Examining the Association Between Binge Eating Behaviors and Depression Symptoms, and Utilizing Symptoms as Predictor Variables

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ABSTRACT

This paper explores the correlation between binge eating behaviors and depression symptoms in adolescents. Understanding this relationship is crucial for effective diagnosis and treatment of these prevalent mental health conditions. The study involved 100 adolescents aged 13-19 years, utilizing standardized scales to measure binge eating behaviors and depression symptoms. Results showed a positive linear correlation (R = ~0.52) between binge eating behaviors and depression symptoms. Specific questions related to "boredom and eating habits" and "guilt after overeating" were significant predictors of depression symptom severity. Similarly, the depression symptom "feeling hopeless about the future" significantly predicted binge eating behavior severity. Consideration of comorbid mental health conditions is important for assessing and treating eating disorders. However, limitations included convenience sampling, lack of diversity, small sample size, and potential response bias. Future research should investigate causal relationships, underlying factors in binge eating disorder, and additional predictors for a comprehensive understanding of mood and eating disorders.

Keywords: Binge Eating Disorder, Depression, Adolescents, Psychology, Comorbidity, Mental Disorders

I. INTRODUCTION

Binge eating disorder (BED) is a serious and potentially life-threatening eating disorder characterized by recurring episodes of consuming large quantities of food, often rapidly and to the point of discomfort. These episodes are accompanied by a profound sense of a loss of control, followed by feelings of shame or distress. Unlike bulimia nervosa, individuals with BED do not engage in compensatory behaviors such as purging, excessive exercise, or the use of laxatives (National Eating Disorders Association, 2018). The primary health risks associated with BED are typically related to clinical obesity and weight stigma. It is worth noting that while up to two-thirds of individuals with BED may be clinically obese, it does not imply that everyone who is obese has BED. People with BED can have a range of body weights, and the diagnosis of BED does not depend on an individual's weight, as the DSM-5 criteria does not include weight as a defining factor (National Eating Disorders Association, 2018).

Depression, also known as major depressive disorder or clinical depression, is a prevalent mood disorder characterized by persistent feelings of sadness, lack of interest in daily activities, and an overall diminished enjoyment of life for extended periods (World Health Organization, 2023). According to the World Health Organization, approximately 5% of adults worldwide suffer from depression, amounting to an estimated 280 million people affected by this condition (Institute for Health Metrics and Evaluation, 2019). Various forms of treatment, such as medications, psychotherapy, and hospital or residential care, are available to address depression (Mayo Clinic, 2018).

There are notable intersections between different mental disorders. For instance, individuals with BED often have or have had other psychiatric diagnoses. In a 2008 study, researchers found that 73.8% of patients with BED had at least one additional lifetime psychiatric disorder, and 43.1% had at least one current psychiatric disorder. Moreover, patients with a current comorbidity showed significantly higher levels of eating disorder psychopathology (cognition, behaviors, or experiences) compared to patients with BED who had a noncurrent, lifetime psychiatric disorder or no psychiatric history (Grilo et al., 2009). Another study conducted in 2013 focused on adolescents with an eating disorder (ED) and comorbid anxiety or depression. The findings revealed that those with an ED and comorbid depression exhibited

more severe symptoms, particularly in relation to binge eating, purging, and dietary restraint, compared to individuals without a comorbid disorder.

This particular study aimed to gain a deeper understanding of the association between binge eating behaviors and symptoms of depression. The researcher was specifically interested in exploring the correlation between binge eating and depression and sought to identify which survey questions related to binge eating behaviors were the strongest predictors of the severity of depression symptoms. Similarly, they wanted to determine which depression symptoms from the survey were the most influential predictors of the severity of binge eating behaviors. The null hypothesis of the study proposed no relationship between depression symptoms and binge eating behaviors, while the alternative hypothesis suggested a linear relationship, with specific questions or symptoms being statistically significant predictors of either depression or binge eating severity.

II. METHODS

Participants
This study aimed to investigate binge eating behaviors and depression symptoms in a sample of adolescents aged 13 to 19 years. The participants were intentionally diverse in terms of gender, race/ethnicity, and yearly household income. Due to logistical constraints, random sampling was not feasible, and the samples were obtained through convenient sampling methods. Despite this limitation, the total sample can be considered reasonably representative of the broader population under study. It is important to note that the participants' responses to the survey exhibited a wide range of perspectives and experiences, contributing to a comprehensive understanding of the research topic.

