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Determinants of binge eating disorder among normal weight and overweight female college students in Korea

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Abstract

Purpose The aim of the present study was to describe the clinical features of binge eating disorder (BED) in normal weight and overweight undergraduate Korean women.

Methods 117 overweight (BMI ≥ 25 kg/m^2) and 346 normal weight (18 kg/m$^2 \leq$ BMI < 25 kg/m^2) undergraduate Korean women completed questionnaires to assess for BED. Their emotional eating behaviors, binge eating-related behaviors, a spectrum of compulsive behaviors such as substance abuse and obsessive–compulsive disorder, and psychological profiles were evaluated through personal interviews and questionnaires. The features of those with BED were compared to those without BED in the overweight and normal weight groups.

Results Both normal weight and overweight BED women had higher levels of functional impairment, eating disorder psychopathology including emotional and external eating behaviors, and neuroticism than their non-BED counterparts. In the normal weight group, BED women had more frequent alcohol consumption and obsessive–compulsive symptoms than non-BED women. In the overweight group, BED women had higher levels of depression and lower extraversion than non-BED women.

Conclusions BED is associated with global functional impairment and mental health problems. Thus, the association with high functional impairments and psychiatric comorbidities suggest that people with BED may benefit from treatment.

Level III Evidence obtained from well-designed case–control analytic studies, from more than one center.

Keywords Binge eating disorder · Women · Overweight · Compulsive overeating · Emotional eating · Eating behavior

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Introduction

Binge eating disorder (BED) is an eating disorder characterized by recurrent and persistent binge eating episodes without inappropriate compensatory weight loss behaviors of bulimia nervosa. BED has recently been added into the Diagnostic and Statistical Manual of Mental disorders Fifth Edition (DSM-5) [1] as a new form of eating disorder. It is no longer included as a subtype of eating disorders not otherwise specified (EDNOS). BED is the most common eating disorder across the world, with a lifetime prevalence of 1.4% in adults based on DSM-IV criteria [2]. Its prevalence has been reported to be 5.58% in Australian adults based on DSM-5 criteria [3]. The prevalence of BED in students has been reported to be 3.53% among female university students in China based on DSM-IV criteria [4] and 7.8% among university students in the US based on DSM-5 criteria [5]. An epidemiological study revealed that a 12-month and lifetime prevalence of BED is similar across non-Latino White, Latina, Asian, and African American women in the US [6].

Regarding gender, BED has been found to be more prevalent in females than in males in the US (3.5 vs. 2.0%), although the gender ratio is more balanced than other eating disorders [7]. The prevalence of BED is highest in females in late teens or twenties [3].

Health care burden and cost associated with BED are increasing [8]. Two-thirds of those with BED become obese, and depression, deliberate self-harm and poor vocational performance were found to be common in cross-sectional studies [2, 9]. In addition, the risk of developing drug and alcohol abuse is increased for those who have BED, with odds ratio (OR) of 2.3 and 1.7, respectively, compared to those who do not have BED [10]. Role impairment due to eating disorders has been reported by 46.7% of people with BED in 12 months, with 21.8% of the respondents reporting severe functional impairment [2].

Early recognition and accurate diagnosis may help to mitigate the long-term impact of BED [11], and identifying the clinical problems of BED people that are distinct from non-BED people can improve outcomes in treatment of BED. However, majority of the patients with BED do not present for treatment [12]. In addition, BED cannot be easily detected in primary care [13]. It is possible that a limited awareness of mental health burden associated with BED and the sub-threshold diagnoses cause fewer individuals being referred to mental health services [13]. Moreover, BED is strongly associated with obesity with OR between 4.9 and 5.8 compared to those without BED [2, 7, 14]. Binge eating has been found to be associated with life transitions such as starting college. Disturbed eating patterns are common among college students, especially among females [15], and body dissatisfaction is one of the most robust risk factors for eating pathology [16, 17]. Investigation of disturbed eating behaviors in BED is important to determine appropriate interventions for reducing the problematic eating patterns. Female college students who are overweight are at a higher risk of developing BED compared to those who are normal weight [5]. Obese individuals with BED are more likely to have comorbidities and experience functional impairment compared to obese individuals without BED [14, 18].

Despite the strong association between BED and obesity, more than half of the individuals with BED are actually not obese [14]. Obese individuals with BED vs. non-obese individuals with BED are different in regards to overeating-related behaviors [14]. In addition, BED is associated with considerable psychological dysfunction and functional impairments that distinguish it from obesity [19, 20]. Recently, it has been suggested that a dysfunction in a common neuro-computational mechanism may underlie diverse disorders involving compulsion such as BED, substance dependency, and obsessive–compulsive disorder [21]. As early recognition and accurate diagnosis may help mitigate the long-term impact of BED [11], we were interested in clarifying the characteristic features of BED. Most of the previous studies were carried out in treatment-seeking people who may not be a representative for individuals with BED in the general population, and only a few studies have been carried out to clarify the characteristic features of BED in community populations. We were interested in investigating the clinical problems of BED in overweight and normal weight people as the differentiated features of BED by weight is useful in treatment of people with BED.

