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ADAPTATION OF THE MINDFUL EATING QUESTIONNAIRE IN GREEK

Ioanna Koptsi[1], Dimosthenis Tsapekos[2], & Dimitrios G. Goulis[1]
[1]Aristotle University of Thessaloniki, Greece
[2]King's College, United Kingdom

Abstract. The aim of this study was to adapt the Mindful Eating Questionnaire (MEQ) in a Greek sample (N = 300), with age ranging from 18 to 95 years old. Exploratory factor analysis revealed a three-factor model (Emotional Disinhibition, Awareness, Distraction) retaining 20 items (MEQ-20). Confirmatory factor analysis demonstrated a good fit between the three-factor model and the sample data. Cronbach's alpha and item-total correlations were satisfactory. As regard MEQ-20 validity, there was only weak correlation between the MEQ-20 and EAT-13 subscales and total scores. However, MEQ-20 total score significantly discriminated between participants with and without healthy BMI. The findings suggest that MEQ-20 is a reliable and valid instrument for evaluating mindful eating in the Greek population, for clinical and research applications.

Keywords: Body Mass Index, Eating disorders, Mindful eating, Mindful Eating Questionnaire

INTRODUCTION

"Mindfulness" can be defined as the discerning and non-judgmental awareness of the present moment (Kabat-Zinn, 2003). This acquired ability has been associated with many effects on health and mental health (Veehof et al., 2016; Winkens et al., 2019). The non-judgmental consciousness of physical senses and feelings, concerning eating in food-related settings, is defined as "mindful eating". The basic claim is that when an individual is aware of the reasons of their physical senses of hunger, they are better able to control their eating behaviour (Kristeller et al., 2013; Mennitto et al., 2020). This suggests that mindful eating could be used as an acquired skill in both clinical and non-clinical populations to provide health benefits.

Address: Ioanna Koptsi, Tsimiski 61, 546 25 Thessaloniki, Greece. Tel. +30- 6978424630. E-mail: joannakoptsi@gmail.com; Dimosthenis Tsapekos, e-mail: dtsapekos@gmail.com; Dimitrios G. Goulis, e-mail: dgg@auth.gr

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Mindful eating refers to focusing on the eating process without being judgmental, developing awareness of physical and emotionally triggered hunger, making conscious food choices, and eating healthfully in response to satiety cues. Mindfulness in relation to eating involves, firstly, the component of *Awareness*, which indicates the attention to the appearance, taste, and smell of the food. Another component of mindful eating is *Distraction* indicating the extent that individuals focus on other activities while eating. The third component is *Disinhibition* which corresponds to the inability to stop eating when feeling satiation. Furthermore, the component of *External Cues* is equivalent to eating in response to environmental cues (e.g., advertising), while the fifth component is *Emotional Response*, which represents eating in response to negative emotional states. There is no single conceptualization of mindful eating, however these main features are typically found in the relevant bibliography (Framson et al., 2009).

Mindfulness teaches individuals to observe upsetting physical senses, thoughts, perceptions, and emotions. By raising awareness of the above-mentioned cues, individuals are then able to accept their distress and go through it. This process helps them to avoid non-physical cues that force them to eat (Ouwens et al., 2015). Mindfulness also decreases misinterpretation of sensations as hunger and therefore helps in the reduction of eating in response to non-physical cues. Outcomes of fMRI studies indicate that mindfulness is related to reduced activity in amygdala and the anterior cingulate cortex region (Warren et al., 2017). Therefore, mindfulness reduces emotional arousal and impulsive behaviour, decreasing non-physical cues to eat, such as emotional and external, and increasing inner physical cues to eat, such as hunger and satiety.

Mindful eating can improve binge eating, emotional eating, and eating in response to external cues (Kristeller & Wolever, 2011; O'Reilly et al., 2014), assist the treatment of eating disorders (Hepworth, 2011; Warren et al., 2017), and improve food-related anxiety and body image (Konttinen et al., 2010; Zoogman et al., 2014). It can also enhance digestion and reduce stress-related symptoms, such as bloating (Kindwell et al., 2015; Weinstein et al., 2009); it has also been associated with decreased body mass index (BMI) (Cucarella & Rodriquez-Salgado, 2016; Mantzios & Giannou, 2014) and symptom improvement in type 2 diabetes mellitus (T2DM) (Wilson et al., 2017; Zhang, 2017). At the same time, various researchers have indicated that “mindless eating” fail to maintain healthy dietary achievements, following weight loss interventions (Levoy et al., 2017; Olson & Emery, 2015).

However, current bibliography sparsely reports negative or moderate effects of Mindfulness-Based Programs (MBPs) and the prevalence of its potential harm is unclear. All of the MBPs outcomes should be interpreted cautiously since most studies refer to group averages and this may mask worsening in some participants (Baer et al., 2019). In addition, MBPs report some effect on eating disorders, however, these studies do not usually have a control condition and their results are on within-condition effects (Turgon et al., 2019). Therefore, the connection between eating disorders and mindfulness is not evident and needs more exploration. Moreover, the ethical commitment requires enhancement of the monitoring methods to determine possible risks of MBPs.

