Article

Investigating Associations Between Health Status Indicators and DSM-5 Binge-Eating Disorder Diagnostic Features for the Phenomenon of Binge-Eating Within a Community Population

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Abstract

Background: This study explored the relationships between Diagnostic and Statistical Manual of Mental Disorders, Fifth edition (DSM-5) binge-eating disorder (BED) diagnostic features (Criteria B and C) with weight/shape overvaluation, anxiety/depression, pain, and physical and mental health related quality of life (QoL) in a general population sample.

Methods: Data comprised 280 participants aged >15 years, from a State epidemiological sample. Participants reported weekly recurrent binge-eating (DSM-5 BED criteria) without another main eating disorder diagnoses. Bivariate and multivariable analyses were used to explore associations.

Results: After adjustment for age and sex, Criterion B1, "rapid eating" was associated with increased distress, lower weight/shape overvaluation and higher pain/discomfort; B2, "uncomfortably full eating" was associated with higher weight/shape overvaluation; B3, "non-hungry eating" was associated with higher weight/shape overvaluation; and, B5, binge-eating "disgust, guilt, or depression" was associated with increased binge-eating distress, higher weight/shape overvaluation, anxiety/depression and lower mental health related QoL. Criterion C ("binge-eating distress") was associated with greater pain/discomfort and anxiety/depression and lower mental health related QoL Low frequency of B4 (n = 12, 4.3%; "Solitary binging due to embarrassment") precluded multivariable analyses.

Conclusions: These findings indicate clinical associations of these DSM-5 criteria and suggest each may have singular value. In particular, disgust with eating (B5) and binge-eating distress (Criterion C) appeared to have the most consistent associations with indicators of mental health and eating disorder symptoms.

Keywords

binge-eating disorder; DSM-5; ICD-11; diagnostic features; validity; community

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Introduction

Binge-eating is the key characteristic of binge-eating disorder (BED), the most prevalent type of eating disorder worldwide and which has significant physical and mental health consequences [1]. The American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders, Fifth edition (DSM-5) [2] requires for its diagnosis that recurrent binge-eating episodes (Criteria A and D) are accompanied by three or more behavioural indicators of (Criterion B): (1) "rapid eating"; (2) "uncomfortably full eating"; (3) "non-hungry eating"; (4) "eating in isolation due to embarrassment over the amount of food being consumed"; (5) "feelings of disgust, guilt, or depression". These are not mandated by the International Classification of Diseases, 11th Revision (ICD-11) [3] although the presence of marked distress about binge-eating (DSM Criterion C) is required by both. Two studies, one in a clinical [4] and one in a non-clinical general population [5] comparing the two schemes found despite not needing to have DSM5 Criterion B, participants diagnosed with ICD-11 BED had similar levels of symptom severity and mental health related quality of life (QoL) as had individuals meeting the full DSM-5 criteria. (In the latter study however only 7 people met the full DSM5-criteria and 41 met ICD-11 criteria [5]) These behavioural indicators and distress are as well not required by either diagnostic system for other disorders characterised by recurrent binge episodes [2,3] and have mixed supporting evidence.

An early study [6] investigated the five behavioural indicators of Criterion B in a self-selected online community sample. The highest positive predictive value for identifying presence of recurrent binge-eating (Criterion A) was observed for Criterion B4 and B3. A second study [7] in an expanded online community sample found that presence of binge-eating distress (Criterion C) differentiated people with higher levels of eating disorder symptoms and depression from those with only Criteria A and B of BED. In more contemporary research in college cohorts, Klein *et al*. [8] identified that presence of B5 alone effectively predicted significant distress (Criterion C) in people with BED or sub-threshold BED. Richson *et al*. [9] in a transdiagnostic student sample of people with an eating disorder (majority with BN or sub-threshold BN) and recurrent binge eating (majority with BN or sub-threshold BN) found only B3 and B4 predicted binge-eating frequency and only B4 predicted eating disorder related QoL. Mohsin *et al*. [10], recent investigation in an adult general population sample of people with a high body mass index (BMI) and recurrent binge-eating, found three of DSM-5 BED Criterion B features (B3, B4, and B5) and Criterion C to be associated with a higher BMI, but "eating rapidly" (B1) was associated with a lower BMI. Reporting three or more of the five Criterion B specifiers was uncommon (6.8% of the sample). However, this study was focused only on binge-eating features as they may be associated with a high BMI.

Only one of these studies has examined relationships between Criteria B and C for BED [8] only two [7,10] have examined health status external to the eating disorder such as depression [7] and obesity [10] and only one [10] was in a representative community sample. Thus the present study was planned to further investigate the DSM-5 Criteria B and C in a representative general population sample, i.e., within the Research Domain Criteria framework of studying phenomena independent of presumptions made by current diagnostic schemes [11]. We chose this sample as it minimises the effects of selection bias known in clinical samples, in particular Berkson's bias [12] whereby inherent features and associations of diagnostic criteria for a disorder may not be found in population of higher illness severity [13]. We also sought to examine more comprehensively than any other previous study the BED Criteria B1-B5 and C along with putative features external to eating disorder symptoms.

