

# Investigation of Questionnaire Items to Evaluate Potential Abnormal Eating Behaviors in Female Athletes: Based on a Study of Female Athletes with Subjective Awareness of Abnormal Eating Behaviors

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**Abstract** Eating disorders are serious life-threatening illnesses, and the risk of onset is particularly high in female athletes. Eating disorders tend to be caused by continuous abnormal eating behaviors; thus, early detection is important. This study aimed to develop items for screening female athletes with abnormal eating behaviors, which are precursors for eating disorders. A total of 239 female athletes were surveyed to determine whether they had experienced 69 pre-selected items evaluated for content validity related to behaviors and thought patterns in those with abnormal eating behaviors. The targets were classified into those “aware of having abnormal eating behaviors” placed in the disordered eating (DE) group and those “not aware of having an eating disorder” placed in the non-DE group. The differences between the groups in each item were compared using an independence test, and the criterion for the evaluation of abnormal eating behavior was set to 75%. In this study, the significance level for statistical hypothesis testing was 5%, and it was controlled using the Bonferroni method. In addition, the association coefficient among the selected items was calculated and, if significant and  $\geq 0.5$ , the integration of the items was evaluated. As a result of the analysis, 44 items were found to be statistically significant. Of these, 19 items were rated as “experienced” by at least 75% of those in the DE group. The calculation results of the association coefficient among the above items led to a decision that 8 items could be integrated into 4 items. Ultimately, 15 items pertaining to eating behaviors, weight, and self-evaluation/evaluation by others were considered potentially useful for easily identifying female athletes with abnormal eating behaviors.

**Keywords:** eating disorder, dieting behaviors, lose weight, body shape, item selection

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## 1. Introduction

Eating disorders are serious mental disorders that can involve life-threatening physical and psychological complications. The number of patients with eating disorders has increased by approximately ten-fold from 1980 to 2016 [1]. In Japan, approximately 210,000 patients were diagnosed with eating disorders in 2017 [2]. Notably, eating disorders affect people in their teens to 40s most often [3]. The Japan Society of School Health reports [4] that approximately 70% of female junior and senior high school students have the desire to lose weight and that this is considered to be one of the factors behind the increasing number of young female patients with eating disorders [5,6].

Apart from eating disorders described above, abnormal eating behaviors, which are considered to be their precursor, are also a well-known problem [7,8]. Petrie [9] stated that persistent abnormal eating behaviors increased the risk of progression to eating disorders. Levine [10] reported the various negative impacts of prolonged abnormal eating behaviors, such as diet restrictions and binge eating, on physical and mental health, even without a diagnosis of eating disorder. These risks emphasize the importance of detecting abnormal eating behaviors in the early stages to prevent the onset of eating disorders.

In recent years, the success of female athletes has attracted much attention. Behind their glory, many female athletes suffer from the “female athlete triad,” a combination of low energy availability, hypothalamic amenorrhea, and osteoporosis [11]. Low energy

availability suppresses the regular secretion of luteinizing hormone, which induces amenorrhea [12], thereby leading to low estrogen levels and consequently resulting in low bone mass [13]. Continuing rigorous training without adequate intake of energy from the diet results in “low energy availability.” One of the factors known to cause this state in female athletes is abnormal eating behaviors, including eating disorders [14]. Eating disorders are twice as common in female athletes than in the general female population [15], and the incidence is particularly high in sports that require esthetic perfection, weight restrictions, and endurance [16]. As in the general female population, prolonged abnormal eating behaviors of female athletes increase the risk of progression to eating disorders [17]. Thus, the early detection of abnormal eating behaviors in female athletes is essential for saving their lives and improving their competitive performance.