The aim of the present study was to identify the determinants of BED associated with normal weight and overweight groups in a community sample of young women in Korea. The main features investigated were emotional eating behaviors, binge eating-related behaviors, a spectrum of compulsive behaviors, and psychological profiles of individuals with BED. We also investigated associations between these features and obesity in BED to observe if an eating disorder and obesity are associated with additive and interactive negative effects, via comparisons of overweight BED individuals with overweight non-BED individuals. We hypothesized that (1) the individuals with BED would have distinct clinical features from the individuals without BED, the profiles of which would be different between the NW and OW groups, and that (2) the overweight BED group would have more psychopathological dysfunctions than the normal weight BED group would.

Materials and methods

Participants

A total of 463 undergraduate women (346 normal weight and 117 overweight) were included in the study. The sample was restricted to normal weight (NW, $18 \text{ kg/m}^2 \leq \text{BMI} < 25 \text{ kg/m}^2$) or overweight (OW, $\text{BMI} \geq 25 \text{ kg/m}^2$). In the OW group, obese women ($\text{BMI} > 30 \text{ kg/m}^2$, $n = 27$) were included, as the study was focused on observing the overweight people rather than on the severity of obesity. The mean age of total participants was 21.71 ± 2.0 years.

Procedures

This was a part of another research investigating the effect of weight and eating behaviors on young women's health in Korea. The project was conducted during 2016, and it recruited undergraduate students by posting an advertisement on the social networking websites of 14 universities in Seoul metropolitan area. The advertisement included the aim of the research, study procedures, contact information of research staff, and a QR code that could be used to sign up for participation. Participation was voluntary, anonymous, and confidential. Subjects who signed up by calling,

sending an e-mail, or scanning the QR code were screened for participation requirements. Participants were subjected to interview, questionnaires, and physical measurements. A total of 467 undergraduate women (349 with NW and 118 with OW) were included in the study. Participants with learning disabilities and those who had serious mental or physical illnesses requiring treatment were excluded from this study. Those who were underweight (BMI ≤ 18 kg/m^2) were also excluded as the prevalence of BED in underweight population was very low. Among the participants, four students did not complete the questionnaires, so a total of 346 participants in the NW group and 117 participants in the OW group completed this study.

The informed consent stated eligibility requirements. All participants provided written informed consent. Participants were given $40 as a compensation for their time and travel cost. This study was approved by the Institutional Review Board (IRB) of Inje University (IRB no. INJE 2016-01-003-002).

Measures

We used a combination of assessment questionnaires to collect information on participants' emotional eating behaviors, binge eating-related behaviors, a spectrum of compulsive behaviors such as substance abuse and obsessive–compulsive disorder, and psychological profiles.

Screening of binge eating disorder

All participants completed the Eating Disorders Diagnostic Schedule DSM-5 version (EDDS-5) [22] derived from EDDS [23] for diagnostic evaluation of BED. EDDS is a 22-item self-report measure that screens for clinically significant symptoms of eating disorders to assess symptoms of anorexia nervosa, bulimia nervosa, and BED. The Korean translation with the permission of its developer (Dr. Eric Stice) was prepared by the first author and was controlled by a retranslation through a professional translator, using the techniques of back translation, discussion, and pilot studies. The internal consistency of the Korean EDDS-5 was Cronbach's alpha = 0.86 for a non-clinical sample and 0.81 for patients with eating disorders, and the test–retest reliability was $r = 0.87$ (unpublished data). A total of 18.6% (22/117) in the OW group and 8.3% (29/346) in the NW group were found to have BED.

Assessment

The demographic assessment consisted of age and household income. Height and weight were measured after taking off the outer garments and removing any belongings.

Lifestyle assessments The assessment of lifestyle behaviors consisted of sleep duration in 24 h, alcohol consumption frequency, and smoking status. The items were selected from the cross-sectional nationwide Korean National Health and Nutrition Examination Survey (KNHANES) of the Korea Centers for Disease Control and Prevention [24].

Eating habits The eating habits were assessed using a six-item self-report which consisted of dietary habits (e.g., regular meal times per week, estimated time required to finish a meal, and the amount of rice per meal), emotional eating behaviors (e.g., changes in food consumption and preferred taste when feeling negative emotions), and binge eating behaviors (e.g., the frequency of overeating and preferred taste when feeling negative emotions). The items were selected from the existing validated questionnaires in accordance with the purpose of this study. Three items for the dietary habits section were selected from the questionnaire for dietary habit survey [25], and three items for the eating behaviors section were selected from the questionnaire for dietary behaviors [26].

Eating Disorder Examination Questionnaire (EDE-Q) The EDE-Q is a 28-item self-report scale to measure the severity of eating-related psychopathology on four subscales over a 28-day period [27]. The Korean EDE-Q is a reliable and valid instrument [28] and has been widely used in Korean studies. In the present study, the Cronbach's alpha values of its internal consistency for restraint concern, eating concern, shape concern, and weight concern were 0.86, 0.73, 0.86, and 0.78, respectively.

Dutch Eating Behavior Questionnaire (DEBQ) The DEBQ is a 33-item self-report scale consisting of abstinent eating, emotional eating and external eating for the dietary behavior [29]. The Korean DEBQ is a reliable and valid instrument [30] and has been widely used in Korean studies. In the present study, the Cronbach's alpha values of its internal consistency for restrained eating, emotional eating, and external eating were 0.91, 0.91, and 0.74, respectively.