Specific aims were to examine BED DSM-5 criteria associations and eating disorder diagnostic features and attributes, particularly the presence of binge-eating distress, weight/shape overvaluation, anxiety/depression, mental health related QoL, pain/discomfort and physical health related QoL in people who met all other criteria for DSM-5 BED, i.e., A—presence of binge-eating, D—binge-eating at least weekly, and E—not having another main eating disorder, anorexia nervosa (AN) or bulimia nervosa (BN). Based on previous research we hypothesised that Criterion C may be associated with greater anxiety/depression, C and B4 with more impaired QoL, and B3 and B4 with other eating disorder illness severity indictors such as binge-eating frequency. All other analyses were exploratory.

Materials and Methods

Study Design

The present study data were obtained from the 2017 South Australian Health Omnibus Survey (HOS). The HOS was an annual face-to-face cross-sectional survey [14,15] of people aged 15 years and over which in 2017 included questions related to BED and health status provided by the authors (REDACTED [10]).

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Sample and Procedure

Both representative metropolitan and country area State households were surveyed with a two-stage design [14]. A starting point was randomly selected for each statistical area and 10 dwellings were chosen using a predetermined selection process based on a "skip pattern" of every fourth household [14]. Data were gathered using in person interviews from 08/2017 to 12/2017 by trained interviewers (one person interviewed per home). Up to six visits were made to each home.

In all, 5300 households were selected for participation, of which a total of 2977 individuals were interviewed, resulting in a response rate ("completed interviews/initial eligible sample") of 57.0% and a participation rate ("completed interviews/(initial eligible sample – non-contact after six attempts)") of 65.3% [14]. Reasons for non-participation were listed as predominantly refusal, being not present in the home, dwelling was inaccessible, and being unwell or not fluent in English [14]. Of 2977, 249 (n = 280 with weighting) participants were included in this study who were experiencing weekly binge-eating (Criteria A and D of BED in the DSM-5) category and who did not meet criteria for BN/AN diagnosis and thus were eligible for the diagnosis of BED. Based on a standard deviation (SD) of 9.7 for mental health related QoL (mean 49.5, n = 280), a sample size of 164 was estimated in retrospect to be sufficient for this study (95% confidence interval [CI] and a margin of error of 1.5) [16]. Similarly, with a SD of 10.5 for physical health related QoL (mean 48.0), the retrospective power analysis estimated n = 192 was required [16]. As BMI was not investigated in this paper, this sample included people who had not reported BMI and thus was larger than in the former paper of 230 unweighted (255 weighted) participants [10].

HOS data were weighted to the sex, age, geographical area profile of the population of interest and the probability of selection within a household to ensure that the survey findings were applicable to that population as a whole [14]. The 2016 Australian Bureau of Statistics Estimated Residential Population data were used for the weighting process [14].

Study Instruments

The study interview questions included sociodemographic features, height and weight, current eating DSM-5 disorder diagnostic symptoms adapted from Fairburn [17] see also [15] and anxiety/depression, mental/physical health related QoL, and pain/discomfort. Participants were asked if they had experienced binge eating episodes (uncontrolled episodes of objectively and unusually large amounts of food) in the last 3 months and any of the five B criteria and criterion C (distress). Binge distress responses were coded as none, a little and a lot and distress was referenced to it resulting in functional life impacts [2]. Because of low numbers with "a lot" of distress (n = 35) any distress was used as an indicator of Criterion C or marked distress.

DSM-5 criteria for BN and AN were also asked, e.g., purging: regular (>weekly) laxatives/diuretics/self-induced vomiting for weight/shape and overvaluation—rated 0/not at all to 6/extreme importance to self-view. Scores of "0–3" were categorized as "no" and "4–6" as "yes" (indicating overvaluation was present).

Pain/discomfort, and anxiety/depression were measured with the respective dimension items from the validated ED-5D [18] prompt cards defining levels i.e., 1 = absent (i.e., "I have no pain or discomfort/I am not anxious or depressed" , 2 = slight, 3 = moderate, 4 = severe, and 5 = extreme "I have extreme pain or discomfort/I am extremely anxious or depressed"). The widely used 12-item Short Form Health Survey (SF-12) determined mental/physical health related QoL [19–21]. It has a Physical Component Scale (PCS) and Mental Component Scale (MCS). The first queries general/physicalhealth physical-role limitations, and pain, while the MCS queries mental health, emotional role limitations, and socialisation. Scores range zero to 100 and scores above 50 indicate higher than population mean HRQoL and less than 50 is suggestive of lower than population mean HRQoL. The SF-12 has been validated worldwide across many health conditions and for use within the Australian population [19–21].

Ethical Considerations

Verbal informed consent was recorded and signed also by the parent/carer of those aged 15–17 years. Ethics approval for the HOS 2017 was granted by the University of Adelaide's Human Research Ethics Committee Approval number (H097-2010).