The Mindful Eating Questionnaire (MEQ) was developed in 2009 (Framson et al., 2009) to provide a more accurate analysis of this concept. Since then, MEQ has been shown as a satisfactory tool to explore the way people identify dietary patterns (Artiles et al., 2019; Sala et al., 2020). As an example, the mindfulness construct helps to conceptualize the reaction to

satiety (i.e., understanding satisfaction and fullness), and identifying but not responding to cues for eating, such as advertising, dullness, or anxiety. Recently, an Italian abbreviated version of MEQ has been developed (Clementi et al., 2017) as well as a version of MEQ for children (Hart et al., 2018), an Iranian version of MEQ (Abbaspoor et al., 2018), a Malaysian version (Abdul Basir et al., 2021) and a version adjusted for pregnancy (Apolzan et al., 2016).

At the original scale (Framson et al., 2009), the mean MEQ score was 2.92 ± 0.37, with a reliability (Cronbach's alpha) of .64, while the reliability of the subscales ranged from .64 to .83. Correlations between the subscales and total score ranged from .57 to .71. Apart from the .03 correlation between external cues and emotional response, there were weak (.14) to moderate (.47) correlations between all the other subscales. At the Italian-Abbreviated version of MEQ (Clementi et al., 2017) content analysis reduced MEQ to 20 items. Exploratory and confirmatory factor analyses supported a two-factor model based on Awareness and Recognition. These factors showed adequate internal consistency (Cronbach's alpha = .75 and .83) and intraclass correlation (ICC = .73 and .85). This suggests that the six subscales of MEQ were not confirmed.

With respect the MEQ version for children (Hart et al., 2018), exploratory factor analysis revealed two factors (awareness and mindless eating) with good construct validity, while a test-retest analysis with a subsample (n = 93) indicated moderate correlations for both factors. At the Iranian version (Abbaspoor et al., 2018), MEQ content validity index score was .93. Internal consistency analysis, including Cronbach's alpha (ranging from .73 to .81) and ICC (ranging from .73 to .91) were satisfactory. The exploratory factor analysis (EFA) with the 28 items accounted for 53.78% of the observed variance and revealed a two-factor model. The results of the EFA showed that the item "*When a restaurant portion is too large, I stop eating when I'm full"* loaded the external cues subscale rather than the disinhibition subscale. This displacement improved the reliability coefficient for this subscale.

In the case of the Malaysian MEQ adaptation (Basir et al., 2021), the EFA indicated a seven-factor model explaining 58% of the overall variance. The seven factors were labeled as Environment disinhibition, Emotional response, Taste awareness, Emotion awareness, Portion disinhibition, External cues of food, and, finally, External cues of place. The factor loadings ranged from .43 to .79. The internal consistency of the whole scale was Cronbach's alpha = .64. Cronbach's alpha values of the subscales ranged from .27 to .70. As alpha values were in some of the factors nonsignificant, it is evident that the seven-factor solution is not appropriate for MEQ.

With regards the MEQ version adjusted for pregnancy (Apolzan et al., 2016), the test-retest reliability was satisfactory, r = .85, but the internal consistency reliability of the whole scale was poor, Cronbach's α = .56. The subscale alphas ranged from .59 to .68, apart from the External Cues subscale, which was not internally consistent (Cronbach's α = .31). After the exclusion of this subscale, the MEQ total scale internal consistency was acceptable (α = .62).

To sum up, both the original and the adapted versions of the MEQ presented acceptable psychometric properties supporting the applicability of the measure across different cultural settings.

Aim of the present study

For the reasons mentioned above, the construct of mindful eating has emerged as a field of great scientific interest over the last fifteen years. A recent literature review of 68 publications refers to MEQ as the most common tool used to measure mindful eating (Warren et al., 2017). The authors of MEQ have recommended the adaptation of this measure to various populations before it can be widely used for each respective one. Yet, MEQ has never been adapted to the Greek population. Filling this gap is of great importance, since such a study will contribute to the existing knowledge and will provide an instrument for use by relevant clinicians to evaluate mindful eating skills in Greek population. Therefore, the first aim of this study was to adapt MEQ to the Greek culture by examining its factor structure in a large sample of Greek adults. No hypothesis was set because of the lack of consensus on the factorial structure of the various adaptations of MEQ in other cultures/populations. The second aim was to evaluate the psychometric properties (reliability, construct validity) of the Greek version of the MEQ. To test construct validity, we used the Greek version of the Eating Attitude Test (EAT-13). The prediction was that there would be positive correlation between MEQ and EAT-13. In addition, we examined the predictive ability of the Greek MEQ using as relevant external criterion the BMI. The prediction was that mindful eating scores will sufficiently discriminate between people with and without healthy BMI.