Measures
The survey employed two standardized scales to measure binge eating behaviors and depression symptoms. The first scale utilized was the 16-item Binge Eating Scale (BES), which was developed and validated in a separate study (Karia et al., 2022). The BES captures both the behavioral aspects of binge eating (e.g., consuming large amounts of food) and the emotional and cognitive components associated with binge episodes (e.g., guilt, fear of losing control). Each of the 16 items consists of four statements that reflect varying levels of severity, ranging from 0 (indicating no binge eating problem) to 3 (indicating a severe binge eating problem). Scores on the BES are obtained by summing the values for each item, resulting in a possible score range of 0 to 46 (Timmerman, 1999). Based on the BES scores, participants' eating behaviors were classified into three levels of severity: scores of 17 or below indicated non-binge eaters, scores between 18 and 26 indicated moderate binge eaters, and scores of 27 and above indicated severe binge eaters (Robert et al., 2013). Extensive testing of the scale has demonstrated its ability to effectively discriminate among individuals assessed by trained interviewers as having no binge eating problem, a moderate problem, or a severe problem (Gormally et al., 1982). Therefore, the Binge Eating Scale (BES) was employed to quantify binge eating symptoms in this study.

To measure depression symptoms, a shortened version of the Symptom Checklist-90 (SCL90) was administered (*Symptom Checklist-90 (SCL90)*, n.d.). The SCL90 is a comprehensive 90-item questionnaire designed to assess various psychological problems. For the purposes of this study, only the 12 questions specifically related to depression (items 5, 14, 20, 22, 26, 29, 30, 31, 32, 54, 71, and 79) were utilized. This subscale focuses on clinical depression symptoms such as low mood, decreased energy levels, pessimism, despair, lack of motivation, and suicidal thoughts (Masal et al., 2013). Participants rated their responses to each of the 12 questions on a scale ranging from 0 to 4, with higher scores indicating more severe depression symptoms. In terms of interpretation, scores ranging from 0.0 to 1.5 (total scores of 18 or below) were considered within the normal range, scores between 1.5 and 2.5 (total scores between 19 and 30) indicated a high level of symptoms, and scores from 2.5 to 4.0 (total scores between 31 and 48) indicated a very high level of symptoms (Masal et al., 2013).

For the complete list of survey questions utilized for both the SCL90 depression scale and BES, please refer to Appendix A.

Procedure
The BES and shortened SCL90 scales were incorporated into a comprehensive Google Survey, which also included a series of demographic questions. This survey was distributed to various target groups, including students from Stanford Online High School (SOHS), several Discord communities (including SOHS, ED support groups, and other schooling servers), eating disorder support networks/platforms, relevant Facebook groups, as well as individuals accessible to the researcher. Therefore, the sampling method employed for this study was convenient sampling, given the accessibility and availability of these specific groups. A total of 102 responses were initially collected for the study. However, two samples had to be excluded from the final analysis as they fell outside the designated study population, with ages of 25 and 12 years old, respectively. As a result, the final sample size utilized for data analysis and interpretation consisted of 100 participants.

III. RESULTS

Demographics
The study included a total sample size of 100 participants. The mean age was about 16 years old, with a narrow dispersion indicated by a standard deviation of 1.56. 64% of participants identified as female, 27% identified as male, and 9% identified as non-binary. Within race/ethnicity, the two largest groups were Caucasian/White and Asian at 46% and 34%, respectively. The largest segment in terms of household income was the 100-200K group, at 30%.

For a detailed overview of the demographics, please refer to Table 1 below. This table provides comprehensive information on various demographic categories, allowing for further analysis and interpretation of the study's results.

Variables (N = 100)	% of N	Mean	SD
Age		15.98	1.56
Gender			
Female	64%		
Male	27%		
Non-binary	9%		
Race/ethnicity			
Caucasian/White	46%		
Hispanic	1%		
African American/Black	2%		
Pacific Islander	1%		
Asian	34%		
Latinx/Latino/a	1%		
Chicano/a	1%		
Middle Eastern	2%		
Other, Mixed	12%		
Yearly household income			
Less than 25K	8%		
25-50K	8%		
50-100K	27%		
100-200K	30%		
More than 200K	27%		

TABLE 1. Participant demographics

Data Analysis
Following the assignment of numerical values to depression symptoms and binge eating behaviors, a comprehensive series of statistical tests was conducted using the statistical analysis software R. Table 2 and Table 3 shed light on the distributions for the SCL90 depression scores and the binge eating behavior scores by detailing the summary statistics.