Statistical Analysis

Descriptive statistics for all measures were generated for both non-weighted (n = 249) and weighted (n = 280) data. Initially, the associations of sociodemographic and clinical variables were explored through bivariate analysesand inferential statisticssuch as chi-square (χ^2), *t* and F-tests examined between-group differences (a priori al-

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pha value <0.05, two-sided tests) differences across subgroups. In measures with two categories i.e., 2 by 2 chi-square tables where number of cases for any groups are smaller than 5 in that situation Fishers Exact test were used; and for items with more than 2 categories where number of cases for any groups are smaller than 5 in that situation Pearson's continuity correction factor was used to estimate the *p*-values. The effect size, Cohen's d for individual measures were calculated by comparing means among two groups, with a Cohen's d of 0.2 denoting a small effect, 0.5 a medium effect, 0.8 and above a large effect [22]. The effect size, partial Eta squared estimated through analysis of variance (ANOVA) for individual measures by comparing means in more than two groups [21]. Value of partial Eta squared indicates small effect = 0.01 (explains 1% of the variance); medium effect = 0.06 (explains 6% of the variance); and large effect = 0.14 (explains 14% or more of the variance). Measures found to be statistically significant ($p < 0.05$) in bivariate analyses are included in multivariable logistic (for dichotomous variables) and linear regression (for continuous variables) analysis to further examine the relative contribution of each of these predictive measures adjusting for age and sex. It is to be noted that "presence of any distress (0 = no distress, 1 = any distress)" and "weight/shape overvaluation (no = 0, yes = 1)" are defined as dichotomous and thus multiple logistic regression model was used for these two measures [23]. MCS and PCS were coded as continuous, satisfying the criteria of normality (skewness is in between –2 to +2 and kurtosis between –7 to +7) and thus multivariable linear regression model was used for these two measures [24]. Pain/discomfort and anxiety/depression were coded as 5-point Likert scale and thus multivariable ordinal regression model was used for these two dependent variables which were significantly positively correlated (r = 0.36, $p < 0.01$); assuming that higher pain/discomfort score was associated with higher anxiety/depression score "pain/discomfort" was used as an independent variable for "anxiety/depression". Similarly we adjusted MCS and PCS for individual's status of Anxiety/depression and Pain/discomfort respectively due to the overlap in these constructs. Given the limited number of participants (n = 12) who indicated "yes" for the BED feature B4 it was excluded from the multivariable analyses. The results of the multiple logistic regression models are presented as adjusted odds ratios (aORs) along with a 95% CI; standardised regression coefficients (beta) and multiple correlation "R" were provided from multivariable linear regression analyses. The Statistical Package for Social Sciences, V. 28 (IBM, New York, USA) was used [25].

Results

Participant Features (Weighted Sample)

This sample's mean age was 42.6 years (SD = 16.1, range; 73, 15–88 years; n = 280), 129 (45.9%) participants were women, the majority (n = 175, 62.4%) were married/living as married and were Australasian born (n = 204, 72.9%), 118 (42.1%) were in fulltime employment, and 59 (21.1%) were tertiary qualified.

Weekly binge-eating was reported by 170 (60.7%) and twice weekly by 110 (39.3%) participants. The most frequently reported feature of binge-eating was "eating until feeling uncomfortably full" B2; (n = 134, 47.8%) and 70 (25%) participants did not report a Criterion B feature and only 20 (7.1%) reported three or more. Only 12 (4.3%) reported B4, 34 (12.1%) B5, 43 (15.4%) B1, and 99 (35.4%) B3. Any distress was reported by 118 (42.3%). B2 and B3 were Criterion B features most commonly associated with each other or another behavioural indicator. Mean scores were 49.5 (SD = 9.7) for MCS, 48.0 (SD = 10.5) for PCS, 1.8 (SD = 0.9) for pain/discomfort and 1.4 (SD = 0.7) for anxiety/depression.

A sensitivity analysis was conducted to assess the impact on findings of investigating any distress vs only a lot of distress. On *t*-tests and χ^2, compared to participants reporting "a little" distress (n = 83) participants reporting a lot of distress (n = 35) had significantly ($p < 0.05$) higher levels of pain/discomfort (Cohen's d = –0.49) anxiety/depression (Cohen's d = –0.71) and binge eating frequency but not MCS, PCS or weight shape overvaluation.

Association of BED Gender, Age and Diagnostic Features With Distress and Weight/Shape Overvaluation

The findings from the bivariate analyses (Table 1) found female participants, younger individuals, and those who affirmed diagnostic features B1, B3, B4 and B5 experienced higher levels of distress. The number of diagnostic features reported by individual participants showed a significant linear association with distress levels. As the number of endorsed features increased, so did the distress rate, with 27.1% for those with no-specifiers, 44.4% for those with one specifier and 100% those reported 4 to 5 features. Participants having overeaten two or more times a week have reported significantly higher distress as compared those reported overeaten once a week in past three months (37.3% vs. 50.0%; $p = 0.036$). Furthermore, the results presented in Table 1 indicate that participants who indicated "yes" to diagnostic features B2–B5 were signif-

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icantly more likely to exhibit higher rates of weight/shape overvaluation. Conversely, participants who reported "yes" to diagnostic feature B1 were significantly less likely to experience weight/shape overvaluation.

Adjusted odds ratios (aORs) derived from multiple logistic regression presented in Table 2 indicate that women were 3.32 times more likely to experience distress as compared to men (aOR = 3.32, 95% CI [1.94, 5.69]). After adjusting for age and sex, participants who reported "yes" to diagnostic feature B1 exhibited 3.84 times higher likelihood of experiencing distress (aOR = 3.84, 95% CI [1.79, 8.28]); similarly, those who reported "yes" to B5 (aOR = 2.68, 95% CI [1.13, 6.34]) were 2.68 times more likely to experience distress as compared to others. In alignment with the bivariate results, the aORs revealed that individuals who responded "yes" for B1 were significantly less likely to have weight/shape overvaluation (aOR = 0.29; 95% CI [0.14, 0.61]), while those who reported "yes" for B2 and B5 were more likely to exhibit higher weight/shape overvaluation.