METHOD

Sample

Three-hundred-twelve individuals participated in the study voluntarily. Twelve of them were excluded from the analyses because of incomplete data. The sample comprised students and personnel of the Medical School of the Aristotle University of Thessaloniki and the Department of Psychology of the International Faculty of the University of Sheffield (50%) as well as students, personnel, and visitors of the outpatient clinics of a General Hospital (50%). There were 192 females and 106 males, while two participants did not provide information related to gender. The constitution of the sample is presented in Table 1.

Table 1. Sociodemographic characteristics of the sample (N = 300)

Characteristics	%	*n*
Gender		
Female	64	192
Male	35.3	106
Other	0.7	2
Age (years)		
18-24	32.3	97
25-34	27.3	82
35-44	21.7	65
45-54	10.3	31
55-64	4	12
65-95	4.3	13
BMI		
Underweight	7	21
Normal weight	53	159
Overweight	29	87
Obese	11	33
Education		
Elementary School	1	3
High School	27.7	83
Technical School	4	12
Bachelor's degree	38	114
Master's degree	17.7	53
Doctor of Philosophy	11	33
Other	0.7	2
Annual Income		
≤ 10,000€	53.7	161
10,001 - 18,000€	18.7	56
18,001 - 25,000€	13.3	40
25,001-30,000€	3.3	10
> 30,001€	8.3	25
Physical Activity		
Yes	38.3	115
No	61.7	185
Eating Disorders		
Yes	1.3	4
No	98.7	296
Medication Intake		
Yes	20	60
No	80	240

Note: BMI: Body Mass Index.

Measures

Mindful Eating Questionnaire

The Mindful Eating Questionnaire (MEQ; Framson et al., 2009) comprises 28 items. Responses are on a four-point rating scale ranging from 1 to 4, where 1 is equivalent to Never/Rarely, 2 to Sometimes, 3 to Often and 4 to Usually/Always. MEQ consists of five sub-scales, namely, *Disinhibition* (i.e., inability to stop eating, even when full); *Awareness* (i.e., being aware of how food looks, tastes and smells); *External cues* (i.e., eating in response to environmental cues); *Emotional response* (i.e., eating in response to negative emotional states); and *Distraction* (i.e., not focusing on eating behaviour during the meal). After computation of the reverse scores and exclusion of the answers with a "not-applicable" response, total scores were calculated. Reverse scoring was used in the items 1, 2, 6, 7, 9, 11, 17, 18, 19, 27, 28, while "not-applicable" response was option at the items 4, 8, 17, 23. Higher scores denote higher mindfulness. The Greek version of MEQ was firstly translated into Greek. Both forward and backward translations by native Greek and native English speakers were conducted to avoid language differences and misunderstandings. The translated scale was administered to 20 participants in a pilot study. Few linguistic modifications were made in the final version.

Eating Attitudes Test-13

The Eating Attitudes Test-13 (EAT-13; Douka et al., 2009) is a 13-item self-report questionnaire that measures both symptoms and characteristic behaviours of eating disorders. Although it is not used as a standard screening tool for eating disorders, it is the optimal choice out of the validated questionnaires in the Greek language in terms of evaluating a concept related, even if not similar, to mindful eating. It is rated on a 4-point Likert-type scale, ranging from 0 to 3, where 3 stands for always, 2 is equivalent to usually, 1 to often, 0 to sometimes, rarely, or never. The responses are summed at the end and a total score is extracted, ranging from 0 (minimum) to 39 (maximum). Higher score indicates abnormal eating attitudes and a total score with a cutoff point of ≥ 20 indicates a high level of engagement with dieting behaviour and concerns about eating disorder pathology. The 13 items form three subscales, namely, *Dieting*, *Food Preoccupation*, and *Important Others*. Subscale scores are computed by summing all items assigned to a particular scale. The Greek version of EAT-13 (Douka et al., 2009) has test-retest reliability $r = .85$ ($p < .01$) and confirmatory factor analysis confirmed the model with the three subscales, χ^2 / df = 1.24, AGFI = .91. The *Dieting* scale refers to the avoidance of palatable food choices and to the continuous involvement with thinness (Cronbach's $\alpha = .69$). The *Food Preoccupation* scale refers to preoccupied bulimic behaviour (Cronbach's $\alpha = .77$). The *Important Others* subscale refers to the perceived importance of other people and the environment's pressure to gain weight (Cronbach's $\alpha = .61$).

Body Mass Index

The Body Mass Index (BMI, World Health Organization, 2021) was calculated as weight in kilograms (measured to the nearest 100 gr) divided by height in meters squared (measured to the nearest 0.5 cm), according to the guidelines of World Health Organization. BMI was categorized as follows: < 25, 25 - 29, 30 - 35, and > 35 kg/m^2.

