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ORIGINAL ARTICLE

Association of anthropometric status, perceived stress, and personality traits with eating behavior in university students

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Abstract

Purpose We investigated the association of anthropometric status, perceived stress, and personality traits with eating behavior in university students.

Methods The participants, 1546 Japanese university students (964 males, 582 females), completed a questionnaire which asked for their current height and weight, ideal height and weight, eating behaviors, perceived stress, and personality traits.

Results Restrained eating was higher in normal-weight participants compared with underweight participants in both males and females ($p < 0.001$, both males and females). Restrained eating in normal-weight males was significantly lower in normal-weight females ($p < 0.001$). In addition, normal-weight males reported less stress than normal-weight females (anxiety/uncertainty, $p = 0.037$; tiredness/physical responses, $p < 0.001$; autonomic symptoms, $p < 0.001$; depression/feeling, $p < 0.001$) and underweight males (tiredness/physical responses, $p = 0.018$; autonomic symptoms, $p = 0.001$). Moreover, among normal-weight males, neuroticism was significantly lower compared with normal-weight females ($p < 0.001$). In multiple regression analysis, male participants revealed positive association between restrained eating and body mass index ($\beta = 0.199$, $p < 0.001$) or body mass index difference ($\beta = -0.170$, $p = 0.001$). In contrast, female revealed more significant associations between emotional and external eating and perceived stress or personality traits compared with males.

Conclusions These results indicate that associations between eating behavior and anthropometric status or psychological factors are different by each eating behavior, which is partly influenced by gender difference.

Level of evidence V, cross-sectional descriptive study.

Keywords Eating behavior · Anthropometric status · Stress · Personality · Students · Gender difference

Introduction

Eating behavioral problems are prevalent not only in underweight, overweight, or obese people but also in people within the normal-weight range, particularly young women [1, 2]. It is also reported that disordered eating behavior is associated with obesity or overweight [3–7]. That is, it is crucial to keep appropriate eating behaviour for health

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maintenance. Eating behavior is consisted of different types of eating behaviors: restrained eating, emotional eating, and external eating [8]. In any type of eating behavior, excessive eating behavior can cause eating behavior problem. Since each eating behavior is different from each other, factors causing excessive eating behaviors should also be different. In addition, each type of eating behavior is more pronounced in females than males [2, 9]. Therefore, it is needed to clarify which eating behavior is associated with each of factors in each gender.

Eating behavior has been examined in terms of the relationship with anthropometric status, perception of body shape, and the desire for thinness. On the one hand, disinhibited eating and emotional eating of Three Factor Eating Questionnaire was positively associated with body weight, BMI, waist circumference, and fat mass [10, 11]. In female adolescents, restrained eating was positively associated with BMI and body-size dissatisfaction [12]. Orthorexic behavior was associated with increased BMI, waist circumference, and energy intake [13]. On the other hand, dietary restraint is positively associated with overvaluation and preoccupation with body weight/shape [14]. High dieting score on the Eating Attitude Test-26 was positively associated with a thin ideal physique [15]. Female students in Japan, even those who were underweight, were reported to exhibit a greater drive for thinness than males, and the drive for thinness was positively associated with restrained eating [2]. In addition, in adolescent girls, encouragement to diet by mothers was found to predict girls' drive for thinness and dieting behavior [4]. These studies suggest that eating behavior is associated with not only anthropometric status, but also perception of body shape and body dissatisfaction. However, it has not been well documented about the gender difference on these relationships.

In terms of perceived stress, an association with disordered eating or uncontrollable eating such as overeating [16], binge eating, hunger, and disinhibition [17], and comfort eating [18] has been found in several studies. Regarding eating behavior, a relationship between emotional eating and perceived stress has been reported in several studies. For example, perceived stress is also associated with emotional eating [19]. In addition, comfort eating has been reported to be associated with perceived stress [18], and high levels of depression and anxiety have been linked to increased emotional eating [20]. These previous studies suggest an association between emotional eating and perceived stress. In a study of other eating behaviors, including restrained eating and external eating, Christaki et al. reported that obese or overweight individuals in a stress management group exhibited significant improvements in weight loss and increased rates of restrained eating behavior after intervention, compared with a control group [21]. However, the associations between restrained eating, external eating, and perceived stress have not been fully elucidated, and analysis by gender is also insufficient. Thereby the precise relationships remain unclear.