Obsessive–Compulsive Inventory-Revised (OCI-R) The OCI-R is a 18-item self-report scale consisting of six subscales of symptoms in an obsessive–compulsive disorder: washing, obsessing, mental neutralizing, ordering, hoarding, and doubting [31]. The Korean OCI-R is a reliable and valid instrument [32] and has been widely used in Korean studies. In the present study, the Cronbach's alpha value of its internal consistency for the OCI-R was 0.82.

Depression, Anxiety, and Stress Scale-21 (DASS-21) The DASS-21 is a self-report questionnaire containing 21 items of three subscales (depression, anxiety, and stress) [33]. In

the present study, the Cronbach's alpha values of its internal consistency for depression, anxiety, and stress were 0.87, 0.67, and 0.89, respectively.

NEO Five-Factor Inventory (NEO-FFI) The NEO-FFI is a 60-item self-report instrument that measures personality domains according to the following five traits: N = Neuroticism, E = Extraversion, O = Openness, A = Agreeableness, and C = Conscientiousness (12 items per trait) [34]. The Korean NEO-FFI is a reliable and valid instrument [35] and has been widely used in Korean studies. In the present study, the Cronbach's alpha values of its internal consistency for neuroticism, extraversion, openness, agreeableness, and conscientiousness were 0.86, 0.86, 0.66, 0.69, and 0.83, respectively.

Clinical Impairment Assessment (CIA) The CIA is a 16-item self-report scale including three subscales of symptoms in personal, social, and cognitive impairment, with higher overall scores and subscale scores ('personal', 'social', and 'cognitive') indicating higher severity of impairment [36]. In the present study, the Cronbach's alpha values of its internal consistency for the CIA was 0.84.

Statistical analysis

The BED features by weight group (NW or OW) were explored through comparison between BED and non-BED groups (i.e., NW BED vs. NW non-BED, OW BED vs. OW non-BED). We also explored the features of BED by comparing OW BED with NW BED. Data were assessed for normality through the visual inspection of histograms and calculation of Skewness and Kurtosis values. After

establishing that data were normally distributed, the demographic characteristics were analyzed with independent t test or cross-tabulations for categorical data. As BMIs in the NW BED and the OW BED groups were not normally distributed, Mann–Whitney U tests were used to compare the BED group and non-BED group. To identify the determinants of BED associated with normal weight and overweight groups, we used univariate regression analyses. Moreover, logistic regression analyses were used to determine associations of BED with lifestyle behaviors, eating behaviors, and psychological comorbidities. In the analyses, the first category of the variable was used as a reference category if an independent variable was categorical. If the number of frequency was 0 in a cell of cross-tabulations between a categorical independent variable and a dependent variable, regression analysis was done by adding 0.5 to each cell [37]. All data were analyzed with SPSS 23.0 Statistics software (SPSS Inc., Chicago, IL, USA).

Results

Demographic characteristics of participants

The demographic characteristics of the participants are presented in Table 1. There was no significant difference in mean age between the NW group (21.59 ± 1.85 years) and the OW group (22.05 ± 2.33 years old) ($t = -2.17$, $P = 0.054$). Moreover, there was no significant difference in household income between the two groups ($\chi^2 = 3.36$, $P = 0.498$). There were no significant differences in age between BED and non-BED participants in the NW group ($t = -0.71$, $df = 344$, $P = 0.474$) or OW group ($t = -1.15$,

Table 1 Demographic characteristics of normal weight and overweight college women

	Normal weight women ($n = 346$)				Overweight women ($n = 117$)				a vs. b	
	BED[a] ($n = 29$)	NBED ($n = 317$)	t ($df = 344$)	P	BED[b] ($n = 22$)	NBED ($n = 95$)	t ($df = 115$)	P	t ($df = 49$)	P
Age, years	21.83 (1.94)	21.57 (1.85)	− 0.71	0.474	22.68 (2.96)	21.91 (2.16)	− 1.15	0.257	− 1.17	0.221
BMI, kg/m²	21.83 (1.53)	20.94 (1.56)	$Z = -3.04$	0.002	29.33 (3.92)	27.74 (3.19)	$Z = -2.16$	0.031	$Z = -6.07$	< 0.001
Household income, \$/month[c]										
< 1800	0 (0.0%)	31 (9.8%)	$\chi^2 = 5.15$	0.272	4 (18.2%)	10 (10.5%)	$\chi^2 = 4.28$	0.369	$\chi^2 = 8.98$	0.061
1800–2800	5 (17.2%)	60 (19.0%)			1 (4.5%)	15 (15.8%)				
2800–3700	5 (17.2%)	61 (19.3%)			4 (18.2%)	24 (25.3%)				
3700–4600	9 (31.0%)	58 (18.4%)			3 (13.6%)	17 (17.9%)				
≥ 4600	10 (34.5%)	106 (33.5%)			10 (45.5%)	29 (30.5%)				

Data are shown as mean (SD) unless otherwise specified

Analyses with independent t tests or Mann–Whitney U tests for continuous data, and cross-tabulations for categorical data

BED, binge eating disorder; NBED, non-binge eating disorder; BMI, body mass index

[a]BED women with normal weight

[b]BED women with overweight

[c]Data are shown as frequency (%)

$df = 115$, $P = 0.257$). BED women had higher BMI than non-BED women both in the NW group ($Z = -3.04$, $P = 0.002$) and the OW group ($Z = -2.16$, $P = 0.031$). There were no differences in household income between BED and non-BED women in the NW group ($\chi^2 = 5.15$, $P = 0.272$) or the OW group ($\chi^2 = 4.28$, $P = 0.369$). Less than half (21/51) of women with BED believed that they had an eating disorder, and only one participant was actually diagnosed with an eating disorder by a doctor.