Table 1 reveals that the mean depression score among participants was 21.84. This finding suggests that, on average, participants scored towards the lower end of the "high level symptom" range. Consequently, the results indicate that the majority of participants experienced a level of depression that exceeded what is typically considered "normal." This observation underscores the significance of depression as a prevalent concern within the studied population.

In contrast, Table 2 shows that the mean score for binge eating behavior was calculated to be 13.92. This finding suggests that most participants exhibited non-binge eating behavior, as their scores fell below the threshold of 17. These results imply that the majority of participants did not engage in binge eating behaviors to a significant extent.

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Std.
0	14.75	22	21.84	29	44	10.58

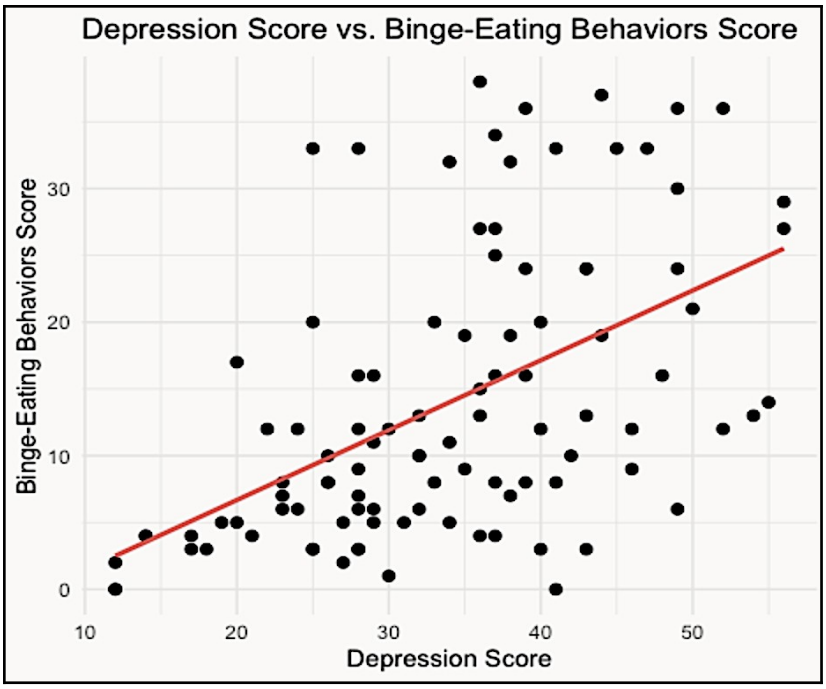
TABLE 2. Summary statistics for SCL90 Depression Scale

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Std.
0.00	5.00	11.00	13.92	20.00	38.00	10.66

TABLE 3. Summary statistics for Binge Eating Scale

The analysis conducted revealed a correlation coefficient of R = 0.5191711 between depression symptoms and binge eating behaviors. The strength of this correlation coefficient indicates a moderate positive association between the two variables. This finding implies that as depression symptoms increase, binge eating behaviors tend to increase as well.

To visually represent this relationship, a scatterplot was generated using R (Graph 1). The scatterplot graphically illustrates the correlation between depression symptoms and binge eating behaviors, providing a clear visualization of the data points and the trend observed. In the scatterplot, a red trend line is included, which represents the correlation between the variables.



GRAPH 1. Correlation between depression and binge-eating behavior scores

Using R, a multivariable regression analysis was conducted, with the depression scores serving as the dependent variable and the binge eating behavior responses as the independent variable. The results of the regression analysis, presented in Table 4 below, revealed that the majority of the Binge Eating Scale questions showed no significant association with depression. However, two specific questions stood out as statistically significant: Question 4, which pertains to boredom and eating habits, and Question 6, which relates to guilt after overeating.

For Question 4 (eat when bored), a p-value of 0.0360 was obtained, indicating a statistically significant association with depression. Similarly, Question 6 (guilt after overeating) yielded a p-value of 0.0353, also indicating a significant association with depression. Specifically, an increase of 1 unit in a participant's score on the "boredom and eating habits" question was associated with a 3 unit increase in their depression symptom score. Likewise, a 1 unit increase in a participant's score on the "guilt after overeating" question was associated with a 3.6 unit increase in their depression symptom score. These results suggest that while the majority of individual binge eating behaviors were not strongly correlated with depression, the specific behaviors captured by Questions 4 and 6 exhibited a noteworthy relationship. However, it is important to recognize the possibility that a larger sample size is required to distinguish statistically significant associations for the remaining questions, rather than assuming that these individual behaviors have no significant connection to depression.