Association of Gender, Age, BED Diagnostic Features, Distress With Pain/Discomfort, Anxiety/Depression, and Health Related Quality of Life: Results From Bivariate and Multivariable Regression Analyses

Pain/discomfort: Results from the bivariate analysis (Table 3; Ref. [19,22,23]) and multivariable ordinal regression model (Table 4) indicate that older adults, as well as individuals who reported "yes" to diagnostic feature B1, those experiencing any form of distress, and individuals who reported "no" for weight/shape overvaluation, were more likely to have significantly higher pain/discomfort scores.

Anxiety/depression: The results from bivariate analysis and the multivariable ordinal regression model reveal that women and those who responded "yes" to diagnostic feature B5 and those experiencing any form of distress were more likely to have significantly higher anxiety/depression scores (Table 3 & 4).

MCS: The findings from bivariate analyses presented in Table 4 indicate that women, younger individuals, and those who reported "yes" to diagnostic features B4, B5 and experiencing any distress were more likely to have significantly lower MCS. Standardised regression co-efficient derived from multivariable linear regression model also reconfirm that participants who responded "yes" to specifier B5, along with the presence of any distress and higher anxiety/depression scores, were more likely to demonstrate poorer MCS (Table 4a).

PCS: The results of bivariate analyses indicate that older individuals and those who reported "yes" to diagnostic feature B2, having presence of any distress and a higher anxiety/depression score were more likely to experience poorer PCS (Table 4a). Multivariable linear regression analysis also revealed that older participants, those who reported "yes" to feature B2, and individuals with higher anxiety/depression levels were more likely to have poorer PCS (with adjustment) by (Table 4a).

Discussion

This study found that there were significant associations between Criterion B specifiers and Criterion C (binge-eating related distress) and overvaluation but adjusting for age and sex, onlyB1 (eating much more quickly) and B5 (feeling disgusted or very down after eating) remained significantly associated with distress. Some associations with overvaluation were retained after adjustment but whilst those who endorsed B2 and B5 had higher levels of overvaluation, those who endorsed B1 had lower levels. Endorsing criteria B1 and C were associated with higher pain and discomfort and endorsing criteria B5 and C were associated with higher levels of anxiety/depression. After adjustment, those who endorsed Criteria B5 and C had poorer mental health related QoL but no Criterion B or C was associated with poorer physical health related QoL.

In this paper Criterion C thus emerged as the most informative indicator of overall health status in the context of binge-eating. Participants who reported experiencing distress consistently demonstrated poorer mental and physical health indices, including poorer mental health related QoL, increased pain/discomfort, and heightened levels of anxiety and depression. This indicates that distress may serve not only as a diagnostic criterion but also as a marker of severity and impairment. These results are consistent with the findings of Grilo and White [7] who reported the presence of Criterion C (as a diagnostic feature of BED in the context of the DSM framework) to be associated with more severe eating disorder symptoms and depression compared to those with BED Criteria A and B alone. This also accords with broader literature e.g., Hay *et al*. [26] which reported associations between distress related to binge-eating and greater functional impairment, as well as a poorer quality of life in their review of the epidemiology of eating disorders.

This paper found few associations between Criteria B features and other health indices with the exception of B5 ("feelings of disgust associated with eating") which was associated with poorer mental health related QoL, anxiety and depression and higher weight/shape overvaluation. This

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Table 1. Association of diagnostic features by presence of any binge-eating related distress and overvaluation [weighted sample n = 280][#].

Participant feature(s)	Presence of any binge-eating distress			Weight/Shape overvaluation		
Gender, age, binge-eating disorder diagnostic features and any distress	N	Yes: a little or a lot		N	Yes (score 4–6)	
		n	row %		n	row %
All participants	279	118	42.3	280	152	54.3
Gender						
Male	152	45	29.6	151	74	49.0
Female	127	73	57.5	129	78	60.5
p-values			<0.001			0.055
Age groups (years)						
15–29	66	35	53.0	68	39	57.4
30–44	90	29	32.2	90	47	52.2
45+	122	53	43.4	122	66	54.1
p-values			0.031			0.808
Binge-eating episodes frequency						
Weekly	169	63	37.3	170	94	55.3
>twice weekly	110	55	50.0	110	58	52.7
p-values			0.036			0.674
B1. Eating much more rapidly than normal						
Not present	237	90	38.0	237	139	58.6
Present	42	28	66.7	43	13	30.2
p-values			0.001			0.001
B2. Eating until uncomfortably full						
Not present	145	66	45.5	146	62	42.5
Present	134	52	38.8	134	90	67.2
p-values			0.071			<0.001
B3. Non-hungry eating						
Not present	180	69	38.3	181	90	49.7
Present	99	49	49.5	99	62	62.6
p-values			0.001			0.042
B4. Solitary binge						
Not present	266	105	39.5	268	141	52.6
Present	12	12	100.0	12	12	100.0
p-values			<0.001			0.001
B5. Disgusted/Guilt/Low mood after binge						
Not present	245	94	38.4	246	126	51.2
Present	34	24	70.6	34	26	76.5
p-values			<0.001			<0.010
n BED features						
Not one	70	19	27.1	70	27	38.6
1	126	56	44.4	128	69	53.9
2	62	29	46.8	62	42	67.7
3	12	6	50.0	12	9	75.0
4 or 5	8	8	100	8	5	62.5
p-values			<0.001			0.008
Any distress						
No (not at all)				161	89	55.3
Yes (yes = a little or a lot)				117	63	53.8
p-values						0.810