Procedure

Nutrition Assessment Shared Resource (NASR) and Fred Hutchinson Cancer Research Center provided permission to validate MEQ in Greek. The sample was recruited in response to an announcement calling for participation. Most participants (*n* = 300) completed the questionnaires online through the Kiwi Survey Platform, whereas 50 of them received hard copies of the materials in a sealed envelope. These procedures ensured anonymity. Data was collected from January to December 2018.

Statistical analyses

To assess the factor structure of MEQ-28 for the Greek sample all original items were submitted to exploratory factor analysis (EFA; Geisinger, 2003), an approach recommended for the adaptation of a translated questionnaire to a different language/culture. EFA was run with principal component as an extraction method and oblique (direct oblimin) rotation. Oblique was preferred over orthogonal rotation since it was hypothesized that items within the original scale would be correlated to each other, even if loading to different subscales. The number of factors to be retained was determined using parallel analysis (O'Connor, 2000). This method works by creating a random dataset and computing eigenvalues (means and percentiles) for each factor based on the correlation matrix of the randomly generated dataset. Eigenvalues from the EFA factors are then compared with the 95th percentile eigenvalues from the random data and are only retained if larger. Parallel analysis has been shown to be more accurate than heuristic approaches, such as the K1 criterion (only retaining factors with eigenvalues above 1) or just visually inspecting the scree plot (Hayton et al., 2004). In terms of item retention, pre-defined criteria included a factor loading equal to or greater than .40 and the absence of cross-loading.

Items retained from the EFA were then submitted to a confirmatory factor analysis (CFA; Milfont & Fischer, 2015) to evaluate the structural validity of the newly emerged MEQ factor structure, as adapted to the Greek population. Model parameters were estimated using maximum likelihood (Kline, 2015). Goodness of fit for the model in consideration was examined using the following indices: a) Chi-squared (χ^2) and the chi-squared to degrees of freedom ratio (χ^2/df); b) the comparative fit index (CFI with a cut-off of > .90); c) the root mean square error of approximation (RMSEA with a cut-off of < .06), and d) the standardized root mean square residual (SRMSR with a cut-off of < .08) (Alavi et al., 2020).

To examine reliability of the adapted questionnaire, Cronbach's alpha coefficient was used as a measure of internal consistency for each subscale and MEQ total. The item-total correlation was also examined using Pearson's *r* coefficient. Item-total correlations were

examined for each item with the respective subscale, with *r* values equal to or greater than .30 considered as satisfactory (Clark & Watson, 1995; Steyn et al., 2005).

For the construct validity of the adapted MEQ, we first examined its convergence with the EAT-13 using Pearson's correlation. In addition, we used independent sample *t*-test to compare MEQ subscale and total scores between participants with a low and a high level of concern for eating disorders according to their EAT-13 total score. Predictive validity of the adapted MEQ was tested using logistic regression with BMI as an external criterion. MEQ would be considered to have predictive validity, if the total score could discriminate between participants with a healthy BMI (18.5-25 kg/m^2) compared to those with an abnormal BMI (< 18.5 or > 25 kg/m^2).

Potential differences in the MEQ total score between sample subgroups based on sociodemographic characteristics (i.e., age, gender, education, annual income, medication intake and physical activity) were examined using one-way analysis of variance (ANOVA) with Bonferroni correction for post-hoc pairwise comparisons. All statistical analyses were conducted using IBM SPSS Statistics (version 27) and the IBM SPSS Amos (version 27) extension for the CFA. Level of statistical significance (two-tailed) was set at .05 for all analyses conducted for this study.

RESULTS

Exploratory factor analysis

All items from the original MEQ were subjected to a principal component EFA with oblique (direct oblimin) rotation. The overall KMO measure of sampling adequacy was 0.78 and the Bartlett's test of sphericity was statistically significant ($p < .001$), suggesting that the variables considered in the EFA were to some extent correlated with each other. This confirmed the appropriateness of our extraction and rotation method for the data. Following a parallel analysis, three factors out of those extracted from the EFA were retained based on their eigenvalues being greater than those generated by the parallel analysis (Appendix, Figure 1). This 3-factor solution accounted for 41% of the variance in the original MEQ.

We examined item loadings for each factor to determine the items fitting under the three newly emerged subscales. At first, six items were excluded due to poor factor loading (< .4; items 1, 3, 8, 13, 17, and 23 of the original MEQ). In addition, two items were excluded due to cross-loading (items 22 and 25 of the original MEQ both loaded above .4 in multiple subscales). This led to an adapted version of the MEQ, including 20 items (MEQ-20) loading to three subscales in total. The factor structure and the item loadings for MEQ-20 are reported in Table 2.