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [18], is used in Japan and other countries to diagnose eating disorders. According to these criteria, symptoms should persist for 3 months for the condition to be diagnosed. Hence, the Eating Attitude Test (EAT) [19], which immediately evaluates the possibility of eating disorders, its short version, EAT-26 [20], and the Japanese version of EAT-26 [21] are widely used in clinical and nonclinical practice. However, these scales were developed a long time ago and may not reflect the sociocultural changes occurring with time. Furthermore, because it comprises items that query the clinical symptoms of eating disorders, it is not necessarily effective in evaluating abnormal eating behaviors, which precede eating disorders [22]. Other scales developed in other countries, such as the Disordered Eating Attitude Scale (DEAS) [23], Disordered Eating Question (DEQ) [24], and Eating Disorder Examination Questionnaire (EDE-Q) [25], similarly evaluate clinical symptoms. Yamatsuta et al. [22] developed a scale for evaluating the tendency of abnormal eating behaviors, but this scale was designed for the general female population. In female athletes, prolonged low energy availability due to abnormal eating behaviors can result in negative impacts on health and competitive performance [26]. Therefore, it is necessary to select multifaceted items that also take into account the activities of their daily lives as athletes, such as training and competitions. Moreover, female athletes themselves [27] and instructors [28] who coach female junior and senior high school athletes often lack knowledge about eating disorders and abnormal eating behaviors, demonstrating that the general awareness about abnormal eating behaviors in sports and school settings is low. Top athletes have better access to physicians, certified psychologists, and registered dietitians as their teams or organizations often work with them. However, such support is not readily available for female athletes competing at the school level, which might make it difficult to notice their abnormal eating behaviors.

These factors highlight the importance of the coaches and families of female athletes in detecting possible abnormal eating behaviors as early as possible to provide appropriate help to the female athletes in the form of support from medical institutions or specialists. This study surveyed the behaviors and thoughts of female athletes

who had experienced abnormal eating behaviors with the aim of investigating the items that may help screen people with possible abnormal eating behaviors.

## 2. Method

### 2.1. Procedure for Selecting Items

Matsuda et al. [29] created and selected questionnaire items that evaluate the coaching abilities of soccer coaches, and Sugita and Sugiura [30] created items regarding levels of achievement in dance steps. This study followed the methodology of the above studies which are described below in terms of two procedures (stages 1 and 2) to create items based on data collected from questionnaire surveys. This study plan was approved by the Committee of Ethics for Research Involving Human Subjects of Fukui University of Technology (Ref. No. 2020-07). The objectives and methods of the survey were explained to participants online, in addition to the policies on protection of personal information. It was made clear to participants that they were free to participate or withdraw their consent for participation. Their participation in the survey was interpreted as their consent to participate in the study.

### 2.2. Preparation of Items (Stage 1)

The 47 total participants in the study in Stage 1 consisted of 17 female athletes with subjective awareness of or previous experience of being evaluated for abnormal eating behaviors (including those later diagnosed with eating disorders) (age  $29.9 \pm 5.3$  years) and 30 registered dietitians with experience working with female athletes with eating disorders or abnormal eating behaviors (certified for  $7.5 \pm 6.9$  years) who provided free-form responses to an online survey on characteristic behaviors and thought patterns of people who may have abnormal eating behaviors. Subsequently, 102 items were aggregated by one board certified sports doctor of the Japan Sport Association (certified for 12 years) who is also a certified public psychologist (certified for 4 years) and one registered dietitian (certified for 4 years) supporting female athletes with abnormal eating behaviors who are still battling with problems related to eating behaviors. The items were tested for content validity, and similar items were integrated, which resulted in the selection of 69 items.

### 2.3. Selection of Items (Stage 2)

An identical lie scale was added as the second item to each of the 69 items selected in Stage 1 to survey 298 female athletes with experience of these items ( $27.2 \pm 6.5$  years old) in an online survey. The responses obtained were closely examined for missing answers and different answers to the same item, etc., resulting in the data of 236 female athletes which were evaluated to be valid for analysis. Participants selected from the following options regarding eating behaviors when they were competing athletes: 1. Diagnosis of eating disorder; 2. Participant thought that they might have an eating disorder but did not seek professional help; 3. Presence of abnormal eating behaviors which were not severe enough to be classified

