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Explaining the structural relationship between mindfulness and binge eating in obese people: The mediating role of cognitive emotion regulation strategies

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Original Article

Abstract

BACKGROUND: This study aimed to investigate the mediating role of cognitive emotion regulation strategies in the relationship between mindfulness and binge eating in obese individuals.

METHODS: This research was performed as correlation research and statistical population included obese and overweight men and women in spring, summer, and autumn 2018 in Karaj City, Iran, 414 of whom were selected by purposive sampling method and participated in the study. Data were collected by calculating participants' body mass index (BMI), Five Facet Mindfulness Questionnaire (FFMQ), Cognitive Emotion Regulation Questionnaire (CERQ), Binge Eating Scale (BES), and structural equation modeling (SEM) and then analyzed using Amos software.

RESULTS: The model has an acceptable fit with the collected data [χ^2/degree of freedom (df) = 3.80, comparative fit index (CFI) = 0.929, goodness of fit index (GFI) = 0.910, adjusted GFI (AGFI) = 0.871, and root mean square error of approximation (RMSEA) = 0.082]. Examination of the path coefficients showed that emotion regulation strategies mediated the relationship between mindfulness and binge eating.

CONCLUSION: Mindfulness affects binge eating in obese people through the mediating role of emotional regulation strategies.

KEYWORDS: Mindfulness; Obesity; Emotion Regulation

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Introduction

Although binge eating disorder (BED) is not limited to obese people, it is common among them, especially among clients seeking treatment for their obesity problem. More than 30 percent of people with obesity and those trying to lose weight may suffer from the disorder.[1] Binge eating involves unusually swallowing large amounts of food and feeling uncontrollable during the eating period, occurring at least twice a week for six months. Patients with BED overeat but do not have compensatory behaviors (used by people with bulimia nervosa).[2]

Psychologists believe that stress is one of the most important predictors of binge eating, which in interaction with biological factors causes weight gain and obesity.[3] According to the theories, it is assumed that people who lose control over their eating and start binge eating believe that eating provides them with conditions to forget their

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negative emotions and reduce their stress.[4] Another variable associated with binge eating is mindfulness. Theoretically, mindfulness is related to psychological well-being. Mindfulness is awareness and non-judgmental acceptance of the individual moment by moment. Mindfulness can act as an antidote to standard forms of psychological distress such as avoidance, repression, or mental and emotional overwork.[5]

Many clinical psychologists are now using mindfulness as a highly effective non-pharmacological tool to reduce stress and anxiety. Researchers have shown that mindfulness can be used to treat many physical, psychological, mental, and chronic pain problems. And stress has a tremendous effect. Numerous studies have demonstrated the effectiveness of mindfulness-based interventions on binge eating.[6] Researchers believe that at high levels of mindfulness and acceptance, people notice their psychological arousals (feelings and thoughts) without trying to avoid or control them, thus reducing the impact of these thoughts and feelings on their behavioral performance.[7]

However, research is needed to be able to pinpoint the mechanisms of this effect. A closer look at hypothetical mechanisms can effectively develop and strengthen future therapies. Another possible mechanism by which mindfulness can influence binge eating is the cognitive regulation of emotion. Researchers have shown the effect of mindfulness on the cognitive-emotional regulation strategies used by individuals.[8] Emotional regulations involve the use of behavioral and cognitive strategies to change the duration or intensity of an emotional experience.[9] Emotion regulations are based on internal and external processes of responding to restraint and monitoring, evaluating, and modifying emotional interactions, especially their transient and rapid characteristics, to achieve the goals.[10] Researchers believe that the inability to evaluate and manage negative emotions properly is a key aspect of binge eating. People who are unable to manage their negative emotions may be vulnerable to stress and anxiety, and thus seek relief from eating.[11] Leehr et al. in 2015 reviewed experimental studies and found that negative emotions acted as a trigger for extreme binge eating in obese people with BED.[12] Boring emotional states, especially stress, anxiety, and depression often trigger binge eating attacks.[13] What these theories suggest about binge eating is that people overeat to regulate negative emotions. It seems that experiencing negative emotions does not directly lead to binge eating and disordered eating behaviors, but to maladaptive emotion regulation strategies to regulate these emotions.[14]