Moreover, previous studies have reported that personality traits are associated with eating behavior. Emotional eating is reported to be positively related to neuroticism, including depression and anxiety, and negatively related to conscientiousness [5, 22–24] and extraversion [22, 23]. External eating has also been associated with impulsiveness and lower self-discipline of conscientiousness [23], and with neuroticism [22–24]. In addition, one study reported that restrained eating was positively related to neuroticism and openness to experience, and emotional eating was positively associated with neuroticism and negatively associated with conscientiousness [24]. Another study indicated that higher levels of neuroticism predict higher scores on cognitive dietary restraint, disinhibition, and susceptibility to hunger [25]. In contrast, several studies reported no significant relationship between restrained eating and neuroticism or extraversion. Therefore, the relationships between restrained eating and personality traits are not necessarily consistent with the relationships between emotional or external eating and personality traits. In addition, gender difference was not assessed.

Taken together, the studies described above raise the possibility that emotional and external eating are different from restrained eating in a relationship with anthropometric status, perceived stress, or personality traits. Therefore, in the present study, we investigated the association between eating behavior and anthropometric status, perceived stress, and personality traits, with focusing gender difference.

Methods

Participants

The survey was conducted using an anonymous, self-administered questionnaire during university classes between 2013 and 2014. Participants were 1660 university students who attended classes in the liberal arts. Participants did not receive remuneration. The questionnaires were delivered to all students in attendance (1660 students), and the completed questionnaires were collected. Of the 1660 questionnaires, 1546 questionnaires contained valid responses. Thus, the response rate, calculated by dividing the number of valid responses by the number of delivered questionnaires, was 93.1% ($n = 1546$, 964 males and 582 females, 18.5 ± 0.8 years). We classified participants into three groups according to the World Health Organization (WHO) criteria: overweight [body mass index (BMI) ≥ 25.0 kg/m^2], normal weight ($18.5 \leq$ BMI < 25.0 kg/m^2), and underweight (BMI < 18.5 kg/m^2). Participants included 258 underweight students (125 males and 133 females), 1177 normal-weight

students (753 males and 424 females), and 111 overweight students (86 males and 25 females).

All participants provided informed consent to participate, and the study was approved by the Human Ethics Committee of the Graduate School of Human Development and Environment, Kobe University.

Measures

We used a questionnaire to determine participants' physical status, eating behaviors, perceived stress, and personality traits. The physical status questions included four items: height, weight, "ideal height," and "ideal weight", based on participants' responses. Concerning heights and weights, we asked participants to write down their self-reported heights and weights, in accord with the methods used in previous studies [26–28]. Each participant's BMI (kg/m^2) was calculated by dividing their weight in kilograms by the square of their height in meters. Each participant's "ideal BMI" was calculated in the same way as their BMI, using the ideal weight and ideal height they provided. The differences between ideal and current height, weight, and BMI were calculated as the "ideal value" minus the "current value".

Eating behavior was assessed using the Japanese version of the Dutch Eating Behavior Questionnaire (DEBQ) [29] which was originally developed by van Strien [8]. The validity and reliability of the Japanese version of the DEBQ were confirmed in a previous study [29]. The DEBQ is a 33-item self-rated questionnaire divided into three subscales: restrained eating (10 items), emotional eating (13 items), and external eating (10 items). Restrained eating refers to dietary restraint, which is eating less than the amount desired to lose or maintain body weight; emotional eating refers to eating in response to negative emotions; external eating refers to eating in response to the sight or smell of food [30]. Participants were asked to rate each question from 1 for "never" to 5 for "very often". Responses to each question were added together in each subscale, then divided by the number of questions included in each subscale to produce a score between 1 and 5. Cronbach's α coefficients were 0.90 for restrained eating, 0.94 for emotional eating, and 0.83 for external eating in the present sample.

Perceived stress was assessed using the Stress Check List Short Form (SCL) [31]. The validity and reliability of the SCL were evaluated in a previous study [31]. The SCL is a self-report scale consisting of 24 items measuring stress responses of young people and adults. SCL has a four-factor structure: anxiety/uncertainty (six items), tiredness/physical (body) response (six items), autonomic symptom (six items), and depression/feeling of insufficiency (six items). Participants were asked to rate each question on a scale from 1 ("never") to 5 ("very often"). Responses to each question were added together for each subscale. Cronbach's α coefficients were 0.86 for anxiety/uncertainty, 0.76 for tiredness/physical (body) response, 0.73 for autonomic symptom, and 0.78 for depression/feeling of insufficiency in the present sample.

Personality traits were evaluated using the Japanese version of the Eysenck Personality Inventory (EPI), which consists of three scales to measure extraversion (24 items), neuroticism (24 items), and lie scale (9 items) [32, 33]. Participants respond to each item using a dichotomous (yes/no) response format. High scores for extraversion reflect sociability, assertiveness, and the tendency to experience positive emotions. High scores on neuroticism reflect moodiness, worry, and the tendency to experience negative emotions. Lie scale was excluded from analysis. Cronbach's α coefficients were 0.75 for extraversion and 0.82 for neuroticism in the present sample.