In the BED group, the BMIs were 29.33 ± 3.92 kg/m^2 and 21.87 ± 1.56 kg/m^2 for the OW and NW BED women ($Z = -6.07$, $P < 0.001$), respectively. There were no significant differences in age ($t = -1.17$, $df = 49$, $P = 0.221$), household income ($\chi^2 = 8.98$, $P = 0.061$), or the age of menarche ($t = 0.67$, $df = 49$, $P = 0.502$) between the OW BED and NW BED women. Greater functional impairments were associated with OW BED than with NW BED (for CIA overall, odds ratio 1.30, 95% CI 1.08–1.57, $P = 0.006$).

Lifestyle behaviors of BED women compared to non-BED women in the NW group and the OW group

Lifestyle behaviors of BED women compared to non-BED women in NW and OW groups are shown in Table 2. In the NW group, BED women had more frequent compulsive alcohol consumption (≥ 2 times/week) than non-BED women (odds ratio 3.03, 95% CI 1.13–8.11, $P = 0.027$). There were no differences in sleep duration or smoking status between BED and non-BED women in the NW group. On the other hand, BED women had more sleep hours than non-BED women (odds ratio 1.46, 95% CI 1.01–2.09, $P = 0.041$) in the OW group, and there were no significant differences in frequency of alcohol consumption or smoking status between the two.

In the BED group, OW BED women were found to sleep more than NW BED women (odds ratio 1.62, 95% CI 1.02–2.58, $P = 0.039$). Also, more frequent alcohol consumption tended to be associated with NW BED than with OW BED (odds ratio 0.06, 95% CI 0.00–1.14, $P = 0.061$).

Eating disorder psychopathology and eating behaviors of BED compared to non-BED women in the NW group and the OW group

Eating disorder psychopathology and eating behaviors of BED and non-BED women in NW and OW groups are shown in Table 3. As expected, BED women scored higher on the DEBQ and EDE-Q scales than non-BED women. In the NW group, BED women had more emotional eating (odds ratio 1.08, 95% CI 1.04–1.12, $P < 0.001$) and external eating (odds ratio 1.19, 95% CI 1.09–1.29, $P < 0.001$) measured by DEBQ than non-BED women. NW BED

women also had higher global scores on EDE-Q (odds ratio 2.07, 95% CI 1.41–3.03, $P < 0.001$) with higher eating concern (odds ratio 2.65, 95% CI 1.81–3.87, $P < 0.001$), shape concern (odds ratio 1.69, 95% CI 1.23–2.32, $P < 0.001$), and weight concern (odds ratio 1.82, 95% CI 1.31–2.53, $P < 0.001$) than NW non-BED women. In the OW group, BED women had more emotional eating (odds ratio 1.04, 95% CI 1.00–1.08, $P = 0.015$) and external eating (odds ratio 1.11, 95% CI 1.01–1.21, $P = 0.023$) than non-BED women measured by DEBQ. OW BED women also had higher global scores on EDE-Q (odds ratio 1.74, 95% CI 1.11–2.73, $P = 0.015$) with higher eating concern (odds ratio 1.71, 95% CI 1.17–2.50, $P = 0.005$), shape concern (odds ratio 1.73, 95% CI 1.13–2.67, $P = 0.012$), and weight concern (odds ratio 1.59, 95% CI 1.06–2.39, $P = 0.023$) than OW non-BED women.

Regarding eating habits, BED women were more likely to report eating more (rather than eating less) in the context of negative emotion (odds ratio 3.80, 95% CI 1.01–14.28, $P = 0.048$) but less likely to report eating a moderate amount of meal (2/3 bowel of rice) (odds ratio 0.29, 95% CI 0.10–0.82, $P = 0.020$) than non-BED women in the NW group. NW BED women also tended to have higher frequency of overeating (≥ 1/day) (odds ratio 8.18, 95% CI 0.97–68.45, $P = 0.052$) than NW non-BED women. In the OW group, BED women showed no differences in binge eating behaviors such as change in food consumption in negative emotion or frequency of overeating compared to non-BED women.

With regard to regular meal habits, there were no significant differences in regular meal frequency, estimated time required to finish a meal, or the amount/portion per meal between BED and non-BED women in either NW group or OW group. Moreover, there was no significant difference in preferred taste in negative emotion between BED and non-BED women in either NW or OW group.

In the BED group, OW BED women were associated with higher global scores on EDE-Q (odds ratio 2.49, 95% CI 1.20–5.14, $P = 0.014$) with higher shape (odds ratio 2.92, 95% CI 1.44–5.94, $P = 0.003$) and weight concerns (odds ratio 3.04, 95% CI 1.42–6.50, $P = 0.004$) than NW BED women. There was no difference in eating behaviors between NW BED and OW BED women (all P values > 0.1).

Psychological comorbidities and functional impairments in BED compared to non-BED women in the NW group and the OW group

Psychological comorbidities and functional impairments of BED women compared to non-BED women in NW and OW groups are shown in Table 4.