as an eating disorder; 4. Slight presence of abnormal eating behaviors; and 5. Absence of abnormal eating behaviors. They were classified according to their answers to these items such that 84 participants with subjective awareness of abnormal eating behaviors (i.e., those who selected 3 or 4, age  $27.2 \pm 7.0$  years, with  $9.0 \pm 4.3$  years of experience as competing athletes) were classified as athletes with Disordered Eating (DE group) and 135 athletes without subjective awareness of abnormal eating behaviors (i.e., those who selected 5, age  $26.9 \pm 6.1$  years, with  $11.0 \pm 5.1$  years of experience as competing athletes) were classified in the non-DE group. To focus on abnormal eating behaviors, which are considered as the precursor to eating disorders, this study did not include the data of 17 participants who answered 1 or 2 above in the analysis. Normally, eating disorders should be classified according to a diagnosis by a physician or based on advice from some other expert; however, the rate of professional help-seeking is presumably low at the stage of suspected abnormal eating behaviors, thus, participants were classified according to whether they were subjectively aware of abnormal eating behaviors. The sport the respondents were currently or previously competing in, and their level of competition are displayed in Tables 1 and 2, respectively. The time period when the participants in the DE group became aware of their abnormal eating behaviors are shown in Table 3.

**Table 1. Sport of the participants**

Sports	DE group n (%)	non-DE group n (%)
Athletics (sprint, jump and throw)	31 (36.9)	40 (29.6)
Softball	6 (7.1)	43 (31.9)
Basketball	11 (13.1)	11 (8.1)
Athletics (middle and long distance, Racewalking)	9 (10.7)	7 (5.2)
Volleyball	1 (1.2)	7 (5.2)
Badminton	3 (3.6)	4 (3.0)
Others	23 (27.4)	23 (17.0)

Note) Sports played by five or fewer total participants between the DE and non-DE groups were classified as "Other." (Sports: Naginata, Tennis, Swimming race, Soft tennis, Table tennis, Baseball, Gymnastics, Cheer leading, Judo, Curling, Sailing, Handball, Equestrian, Kendo, Japanese Archery, Archery, Rugby, Karate, Soccer, Rifle shooting, Alpine skiing, Rhythmic gymnastics, and Artistic swimming).

**Table 4. Frequency and percentage of athletes who experienced items related to abnormal eating behaviors selected in the first stage and the results of the analysis (Stage 2)**

ID	DE group		non-DE group		$\chi^2$	$\phi$
	n	%	n	%		
1. I voluntarily vomit after binge eating	16	19.0	11	8.1	5.69	0.16
2. I skip or reduce the quantity of the next meal after binge eating	76	90.5	75	56.6	27.3*	0.35
3. I fast at least once a week	16	19.0	5	3.7	14.1*	0.25
4. I vomit if my weight increases even a little	2	2.4	2	1.5	0.23	0.03
5. I do not consume carbohydrates	43	51.2	31	23.0	18.4*	0.20
6. I want to eat sweets; hence, I reduce by the amount of my meals	51	60.7	41	30.4	19.6*	0.30
7. I frequently binge eat	53	63.1	37	27.4	27.2*	0.35
8. There are days when I binge eat and days when I fast	65	77.4	58	43.0	24.9*	0.34
9. I relieve stress caused by competitions by eating	55	65.5	57	42.2	11.2	0.23
10. I feel nauseous after binge eating	39	46.4	30	22.2	14.1*	0.25
11. I feel despair or regret after binge eating	71	84.5	55	40.7	40.6*	0.43
12. I sometimes continue to eat until I have heartburn	49	58.3	56	41.5	5.89	0.16
13. I sometimes continue to eat even after I have heartburn	29	34.5	21	15.6	10.6	0.22
14. I sometimes stop eating halfway, although I still have an appetite	46	54.8	44	32.6	10.5	0.22
15. I sometimes continue to consume the same food	57	67.9	64	47.4	8.76	0.20

**Table 2. Competitive level of the participants**

Competitive level	DE group n (%)	non-DE group n (%)
International	2 (2.4)	8 (5.9)
National	30 (35.7)	77 (57.0)
Regional	13 (15.5)	18 (13.3)
Prefectural	26 (31.0)	19 (14.1)
District	13 (15.5)	13 (9.6)

**Table 3. Period when athletes in the DE group became aware of their abnormal eating behaviors**

Period	DE group n (%)
Before elementary school	2 (2.4)
Middle school	25 (29.8)
High school	61 (72.6)
After college student	32 (38.1)

Note) Total number, as participants were allowed to select multiple responses.