Statistical analysis

A one-way analysis of variance (ANOVA) was used to evaluate differences in physical status, eating behaviors, perceived stress, and personality traits among underweight, normal-weight, and overweight students in each gender. For a post hoc analysis, Bonferroni test was used. Student's t tests were used to evaluate differences in physical status, eating behaviors, perceived stress, and personality traits between genders in the underweight, normal-weight or overweight groups. Bonferroni correction was used for multiple comparisons. Pearson's correlation coefficients were calculated between DEBQ scores and BMI, BMI difference, perceived stress, and EPI scores. A multiple linear regression analysis was used to investigate the association between DEBQ scores and BMI, BMI difference, perceived stress, and EPI scores. The level of statistical significance was set at 0.05. All statistical analyses were performed using SPSS® 24.0 for Windows (IBM, Tokyo, Japan).

Results

The means and standard deviations of height, weight, and BMI for all participants were 171.8 ± 5.9 cm, 62.6 ± 9.2 kg, and 21.2 ± 2.9 kg/m^2 in males, and 158.1 ± 5.1 cm, 50.8 ± 6.6 kg, and 20.3 ± 2.4 kg/m^2 in females, respectively. According to the classification of BMI, 16.7% (n = 258) of participants were underweight, while 76.1% (n = 1177) were within the normal-weight range, and 7.2% (n = 111) were overweight. Among males, 13.0% (n = 125) of participants were underweight, 78.1% (n = 753) were within the normal-weight range, and 8.9% (n = 86) were overweight. Among females, 22.9% (n = 133) of participants were underweight, 72.9% (n = 424) were within the normal-weight range, and 4.3% (n = 25) were overweight.

Physical status of underweight, normal-weight, and overweight participants are shown in Table 1. In males, height, weight, BMI, ideal height, ideal weight, ideal BMI, weight difference, and BMI difference were significantly different among underweight, normal-weight, and overweight participants (height, $p = 0.044$; weight, $p < 0.001$; BMI, $p < 0.001$; ideal height $p = 0.001$; ideal weight, $p < 0.001$; ideal BMI, $p < 0.001$; weight difference, $p < 0.001$; BMI difference, $p < 0.001$). After post-hoc test, weight, BMI, ideal weight, and ideal BMI were significantly higher, and weight difference and BMI difference were significantly lower in normal-weight males compared with underweight males (all measures, $p < 0.001$). Weight, BMI, ideal weight, and ideal BMI were significantly higher, and weight difference and BMI difference were significantly lower in overweight males compared with underweight individuals (all measures, $p < 0.001$).

Weight, BMI, ideal weight, and ideal BMI were significantly higher, and height, ideal height, weight difference, and BMI difference were significantly lower in overweight males compared with normal-weight males (height, $p = 0.038$; ideal height, $p = 0.001$; other measures, $p < 0.001$). In females, weight, BMI, ideal weight, ideal BMI, weight difference, and BMI difference were significantly different among underweight, normal-weight, and overweight participants (all measures, $p < 0.001$). After post-hoc test, weight, BMI, ideal weight, and ideal BMI were significantly higher, and weight difference and BMI difference were significantly lower in normal-weight and overweight females compared with underweight females (all measures, $p < 0.001$). Weight, BMI, ideal weight, and ideal BMI were significantly higher, and weight difference and BMI difference were significantly lower in overweight females compared with normal-weight females (all measures, $p < 0.001$). In gender differences, height, weight, ideal height, ideal weight, ideal BMI, height difference, weight difference, and BMI difference were significantly higher in males than females in underweight participants (all measures, $p < 0.001$). In normal-weight participants, height, weight, BMI, ideal height, ideal weight, ideal BMI, height difference, weight difference, and BMI difference were significantly higher in males than females (all measures, $p < 0.001$). In overweight participants, height, weight, ideal height, ideal weight, ideal BMI, height difference, weight difference, and BMI difference were significantly higher in males than females (height difference, $p = 0.017$; weight difference, $p = 0.001$; other measures, $p < 0.001$).