Accordingly, the results of several studies have shown no significant relationship between emotion regulation strategies compatible with eating behaviors. In contrast, maladaptive emotion regulation strategies affect binge eating and emotional eating behaviors.[15,16]

Because stressful events and negative emotions are unavoidable realities in everyday life, eating behaviors, as a way to regulate negative emotions, can shape eating behaviors and lead to weight gain and obesity in the long run. This issue shows the need to study and identify the variables affecting binge eating in overweight and obese people.[17]

Researchers have not studied the relationship between mindfulness and emotion regulation with binge eating in a structural model despite these research findings. Moreover, the mediating role of cognitive emotion regulation in the relationship between binge eating and mindfulness has not been investigated. Therefore, the present study aimed to investigate the mediating role of

cognitive emotion regulation strategies in the relationship between mindfulness and binge eating in obese people.

Methods

The present study was descriptive and correlational [using structural equation modeling (SEM)]. The statistical population included men and women with obesity and overweight that went to nutrition and weight loss clinics in spring, summer, and autumn 2018 (Districts 3, 4, and 37 of Karaj City, Iran). To determine the sample size, the ratio of the subject to the estimated parameters was used. Considering the probability of loss, 414 samples were selected. Demographic factors such as age, sex, marital status, level of education, and body mass index (BMI) were examined. The sample of this study was in the age range of 18 to 50 years, with a BMI of above 30 kg/m^2.

Those with the diagnosis of pregnancy, mental disorders such as bulimia nervosa, food addiction, sleep disorders, and diseases that lead to binge eating such as colitis were excluded. Crohn's disease (CD) and ulcerative colitis are resulted from deficiency of B vitamins, zinc and iron. Moreover, the use of psychiatric medications and drugs can cause them. Inclusion criteria were as being obese, age range of 18-50 years, consent to participate in the study, and inaccuracy in answering questionnaires and cancellation of cooperation were among the exclusion criteria.

Research tools

1. Sociodemographic Variables Questionnaire: The data collection tool in this study was the Sociodemographic Variables Questionnaire, including age, sex, weight, height, education, and marital status. BMI was obtained by dividing weight in kilograms by square of height in meters.

2. Binge Eating Scale (BES): Gormally et al. designed this scale to measure the severity of binge eating in obese people.[1] This scale consists of 16 items, including three or four sentences. The subjects are asked to choose a sentence that best describes them. Women are graded from zero to three, and the overall score varies from zero to 46. A score of 16 indicates the existence of a BED, and a score higher than that indicates binge eating severity. The English, Portuguese, and Italian versions of this scale have validity, sensitivity, and good psychometric properties. Mouloudi et al. examined the psychometric properties of the Iranian version of the BES. They reported the validity of this scale 0.67 by halving method and 0.72 using the retest method. They also obtained Cronbach's alpha coefficient of 0.85.[18]

3. The Five Facet Mindfulness Questionnaire (FFMQ): This is a scale of 39 questions in the Likert scale from 1 (never) to 5 (always). The questionnaire has five subscales of non-response, description, observation, alertness, and non-judgment. The validity and reliability of this scale have been investigated before by Baer et al.[7] In addition, this scale has been studied in Iran.[19] The results of their study showed that the reliability of the subscales of this questionnaire using Cronbach's alpha was between 0.55 to 0.83 and for its total score was 0.80.[19]

4. Cognitive Emotion Regulation Questionnaire (CERQ): The questionnaire is a 36-item tool that measures cognitive emotion regulation strategies in response to life-threatening and stressful events on a five-point scale from one (never) to five (always) in the following nine subscales: self-blame, other-blame, rumination, catastrophizing, positive refocusing, planning, positive reappraisal, putting into perspective, and acceptance.

