5	6	7	8	1
Number of parcels	10	12	14	16	4
Chi-square	41.07	53.78	88.02	125.94	2.03
df	25	39	56	76	2
p	<.05	<.10	<.01	<.01	<.40
Chi-square/df	1.64	1.38	1.57	1.66	1.01
GFI	0.96	0.96	0.97	0.93	1.00
RMSEA	0.06	0.04	0.05	0.06	0.01

Table 2. Correlations between the eight factors of the Eating Disorders Inventory

Factor	Factor						
	DT	B	BD	I	P	ID	IA
B	.74						
BD	.76	.54					
I	.51	.48	.46				
P	.46	.35	.26	.34			
ID	.23	.29	.36	.67	.14		
IA	.63	.61	.51	.86	.33	.56	
MF	.41	.41	.34	.63	.29	.36	.58

Note: DT = Drive for Thinness B = Bulimia BD = Body Dissatisfaction
I = Ineffectiveness P = Perfectionism ID = Interpersonal Distrust
IA = Interoceptive Awareness MF = Maturity Fears

Following the successful confirmation of the eight factor structure, and of the single general factor in the EDI, summary statistics and reliabilities were calculated for all eight subscales and for the EDI as a whole. These data are included in Table 3. The reliability estimates supported the conclusions drawn from the confirmatory factor analyses. Alphas for the eight subscales ranged from .77 to .92 and corrected split-half correlations ranged from .73 to .91. The Alpha estimate for the full EDI was .94 and the corrected split half reliability was .95.

Given the apparent adequacy of the factor structure proposed by the authors of the scale (Garner et al., 1983), and the strength of the general factor underlying the scale as a whole, it appeared appropriate to utilise the responses of the present sample in the derivation of a set of summary statistics and New Zealand norms for both the eight individual subscales and for the measure as a whole. These data are also shown in Table 3.

Discussion

The factor structure of the EDI has been the subject of some controversy. While an eight factor structure has generally been observed in exploratory analyses with samples of people with eating disorders, this has not always been the case with non-clinical samples, in which the inter-item correlations, and consequently the factor structures may be attenuated by the inclusion of a significant amount of data from non-symptomatic respondents. In the present study we examined the factor structure of the EDI in the responses of a substantial sample of female university students, using confirmatory factor analysis. An initial five factor analysis of responses to items from five of the scales showed an acceptable level of support for the five factors originally designated by the authors of the Scale (Garner et al., 1983) and subsequently identified by Klemchuck et al. (1990). Subsequently, the systematic evaluation of the structure as the items of three remaining subscales were added, confirmed the model, up to the eight factors of the full EDI. It was therefore concluded that the eight subscales originally proposed by Garner et al. (1983) were no less discriminable than the five accepted by Klemchuck et al. (1990), and that the potential usefulness of the EDI would therefore be maximised by the use of the eight.

Further support for the eight factor structure was provided by an examination of the pattern of correlations between the factors, which revealed a consistent, moderate level of correlation between them. Given a criterion band of .15 - .80 for these moderate correlations, it was found that

Table 3. Norms, Summary Statistics and Reliabilities of the Subscales and of the total Eating Disorders Inventory

Percentiles	Raw Scores								
	DT	B	BD	I	P	ID	IA	MF	Total
1 - 10	0	0	1	0	0	0	0	0	0 - 9
11 - 20	0	0	2 - 4	0	1	0	0	0	10 - 12
21 - 30	0	0	5	0	2	0	0	1	13 - 18
31 - 40	0	0	6 - 7	0	3	1	1	1	19 - 23
41 - 50	1	1	8 - 9	1	4	1	1	2	24 - 28
51 - 60	2 - 3	1	10 - 12	2	5	2	2	2	29 - 34
61 - 70	4 - 5	2	13 - 16	3	6	3	3	3	37 - 43
71 - 80	6 - 9	2	17 - 19	4 - 5	7 - 8	4	4 - 5	4	44 - 54
81 - 90	10 - 14	3 - 6	20 - 23	6 - 9	9 - 10	5 - 7	6 - 8	5 - 7	55 - 69
91 - 95	15 - 16	7 - 9	24 - 25	10	11 - 13	8	9 - 11	8 - 10	70 - 88
96 - 100	17 - 21	10 - 21	26 - 27	11 - 27	14 - 18	9 - 18	12 - 21	11 - 21	89 - 164
Mean	4.77	2.20	11.42	3.30	5.14	2.51	2.99	2.86	35.19
Std. Dev.	5.74	3.49	8.00	4.49	4.18	3.18	3.95	3.58	25.74
Alpha	.90	.82	.92	.87	.77	.80	.78	.81	.94
Split Half	.89	.75	.91	.85	.81	.81	.78	.73	.95

Note: DT = Drive for Thinness B = Bulimia BD = Body Dissatisfaction I = Ineffectiveness
P = Perfectionism ID = Interpersonal Distrust IA = Interoceptive Awareness MF = Maturity Fears

just one of the 28 fell below the lower bound (by .01) and a second fell slightly further (.06) above the upper bound. As the eight factor and subscale version of the EDI appears to have the greatest potential as a psychometric and screening device, and there appears to be no good case for the use of a smaller number of subscales, the continued use of the full, eight subscale version is therefore supported by the present study.

It was apparent from the correlations between the latent variables shown by the confirmatory analyses that many of the scales were significantly correlated (see Table 2). This, in turn, suggested that their constituent items were also likely to be correlated, providing an independent corroboration of an observation already apparent in the work of Bennett and Stevens (1997). The presence of a single latent variable which would account for these correlations was confirmed by an appropriate analysis.

Reliability estimates supported the conclusions drawn from the confirmatory factor analyses. Those for the eight subscales were generally at acceptable to excellent levels, with Alphas ranging from .77 to .92 and corrected split-half correlations ranging from .73 to .91. Reliabilities for the full EDI were excellent with Alpha estimated at .94 and the corrected split half at .95.

The results suggest that contrary to the conclusions of a number of previous researchers, the EDI including all eight subscales as well as the full scale, may well be a useful instrument with community or non-clinical samples, and that criticisms based upon exploratory factor analyses of the responses of such groups may have been overstated. Previous failures to replicate the complex eight factor structure may have even been a consequence of a statistical cookbook approach to exploratory factor analysis which almost inevitably has problems replicating more than a small number of factors, particularly with single item data (Walkey, 1983). It is suggested that in using this particular measure, that is, the EDI, there may also be a problem of attenuation in data from a community group which includes a substantial number of non-symptomatic individuals. The results also have implications for the "continuum hypothesis debate", providing some support for the notion that the dimensions on which eating disorders are identified are continuous.

The present study also paves the way for the use of the EDI both clinically and in research on eating disorders in New Zealand. Sadly, this group of disorders is not uncommon in New Zealand. For example, Bushnell, Wells, Hornblow, Oakley-Browne and Joyce (1990) reported a prevalence rate for bulimia nervosa of 4.5% among Christchurch women age 18 - 24. Moreover, while the norms we report are from a female University sample, this does not necessarily limit their utility or generalisability, especially when one considers the epidemiology of the eating disorders. In fact, younger women from middle-class families in industrialised nations, seem to constitute most of the cases of eating disorders identified. On this note Barlow and Durand (1999, p.229) have commented that "eating disorders tend to occur in a relatively small segment of the population. More than 90% of the severe cases are young females, mostly in families with upper socioeconomic status, who live in a socially competitive environment.". Hopefully, the EDI is one measure that might usefully be employed to further examine this group of disorders in the New Zealand context.

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