## 2.4. Statistical Analysis

The difference in each item between the groups in the second stage was examined by the test of independence. The criterion for evaluating the possibility of abnormal eating behaviors was 75%, following the method [29,30] described in a previous study. The top 25% and bottom 25% are generally used for classification into upper and lower groups [31,32]. In other words, as 25% is used as one criterion for classifying groups, an item was considered to be effective for evaluating the possibility of abnormal eating behaviors if it was experienced by a significantly higher percentage of the subjects of this study and by  $\geq 75\%$ . The effect size ( $\phi$ ) was calculated to examine the magnitude of the difference, where 0.1, 0.3, and 0.5 represented small, medium, and large effect sizes, respectively [33]. The significance level of the statistical hypothesis test in this study was set at 5%, and the significance level was controlled by Bonferroni's method. In addition, the association between the selected items was examined by the Cramér's V (Cramér's  $\phi_c$ ) coefficient of association, and  $\phi_c \geq 0.5$ , indicating significance, was considered the basis for the integration of items. SPSS Statistics for Windows Ver. 24.0 (IBM) was used for data processing.

ID		DE group		non-DE group		$\chi^2$	$\phi$
		n	%	n	%		
16.	I only eat low-calorie foods	58	69.0	41	30.4	31.3*	0.38
17.	I take dietary supplements instead of meals	34	40.5	28	19.3	11.7*	0.23
18.	There are no limits to the amount of food I can consume if I wanted to	51	60.7	73	54.1	0.93	0.07
19.	I sometimes consume food at night and then regret it	44	52.4	48	34.1	7.17	0.18
20.	I sometimes drink a large amount of carbonated water	14	16.7	20	14.8	0.14	0.03
21.	I sometimes continue to eat mindlessly	49	58.3	36	26.7	21.9*	0.32
22.	The quantities of my meals are unstable	62	73.8	40	29.6	40.6*	0.41
23.	I feel happy at the slightest reduction of my weight	76	90.5	85	63.0	20.1*	0.30
24.	My mood changes with changes in my weight	76	90.5	71	52.6	33.7*	0.33
25.	I believe it is easier for me to move when I weigh less	79	94.0	93	68.9	19.5*	0.30
26.	I feel happy when my body fat percentage decreases	78	92.9	105	77.8	8.57	0.12
27.	I feel depressed all day if my weight in the morning is more than usual	58	69.0	44	32.0	27.7*	0.36
28.	I sometimes avoid eating because I fear gaining weight	60	71.4	37	27.4	40.7*	0.43
29.	I feel happy when I have less appetite	39	46.4	27	20.0	17.2*	0.28
30.	There are times when I cannot suppress my appetite	67	79.8	83	61.5	8.02	0.19
31.	Other people are surprised at my appetite	53	63.1	57	42.2	9.02	0.20
32.	I cannot control my appetite	57	67.9	45	33.3	24.8*	0.34
33.	I want to be able to control my appetite	62	73.8	68	50.4	11.8	0.23
34.	I think it is okay to eat a lot after hard exercise	72	85.7	108	80.0	1.16	0.07
35.	I vomit when I have heartburn from hard exercise	10	11.9	9	6.7	1.79	0.09
36.	I increase the amount of exercise to increase calorie consumption	61	72.6	59	43.7	17.5*	0.28
37.	I try to lose weight by exercising on an empty stomach	52	61.9	26	19.3	41.1*	0.43
38.	I think my performance increases when I lose weight	66	78.6	57	42.2	27.8*	0.36
39.	I think it is okay to have high-calorie meals after hard exercise	59	70.2	82	60.7	2.04	0.10
40.	I panic when I cannot exercise due to injury or poor physical conditions as I that would stop me from burning calories	62	73.8	66	48.9	13.2*	0.25
41.	I want to increase my calorie consumption than I take in	64	76.2	57	42.2	24.2*	0.33
42.	I want to actively exercise and burn calories after eating	60	71.4	52	38.5	22.5*	0.32
43.	I am less motivated when I am not at a weight I consider optimal during matches	57	67.9	25	18.5	53.8*	0.50
44.	My body feels heavy during matches when my weight has increased	64	76.2	53	39.3	28.4*	0.36
45.	I want to become slim to look good in my uniform	59	70.2	49	36.3	23.9*	0.33
46.	I feel envious of the good body shape of other players in uniform at match venues	75	89.3	93	68.9	12.1*	0.24
47.	I feel my performance lowers during matches when I am not at a weight I consider optimal	62	73.8	45	33.3	34.0*	0.39
48.	I aim for the body shape of the celebrities I admire	51	60.7	55	40.7	8.27	0.19
49.	I am conscious of my body shape because others have criticized it in the past	68	81.0	48	35.6	42.8*	0.44
50.	I am happy when other people comment that I have become slim	79	94.0	95	70.4	17.8*	0.29
51.	I want to have the body shape that is considered ideal by other people	75	89.3	92	68.1	12.8*	0.24
52.	I want to sweat to lose weight	68	81.0	63	46.7	25.3*	0.34
53.	I weigh myself every day	69	82.1	82	60.7	11.1	0.23
54.	I weigh myself several times a day	45	53.6	26	19.3	27.8*	0.36
55.	I use laxatives when my weight increases	16	19.0	8	5.9	9.14	0.20
56.	I feel that my eating patterns are different from others	59	70.2	35	25.9	41.5*	0.44
57.	I always want to control my body shape	73	86.9	86	63.7	14.0*	0.25
58.	I compare my body shape with others	75	89.3	91	67.4	13.5*	0.25
59.	I have a fear of gaining weight	73	86.9	70	51.9	28.1*	0.36
60.	I do not think it is good to eat too much	79	94.0	99	73.3	14.6*	0.26
61.	I can never be satisfied with my body shape	77	91.7	87	64.4	20.4*	0.30
62.	I try to specifically lose weight in some body parts	62	73.8	59	43.7	20.0*	0.29
63.	I want to improve my eating patterns	72	85.7	88	65.2	11.1	0.23
64.	I am tired of my eating patterns	57	67.9	38	28.1	33.2	0.39
65.	I feel emotionally satisfied when I eat	65	77.4	106	78.5	0.04	-0.01
66.	My life is controlled by meals	45	53.6	39	28.9	13.3*	0.25
67.	I feel more comfortable on an empty stomach	33	39.3	21	15.6	16.0*	0.27
68.	My appetite decreases when I am in front of food	19	22.6	11	8.1	9.17	0.21
69.	My appetite increases when I exercise	59	70.2	97	71.9	0.07	-0.02