In the NW group, BED women had slightly more obsessive–compulsive symptoms than non-BED women (odds

Table 2 Lifestyle behaviors of BED women compared to non-BED women in normal weight and overweight groups

	Normal weight women (n=346)					Overweight women (n=117)					a vs. b		
	BED[a] (n=29)	NBED (n=317)	B	P	OR (95% CI)	BED[b] (n=22)	NBED (n=95)	B	P	OR (95% CI)	B	P	OR (95% CI)
Sleep, h/day	6.27 (1.19)	6.51 (1.10)	− 0.199	0.263	0.82 (0.57–1.16)	7.09 (1.44)	6.42 (1.29)	0.37	0.041	1.46 (1.01–2.09)	0.488	0.039	1.62 (1.02–2.58)
Alcohol drinking[c]													
< 1 time/month	10 (34.5%)	108 (34.2%)				9 (40.9%)	38 (40.0%)				–	0.840	–
1–4 times/month	10 (34.5%)	176 (55.7%)	− 0.48	0.292	0.61 (0.24–1.52)	13 (59.1%)	50 (52.6%)	0.08	0.866	1.08 (0.42–2.74)	0.36	0.555	1.44 (0.42–4.89)
≥ 2 times/week	9 (31.0%)	32 (10.1%)	1.11	0.027	3.03 (1.13–8.11)	0 (0.0%)	7 (7.4%)	− 1.30	0.384	0.27 (0.01–5.15)	− 21.09	0.999	0 (0.0–0.0)
Smoking status[c]													
Non-smoker	24 (82.8%)	292 (93.3%)				19 (86.4%)	80 (84.2%)				–	0.740	–
Smoker	2 (6.9%)	9 (2.9%)	0.99	0.220	2.70 (0.55–13.22)	2 (9.1%)	2 (2.1%)	1.43	0.164	4.21 (0.55–31.82)	− 1.09	0.472	0.33 (0.01–6.65)
Ex-smoker	3 (10.3%)	12 (3.8%)	1.11	0.102	3.04 (0.80–11.52)	1 (4.5%)	13 (13.7%)	− 1.12	0.291	0.32 (0.04–2.63)	− 0.23	0.823	0.79 (0.10–6.15)

Data are shown as mean (SD) unless otherwise specified

Analyses with univariate regression

BED, binge eating disorder; NBED, non-binge eating disorder

[a]BED women with normal weight

[b]BED women with overweight

[c]Data are shown as frequency (%)

Table 3 Eating disordered psychopathology and eating behaviors of BED women compared to non-BED women in normal weight and overweight groups