The alpha coefficient for the subscales of this questionnaire was reported by Garnefski et al. (2002) in the range of 0.71 to 0.81 and the validity coefficient of its subscales by retesting in 14 months was reported in the range of 0.48 to 0.61.[20]

In Iran, the alpha coefficient for the subscales

of this test ranged from 0.62 to 0.91, and also, the validity coefficient of these factors was retested with a one-week interval between 0.75 and 0.88. The principal component factor analysis (PCA) results showed that CERQ had a seven-factor structure that included positive refocusing/planning, positive evaluation/ broad perspective, acceptance, blaming others, self-blame, rumination, and catastrophizing. The content validity of the CERQ was evaluated based on the judgment of eight psychologists, and the coefficients of the agreement were calculated for the subscales from 0.81 to 0.92. In addition, the correlation of the subscales of the CERQ with the total score of the Depression, Anxiety and Stress Scale-21 Items (DASS-21) indicated its convergent and divergent validity.[20]

This study was extracted from a PhD thesis in health psychology in Islamic Azad University, Central Tehran Branch, Tehran, Iran, with ethical code of 10120709981006.

Results

In this study, 414 participants (235 women and 179 men) with a mean and standard deviation (SD) of age of 30.62 ± 7.98 years were present. Among the participants, 260 were single (62.8%), and 154 were married. Education rate of 54 (13%) participants was under diploma, 106 (25.6%) diploma, 46 (11.1%) post-diploma, 147 (35.5%) bachelor's degree, and 61 (14.7%) had a master's degree or higher.

BMI in 147 (35.5%) participants was less than 32 kg/m^2, 140 (33.8%) participants had a BMI of 32 to 34 kg/m^2, and 127 (30.7%) had a BMI higher than 34 kg/m^2. It should be noted that the mean and SD of BMI of participants was 33.20 ± 3.01 kg/m^2.

Mean, SD, and correlation coefficients between mindfulness components (observation, description, action with awareness, non-judgment, and non-reactivity), adaptive cognitive emotion regulation strategies (acceptance, positive refocusing, program planning, positive re-evaluation, and perspective), maladaptive strategies of cognitive emotion regulation (self-blame, blaming others, rumination, and catastrophizing), and binge eating in this research were evaluated. According to correlation coefficients between the variables of the present study, the components of mindfulness and adaptive strategies of emotional, cognitive regulation were negatively correlated and non-adaptive strategies of cognitive regulation were positively correlated with binge eating at a significance level of 0.01 (Table 1).

to evaluate the assumption of normality of univariate data distribution, elongation and skewness of individual variables were investigated. Besides, in order to evaluate the establishment/non-establishment of the hypothesis of linearity, variance inflation factor (VIF) and tolerance coefficient were evaluated. Results showed that all variables' elongation and skew values were in the range of ±2. This indicated that data distribution related to research variables did not deviate from the univariate normality.

Table 1 also shows that the assumption of alignment was established between the data of the present study, because the values of the tolerance coefficient of the predictor variables were greater than 0.1 and the values of the VIF of each of them were less than 10 (Table 2).

In this study, to assess the establishment/non-establishment of the assumption of the normality of multivariate distribution, the analysis of information related to the "distance-distance" and the distribution diagram were used. The skewness values and elongation of the scores were 1.68 and 5.44, respectively, which shows that the assumption of multivariate normal distribution among the data is not established. For this reason, a box plot diagram was drawn, and the results showed that the information about 6 participants was multivariate. Therefore, the data of those 6 people were removed.