Note): \* $p < 0.05/69 = 0.0007$ , Tinted area:  $p < 0.0007$  and 75% or more.

Table 5. Association matrix among 19 selected items

	2	8	11	23	24	25	38	41	44	46	49	50	51	52	57	58	59	60
2																		
8	0.23																	
11	0.49	0.36																
23	0.44	0.16	0.49															
24	0.43	0.30	0.58	0.62														
25	0.24	0.14	0.36	0.42	0.42													
38	0.31	0.22	0.34	0.41	0.42	0.52												
41	0.38	0.32	0.52	0.48	0.48	0.47	0.57											
44	0.29	0.19	0.27	0.38	0.42	0.36	0.50	0.39										
46	0.18	0.17	0.36	0.33	0.44	0.34	0.43	0.37	0.24									
49	0.29	0.22	0.38	0.37	0.42	0.29	0.40	0.39	0.37	0.37								
50	0.23	0.14	0.39	0.51	0.48	0.42	0.42	0.45	0.32	0.52	0.27							
51	0.18	0.24	0.37	0.40	0.46	0.36	0.35	0.36	0.25	0.45	0.27	0.46						
52	0.29	0.23	0.43	0.50	0.49	0.48	0.52	0.56	0.37	0.39	0.39	0.55	0.44					
57	0.31	0.10	0.40	0.49	0.49	0.33	0.41	0.39	0.29	0.41	0.32	0.42	0.45	0.45				
58	0.26	0.19	0.40	0.39	0.40	0.28	0.36	0.37	0.29	0.52	0.34	0.43	0.41	0.39	0.42			
59	0.31	0.25	0.52	0.49	0.53	0.39	0.46	0.50	0.44	0.35	0.43	0.47	0.36	0.40	0.43	0.44		
60	0.30	0.17	0.44	0.53	0.41	0.43	0.38	0.46	0.28	0.43	0.32	0.51	0.42	0.47	0.44	0.44	0.56	
61	0.15	0.19	0.38	0.39	0.51	0.29	0.38	0.47	0.28	0.53	0.40	0.51	0.44	0.41	0.40	0.56	0.51	0.51

Note) Tinted area:  $p < 0.05$  and 0.5 or more.