Table 2. MEQ-20 factor structure based on the EFA

Items (MEQ-28 Subscale)	Emotional disinhibition	Awareness	Distraction
2 (Di)	.42		
5 (Di)	.75		
7 (Di)	.54		
9 (Di)	.62		
11 (Di)	.67		
15 (Di)	.74		
18 (Di)	.74		
19 (ER)	.42		
27 (ER)	.44		
4 (EC)		.53	
10 (A)		.66	
12 (A)		.56	
14 (EC)		.48	
16 (A)		.49	
20 (A)		.56	
21 (A)		.54	
24 (EC)		.51	
26 (A)		.60	
6 (Da)			.72
28 (Da)			.74
Cronbach's *alpha*	.79	.74	.71

The first subscale included seven items from 'Disinhibition' (items 2, 5, 7, 9, 11, 15, and 18 of the original MEQ) and two items from 'Emotional response' (items 19 and 27 of the original MEQ). This subscale was renamed *Emotional Disinhibition.* The second subscale comprised six items from 'Awareness' (items 10, 12, 16, 20, 21, and 26 of the original MEQ) and three items from 'External cues' (items 4, 14, and 24 of the original MEQ). For the MEQ-20, this subscale was renamed to *Awareness*. Finally, two items from *Distraction* were grouped under the third subscale (items 6 and 28), for which the original subscale name was maintained in the MEQ-20. A comparison of the original MEQ-28 factors and items with the adapted 20-item Greek version is presented in Table 3.

Table 3. Comparison of factors and items between MEQ-28 and MEQ-20

MEQ-28 factors	MEQ-20 factors
Disinhibition Items: 2, 5, 7, 9, 11, 15, 18, 25	Emotional disinhibition Items: 2, 5, 7, 9, 11, 15, 18
Awareness Items: 10, 12, 16, 20, 21, 22, 26	Awareness Items: 10, 12, 16, 20, 21, 26
External cues Items: 3, 4, 8, 14, 23, 24	
Emotional response Items: 13, 17, 19, 27	
Distraction Items: 1, 6, 28	Distraction Items: 6, 28

Confirmatory factor analysis

The three-factor structure of the adapted MEQ was tested with a maximum likelihood CFA. Most fit indices met the pre-defined cut-off values: a) The extracted value for chi-squared was significant, $\chi^2(143) = 250.06$, $p < .01$, which might be affected by the large sample size. However, the chi-squared to degrees of freedom ratio was below 2 ($\chi^2/df = 1.75$), which indicates a good fit between the tested model and the sample data (Alavi et al., 2020); b) the CFI was above the .90 cut-off (CFI = .92); c) the RMSEA was below .06 (RMSEA = .05, 90% CI: .04 – .06), and d) the SRMSR was below .08 (SRMSR = .06). Factor loadings were moderate to strong ($\beta > .35$), except Item 24 which had a weak loading to factor *Awareness* ($\beta = .27$). Results from the CFA are presented in Figure 1.

Reliability

Cronbach's alpha ranged from .71 to .79 for the three subscales and was .72 for the entire MEQ-20 scale, indicating acceptable internal consistency levels (see Table 2). Corrected item-total correlations (as estimated by Pearson's *r* coefficient) with the respective subscale ranged from .31 to .62 for *Emotional Disinhibition*, from .35 to .50 for *Awareness*, and from .54 to .55 for *Distraction*. None of the items showed a correlation below the threshold of .30 with its respective factor.