Question #	Estimate	Std. Error	P-value ($\alpha = 0.05$)
Intercept	21.8793	2.1778	5.32^{-16}
Question 1 (Self-conscious about weight)	1.8344	1.3782	0.1868
Question 2 (Eat Quickly)	0.1500	1.2175	0.9022
Question 3 (Difficulty controlling Eating Urges)	-2.8755	1.6768	0.0901
Question 4 (Eat when bored)	**3.0871**	**1.4482**	**0.0360**

Question 5 (Eat when not hungry)	0.1913	1.7551	0.9135
Question 6 (Guilt after overeating)	**3.6493**	**1.7055**	**0.0353**
Question 7 (Diet and Binge)	-0.4239	1.8106	0.8155
Question 8 (Eat 'til stuffed)	1.6642	1.5556	0.2878
Question 9 (Diet/restrict and binge)	-1.3977	1.4085	0.3239
Question 10 (Difficulty controlling eating)	1.0689	2.4032	0.6576
Question 11 (Eat till stuffed or sometimes vomit)	-4.3598	2.2633	0.0575
Question 12 (Conceal eating)	1.5465	1.3943	0.2706
Question 13 (Eat continually)	0.8225	1.4391	0.5692
Question 14 (Preoccupation with eating)	0.8043	1.7882	0.6540
Question 15 (Preoccupied with food)	0.9388	1.6108	0.5616
Question 16 (Uncertain how much food is normal)	2.1492	1.8812	0.2566

TABLE 4. Multivariable depression regression

Using R, another multivariable regression analysis was conducted, this time with the binge eating behavior responses as the dependent variable and depression as the independent variable. The results of the regression analysis, presented in Table 5 below, indicate that the majority of depression symptoms were not significantly associated with binge eating behaviors. However, one symptom emerged as statistically significant: "Feeling hopeless about the future," with a p-value of 0.0173.

According to the analysis, a 1 unit increase in a participant's score on the "feeling hopeless about the future" symptom was associated with a 2 unit increase in their binge eating behavior score. This significant association suggests that this particular symptom holds relevance in understanding binge eating behaviors. However, it is important to note that while most depression symptoms appear weakly correlated with binge eating behaviors, the usage of a larger sample size could allow future investigations to identify statistically significant symptom associations.

Symptom	Estimate	Std. Error	P-value ($\alpha = 0.05$)
Intercept	-2.16164	3.66311	0.5566
Loss of sexual interest or pleasure	0.63850	0.83235	0.4451
Feeling low in energy or slowed down	0.35602	0.86703	0.6824
Crying Easily	0.44695	0.77642	0.5663
Feeling of being trapped or caught	0.50035	0.92550	0.5902
Blaming yourself for things	-0.07556	0.85673	0.9299
Feeling lonely	0.42147	0.87715	0.6321
Feeling blue	-1.37981	0.91281	0.1343
Worrying too much about things	0.64586	0.85115	0.4500

Feeling no interest in things	1.43533	0.78159	0.0697
Feeling hopeless about the future	**2.00477**	**0.82603**	**0.0173**
Feeling everything is an effort	-0.21787	0.93657	0.8166
Feelings of worthlessness	1.12101	0.87448	0.2033

TABLE 5. Multivariable binge eating behavior regression

IV. DISCUSSION

According to the assessed correlation coefficient (R = 0.5191711), there is a positive linear correlation between binge eating behaviors and depression symptoms. Furthermore, based on the multivariable depression regression model, it was determined that Question 4 (eat when bored) and Question 6 (guilt after overeating) were both strong predictors to assess the dependent variable, depression symptom severity. In another multivariable regression model for binge eating behaviors, it was determined that the depression symptom “Feeling hopeless about the future” was a strong predictor to assess the binge eating behavior severity.