Eating behavior, perceived stress, and personality traits in underweight and normal-weight participants are shown in Table 2. In males, restrained eating, anxiety/uncertainty, tiredness/physical response, autonomic symptom, and extraversion were significantly different among underweight, normal-weight, and overweigh participants (restrained eating, $p < 0.001$; anxiety/uncertainty, $p < 0.001$; tiredness/physical response, $p = 0.002$; autonomic symptom, $p = 0.001$; extraversion, $p = 0.001$). After post-hoc test, restrained eating and

Table 1 Physical status of underweight, normal-weight and overweight participants

	Male			Female		
	Underweight ($n = 125$)	Normal weight ($n = 753$)	Overweight ($n = 86$)	Underweight ($n = 133$)	Normal weight ($n = 424$)	Overweight ($n = 25$)
Height (cm)	$171.8 \pm 6.0^{*,\S}$	$172.0 \pm 5.8^{\S}$	$170.3 \pm 6.2^{\ddagger,\S}$	159.0 ± 5.2	157.9 ± 5.1	157.3 ± 4.8
Weight (kg)	$52.3 \pm 4.2^{*,\S}$	$62.2 \pm 6.3^{\dagger,\S}$	$80.5 \pm 9.8^{\dagger,\ddagger,\S}$	$44.6 \pm 3.4^{*}$	$51.6 \pm 4.6^{\dagger}$	$68.9 \pm 6.7^{\dagger,\ddagger}$
BMI (kg/m^2)	$17.7 \pm 0.7^{*}$	$21.0 \pm 1.6^{\dagger,\S}$	$27.7 \pm 2.8^{\dagger,\ddagger}$	$17.6 \pm 0.7^{*}$	$20.7 \pm 1.4^{\dagger}$	$27.8 \pm 2.1^{\dagger,\ddagger}$
Ideal height(cm)	$176.9 \pm 5.0^{*,\S}$	$177.5 \pm 5.0^{\S}$	$175.5 \pm 4.9^{\ddagger,\S}$	160.9 ± 4.0	160.3 ± 3.8	160.2 ± 3.1
Ideal weight (kg)	$62.8 \pm 6.8^{*,\S}$	$66.0 \pm 6.7^{\dagger,\S}$	$70.1 \pm 8.1^{\dagger,\ddagger,\S}$	$45.2 \pm 3.3^{*}$	$47.6 \pm 3.6^{\dagger}$	$51.7 \pm 3.5^{\dagger,\ddagger}$
Ideal BMI (kg/m^2)	$20.1 \pm 1.7^{*,\S}$	$20.9 \pm 1.6^{\dagger,\S}$	$22.7 \pm 2.2^{\dagger,\ddagger,\S}$	$17.5 \pm 1.2^{*}$	$18.5 \pm 1.2^{\dagger}$	$20.2 \pm 1.6^{\dagger,\ddagger}$
Height difference (cm)	$5.1 \pm 5.5^{\S}$	$5.5 \pm 4.9^{\S}$	$5.1 \pm 3.9^{\S}$	1.9 ± 5.1	2.4 ± 4.2	2.9 ± 4.6
Weight difference (kg)	$10.5 \pm 6.1^{*,\S}$	$3.7 \pm 6.5^{\dagger,\S}$	$-10.3 \pm 9.5^{\dagger,\ddagger,\S}$	$0.5 \pm 5.0^{*}$	$-4.0 \pm 4.0^{\dagger}$	$-17.2 \pm 6.6^{\dagger,\ddagger}$
BMI difference (kg/m^2)	$2.3 \pm 1.6^{*,\S}$	$-0.1 \pm 1.9^{\dagger,\S}$	$-5.0 \pm 3.0^{\dagger,\ddagger,\S}$	$-0.2 \pm 1.4^{*}$	$-2.2 \pm 1.4^{\dagger}$	$-7.7 \pm 2.6^{\dagger,\ddagger}$

Values are means ± standard deviations

BMI body mass index, *difference* ideal value minus current value

*Significantly different among underweight, normal weight, and overweight in each gender (one-way analysis of variance)

†Significantly different from underweight in each gender (Bonferroni test for post-hoc test)

‡Significantly different from normal weight in each gender (Bonferroni test for post-hoc test)

§Significantly different between male and female in each of underweight, normal weight, or overweight (Student's *t* test)

Table 2 Eating behavior, perceived stress and personality traits of underweight, normal-weight and overweight participants