Table 1. Descriptive findings related to research variables

Research variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1. Mindfulness - observation															
2. Mindfulness - description	0.55**														
3. Mindfulness - action with awareness	0.50**	0.41**													
4. Mindfulness - lack of judgment	0.39**	0.33**	0.53**												
5. Mindfulness - no reaction	0.55**	0.48**	0.44**	0.62**											
6. Adaptive strategies - acceptance	0.09	0.08	0.20**	0.15**	0.13**										
7. Adaptive strategies - positive refocusing	0.24**	0.19**	0.29**	0.22**	0.22**	0.47**									
8. Adaptive strategies - focus on the program	0.28**	0.24**	0.25**	0.17**	0.24**	0.45**	0.63**								
9. Adaptive strategies - positive reassessment	0.28**	0.22**	0.30**	0.19**	0.19**	0.47**	0.67**	0.77**							
10. Adaptive strategies - perspectives	0.17**	0.23**	0.29**	0.13**	0.10*	0.46**	0.57**	0.65**	0.43**						
11. Non-adaptive strategies - self-blame	-0.38**	-0.17**	-0.07	-0.08	-0.10*	0.17**	0.08	-0.04	-0.02	-0.05					
12. Non-adaptive strategies - other-blame	-0.40**	-0.25**	-0.19**	-0.26**	-0.24**	0.10*	0.07	-0.08	-0.11*	0.03	0.46**				
13. Non-adaptive strategies - ruminations	-0.31**	-0.16**	0.03	-0.11*	-0.07	0.21**	0.12*	-0.06	-0.05	-0.12*	0.68**	0.54**			
14. Non-adaptive strategies - catastrophizing	-0.34**	-0.16**	-0.06	-0.32**	-0.14**	0.14**	0.02	-0.02	-0.02	-0.07	0.61**	0.62**	0.72**		
15.Binge eating	-0.51**	-0.21**	-0.32**	-0.17**	-0.31**	-0.16**	-0.40**	-0.25**	-0.14**	-0.18**	0.30**	0.33**	0.31**	0.24**	
Mean ± SD	23.39 ± 5.04	22.81 ± 5.33	26.88 ± 7.14	27.46 ± 6.83	17.86 ± 4.41	12.37 ± 4.31	14.18 ± 3.50	13.17 ± 3.76	14.62 ± 3.72	12.86 ± 3.64	11.31 ± 4.70	9.49 ± 2.89	12.30 ± 3.64	10.83 ± 3.25	29.94 ± 6.74

P < 0.05; **P < 0.018
SD: Standard deviation

Table 2. Investigation of the assumptions of normality of data distribution and alignment

Variables	Normality of data distribution		Alignment	
	Skewness	Elongation	Tolerance coefficient	Inflation variance
1. Mindfulness - observation	-0.54	-0.17	0.43	2.29
2. Mindfulness - description	-0.23	-0.70	0.53	1.87
3. Mindfulness - action with awareness	-0.58	-0.80	0.47	2.11
4. Mindfulness - lack of judgment	0.22	-1.04	0.51	1.95
5. Mindfulness - no reaction	-0.26	-0.95	0.45	2.19
6. Adaptive strategies - acceptance	-0.44	-0.60	0.66	1.51
7. Adaptive strategies - positive refocusing	-1.25	1.21	0.46	2.15
8. Adaptive strategies - refocusing on the program	0.55	-0.68	0.34	2.91
9. Adaptive strategies - positive reassessment	0.18	0.54	0.28	3.48
10. Adaptive strategies - perspectives	-0.89	-0.12	0.42	2.53
11. Non-adaptive strategies - self-blame	-0.01	-0.23	0.44	2.22
12. Non-adaptive strategies - other-blame	0.38	-0.69	0.53	1.86
13. Non-adaptive strategies - ruminations	-0.52	-1.17	0.33	3.01
14. Non-adaptive strategies - catastrophizing	0.09	1.21	0.37	2.68
15. Binge eating	0.46	-0.41	-	-

By this action, the values of skewness and elongation to the scores of Mahalanobis distance (MD) were reduced to 0.87 and 0.64, respectively, which shows that the distribution of multivariate data after deleting multiple data is a normal variable. Data were analyzed by SEM. Mindfulness, adaptive strategies for cognitive emotion regulation, and non-adaptive strategies were latent variables that formed the research measurement model. How to fit the measurement model with the collected data was evaluated using the confirmatory factor analysis (CFA) method by version 24 of AMOS software and the maximum likelihood estimation (MLE) method. The fit indices of the measurement model and the structural model were determined (Table 3).

Two goodness of fit index (GFI) and standardized root mean square residual (SRMR) indices from the CFA did not support the acceptable fit of the measurement model with the aggregated data. For this reason, the measurement model was modified by creating covariance between the two indicators of non-judgment and non-reaction of mindfulness. Finally, the fit indices were obtained, which showed that the measurement model had an acceptable fit with the collected data [χ^2/degree of freedom (df) = 3.80, comparative fit index (CFI) = 0.929, GFI = 0.910, adjusted GFI (AGFI) = 0.871, and root mean square error of approximation (RMSEA) = 0.082]