These results are helpful in better understanding the intersections between binge eating and depression. First of all, as there is a positive correlation between binge eating behaviors and depression symptoms, researchers can better predict the severity of such disorders based on scaled questionnaires. Understanding this correlation can help in providing more effective treatments for eating disorders. In particular, since comorbidities are so common in EDs (e.g. binge eating and depression or anorexia and anxiety), there is a potential for altering treatment methods to focus on the comorbid mood disorders rather than just the eating disorder behaviors. By rewiring treatment towards a predicting variable—although, note that this study does not assess cause and effect relationships—researchers may be able to halt the root of the eating disorder. In doing so, the root of the problem will wither, providing space for a more complete and successful recovery.

Throughout the study, there were certain limitations—convenience sampling, lack of diversity, a small sample-size, the potential for response-bias—which constrained the research process and potential findings. One of the greatest limitations in data collection was the lack of diversity due to the limited amount of time and resources to collect data. The researcher resorted to convenience sampling while still making an effort to obtain a representative sample of the population. As a result, the majority of the 100 participants were Caucasian/White or Asian, of higher socioeconomic status, and female. This restricts results from being relevant towards a more general population of adolescents between 13 and 19 years of age. The study used a method of self-reported data through surveys. Unfortunately, self-reports leave room for response-bias (Rosenman et al., 2011). Most survey questions were subjective and based on self-reflection. To help alleviate the risk of response-bias, the researcher adhered to an anonymous and confidential survey. However, it is very difficult to completely eliminate response-bias in self-reported data.

Future work and research may include exploring the cause and effect relationships between eating and mood disorders. In particular, the roots of binge eating disorder must be determined; if they involve variables such as mood abnormalities (e.g. severe stress or depression), it would be helpful to explore whether or not altering ED treatments can benefit patients in the long-term. Furthermore, based on the results of the multivariable regressions, another area of future work may include symptom scales for various disorders. In this study, specific questions or symptoms were more successful as predictors than others. It would be worthwhile to explore why this is the case, what other predictors there are, and also how such predictors can benefit having a more complete understanding of mood and eating disorders.

Appendix A

Symptom Checklist-90 Depression Scale and Scoring:

1. Loss of sexual interest or pleasure
2. Feeling low in energy or slowed down
3. Crying easily
4. Feeling of being trapped or caught
5. Blaming yourself for things
6. Feeling lonely
7. Feeling blue
8. Worrying too much about things
9. Feeling no interest in things
10. Feeling hopeless about the future
11. Feeling everything is an effort
12. Feelings of worthlessness

(0=None, 1=Little, 2=Medium level, 3=Much, 4=Too much)

Normal Symptom; scores from 0.00 up to 1.50; less than 19
High Level Symptom; scores from 1.51 up to 2.50; 19–30
Very High Level; scores from 2.51 up to 4.00; greater than 30

Questions in Binge Eating Scale and Scoring:

1. Self-conscious about weight:
    - I don't feel self-conscious about my weight or body size when I'm with others.
    - I feel concerned about how I look to others, but it normally does not make me feel disappointed with myself.
    - I do get self-conscious about my appearance and weight which makes me feel disappointed in myself.
    - I feel very self-conscious about my weight and frequently, I feel intense shame and disgust for myself. I try to avoid social contacts because of my self-consciousness.
2. Eat quickly:
    - I don't have any difficulty eating slowly in the proper manner.
    - Although I seem to "gobble down" foods, I don't end up feeling stuffed because of eating too much.
    - At times, I tend to eat quickly and then, I feel uncomfortably full afterwards.
    - I have the habit of bolting down my food, without really chewing it. When this happens I usually feel uncomfortably stuffed because I've eaten too much.
3. Difficulty controlling Eating Urges:
    - I feel capable to control my eating urges when I want to.
    - I feel like I have failed to control my eating more than the average person.
    - I feel utterly helpless when it comes to feeling in control of my eating urges.
    - Because I feel so helpless about controlling my eating I have become very desperate about trying to get in control.
4. Eat when bored:
    - I don't have the habit of eating when I'm bored.
    - I sometimes eat when I'm bored, but often I'm able to "get busy" and get my mind off food.
    - I have a regular habit of eating when I'm bored, but occasionally, I can use some other activity to get my mind off eating.

- I have a strong habit of eating when I'm bored. Nothing seems to help me break the habit.