### 3. Results

The frequency and percentage of female athletes who experienced items related to abnormal eating behaviors selected in the first stage and the results of the analysis are displayed in Table 4. The analysis revealed a significant difference for 44 out of 69 items. Among these,  $\geq 75\%$  of those in the DE group answered that they had experienced 19 items—items 2, 8, 11, 23, 24, 25, 38, 41, 44, 46, 49, 50, 51, 52, 57, 58, 59, 60, and 61. The association matrix among 19 items experienced by  $\geq 75\%$  of those in the DE group is presented in Table 5, which shows that the coefficient of association of 24 items was significant and  $\geq 0.5$  ( $V = 0.10$ ,  $p > 0.05$ ).

### 4. Discussion

In total,  $\geq 75\%$  of those in the DE group had experienced 19 items, i.e., items 2, 8, 11, 23, 24, 25, 38, 41, 44, 46, 49, 50, 51, 52, 57, 58, 59, 60, and 61. Further, 7 items, i.e., items 2, 23, 24, 25, 50, 60, and 61, were experienced by  $\geq 90\%$  of those in the DE group, suggesting that these behaviors and thought patterns

affected their eating behaviors. Furthermore, 13 of the 19 items had a medium effect size ( $\phi$ : 0.30 - 0.44), whereas 6 had a small effect size ( $\phi$ : 0.24 - 0.29). Guilt after eating or self-blame about eating behaviors were the typical thought patterns observed in abnormal eating behaviors and eating disorders. Further, pressure from the coach about body shape can trigger eating disorders. These were considered to be the reasons for the larger effect sizes of items 11 and 49 in comparison with the other items. The results of this study suggested that criticism from others about weight affects eating behaviors. Behaviors and thought patterns selected by female athletes who had experienced abnormal eating behaviors included items that were independently associated with competitive performance or competitions rather than items in EAT and other scales, highlighting the importance of the need for a scale designed specifically for female athletes. Moreover, the majority of existing eating disorder scales include items related to elimination behaviors, such as self-induced vomiting or the use of laxatives. However, these items were not selected in this study. Hence, the behaviors and thoughts of female athletes with abnormal eating behaviors require further investigation.

Table 6. Association matrix among 19 selected items

Old items	Association matrix	New items
23. I feel happy at the slightest reduction of my weight	0.62*	h) My mood changes with changes in my weight
24. My mood changes with changes in my weight		
25. I believe it is easier for me to move when I weigh less	0.52*	j) I think my performance increases when I lose weight
38. I think my performance increases when I lose weight		
41. I want to increase my calorie consumption than I take in	0.56*	g) I want to increase my calorie consumption than I take in
52. I want to sweat to lose weight		
46. I feel envious of the good body shape of other players in uniform at match	0.52*	m) I compare my body shape with others
58. I compare my body shape with others		

Note) \*:  $p < 0.05$ .

The majority of non-DE group (51.9 - 73.3%) had experienced 12 items, i.e., items 2, 23, 24, 25, 46, 50, 51, 57, 58, 59, 60, and 61, and  $\geq 70\%$  of those in this group had experienced items 50 and 60. Regardless of abnormal eating behaviors, eating habits such as skipping meals, cutting out staple foods, eating less, and replacing meals with snack have recently been recognized as problems in female athletes [37]. In other words, these 12 items were behaviors and thought patterns that corresponded to the majority of female athletes, which can be interpreted as daily behaviors that they did not find problematic. However, continuing these could be associated with abnormal eating behaviors and increase the risk of progression to eating disorders. In this study, the non-DE group comprised current or retired female athletes who were not aware of their abnormal eating behaviors. The former may already be at risk of abnormal eating behaviors. Reducing the number of items is considered important for increasing the feasibility of implementing a new survey [38]. That is, if 19 of the selected items in this study were related to each other, then they could be integrated. However, occasionally, the associations are incidental [39]. When pairs of items had coefficients of association that were significant and  $\geq 0.5$ , the ethical validity was tested and the integration of the pairs into one item was considered. This showed that items 23 (DE: 90.5%, non-DE: 63.0%) and 24 (DE: 90.5%, non-DE: 52.6%) both represented changes in emotions that were associated with changes in weight. Hence, the former was included in the latter. Similarly, items 25 (DE: 90.4%, non-DE: 68.9%) and 38 (DE: 78.6%, non-DE: 42.2%) were both about idealizing low body weight. Hence, the former was included in the latter. Items 41 (DE: 76.2%, non-DE: 42.2%) and 52 (DE: 81.0%, non-DE: 46.7%) were both about behaviors related to burning energy. Hence, the latter was included in the former. Items 46 (DE: 89.3%, non-DE: 68.9%) and 58 (DE: 89.3%, non-DE: 67.4%) both evaluated comparing one's own body shape to others'. Hence, the former was included in the latter. In this way, 8 items could be integrated into 4 (Table 6).