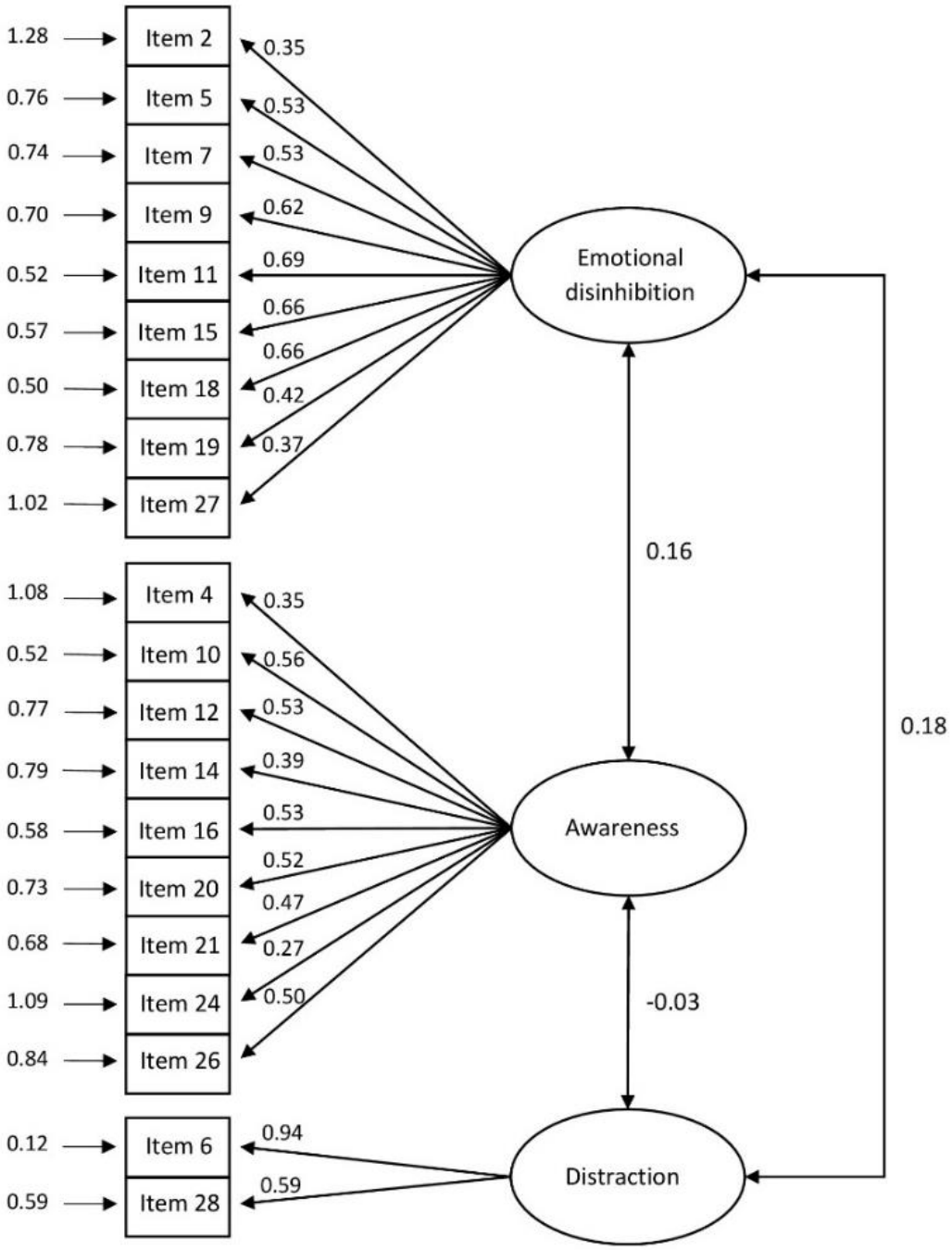

Figure 1. Standardized solution of the confirmatory factor analysis for the three-factor MEQ-20, including measurement error variance, factor loadings, and correlations among factors

Among the MEQ-20 subscales, significant positive correlations were observed between the three subscales and the total, r = .23 – .76, p < .001, while *Distraction* was positively correlated with *Emotional Disinhibition*, r = .14, p = .02, and negatively with *Awareness*, r = -.13, p = .02.

Validity

For the construct validity of the MEQ-20, we examined its convergence with the EAT-13 questionnaire. Correlations between MEQ-20 and EAT-13 subscales were low, with significant *r* values ranging between .14 and .23 (see Table 4). Of note, the EAT-13 subscale demonstrating the strongest significant correlations with MEQ-20 total score was 'Food preoccupation', $r = .25$, $p < .001$. Total scores of the two instruments were not significantly correlated, which suggests a weak overall convergence between the MEQ-20 and the EAT-13. Comparing MEQ-20 scores between participants with low and high levels of concern for eating disorders according to their EAT-13 total score, we found that only scores in *Awareness* differed significantly between these two subgroups, $t(298) = -2.21$, $p = .03$, with greater mindful eating scores for those with higher levels of concern, Cohen's $d = 0.26$. Details for all comparisons are provided in Table 4.

Table 4. Means, standard deviations (SD), and t-test values of the MEQ-20 subscales per EAT-13 levels

MEQ-20	EAT-13 levels of concern for ED			
	Low level (n = 173)	High level (n = 127)	*t* statistic	*p*
MEQ-20 Emotional Disinhibition	2.71 (.61)	2.66 (.67)	2.29	.13
MEQ-20 Awareness	2.65 (.61)	2.79 (.52)	3.65	.05
MEQ-20 Distraction	2.51 (.82)	2.52 (.89)	0.81	.36
MEQ-20 Total score	2.66 (.41)	2.71 (.39)	0.12	.72

Note: EAT-13: Eating Attitude Test 13-item; ED: Eating disorders; MEQ-20: Mindful Eating Questionnaire 20-item.

For assessing predictive validity, logistic regression was carried out with the MEQ-20 total score as a predictor and the binary coded BMI (i.e., healthy: $n = 159$; abnormal: $n = 141$) as an outcome. MEQ-20 total score significantly predicted BMI categorization, $\chi^2(1) = 15.3$, $p < .001$; Odds Ratio (OR) = 0.31, 95% CI 0.17 – 0.57. According to the OR index, having an abnormal BMI is significantly less likely as the score of mindful eating increases. Specifically, for each 1-unit increase in the MEQ-20 total score the odds of having an abnormal BMI decrease by 21% on average. Thus, MEQ-20 was able to significantly distinguish participants with health BMI from those with an abnormal one, suggesting good predictive validity for the scale.