Notes: [#]The numbers (Ns) in this table do not always add up to 280 due to the exclusion of not stated/inadequate or missing data (e.g., for presence of any distress' a response was missing for one participant and was excluded from the distress related analysis); *p* (alpha) values are calculated based on Chi-square test; in 2 by 2 tables where number of cases for any groups are smaller than 5 in that situation Fishers Exact test were used; and for items with more than 2 categories where number of cases for any groups are smaller than 5 in that situation Pearson's continuity correction factor was used to estimate *p*-values.

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Table 2. Association of gender, age and binge-eating disorder diagnostic features (coded as no = 0, yes = 1) with presence of any binge-eating related distress and weight/shape overvaluation (score 0–3 = no, score 4–6 = yes): adjusted odds ratios with 95% confidence interval from multiple logistic regression analyses (weighted sample n = 280).

Participant feature(s)	Any (little/a lot) distress (no = 0, yes = 1)		Shape overvaluation (no = score 0–3, yes = score 4–6)	
Gender, age and binge-eating disorder diagnostic features	aOR (95% CI)	*p*-values	aOR (95% CI)	*p*-values
Gender (male = 0, reference category, female = 1)	3.32 (1.94, 5.69)	0.001	Not included in model*	
Age groups		0.050	Not included in model*	
15–29 years [reference category]	1.00			
30–44	0.42 (0.21, 0.85)	0.020		
>45 years	0.70 (0.36, 1.35)	0.290		
B1. Eating much more rapidly than normal (no = ref. cat)	3.84 (1.79, 8.28)	0.001	0.29 (0.14, 0.61)	0.001
B2. Eating until uncomfortably full (no = ref. cat)	0.84 (0.49, 1.43)	0.520	2.50 (1.51, 4.14)	0.001
B3. Non-hungry eating (no = ref. cat)	1.19 (0.67, 2.11)	0.550	1.37 (0.79, 2.37)	0.260
B4. Solitary binge (no = ref. cat)	$Excluded	-	$Excluded	
B5. Disgusted/Guilt/Low mood after binge (no = ref. cat)	2.68 (1.13, 6.34)	0.030	3.17 (1.28, 7.89)	0.013
Model summary				
–2 Log likelihood	327.89		348.97	
Model Chi-square	51.78	0.001	37.59	0.001

*Not included in the multiple logistic regression model as was not found to be statistically significant ($p > 0.05$) in bivariate analysis (Table 2); $Excluded from the multiple logistic regression model as B4 specifier was reported as "yes" by 12 participants, all 12 participants also reported having reported distress as "yes" and, also, all of these 12 participants reported "yes" for weight/shape overvaluation and thus there were no participants for reference category "no" i.e., the logistic regression model was unable to estimate aOR for this item B4 specifier (for both variables "any type of distress" and "weight/shape overvaluation"); aOR, adjusted odds ratio; CI, confidence interval.

is consistent with previous research of Wilfley *et al*. [27] who noted that these adverse emotions contributed to the persistence of the disorder, reinforcing feelings of shame and guilt, which subsequently resulted in more binge-eating episodes [27]. The present findings however contrast with those of Richson *et al*. [9] who found the requirement for three Criterion B specifiers to be present was associated with an incrementally higher severity indicator i.e., binge eating frequency. There was a variable pattern of associations with other symptoms and with indices of severity; in the present study B5 and Criterion C were associated with mental health related QoL and in Richson *et al*. [9] B4 and B3 were associated with binge-eating frequency and only B4 was associated with eating disorder specific QoL. Variations in participant samples may explain inconsistences with Richson *et al*. [9] whose sample represented a younger and well-educated population (a university student population). Previous findings of B3, B4, B5 and Criterion C to be associated with higher weight [10] might also be considered to be consistent with their association with mental or physical health severity indicators. However, this was only the case for Criterion C and B5 in the present study. Relationships between high weight and BED are complex [1] and these findings may reflect that it cannot be assumed that a higher weight necessarily indicates more severe BED.

Previous studies have reported a strong association between weight/shape overvaluation and increased psychopathology in BED, as well as depression [28–33] and as a potential indicator of BED severity and health status [32,33]. This present research has further identified a consistent association between higher levels of weight/shape overvaluation and specific binge-eating diagnostic features, particularly B2 andB5. It was not expected that B1 would be associated with lower overvaluation and this is not readily explained and has not been previously reported. It may be that this is a Type 2 error due to low numbers. However, B1 was not the least frequently reported Criteria B feature.

The physical health related impacts were most evident for B1 and distress with both were significantly associated with increased pain and discomfort, but no features were associated with impaired physical health related QoL after adjustment. It may be possible that rapid eating might be directly associated with physical pain and discomfort and binge-eating related distress with pain and discomfort via a mediator, such as known somatic effects of anxiety/stress like chest pain albeit these relationships are complex [34]. Further research is needed to investigate the physical health status of people with these BED diagnostic features in larger and different populations and the present findings should be regarded as preliminary in this area.