Although significant differences were also found for 25 items, i.e., items 3, 5, 6, 7, 10, 16, 17, 21, 22, 27, 28, 29, 32, 36, 37, 40, 42, 43, 45, 47, 54, 56, 62, 66, and 67, they were experienced by  $<75\%$  of those in the DE group (19.0 - 73.8%). Thus, these items were not selected as items indicating the possibility of abnormal eating behaviors. Although the effect size of item 43 was large ( $\phi = 0.50$ ), it was not selected due to the abovementioned reason (DE: 67.9%, non-DE: 18.5%). As there is individual variation in the behaviors and thoughts of people with abnormal eating behaviors [40], it is possible that these items correspond to some female athletes. Therefore, it is important to carefully enquire about individual eating behaviors and awareness. The 20 items that were not selected in this study but were experienced by the majority can also be used as references.

When those in the DE group were asked about when they became aware of their abnormal eating behaviors, 72.6% answered that they became aware during senior high school. For women, the accumulation of subcutaneous fat and weight gain during puberty [41] can make them feel negative about their body shapes, which makes many of them engage in dieting behaviors [6,42].

This is why the junior and senior high school years are considered to be periods when women are vulnerable to developing abnormal eating behaviors. Despite this, awareness regarding abnormal eating behaviors seems to be low among teachers coaching female athletes [28]. Further, there are few initiatives that seek to provide interventions for eating behaviors [43]. Hence, interventions for abnormal eating behaviors in schools should be investigated in the future.

The subjects in the second stage were not evaluated as having abnormal eating behaviors by medical diagnosis or interview but were aware of their own abnormal eating behaviors, which were also pointed out by people around them. Therefore, caution should be exercised when generalizing the findings of this study to others. Furthermore, it is necessary to test the reliability and objectivity of the selected items and verify their associations with changes in performance or health conditions. Given these limitations and challenges, finding more scientific evidence would increase the accuracy of screening and aid in establishing items that can be used by people who do not necessarily have expert knowledge about abnormal eating behaviors. Such developments should lead to suspecting abnormal eating behaviors in female athletes more cautiously. This may ultimately aid in the early detection of abnormal eating behaviors and eating disorders among female athletes and enable the provision of support to them, consequently helping to save their lives and improve their competitive performance.

## 5. Conclusion

Out of 69 items, 19 were considered to be effective in evaluating abnormal eating behaviors among female athletes. Among these, 8 could be integrated into 4 items, ultimately yielding 15 items related to eating behaviors, weight, self-evaluation, and others' evaluation in the scale (Table 7).

Table 7. Selected items

a) I skip or reduce the quantity of the next meal after binge eating
b) There are days when I binge eat and days when I fast
c) I feel despair or regret after binge eating
d) I do not think it is good to eat too much
e) I have a fear of gaining weight
f) I always want to control my body shape
g) I want to increase my calorie consumption than I take in
h) My mood changes with changes in my weight
i) My body feels heavy during matches when my weight has increased
j) I think my performance increases when I lose weight
k) I am happy when other people comment that I have become slim
l) I want to have the body shape that is considered ideal by other people
m) I compare my body shape with others
n) I am conscious of my body shape because others have criticized it in the past
o) I can never be satisfied with my body shape

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## Conflict of Interest Statement

The authors declare no conflicts of interest associated with this manuscript.

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