Table 5. Correlation coefficients between MEQ-20 and EAT-13 subscales and total scores (N = 300)

	EAT-13 Food preoccupation		EAT-13 Dieting		EAT-13 Important others		EAT-13 total score	
MEQ-20	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*
Emotional Disinhibition	.13	.01	-.11	.05	-.23	< .01	-.03	.52
Awareness	.22	.00	.13	.01	.08	.13	.21	.00
Distraction	.02	.63	.02	.64	-.07	.21	.00	.93
Total score	.24	.00	.01	.81	-.12	.03	.11	.05

Note: EAT-13: Eating Attitude Test 13-item; MEQ-20: Mindful Eating Questionnaire 20-item.

Differences between sociodemographic subgroups

One-way ANOVAs were conducted to examine mindful eating differences across participant subgroups for different sociodemographic characteristics. There was a significant main effect of age, $F(5, 294) = 5.18$, $p < .001$, $\eta_p^2 = .08$, and BMI, $F(3, 296) = 6.08$, $p < .001$, $\eta_p^2 = .06$, on MEQ-20 total score. Post-hoc comparisons with Bonferroni correction showed that there was no significant difference in MEQ-20 total score between the age subgroups, except for the older adults. Participants in the 65-95 age subgroup scored significantly lower compared to all other age groups ($M = 2.22$, $SD = 0.49$; all ps < .02). For BMI subgroups, Bonferroni corrected post-hoc comparisons revealed that participants in the normal weight category had the highest MEQ total score ($M = 2.77$, $SD = 0.38$), while overweight participants had the lowest score ($M = 2.55$, $SD = 0.43$) followed by obese and underweight participants. The difference between normal weight and overweight participants was the only statistically significant between BMI subgroups ($p < .001$).

Although no difference was detected between genders in the MEQ-20 total score, male and female participants scored differently regarding *Awareness* (men: $M = 2.58$, $SD = 0.61$; women: $M = 2.79$, $SD = 0.54$), $F(2, 297) = 5.25$, $p = .006$, $\eta^2 = .03$, and *Distraction* (men: M = 2.69, SD = 0.87; women: M = 2.42, $SD = 0.83$), $F(2, 297) = 3.63$, $p = .03$, $\eta_p^2 = .02$. Further exploratory analyses revealed no association between MEQ scoring and education level, physical exercise, annual income, and medication uptake.

DISCUSSION

The aim of this study was to adapt the MEQ in the Greek adult population, through the evaluation of its factor structure, and evaluation of its psychometric properties. In accordance with EFA results, MEQ-28 was revised to 20 items (MEQ-20), with three factors: *Emotional Disinhibition* (i.e., one's inability to stop eating, even when full and eating in response to negative emotional state), *Awareness* (i.e., one's awareness of food components and eating in response to environmental stimulus), and *Distraction* (i.e., one's focus on other activities while eating). The fit of the three-factor adapted MEQ (MEQ-20) was supported by the results of a CFA. Cronbach's alpha indicated acceptable internal consistency levels for all emerging subscales and the MEQ-20 as a whole. Convergence between the MEQ-20 and the EAT-13 subscales was poor overall, with *Food Preoccupation* being the eating attitude dimension

presenting the strongest association with mindful eating. In addition, MEQ-20 scores significantly discriminated between people with and without a healthy BMI. Our findings suggest that the dimensionality of mindful eating, as measured by the MEQ, might vary between cultures with different eating traditions and practices. However, the adapted MEQ-20 may be considered valid for the detection of certain dysfunctional eating habits and potential body weight problems.

The MEQ adaptation to the Greek culture indicated 20 items and three subscales, namely, *Emotional Disinhibition, Awareness,* and *Distraction*. The third factor was not strong, because it comprised only two items. The three factors had acceptable internal consistency levels. Although not directly comparable, the alphas of MEQ-20 were more satisfactory than those of the original scale (Framson et al., 2009), Iranian (Abbaspoor et al., 2018), Malaysian (Abdul Basir et al., 2021), and pregnancy scale (Apolzan et al., 2016).

With regards the factorial structure of MEQ-20, our findings are different from the American original instrument (Framson et al., 2009) as well as the Iranian (Abbaspoor et al., 2018) and Malaysian adaptations (Abdul Basir et al., 2021), in which all the items were maintained. The structure of the Greek MEQ-20 also differed from that of the Italian version (Clementi et al., 2017), in which 20 items were preserved. Our findings suggest that eating traditions and practices reflecting the cultural identity of Greek people are partly different from American, Malaysian, and Iranian populations, where the MEQ has been also adapted. These findings suggest different effects of food-advertisement, food consumption, and attitudes towards food and cultural practices among all these populations (Bendall et al., 2018; Lopez-Guimera et al., 2012). Therefore, the factors that emerged in this study depict unique characteristics of this sample of participants. Further cross-cultural exploration is needed to better comprehend the dimensionality of MEQ in various cultures, especially now that there are already relevant findings.