	Male			Female		
	Underweight ($n=125$)	Normal weight ($n=753$)	Overweight ($n=86$)	Underweight ($n=133$)	Normal weight ($n=424$)	Overweight ($n=25$)
Dutch Eating Behavior Questionnaire						
Restrained eating	$1.7\pm0.7^{*,\S}$	$2.1\pm0.8^{\dagger,\S}$	$2.6\pm0.8^{\dagger,\ddagger}$	$2.5\pm0.9^{*}$	$2.9\pm0.8^{\dagger}$	2.8 ± 0.7
Emotional eating	$1.8\pm0.7^{\S}$	$1.8\pm0.7^{\S}$	$1.8\pm0.8^{\S}$	2.3 ± 1.0	2.3 ± 0.9	2.3 ± 0.9
External eating	$3.0\pm0.8^{\S}$	$3.1\pm0.7^{\S}$	$3.1\pm0.7^{\S}$	3.4 ± 0.8	3.5 ± 0.7	3.4 ± 0.5
Stress Check List Short Form						
Anxiety/uncertainty	$18.5\pm4.9^{*}$	$17.7\pm5.1^{\S}$	$20.0\pm5.2^{\ddagger}$	18.0 ± 4.6	18.4 ± 5.1	19.4 ± 5.0
Tiredness/physical responses	$18.4\pm4.7^{*}$	$17.1\pm4.5^{\dagger,\S}$	$18.5\pm5.0^{\ddagger}$	$19.0\pm4.7^{*}$	18.8 ± 4.7	$16.4\pm4.4^{\dagger,\ddagger}$
Autonomic symptoms	$12.9\pm4.0^{*}$	$11.6\pm3.8^{\dagger,\S}$	11.7 ± 4.3	12.4 ± 3.9	12.5 ± 4.2	10.9 ± 3.4
Depression/feeling of insufficiency	16.8 ± 4.5	$16.1\pm4.6^{\S}$	17.0 ± 4.9	17.4 ± 4.6	17.5 ± 4.6	16.4 ± 4.3
Eysenck Personality Inventory						
Extraversion	$9.8\pm4.1^{*}$	$10.9\pm4.4^{\dagger,\S}$	$9.4\pm4.4^{\ddagger}$	10.9 ± 4.6	11.4 ± 4.3	11.1 ± 3.6
Neuroticism	13.3 ± 5.6	$12.6\pm4.8^{\S}$	13.6 ± 4.5	13.4 ± 4.6	13.6 ± 5.0	13.3 ± 4.4

Values are means ± standard deviations

*Significantly different among underweight, normal weight, and overweight in each gender (one-way analysis of variance)

†Significantly different from underweight in each gender (Bonferroni test for post-hoc test)

‡Significantly different from normal weight in each gender (Bonferroni test for post-hoc test)

§Significantly different between male and female in each of underweight, normal weight, or overweight (Student's *t* test)

extraversion were significantly higher, and tiredness/physical response and autonomic symptom were significantly lower in normal-weight males compared with underweight males (restrained eating, $p<0.001$; tiredness/physical response, $p=0.018$; autonomic symptom, $p=0.001$; extraversion, $p=0.031$). Restrained eating was significantly higher in overweight males than underweight males ($p<0.001$). Restrained eating, anxiety/uncertainty, and tiredness/physical response were significantly higher, and extraversion was significantly lower in overweight males than normal-weight males (restrained eating, $p<0.001$; anxiety/uncertainty, $p<0.001$; tiredness/physical response, $p=0.038$; extraversion, $p=0.006$). In females, restrained eating and tiredness/physical response were significantly different among underweight, normal-weight, and overweigh participants (restrained eating, $p<0.001$; tiredness/physical response, $p=0.034$). After post-hoc test, restrained eating was significantly higher in normal-weight females than underweight females ($p<0.001$). Tiredness/physical response was significantly lower in overweight females than underweight ($p=0.031$) and normal-weight females ($p=0.038$). In gender differences, restrained eating, emotional eating, and external eating were significantly lower in males than females in underweight participants (all measures, $p<0.001$). In normal-weight participants, restrained eating, emotional eating, external eating, anxiety/uncertainty, tiredness/physical response, autonomic symptom, depression/feeling of insufficiency, extraversion, and neuroticism were significantly lower in males than females (anxiety/uncertainty, $p=0.037$; extraversion, $p=0.034$; other measures, $p<0.001$). In overweight participants, emotional eating and external eating were significantly lower in males than females (emotional eating, $p=0.029$; external eating, $p=0.028$).