5. Eat when not hungry:
   - I'm usually physically hungry when I eat something.
   - Occasionally, I eat something on impulse even though I really am not hungry.
   - I have the regular habit of eating foods, that I might not really enjoy, to satisfy a hungry feeling even though physically, I don't need the food.
   - Although I'm not physically hungry, I get a hungry feeling in my mouth that only seems to be satisfied when I eat a food, like a sandwich, that fills my mouth. Sometimes, when I eat the food to satisfy my mouth hunger, I then spit the food out so I won't gain weight.
6. Guilt after overeating:
   - I don't feel any guilt or self-hate after I overeat.
   - After I overeat, occasionally I feel guilt or self-hate.
   - Almost all the time I experience strong guilt or self-hate after I overeat.
7. Diet and Binge:
   - I don't lose total control of my eating when dieting even after periods when I overeat.
   - Sometimes when I eat a "forbidden food" on a diet, I feel like I "blew it" and eat even more.
   - Frequently, I have the habit of saying to myself, "I've blown it now, why not go all the way" when I overeat on a diet. When that happens I eat even more.
   - I have a regular habit of starting strict diets for myself, but I break the diets by going on an eating binge. My life seems to be either a "feast" or "famine."
8. Eat 'til stuffed:
   - I rarely eat so much food that I feel uncomfortably stuffed afterwards.
   - Usually about once a month, I eat such a quantity of food, I end up feeling very stuffed.
   - I have regular periods during the month when I eat large amounts of food, either at mealtime or at snacks.
   - I eat so much food that I regularly feel quite uncomfortable after eating and sometimes a bit nauseous.
9. Diet/restrict and binge:
   - My level of calorie intake does not go up very high or go down very low on a regular basis.
   - Sometimes after I overeat, I will try to reduce my caloric intake to almost nothing to compensate for the excess calories I've eaten.
   - I have a regular habit of overeating during the night. It seems that my routine is not to be hungry in the morning but overeat in the evening.
   - In my adult years, I have had week-long periods where I practically starve myself. This follows periods when I overeat. It seems I live a life of either "feast or famine."
10. Difficulty controlling eating:
    - I usually am able to stop eating when I want to. I know when "enough is enough."
    - Every so often, I experience a compulsion to eat which I can't seem to control.
    - Frequently, I experience strong urges to eat which I seem unable to control, but at other times I can control my eating urges.
    - I feel incapable of controlling urges to eat. I have a fear of not being able to stop eating voluntarily.
11. Eat till stuffed or sometimes vomit:
    - I don't have any problem stopping eating when I feel full.
    - I usually can stop eating when I feel full but occasionally overeat leaving me feeling uncomfortably stuffed.
    - I have a problem stopping eating once I start and usually I feel uncomfortably stuffed after I eat a meal.
    - Because I have a problem not being able to stop eating when I want, I sometimes have to induce vomiting to relieve my stuffed feeling.
12. Conceal eating:
    - I seem to eat just as much when I'm with others (family, social gatherings) as when I'm by myself.

- Sometimes, when I'm with other persons, I don't eat as much as I want to eat because I'm self-conscious about my eating.
- Frequently, I eat only a small amount of food when others are present, because I'm very embarrassed about my eating.
- I feel so ashamed about overeating that I pick times to overeat when I know no one will see me. I feel like a "closet eater."

13. Eat continually:
    - I eat three meals a day with only an occasional between meal snack.
    - I eat 3 meals a day, but I also normally snack between meals.
    - When I am snacking heavily, I get in the habit of skipping regular meals.
    - There are regular periods when I seem to be continually eating, with no planned meals.
14. Preoccupation with eating:
    - I don't think much about trying to control unwanted eating urges.
    - At least some of the time, I feel my thoughts are pre-occupied with trying to control my eating urges.
    - I feel that frequently I spend much time thinking about how much I ate or about trying not to eat anymore.
    - It seems to me that most of my waking hours are pre-occupied by thoughts about eating or not eating. I feel like I'm constantly struggling not to eat.
15. Preoccupied with food:
    - I don't think about food a great deal.
    - I have strong cravings for food but they last only for brief periods of time.
    - I have days when I can't seem to think about anything else but food.
    - Most of my days seem to be pre-occupied with thoughts about food. I feel like I live to eat.
16. Uncertain how much food is normal:
    - I usually know whether or not I'm physically hungry. I take the right portion of food to satisfy me.
    - Occasionally, I feel uncertain about knowing whether or not I'm physically hungry. At these times it's hard to know how much food I should take to satisfy me.
    - Even though I might know how many calories I should eat, I don't have any idea what is a "normal" amount of food for me.

Non-binging; less than 17
Moderate binging; 18–26
Severe binging; 27 and greater

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