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Table 3. Association of binge-eating disorder diagnostic features andbinge distress and weight/shape overvaluation with pain/discomfort, anxiety/depression, and health related quality of life (weighted sample n = 280[#]).

Participant feature(s)	Pain/ Discomfort		Anxiety/ Depression		MCS		PCS	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
All participants	1.8	0.9	1.4	0.7	49.5	9.7	48.0	10.5
Gender								
Male	1.7	0.9	1.3	0.6	51.1	8.4	48.5	10.5
Female	1.8	0.9	1.6	0.8	47.7	10.8	47.5	10.6
p-values from *t*-test	0.710		0.006		0.005		0.420	
Cohen's d	–0.04		–0.34		0.35		0.10	
Age groups (years)								
15–29	1.5	0.8	1.5	0.7	47.0	10.3	53.7	7.3
30–44	1.7	0.7	1.4	0.6	50.4	8.2	49.4	8.8
45 and above	2.0	1.0	1.4	0.8	50.3	10.2	43.9	11.5
p-values from F-test	0.003		0.551		0.044		0.001	
Partial Eta squared	0.042		0.005		0.034		0.165	
B1. Eating much more rapidly than normal								
Not present	1.7	0.8	1.4	0.7	49.7	9.8	48.0	10.8
Present	2.1	1.0	1.7	0.9	48.7	9.4	48.3	8.7
p-values from *t*-test	0.012		0.082		0.544		0.831	
Cohen's d	–0.50		–0.35		0.10		–0.03	
B2. Eating until uncomfortably full								
Not present	1.8	0.9	1.4	0.7	49.9	9.2	49.3	9.5
Present	1.7	0.9	1.5	0.8	49.2	10.3	46.6	11.4
p-values from *t*-test	0.309		0.780		0.554		0.033	
Cohen's d	0.12		–0.03		0.07		0.26	
B3. Non-hungry eating								
No	1.7	0.8	1.4	0.7	50.2	9.0	48.9	9.6
Yes	1.9	1.0	1.5	0.7	48.3	10.9	46.4	11.9
p-values from *t*-test	0.073		0.492		0.138		0.058	
Cohen's d	–0.24		–0.08		0.20		0.25	
B4. Solitary binge								
Not present	1.8	0.9	1.4	0.7	49.9	9.5	47.9	10.4
Present	1.6	0.9	1.8	0.6	40.9	10.6	49.7	12.9
p-values from *t*-test	0.444		0.093		0.012		0.652	
Cohen's d	0.23		–0.45		0.94		–0.17	
B5. Disgust/Guilt/Low mood after binge								
Not present	1.7	0.9	1.3	0.6	51.0	8.4	48.1	10.2
Present	2.0	1.1	2.2	1.1	39.1	12.4	47.2	12.6
p-values from *t*-test	0.150		<0.001		<0.001		0.693	
Cohen's d	–0.33		–1.24		1.32		0.09	
Frequency B1-B5								
Zero present	1.7	0.8	1.3	0.5	52.0	6.3	48.9	9.1
One present	1.7	0.9	1.4	0.7	49.3	10.5	48.9	10.4
Two present	1.9	1.0	1.4	0.7	50.4	8.5	46.6	10.8
Three present	2.0	1.0	1.9	1.0	44.8	12.2	43.1	15.1
Four or five present	2.3	1.3	2.4	1.2	32.5	9.0	45.5	13.0
p-values from F-test	0.161		0.001		0.001		0.230	
Partial Eta squared	0.024		0.095		0.118		0.026	

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Table 3. Continued.

	Pain/ Discomfort		Anxiety/ Depression		MCS		PCS	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Binge-eating episodes/3-month frequency								
Weekly	1.6	0.8	1.3	0.6	49.9	9.3	49.5	10.2
More than once weekly	2.0	1.0	1.6	0.9	48.9	10.3	45.7	10.6
p-values from *t*-test	<0.001		0.001		0.19		0.002	
Cohen's d	-0.52		–0.38		0.11		0.37	
Presence of any distress								
No	1.6	0.7	1.2	0.4	53.0	6.5	49.2	9.5
Yes	2.0	1.0	1.8	0.9	45.0	11.2	46.3	11.7
p-values from *t*-test	<0.001		<0.001	0	<0.001		0.032	
Cohen's d	–0.48		–0.96		0.92		0.27	
Weight/Shape overvaluation								
No	1.9	1.0	1.5	0.7	50.1	9.3	47.7	9.2
Yes	1.6	0.8	1.4	0.7	49.1	10.1	48.3	11.6
p-values from *t*-test	0.002		0.609		0.401		0.611	
Cohen's d	0.39		0.06		0.10		-0.06	

Notes: #The numbers (Ns) do not always add up to 280 due to exclusion of not stated/ inadequate or missing data; MCS and PCS are the mental and physical health component scores of the health related quality of life measure respectively [19]; *p* (alpha) *t*-test for 2 groups and F-test for 3 or more groups; Cohen's d: The effect size individual measures were calculated by comparing means in two groups. Cohen's d indicates: small effect = 0.20; medium effect = 0.50; large effect = 0.80 [22]. Partial Eta squared: The effect size for individual measures were calculated by comparing means in more than two groups. Value of partial Eta squared indicates: small effect = 0.01 (explains 1% of the variance); medium effect = 0.06 (explains 6% of the variance); large effect = 0.14 (explains 14% or more of the variance) [23]; SD, standard deviation; BED, binge-eating disorder.