Pearson's correlation coefficients between eating behavior, perceived stress, and personality traits are shown in Table 3. Restrained eating was significantly positively correlated with BMI (male, $r=0.326$, $p<0.001$; female, $r=0.140$, $p=0.001$), and negatively correlated with BMI difference (male, $r=-0.322$, $p<0.001$; female, $r=-0.155$, $p<0.001$) among both males and females. Emotional eating was significantly positively correlated with anxiety/uncertainty (male, $r=0.117$, $p<0.001$; female, $r=0.229$, $p<0.001$), tiredness/physical response (male, $r=0.158$, $p<0.001$; female, $r=0.231$, $p<0.001$), autonomic symptom (male, $r=0.167$, $p<0.001$; female, $r=0.234$, $p<0.001$), depression/feeling of insufficiency (male, $r=0.214$, $p<0.001$; female, $r=0.289$, $p<0.001$), extraversion (male, $r=0.082$, $p=0.011$; female, $r=0.125$, $p=0.003$) and neuroticism (male, $r=0.196$, $p<0.001$; female, $r=0.271$, $p<0.001$) in both males and females. External eating was significantly positively correlated with anxiety/uncertainty (male, $r=0.064$, $p=0.046$; female, $r=0.147$, $p<0.001$), tiredness/

Table 3 Pearson's correlation coefficients between eating behavior and physical status, perceived stress and personality

	Males ($n=964$)			Females ($n=582$)		
	Restrained eating[a]	Emotional eating[a]	External eating[a]	Restrained eating[a]	Emotional eating[a]	External eating[a]
BMI	0.326*	0.037	0.021	0.140*	0.041	−0.001
BMI difference	−0.322*	−0.044	0.004	−0.155*	−0.036	0.011
Anxiety/uncertainty[b]	0.019	0.117*	0.064*	0.004	0.229*	0.147*
Tiredness/physical responses[b]	0.040	0.158*	0.153*	−0.007	0.231*	0.138*
Autonomic symptom[b]	0.016	0.167*	0.046	−0.038	0.234*	−0.042
Depression/feeling of insufficiency[b]	0.038	0.214*	0.140*	0.043	0.289*	0.156*
Extraversion[c]	−0.012	0.082*	0.258*	0.050	0.125*	0.187*
Neuroticism[c]	0.058	0.196*	0.136*	0.074	0.271*	0.158*

BMI body mass index, *difference* ideal value minus current value

*$p<0.05$ (Pearson's correlation coefficient)

[a]Dutch Eating Behavior Questionnaire, [b]Stress Check List Short Form

[c]Eysenck Personality Inventory

physical response (male, $r=0.153$, $p<0.001$; female, $r=0.138$, $p=0.001$), depression/feeling of insufficiency (male, $r=0.140$, $p<0.001$; female, $r=0.156$, $p<0.001$), extraversion (male, $r=0.258$, $p<0.001$; female, $r=0.187$, $p<0.001$), and neuroticism (male, $r=0.136$, $p<0.001$; female, $r=0.158$, $p<0.001$) in both males and females.

Table 4 shows the results of the multiple linear regression analysis between eating behavior and BMI, BMI difference, perceived stress, and personality traits in males. BMI was significantly positively associated with restrained eating ($\beta=0.199$ $p<0.001$), and BMI difference was significantly negatively associated with restrained eating ($\beta=-0.170$, $p=0.001$). Depression/feeling of insufficiency, extraversion, and neuroticism were significantly positively associated with emotional eating (depression/feeling of insufficiency, $\beta=0.150$, $p=0.002$; extraversion, $\beta=0.146$, $p<0.001$; neuroticism, $\beta=0.113$, $p=0.005$). Tiredness/physical response, extraversion, and neuroticism were significantly positively associated with external eating (tiredness/physical response, $\beta=0.136$, $p<0.001$; extraversion, $\beta=0.328$, $p<0.001$; neuroticism, $\beta=0.115$, $p=0.004$).

Table 5 shows the results of multiple linear regression analysis between eating behavior and BMI, BMI difference, perceived stress, and personality traits in females. Neuroticism was significantly positively associated with restrained eating ($\beta=0.114$, $p=0.034$). Anxiety/uncertainty, autonomic symptom, and extraversion were significantly positively associated with emotional eating (anxiety/uncertainty, $\beta=0.179$, $p=0.001$; autonomic symptom, $\beta=0.106$, $p=0.028$; extraversion, $\beta=0.236$, $p<0.001$). Anxiety/uncertainty, tiredness/physical response, extraversion, and neuroticism were significantly positively associated with

Table 4 Association between eating behavior and physical status, perceived stress and personality in males ($n=964$)

	Restrained eating[a]		Emotional eating[a]		External eating[a]	
	β	p value	β	p value	β	p value
BMI	0.199	<0.001	0.021	0.679	0.040	0.413
BMI difference	−0.170	0.001	−0.043	0.395	0.024	0.627
Anxiety/uncertainty[b]	−0.065	0.162	−0.027	0.573	0.051	0.276
Tiredness/physical response[b]	0.011	0.769	0.034	0.390	0.136	<0.001
Autonomic symptoms[b]	0.019	0.622	0.072	0.062	−0.067	0.072
Depression/feeling of insufficiency[b]	0.036	0.440	0.150	0.002	0.071	0.129
Extraversion[c]	0.000	0.997	0.146	<0.001	0.328	<0.001
Neuroticism[c]	0.067	0.090	0.113	0.005	0.115	0.004