	Normal weight women (n = 346)					Overweight women (n = 117)					a vs. b		
	BED[a] (n = 29)	NBED (n = 317)	B	P	OR (95% CI)	BED[b] (n = 22)	NBED (n = 95)	B	P	OR (95% CI)	B	P	OR (95% CI)
DEBQ													
Restrained eating	35.03 (6.70)	32.79 (8.72)	0.03	0.181	1.03 (0.98–1.08)	31.72 (7.83)	34.03 (6.80)	− 0.04	0.168	0.95 (0.89–1.02)	− 0.06	0.115	0.93 (0.86–1.01)
Emotional eating	40.17 (9.25)	30.42 (10.77)	0.08	0.000	1.08 (1.04–1.12)	41.86 (10.52)	33.86 (13.68)	0.04	0.015	1.04 (1.00–1.08)	0.01	0.537	1.01 (0.96–1.07)
External eating	38.00 (4.56)	33.73 (5.39)	0.17	0.000	1.19 (1.09–1.29)	37.45 (5.67)	34.28 (5.66)	0.10	0.023	1.11 (1.01–1.21)	− 0.02	0.699	0.97 (0.87–1.09)
EDE-Q													
Restraint	1.99 (1.06)	1.61 (1.39)	0.18	0.156	1.20 (0.93–1.57)	2.18 (1.47)	1.91 (1.38)	0.13	0.417	1.14 (0.82–1.57)	0.12	0.589	1.13 (0.72–1.77)
Eating concern	1.75 (1.07)	0.81 (0.78)	0.97	0.000	2.65 (1.81–3.87)	2.33 (0.93)	1.48 (1.23)	0.53	0.005	1.71 (1.17–2.50)	0.56	0.057	1.76 (0.98–3.16)
Shape concern	3.41 (1.12)	2.56 (1.29)	0.52	0.001	1.69 (1.23–2.32)	4.44 (0.80)	3.62 (1.38)	0.55	0.012	1.73 (1.13–2.67)	1.07	0.003	2.92 (1.44–5.94)
Weight concern	2.92 (0.95)	2.01 (1.23)	0.60	0.000	1.82 (1.31–2.53)	3.82 (0.86)	3.12 (1.32)	0.46	0.023	1.59 (1.06–2.39)	1.11	0.004	3.04 (1.42–6.50)
Global	2.52 (0.88)	1.75 (1.00)	0.72	0.000	2.07 (1.41–3.03)	3.19 (0.83)	2.53 (1.13)	0.55	0.015	1.74 (1.11–2.73)	0.91	0.014	2.49 (1.20–5.14)
Frequency of overeating, times[c]													
None	1 (3.4%)	30 (9.5%)			–	0 (0.0%)	2 (2.1%)			–	–	1.00	–
1–6/week	19 (65.5%)	254 (80.1%)	0.80	0.439	2.24 (0.29–17.36)	15 (68.2%)	78 (82.1%)	− 0.01	0.994	0.98 (0.04–21.58)	20.96	1.00	0 (0.0–0.0)
≥1/day	9 (31.0%)	33 (10.4%)	2.10	0.052	8.18 (0.97–68.45)	7 (31.8%)	15 (15.8%)	0.88	0.584	2.41 (0.10–56.97)	20.95	1.00	0 (0.0–0.0)
Changes in food consumption when feeling negative emotion[c]													
Less than usual	2 (6.9%)	66 (20.8%)			–	1 (4.5%)	16 (16.8%)			–	–	–	–
No difference	0 (0.0%)	59 (18.6%)	− 1.49	0.337	0.22 (0.01–4.75)	0 (0.0%)	15 (15.8%)	− 1.03	0.535	0.35 (0.01–9.38)	–	–	–
More than usual	27 (93.1%)	192 (60.6%)	1.33	0.048	3.80 (1.01–14.28)	21 (95.5)	64 (67.4%)	1.29	0.144	3.66 (0.64–20.91)	0.42	0.726	1.55 (0.13–18.34)
Preferred taste when feeling negative emotion[c]													
Salty/sour/bitter	1 (3.4%)	19 (6.0%)			–	3 (13.6%)	11 (11.6%)			–	–	0.320	–
Sweet	13 (44.8%)	146 (46.2%)	0.52	0.622	1.69 (0.20–13.66)	7 (31.8%)	46 (48.4%)	− 0.58	0.447	0.55 (0.12–2.51)	− 1.72	0.168	0.17 (0.02–2.07)
Spicy	14 (48.3%)	133 (42.1%)	0.69	0.515	2.00 (0.24–16.08)	9 (40.9%)	30 (31.6%)	0.09	0.899	1.10 (0.25–4.82)	− 1.54	0.211	0.21 (0.02–2.39)
Greasy	1 (3.4%)	18 (5.7%)	0.05	0.970	1.05 (0.06–18.17)	3 (13.6%)	8 (8.4%)	0.31	0.735	1.37 (0.21–8.66)	0.00	1.00	1.00 (0.04–24.54)
Regular meal times per week, days[c]													
6–7/week	0 (0.0%)	8 (2.5%)			–	2 (9.1%)	5 (5.3%)			–	–	0.924	–
2–5/week	25 (86.2%)	290 (91.5%)	0.40	0.785	1.49 (0.08–26.60)	18 (81.8%)	77 (81.1%)	− 0.53	0.540	0.58 (0.10–3.25)	21.89	0.999	0 (0.0–0.0)
< 1/week	4 (13.8%)	19 (6.0%)	1.36	0.377	3.92 (0.18–81.25)	2 (9.1%)	13 (13.7%)	− 0.95	0.398	0.38 (0.04–3.52)	0.36	0.692	1.44 (0.23–8.73)
Estimated time required to finish a meal, min[c]													
> 30	0 (0.0%)	31 (9.8%)			–	2 (9.1%)	3 (3.2%)			–	–	0.999	–
10–30	26 (89.7%)	272 (85.8%)	1.81	0.208	6.12 (0.36–102.99)	18 (81.8%)	86 (90.5%)	− 0.69	0.571	0.50 (0.04–5.51)	− 21.60	0.999	0 (0.0–0.0)
< 10	3 (13.3%)	14 (4.4%)	2.72	0.078	15.20 (0.73–314.03)	2 (9.1%)	6 (6.3%)	− 1.15	0.222	0.31 (0.04–2.01)	− 21.57	0.999	0 (0.0–0.0)

Table 3 (continued)

	Normal weight women (n=346)					Overweight women (n=117)					a vs. b		
	BED[a] (n=29)	NBED (n=317)	B	P	OR (95% CI)	BED[b] (n=22)	NBED (n=95)	B	P	OR (95% CI)	B	P	OR (95% CI)
Amount of rice per meal, bowl of rice[c]													
≥1	18 (62.1%)	129 (40.7%)				15 (68.2%)	53 (55.8%)				–	0.529	–
2/3	5 (17.2%)	120 (37.9%)	−1.20	0.020	0.29 (0.10–0.82)	5 (22.7%)	35 (36.8%)	−0.68	0.223	0.50 (0.16–1.51)	0.18	0.801	1.20 (0.29–4.94)
≤1/2	6 (20.7%)	68 (21.5%)	−0.45	0.354	0.63 (0.24–1.66)	2 (9.1%)	7 (7.4%)	0.00	0.991	1.01 (0.19–5.37)	−0.91	0.302	0.40 (0.07–2.28)

Data are shown as mean (SD) unless otherwise specified

Analyses with univariate regression

BED, binge eating disorder; NBED, non-binge eating disorder; DEBQ, Dutch Eating Behavior Questionnaire; EDE-Q, eating disorders examination questionnaire

[a] BED women with normal weight

[b] BED women with overweight

[c] Data are shown as frequency (%)

ratio 1.04, 95% CI 1.01–1.07, $P = 0.009$). However, there were no significant differences in depression, anxiety, or stress measured by DASS between NW BED and NW non-BED women. NW BED women also scored slightly higher in neuroticism on the NEO personality measure than NW non-BED women (odds ratio 1.06, 95% CI 1.01–1.11, $P = 0.017$). Moreover, NW BED women had greater functional impairments (in CIA, odds ratio 1.24, 95% CI 1.09–1.41, $P = 0.001$).