Clinical Implications

Although the paper found variability and inconsistencies with previous research for the criterion B features the findings in the present paper should not be taken as an indication for clinicians to cease exploring the DSM-5 diagnostic characteristics of binge eating in in their patients. In particular, any distress, not merely marked distress, related to the binge eating episodes emerged as a feature that supports the likelihood of other relevant clinical features being present and impaired levels of mental health related quality of life. Other criterion B features, particularly B5 (having discussed guilt or depression after binge eating episodes) were also associated with other indices of poorer mental health and overvaluation. B4 was too infrequent for multivariable analyses but this should not be taken to imply it is not a useful feature to inquire about. Together with research that has found people without these features to have similar levels of mental health related quality of life impairment and binge eating severity, the present findings support the position that the ICD-11 approach to binge eating disorder diagnosis may be more useful in the clinic and more people would meet diagnostic criteria which may be needed to access care. (In Brytek-Matera *et al*. [5] only 7 people met the full DSM5-criteria but 41 met ICD-11 criteria).

Strengths and Limitations

Strengths of the study include the use of a representative population sample and minimising biases associated with clinical or self-selected populations and the use of a diagnostic interview. Limitations include the incomplete assessment of anxiety, depression, and pain/discomfort, with single item measures which may be subject to measurement error, along with the subjective reporting of dietary restriction and simplifying Criterion C "marked distress" to "any or a lost distress". There is also potential for the overestimation or underestimation of the psychopathology occurrences among participants due to the interviewers' backgrounds, despite a fidelity review of 10% of the interviewer's work. Furthermore, some analyses lacked statistical power due to small cell counts. This impacted on studying levels of B4 and also marked distress (a little or a lot, the latter which more closely accords with the DSM-5 marked distress criterion) and the sensitivity analysis indicated this, thus the strength of associations found for distress and pain/discomfort and anxiety/depression may have been reduced. Finally, the study was cross-sectional in na-

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Table 4. Association of gender, age, binge-eating disorder diagnostic features (B1-B5), presence of any distress (no = 0, yes = 1) and weight/shape overvaluation by main health status measures pain/discomfort and anxiety/depression: estimates from ordinal regression analyses (n = 280).

Participant feature(s)	Pain/Discomfort		Anxiety/Depression		Anxiety/Depression (without pain/discomfort)	
Gender, age, binge-eating disorder diagnostic features, distress, pain/discomfort, anxiety, weight/shape overvaluation	Estimates	*p*-values	Estimates	*p*-values	Estimates	*p*-values
Threshold for dependent variables						
1	0.98	0.003	0.13	0.86	2.16	0.001
2	2.89	0.001	2.44	0.001	4.29	0.001
3	4.44	0.001	4.35	0.001	6.04	0.001
4 (ref. cat.)	-		-		-	
Independent variables						
Gender [male (ref. cat.), female]	Not included		0.19	0.521	0.01	0.987
Age groups (years)						
15–29 (ref. cat.)						
30–44	0.77	0.023	0.82	0.128	0.23	0.662
45 and above	1.1	0.001	0.64	0.217	0.64	0.217
Presence of any distress [no (ref. cat.), yes]	0.83	0.001	0.13	0.685	1.93	0.001
B1. Eating much more rapidly than normal [no (ref. cat.), yes]	0.72	0.032	Not included		Not included	
B5. Disgust/Guilty/Low mood after binge [no (ref. cat.), yes]	Not included		1.61	0.001	1.48	0.001
Binge eating episodes [once a week (ref. cat.), 2 or more weeks]	0.73	0.003	0.13	0.685	0.39	0.179
Weight/Shape overvaluation [score 0–3 (ref. cat.), score 4–6]	–0.66	0.006	Not included		Not included	
Pain/Discomfort	Not applicable				Not included	
1. I have no pain or discomfort			–3	0.001		
2. I have slight pain or discomfort			–1.72	0.001		
3. I have moderate pain or discomfort			–1.39	0.036		
4 & 5. I have severe or extreme pain or discomfort. (ref. cat.)						
Model fitness index						
Model chi-square	54.01 (df = 7)	<0.001	107.54 (df = 10)	<0.001	100.15 (df = 7)	<0.001
Pseudo R-square						
Cox and snell	0.176		0.32		0.245	
Nagelkerke	0.197		0.389		0.298	

Not included: B2, B3 and B4 are not included in the regression model as this was not found to be statistically significant ($p > 0.05$) in bivariate analysis (Table 3) B2, B3 and B4 were not found to be significantly associated with pain/discomfort and anxiety/depression in Table 3 so are not included in multivariable model. Binge eating episodes coded as 1 = once a week, 2 = two or more times a week; ref.cat. = reference category.

ture, which precludes the ability to draw causal inferences and prospective research is indicated to investigate the specifiers' predictive validity and the casual nature of their relationships with other clinical features and health impacts. Given the low frequency of Criterion B and C features of BED in the general population much larger epidemiological studies are needed alongside prospective clinical studies to test the predictive validity of these criteria. It would also be relevant to study other aspects of validity in larger samples e.g., sensitivity and specificity of individual criteria and the classification performance of alternative diagnostic thresholds, e.g., any versus marked binge-eating related distress.