Adjusted R^2: 0.117 (restrained eating), 0.075 (emotional eating), 0.125 (external eating)

BMI body mass index, *difference* ideal value minus current value

[a]Dutch Eating Behavior Questionnaire, [b]Stress Check List Short Form

[c]Eysenck Personality Inventory

Table 5 Association between eating behavior and physical status, perceived stress and personality in females ($n=582$)

	Restrained eating[a]		Emotional eating[a]		External eating[a]	
	β	p value	β	p value	β	p value
BMI	0.039	0.605	0.086	0.216	0.036	0.613
BMI difference	−0.120	0.107	0.063	0.362	0.070	0.322
Anxiety/uncertainty[b]	−0.065	0.270	0.179	0.001	0.187	0.001
Tiredness/physical response[b]	−0.004	0.948	0.033	0.518	0.131	0.011
Autonomic symptoms[b]	−0.091	0.075	0.106	0.028	−0.213	<0.001
Depression/feeling of insufficiency[b]	0.059	0.356	0.108	0.072	0.028	0.647
Extraversion[c]	0.045	0.326	0.236	<0.001	0.286	<0.001
Neuroticism[c]	0.114	0.034	0.096	0.058	0.138	0.007

Adjusted R^2: 0.027 (restrained eating), 0.150 (emotional eating), 0.135 (external eating)

BMI body mass index, *difference* ideal value minus current value

[a]Dutch Eating Behavior Questionnaire, [b]Stress Check List Short Form

[c]Eysenck Personality Inventory

external eating (anxiety/uncertainty, $\beta=0.187$, $p=0.001$; tiredness/physical response, $\beta=0.131$, $p=0.011$; extraversion, $\beta=0.286$, $p<0.001$; neuroticism, $\beta=0.138$, $p=0.007$), and autonomic symptom was significantly negatively associated with external eating ($\beta=-0.213$, $p<0.001$).

Discussion

In the present study, we attempted to clarify the gender-related association between eating behavior and anthropometric status, perceived stress, and personality traits in Japanese university students.

All three DEBQ scores were higher in females compared with males except restrained eating in overweight. Previous studies also reported that DEBQ scores in females were higher than in males [2, 34–36]. However, relatively few studies have compared eating attitudes between genders and BMI classification. Ohara et al. reported that all DEBQ scores, except emotional eating among underweight individuals, were higher among females compared with males [2], similar to the present results. These results indicate that DEBQ scores in females are high compared with males, regardless of anthropometric status.

In addition, restrained eating in the present study was higher among individuals within the normal-weight range compared with underweight individuals, in both males and females, whereas emotional and external eating exhibited no differences between underweight and normal-weight participants. These findings are consistent with the results of a previous study [2]. Restrained eating refers to the practice of restricting food intake to achieve weight loss [9], and is reported to be associated with anthropometry-related indicators, such as body image or body dissatisfaction [2, 12, 37] and a desire for thinness [2, 37]. From these results, anthropometry-related differences were exhibited in the present study sample. Interestingly in the present results, restrained eating in normal-weight females was almost equal to that in overweight females, whereas restrained eating in normal-weight males was less than overweight males. In several reports, drive for thinness was strong in females [38, 39], and the drive for muscularity which is a desire to enhance one's musculature has been reported in males [40–43]. Moreover, in the present study, overweight males and females and normal-weight females expressed a desire to reduce their weight, and underweight females expressed a desire to maintain their weight. In contrast, both normal-weight and underweight males expressed a desire to increase their weight. Previous studies in Japanese students showed similar results to the present study [1, 2]. Thus, these results indicate that females had a stronger desire to reduce their weight than males, indicating that goals regarding body weight differed between males and females.