In the OW group, BED women were not found to have more obsessive–compulsive symptoms, but they scored higher on depression (odds ratio 1.11, 95% CI 1.02–1.21, $P = 0.010$) and neuroticism (odds ratio 1.07, 95% CI 1.01–1.13, $P = 0.023$) and scored lower on extraversion (odds ratio 0.91, 95% CI 0.85–0.97, $P = 0.004$) on the NEO personality measure. Also OW BED women had greater functional impairments (in CIA, odds ratio 1.19, 95% CI 1.05–1.34, $P = 0.005$).

In the BED group, OW BED women had a tendency to have higher levels of depression (odds ratio 1.09, 95% CI 0.99–1.21, $P = 0.066$) and lower levels of extraversion (odds ratio = − 0.90, 95% CI 0.83–0.98, $P = 0.017$) than NW BED women.

Discussion

In this study, we investigated the core features of behavioral and psychological facets of BED. As expected, the BED group had higher concerns for eating, shape, and weight and had more emotional eating. The NW BED female students were more associated with obsessive–compulsive symptoms, whereas the OW BED female students were more associated with affective symptoms. Only 41.2% of Korean BED female students considered that they had an eating disorder, and furthermore, majority had not sought treatment despite having higher levels of functional impairment.

In this study, we used the DSM-5 BED diagnostic criteria to screen for BED in a general population of female college students. Our findings revealed that 8.3% of the NW female students and 18.6% of the OW female students had DSM-5 BED. These data are comparable to the results of previous studies which found that 7.8% of male and female university students had BED [5], considering that the prevalence of binge eating is higher among female college students than male college students [38]. A recent study of Korean female high school students (aged 17–18 years) reported that 28% of them showed a tendency for binge eating [39]. However, other studies carried out in different samples of adolescents with longitudinal follow-up reported lower rates [40, 41]. Therefore, direct comparisons of studies are difficult due to differences in samples such as gender and age.

Table 4 Psychological comorbidities and functional impairments of BED women compared to non-BED women in normal weight and overweight groups

	Normal weight women (n = 346)					Overweight women (n = 117)					a vs. b		
	BED[a] (n = 29)	NBED (n = 317)	B	P	OR (95% CI)	BED[b] (n = 22)	NBED (n = 95)	B	P	OR (95% CI)	B	P	OR (95% CI)
CIA, overall	4.02 (3.08)	2.39 (2.30)	0.21	0.001	1.24 (1.09–1.41)	7.06 (3.63)	4.50 (3.57)	0.17	0.005	1.19 (1.05–1.34)	0.26	0.006	1.30 (1.08–1.57)
OCI-R, total	20.13 (14.16)	14.69 (10.05)	0.04	0.009	1.04 (1.01–1.07)	23.27 (12.63)	18.46 (12.74)	0.02	0.118	1.02 (0.99–1.06)	0.01	0.409	1.01 (0.97–1.06)
DASS-21													
Stress	6.68 (6.00)	5.99 (4.55)	0.03	0.444	1.03 (0.95–1.11)	8.31 (5.34)	6.70 (5.34)	0.05	0.205	1.05 (0.97–1.14)	0.05	0.314	1.05 (0.95–1.16)
Depression	5.93 (5.63)	4.48 (4.17)	0.06	0.088	1.07 (0.99–1.15)	9.00 (5.75)	5.60 (5.09)	0.11	0.010	1.11 (1.02–1.21)	0.09	0.066	1.09 (0.99–1.21)
Anxiety	3.62 (3.83)	3.10 (3.00)	0.05	0.386	1.05 (0.93–1.17)	4.77 (4.08)	3.47 (3.44)	0.09	0.133	1.09 (0.97–1.23)	0.07	0.301	1.07 (0.93–1.24)
Total	16.24 (14.10)	13.58 (10.24)	0.02	0.200	1.02 (0.98–1.05)	22.09 (12.66)	15.77 (12.09)	0.03	0.036	1.04 (1.00–1.07)	0.03	0.134	1.03 (0.99–1.07)
NEO-FFI													
Neuroticism	39.79 (8.18)	36.05 (7.91)	0.05	0.017	1.06 (1.01–1.11)	42.18 (7.46)	37.67 (8.13)	0.06	0.023	1.07 (1.01–1.13)	0.04	0.286	1.04 (0.96–1.12)
Extraversion	39.75 (9.25)	39.74 (7.78)	0.00	0.994	1.00 (0.95–1.05)	33.63 (6.32)	39.35 (7.91)	− 0.09	0.004	0.91 (0.85–0.97)	− 0.09	0.017	0.90 (0.83–0.98)
Openness to experience	40.48 (5.91)	39.80 (5.91)	0.02	0.552	1.02 (0.95–1.08)	40.00 (4.72)	41.40 (5.75)	− 0.04	0.298	0.95 (0.87–1.04)	− 0.01	0.753	0.98 (0.88–1.09)
Agreeableness	41.96 (5.28)	43.51 (5.74)	− 0.04	0.163	0.95 (0.89–1.01)	41.36 (5.90)	41.82 (5.71)	− 0.01	0.735	0.98 (0.91–1.06)	− 0.02	0.697	0.98 (0.88–1.08)
Conscientiousness	39.55 (7.60)	40.17 (6.47)	− 0.01	0.627	0.98 (0.93–1.04)	36.54 (7.35)	39.05 (6.74)	− 0.05	0.127	0.94 (0.88–1.01)	− 0.05	0.166	0.94 (0.87–1.02)