Table 3. Processing indices of measurement and structural models

Fitness indicators	Measurement model		Structural model	Cutting point
	Initial model	Modified model		
χ^2	321.470	277.440	312.540	-
df	74.000	73.000	85.000	-
χ^2/df	4.340	3.800	3.670	< 3.000
GFI	0.897	0.910	0.906	> 0.900
AGFI	0.854	0.871	0.868	> 0.850
CFI	0.914	0.929	0.928	> 0.900
RMSEA	0.090	0.082	0.081	< 0.080

χ^2: Chi-square; Df: Degree of freedom; GFI: Goodness of fit index; AGFI: Adjusted goodness of fit index; CFI: Comparative fit index; RMSEA: Root mean square error of approximation

After ensuring an acceptable fit of the measurement model with the collected data and ensuring the power of markers in measuring latent variables, the structural model was tested using the SEM method. The structural model assumed that mindfulness in obese people mediated binge eating through emotion regulation strategies. As table 3 shows, the fit indices obtained from SEM analysis supported the fit of the structural model with the aggregated data ($\chi^2/df = 3.68$, CFI = 0.928, GFI = 0.906, AGFI = 0.968, and RMSEA = 0.081). Path coefficients between the variables in the structural model of the research were evaluated (Table 4).

The total path coefficient between mindfulness and binge eating ($P < 0.01$, $\beta = -0.517$) was negative and significant at the level of 0.01. In addition, the path coefficient between non-adaptive strategies of emotion regulation and binge eating ($P < 0.01$, $\beta = 0.313$) was positive, and the path coefficient between adaptive strategies of emotion regulation and binge eating ($P < 0.01$, $\beta = -0.447$) was negative and significant at the level of 0.01. According to the results of table 4, the indirect path coefficient between mindfulness and binge eating ($P < 0.01$, $\beta = 0.263$) was negative at the level of 0.01. Accordingly, it can be said that adaptive and non-adaptive strategies of emotional regulation mediate the effect of mindfulness on binge eating in a negative and meaningful way. Despite this significance/non-significance, the role of the two mediating variables (adaptive emotional regulation strategies and non-adaptive emotional regulation strategies) in the relationship between mindfulness and binge eating was unclear. For this reason, to determine the significance or non-significance of the mediating role of the two mediating variables, the Baron and Kenny's formula.[5]

Using Baron and Kenny's formula showed that the indirect path coefficient between mindfulness and eating through non-adaptive emotion regulation strategies ($P < 0.01$, $\beta = -0.094$) was negative at the level of 0.01. Besides, the Baron and Kenny's formula results showed that the indirect path coefficient between the two variables through adaptive emotion regulation strategies ($P < 0.01$, $\beta = -0.169$) was also negative and significant at the level of 0.01. Based on this, it was concluded that adaptive and non-adaptive cognitive regulation strategies negatively and significantly mediated the effect of mindfulness on binge eating. A structural model of research was determined to explain mindfulness effect on eating mediated by emotional regulation strategies. The sum of the squares of multiple correlations for the binge eating variable was 0.53. This finding indicates that mindfulness and emotion regulation strategies explain 53% of the eating variance (Figure 1).

Discussion

This study aimed to explain the structural relationships between mindfulness and binge eating in obese people mediating cognitive emotion regulation strategies.

Table 4. Path coefficient between variables in the model

Path coefficients	b	SE	β	P
Mindfulness ➔ non-adaptive strategies	-0.273	0.065	-0.300	0.001
Mindfulness ➔ adaptive strategies	-0.225	0.052	0.378	0.001
Non-adaptive strategies ➔ binge eating	0.669	0.113	0.313	0.001
Adaptive strategies ➔ binge eating	-1.552	0.265	-0.447	0.001
Direct path coefficient of mindfulness ➔ binge eating	-0.516	0.139	-0.252	0.001
Indirect path coefficient of mindfulness ➔ binge eating	-0.523	0.092	-0.265	0.001
Total path coefficient of mindfulness ➔ binge eating	-1.054	0.118	-0.517	0.001