Males within the normal-weight range felt less stress than normal-weight females and underweight and overweight males. This result suggests that gender differences and BMI difference may be associated with differences in perceived stress. Previous studies have measured gender differences in stress using a range of methods. For example, several studies reported that perceived stress scores, as measured by the Perceived Stress Scale-10 (PSS-10) or -4 (PSS-4) were higher among female students compared with male students [44–46]. Academic stress levels were also reported to be higher among female than male students [47]. Perceive job-related stress was higher in females than men [48]. In addition, psychological distress measured by The Self-Reported Questionnaire (SRQ-20) was found to be higher in females than males [49]. These results support the finding that the gender differences observed in the current study are attributable to differences in stress. In contrast, Chen reported no differences in depression between genders [50]. Regarding the relationship between perceived stress and anthropometric

status, Hootman reported that perceived stress had a positive relationship with changes in weight and BMI in male university students [11]. In addition, psychosocial factors were suggested to also play a role in weight gain among freshman students; prior cross-sectional studies in freshman students identified associations between psychological constructs, including dietary restraint and the behavioral tendency to overeat due to emotional cues or stress, and weight-gain [51–53]. Momentary appearance-related stress preceded binge eating and vomiting, and momentary anxiety mediated the prospective association between appearance-related stress and ED behaviors in women [54]. Also in the present study, underweight males exhibited more perceived stress than normal-weight males, whereas there was no difference in perceived stress between underweight and normal-weight females. These results indicate that anthropometric status is related to perceived stress in males. Moreover, neuroticism in normal-weight males was lower than that in normal-weight females. Extraversion in normal-weight males was lower than that in normal-weight females, and higher than that in underweight males. Zainal reported that generalized anxiety disorder, major depressive disorder, and panic disorder were more prevalent in females than males [55]. In a study of middle-aged people in Japan, BMI was positively associated with extraversion, and negatively associated with neuroticism measured using the Eysenck Personality Questionnaire [56]. These results suggest that anthropometric status is an important factor for perceived stress and personality traits, in addition to gender differences.

The analysis of correlation coefficients revealed that restrained eating was correlated with BMI and BMI difference, whereas emotional and external eating were correlated with perceived stress and personality traits. In multiple regression analysis, similar results were observed in both males and females, but this tendency in restrained eating was prominent in males, and the tendency in emotional and external eating was prominent in females. In previous reports, emotional eating and external eating were found to be positively related to neuroticism, and negatively related to conscientiousness, whereas restrained eating was negatively related to neuroticism and positively related to conscientiousness [23]. In addition, emotional eating and external eating were positively related to impulsiveness, whereas restrained eating was positively related to dutifulness [23]. Ebneter et al. reported that greater emotional eating was correlated with higher attentional impulsivity and higher motor impulsivity, and greater external eating was correlated with higher motor impulsivity [57]. Yeomans reported that impulsiveness was related to disinhibition, but not restrained eating [58]. Women with higher levels of psychological demands had higher levels of binge eating and depressive symptomatology [48]. Therefore, emotional and external eating, which are related to impulsiveness, may have an association with perceived stress, neuroticism, and extraversion.

Limitations

The present study involved several limitations that should be considered. The study sample was collected from a restricted geographic area, and the participants were all Japanese students. Regarding the cut-off points for the underweight and overweight groups, WHO criteria are commonly also used for Japanese people. However, in general, Japanese individuals are considerably thinner and shorter than age-matched North American and European individuals. Therefore, the number of overweight participants in the present study was not sufficiently large to analyze.

Height and body weight in the present study were not measured but self-reported, which can lead to a misclassification of BMI due to information bias. According to the National Health and Nutrition Survey, mean BMI in 15–19 years old men and women were 20.65 and 20.44, respectively, and those in 20–29 years old men and women were 22.65 and 20.93, respectively [59]. The present BMI in men and women were which are similar with the BMI in the present results were 21.2 and 20.3, respectively, which are similar with the results in the national survey.

Conclusions

In the present study, we attempted to clarify the association of anthropometric status, perceived stress, and personality traits with eating behavior in Japanese university students. The results revealed that female participants expressed a stronger desire to reduce their weight and BMI, compared with male participants. Gender differences were found in all DEBQ scores. In addition, normal-weight males less stress than normal-weight females and underweight males. In addition, perceived stress was lower in normal-weight males compared with normal-weight females and underweight males. Restrained eating was associated with BMI and BMI difference, which were prominent in males. Emotional and external eating were associated with perceived stress and personality traits, which were prominent in females. These results indicate that associations between eating behavior and anthropometric status or psychological factors are different by each eating behavior, which is partly influenced by gender difference.

Proper eating behavior is important for the prevention of disease and the promotion of health. However, since eating behavior is influenced by various factors, it is important to comprehensively grasp the relationship with these factors. In the present study, relationships were evaluated by combining

factors such as gender, Anthropometric status, perceived stress, and personality. Therefore, the findings of the present research are expected to contribute to the comprehension and practice of eating behavior or practice of food education.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no potential conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the Human Ethics Committee of the Graduate School of Human Development and Environment, Kobe University.

Informed consent Informed consent was obtained from all individual participants included in the study.

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