Data are shown as mean (SD)

Analyses with univariate regression

BED, binge eating disorder; NBED, non-binge eating disorder; CIA, Clinical Impairment Assessment Questionnaire; OCI-R, Obsessive–Compulsive Inventory-Revised; DASS-21, Depression, Anxiety, Stress Scale-21; NEO-FFI, NEO Five-Factor Inventory

[a]BED women with normal weight

[b]BED women with overweight

Our results showed that the profiles in eating and lifestyle behaviors and personality of BED were somewhat different between the NW and the OW groups, which supported our first hypothesis. In detail, in the NW group, the NW BED women had more emotional and external eating, more extreme alcohol consumption, and higher levels of neuroticism than the NW non-BED women. In the OW group, the OW BED women had more sleep duration, more emotional and externally driven eating, higher levels of neuroticism, and lower extraversion than the OW non-BED women. Moreover, the DASS and EDE-Q global scores were higher in the OW BED women than in the OW non-BED women. These findings are in accordance with previous studies which found that obese BED women reported greater negative affect and eating psychopathology than obese non-BED women [42].

In this study, we provided evidences of emotional eating, compulsive overeating and compulsive substance use behaviors in BED, which may be associated with the underlying mechanism of this disorder. Emotional eating, the propensity to eat in response to positive and negative emotions, was increased both in the NW BED and the OW BED women as what has been previously reported [43, 44]. In compulsive overeating reflected by high frequency of overeating (≥ 1/days), NW BED women had more compulsive overeating than NW non-BED women, whereas there was no difference in compulsive overeating between OW BED women and OW non-BED women. Compulsive overeating in BED women might reflect their obsessive compulsive traits which was suggested to be a biological vulnerability for binge eating based on animal models [45]. The compulsive traits were also found in alcohol consumption in NW BED women. In our study, the NW BED women had a higher frequency of compulsive alcohol consumption than the NW non-BED women (odds ratio 3.03, 95% CI 1.13–8.11, $P = 0.027$ in NW BED vs. NW non-BED). However, this pattern of drinking was not observed in OW BED women. Compulsive consumption or reward seeking behavior can be mapped onto one domain in the Research Domain Criteria (RDoC) framework [46]. Compulsivity is observed in obsessive–compulsive symptoms, substance use behaviors, and binge eating behaviors [47]. Common neuronal mechanism underpinning the spectrum of disorders have been found [21], which may represent a different manifestation of impulsive–compulsive traits that are common in these disorders.

Our second hypothesis was partially supported by the findings. In the BED group, OW BED women had more eating disorders psychopathology, functional impairments and lower levels of extraversion than NW BED women, whereas there were no differences between OW BED and NW BED women with regards to eating behaviors and general psychopathology. It has been reported that overweight women with BED have higher weight concerns than normal weight women with BED [48]. The higher levels of extraversion found in the NW BED women are in line with the previous study reporting normal weight BED endorsing greater usage of healthy (i.e., exercise, food avoidance) and unhealthy (i.e., vomiting; ipecac, laxative, diuretic, or diet pill use; skipping meals; chronic dieting) weight control behaviors than overweight BED people [49]. Because weight gain occurs as a consequence of binge eating [50], prevention or early intervention strategies for young adults with binge eating behaviors may prevent this deterioration in quality of life.

This study has a few limitations. First, we did not gather information on the age of onset or duration of BED. Second, data for lifestyle and eating behaviors were gathered from self-report questionnaires which could be subject to bias and recall errors. Third, the diagnosis of BED was made from a questionnaire rather than an interview. Finally, this study only included a restricted age range of female university students who were normal weight or overweight, which may contribute to a higher estimation of BED prevalence.

Some questions need to be investigated in future studies. First, OW BED people might represent those who have longer durations of an untreated loss of control over eating. Second, the loss of control over alcohol and food consumption found in BED people suggests that impulsivity might be an important construct which was not measured in our study. Third, although compulsive behaviors were prominent in the NW BED group, these women did not have higher levels of conscientiousness/perfectionism which are obsessive–compulsive personality disorder features seen in other eating disorders. Lastly, we could not carry out comparisons of NW BED with purging type of bulimic disorder. In previous studies, BED and non-purging type bulimic eating disorder were associated with less severe psychopathology and higher remission rates than purging type of bulimic eating disorders [46]. There are difficulties in differentiating NW BED from bulimia nervosa as people with bulimia nervosa usually carry out the inappropriate compensatory behaviors in secret. Therefore, a future study needs to examine the distinct features of NW BED from bulimia nervosa.

In summary, the clinical features of BED were comprehensively assessed in a sample of undergraduate Korean women in this study. Although the BED women had increased functional impairments, the majority did not recognize that they had an "illness", and only a small proportion had actually sought treatment. NW BED was more likely to be associated with obsessive–compulsive symptoms with a loss of control over alcohol and food consumption, whereas OW BED was more likely to be associated with affective symptoms such as depression and low level of extraversion. Strategies to increase awareness and recognition of BED may be warranted, as these are common sources of distress

in university students and have a protracted course with increasing physical and psychological morbidity [9].

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical approval All procedures performed in this study were in accordance with the ethical standards of the national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical measure.

Informed consent Informed consents were received from each of the participants.

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