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Table 4a. Association of gender, age, binge-eating disorder diagnostic features (B1-B5), presence of any distress (no = 0, yes = 1) and weight/shape overvaluation by health related quality of measures : standardised regression coefficients (β) from multiple linear regression analyses (n = 280).

Participant feature(s)	Dependent variables used in multiple regression model			
Demographic, binge-eating disorder features, any distress, pain/discomfort, anxiety/depression, weight/shape overvaluation	MCS		PCS	
	β	*p*-values	β	*p*-values
Gender (male = 0, female = 1)	–0.002	0.965	Not included	
Age in years	0.09	0.053	–0.282	0.001
B1. Eating much more rapidly than normal (0, 1)	Not included		Not included	
B2. Eating until uncomfortably full (0, 1)	Not included		–0.144	0.072
B3. Non-hungry eating(0, 1)	Not included		Not included	
B4. Solitary binge (0, 1)	Not included		Not included	
B5. Disgust/Guilt/Low moodafter binge (0, 1)	–0.188	<0.001	Not included	
Binge eating episodes (1, 2)	Not included		–0.003	0.956
Presence of any distress (no = 0, yes = 1)	–0.18	<0.001	–0.048	0.347
Pain/Discomfort (1 to 5)	0.088	0.081	–0.529	<0.001
Anxiety/Depression (1 to 5)	–0.487	<0.001	0.037	0.488
Weight/Shape overvaluation (score 0–3 = 0, 4–6 = 1)	Not included		Not included	
Value of multiple R-square	0.447		0.439	
Value of adjusted R-square	0.435		0.426	
Value of F-statistic	36.5	<0.001	35.4	<0.001

MCS and PCS are the mental and physical health component scores of the health related quality of life measure respectively [19]; Not included: variables are not included in the regression model as they were found to be not statistically significant ($p > 0.05$) in bivariate analysis (Table 3).

Conclusions

This study found that Criterion B and C features of BED have disparate frequencies of being affirmed and varied associations with physical and mental health status. In particular, disgust with eating (B5) and marked distress (Criterion C) appeared to have the most clinical utility with Criterion C most consistently associated with indicators of mental health status and other eating disorder diagnostic features. As different BED behaviours are associated with different health indices and 75% of participants reported at least one Criterion B behaviour, there may be utility in retaining them as diagnostic descriptors even if the requirements for 3/5 is not met.

Availability of Data and Materials

Non-re-identifiable data are available subject to request to the corresponding author and approval by an appropriately constituted institutional human research ethics committee. The original dataset is property of Harrison Health. Many publications have emanated from this data including by the current authors a study that also investigated DSM-5 diagnostic features alongside other clinical features and their relationships to obesity/high body weight and on a smaller sample (reference 13 in the current paper). In contrast this paper investigated DSM-5 diagnostic features' relationship to distress, weight/shape overvaluation, anxiety/depression, MHRQoL, pain and physical health-related quality of life (PHRQoL). Thus there are some variables in common but a different research question and different analyses.

Author Contributions

MH contributed to conceptualization, and both MH and SK contributed to project design and administration, writing and editing the final manuscript. MM contributed to project design, data analysis, writing and editing the final manuscript. ST contributed to project design, resourcing, data analysis, and editing the final manuscript. DC contributed to project design, resourcing, and administration, data analysis, and editing the final manuscript. PH contributed to conceptualization, project design, resourcing and administration, data analysis, writing and editing the final manuscript. All authors read and approved the final manuscript. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the

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accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

Recorded verbal informed consent was obtained from all adult participants, and signed written consent was obtained from the parent/guardians of any adolescent participants (15–17 years old). Ethics approval for the HOS 2017 was granted by the University of Adelaide's Human Research Ethics Committee Approval number (H097-2010) [17]. Phillipa Hay was an academic at the University of Adelaide but was no longer affiliated with the university when this research was analysed and written up; the institution is now called Adelaide University. All study procedures complied with the Declaration of Helsinki.

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Conflict of Interest

Phillipa Hay has received sessional fees from the Therapeutic Guidelines publication and the Health Education and Training Institute (HETI, NSW), and royalties/honoraria from Hogrefe and Huber, McGraw Hill Education, Blackwell Scientific Publications, BioMed Central, and PLOS Medicine. She has prepared a report under contract for Takeda (formerly Shire) Pharmaceuticals regarding binge-eating disorder (July 2017 was a consultant to Takeda Pharmaceuticals and is a consultant to Tryptamine Therapeutics. PH served on the Working Group for Eating Disorders for the ICD-11 revision. Stephen Touyz has chaired the Takeda Australian Clinical Advisory Board for binge-eating disorder. He has also been a recipient of travel grants, investigator-initiated research grants as well as commissioned reports. He is a member of the Commonwealth Government's Technical Advisory Group on Eating Disorders and is an inaugural member of the National Eating Disorders Consortium. He receives royalties from Hogrefe and Huber, Taylor and Francis and McGraw Hill for published books/book chapters. All other authors declare that they have no competing interests.

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