SE: Standard error

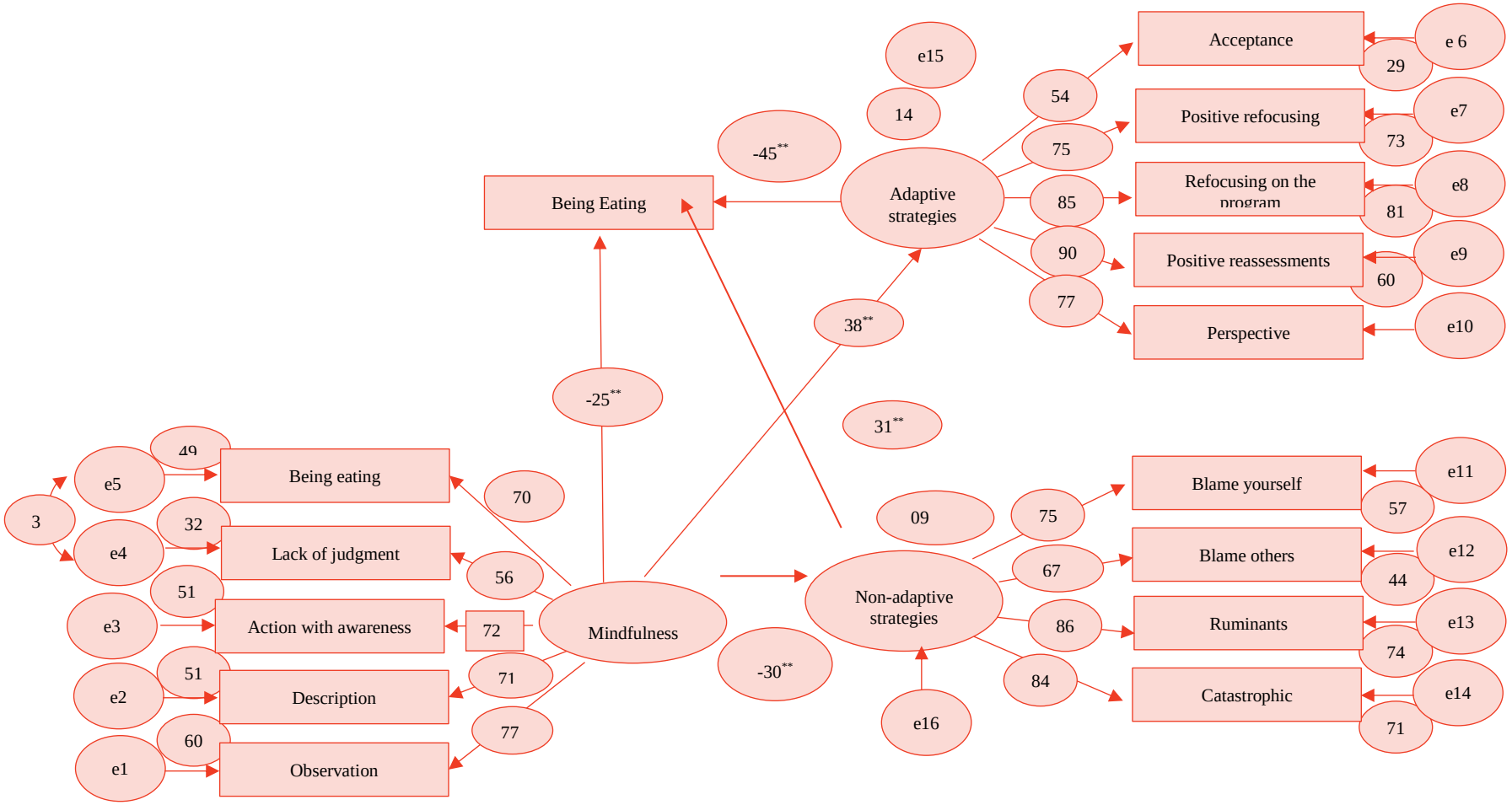

Figure 1. Flowchart

The results showed that the tested model fitted well with the collected data. The fitted model of the present study can be explained in line with the evidence obtained from the model of O'Reilly and Black in 2015; according to this conceptual model, mindfulness mediates attention control and cognitive and emotional flexibility, improves emotion regulation, and thus, reduces binge eating.[21]

Findings of the present study on the direct effect of mindfulness on binge eating are consistent with the results of Lavender et al.[22] in 2021 and Sala et al.[23] in 2020. Some studies have also confirmed the effectiveness of mindfulness-based interventions in reducing eating.[6,24,25] Researchers have found that negative emotions trigger binge eating in obese people with BED.[12] According to the theory of emotional arousal, binge eating is done in response to emotional arousals and to reduce them. According to emotion regulation, emotional eating in anxious and disturbed people is a mediator to cope with negative emotions and high arousal, and excessive binge eating is assumed to improve emotions.[25] Therefore, researchers believe that high levels of mindfulness and acceptance are associated with increased attention and awareness of psychological stimuli (emotions and thoughts) without avoiding or controlling them, which reduces the impact of psychological stimuli on behavior.[7] Negative emotions lead to cognitive limitations and the consumption of limited self-regulation resources, which disrupts cognitive control of binge eating patterns and increases the likelihood of binge eating. Increasing mindfulness seems to reduce binge eating by reducing negative emotions and improving attention control in obese people.[27] Thus, mindfulness improves selective and sustained attention by increasing the ability to self-regulate attention and direct it to the task, thereby increasing people's control of eating patterns and reducing eating.[25,26] The present study's findings confirmed the mediating role of cognitive emotion regulation strategies in the relationship between mindfulness and eating, which is consistent with the model of O'Reilly and Black in 2015.[21] Mindfulness influences emotion regulation strategies through the mediation of attention control and cognitive and emotional flexibility; increasing mindfulness reduces emotion regulation problems and increases the application of adaptive emotion regulation strategies. Researchers have found that emotion regulation strategies play a role in initiating and maintaining eating. Adaptive emotion regulation strategies, in addition to reducing negative emotions through improved cognitive control, attention processes, increased control over limited brain resources, and greater inhibitory ability, indicating reduced responsiveness due to improved descending control, can help reduce binge eating.[20-23] While negative emotions and non-adaptive emotion regulation strategies, by increasing physiological response, reducing sources of self-control, and disrupting self-regulatory processes can lead to eating. When the self-regulatory resources, necessary to pay attention to long-term diet plans, etc., are depleted, the likelihood of binge eating increases. The use of non-adaptive emotion regulation strategies is associated with an increase in negative thoughts and emotions and psychological symptoms that increase the likelihood of binge eating. It seems that people with obesity have limited access to adaptive emotion management strategies, using eating in emotional situations to regulate their negative emotions. Therefore, increasing cognitive, emotional, and attention flexibility is among the key mechanisms for influencing mindfulness on emotion regulation and reducing binge eating. Through these central processes, mindfulness can lead to increased awareness and non-judgmental acceptance, as well as behavioral changes such as conscious,

flexible, and autonomous action. Interpretation of the present study results seems necessary due to some limitations. The results of the present study represent people with obesity in Tehran, and the generalizations of the research to different research groups and communities should be done with caution. Considering the role of cognitive factors such as attention, it is suggested that in future research, the role of this variable in relation to the variables of mindfulness and binge eating is investigated to determine the place of cognitive factors in binge eating. It is also suggested that methods to improve emotion regulation strategies in obese people be considered in the interventions. This study, like any other research, has a number of limitations. One of these limitations was that the samples were selected only from Tehran. Besides, the age range of the people in this study was 18-50 years old, and the generalization of the results to adolescent and elderly groups should be done with caution. In addition, since the study is correlational, it is not possible to achieve causal relationships in the results. In order to remove the existing restrictions, it is suggested that similar studies be conducted in other cities of the country that have different cultures, languages, and religions in the future. It is also suggested that in future studies, this study be performed on other age groups such as adolescents and the elderly. Finally, in order to achieve the cause-and-effect relationships between research variables, experimental studies should be performed.

Conclusion

Based on theoretical concepts and empirical findings, it can be concluded that the interaction of intense emotional states, mindfulness, cognitive factors (such as attention and self-regulation), and emotion regulation is involved in overeating in obese people. Based on this, emotion regulation strategies play a significant role in the etiology and persistence of eating. Focusing on these factors can help prevent and treat eating problems in obese people.

Conflict of Interests

Authors have no conflict of interests.

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