As regards the construct validity of the MEQ-20, correlations between MEQ-20 and EAT-13 subscales were small. Total scores of the two instruments were not significantly correlated which suggests a weak overall convergence between the MEQ-20 and the EAT-13. Comparing MEQ-20 scores between participants with low and high levels of concern for eating disorders according to their EAT-13 total score, we found that only scores in Awareness differed significantly between these two subgroups, with greater mindful eating scores for those with higher levels of concern. In previous research, many studies focused on the effectiveness of MBPs regarding the treatment of eating disorders (McMaster et al., 2020; Richards et al., 2017). However, there are findings suggesting that individuals with eating disorders have decreased emotional awareness, acceptance, and affect regulation basic notions that have been connected to mindfulness (Butryn et al., 2013). Other studies have found that mindful eating is not predictive of eating disorder risk, since mindful eating is predominantly used for weight management (Chetluru, 2018). Therefore, the connection between eating disorders and mindfulness is not clearcut. MBPs show some effect on eating disorders, however, a definitive conclusion cannot be drawn, since these studies do not usually have a control condition (Turgon et al., 2019). Redefining the terms of mindful eating, mindful eating behaviour and MBPs would advance the scientific enquiry and provide more consistent findings (Mantzios, 2020).

There is also a question as to whether the MEQ-20 subscales can predict the risk of developing an eating disorder. This is because the construct of mindful eating was developed based on responses of healthy populations. The weak associations between MEQ-20 and EAT-

13 underscore the differences between them, albeit these two questionnaires measure similar phenomena. EAT-13 was the optimal choice out of the validated questionnaires in the Greek language in terms of evaluating a concept related, even if not similar, to mindful eating.

As hypothesized, MEQ-20 was able to significantly distinguish participants with healthy BMI from those with an abnormal one. Moreover, for BMI subgroups, findings revealed that participants in the normal weight category had the highest MEQ total score, that is, highest eating mindfulness. According to previous literature and the original version of the MEQ, the encouragement of mindful eating is a promising intervention to be included in general weight management to the public. The findings of the original MEQ suggested that high BMI was associated with lower scores on all MEQ subscales, suggesting mindful eating might be useful for long-term weight maintenance (Framson et al., 2009). However, at the Iranian (Abbaspoor et al., 2018) and Malaysian (Abdul Basir et al., 2021) adaptations of MEQ the correlations between BMI and MEQ total scores were not significant. Further research is needed to delineate the relations between mindful eating and BMI.

Our findings further showed a significant main effect of age on MEQ-20 total score with the significant difference located in the comparison of the older adults (65-95) group compared to all others. This finding may have a methodological explanation, that is, the small sample size of this group. However, there is limited literature on mindful eating in older adults as well as the adequacy of MEQ as a valid measure for this age group (Morone & Greco, 2014).

Moreover, the present study showed gender differences, with female participants scoring higher in Awareness and male participants scoring higher in Distraction. However, previous research suggested that females, especially overweight and obese, are usually less mindful eaters in response to emotional cues (Demirbas et al., 2021; Framson et al., 2009). Males, on the other hand, seem to have reduced risk for disordered eating behavior. Nevertheless, they report overeating and are at similar risk for obesity and health consequences related to obesity as women do (Striegel-Moore et al., 2009). Therefore, effective weight management approaches are necessary for both men and women. Further research focusing on the predictors of mindful eating in the two genders is needed.

Limitations

This study used self-report questionnaires, and therefore is subject to the criticism regarding self-reports as measures of behavior. Participants may overstate or underestimate and/or hide their dysfunctional behaviors related to eating-disorders. Moreover, there was no test-retest reliability analysis to measure short-term (1 week or 1 month) stability of the scores across time. Including diagnosed with eating disorders participants in the sample of adults is a step needed in future research. The same regards older adults who often need to be in control of their dietary behaviours.

Implications and further applications

Mindful eating is a skill, related to mindfulness in general, that can be exercised in clinical practice as an additional tool to maintain healthy BMI. Various illnesses both affect and are affected by dietary patterns. As numerous patients experience emotional distress due to their illness, emotional eating needs to be contained. A mindfulness-based training could be an

important tool for clinicians. It would be interesting to study mindful eating in various illnesses, such as gestational diabetes mellitus. In this way, clinicians and researchers will have a practical tool to explore mindfulness, as a specific component, of relevant disorders and illnesses.

Moreover, emotional eating has been associated with macronutrient-poor, high-fat, high-sugar and high-salt foods (Konttinen et al., 2010; Olson & Emery, 2015). People under emotional distress seem to prefer unhealthy food choices, without being aware of the process, stimuli, and emotional cues. At the same time, these foods tend to cost less than healthy choices and, therefore, are consumed more easily and commonly. Therefore, more careful inclusion of such food choices at schools and the market may result in more beneficial and long-term outcomes regarding dietary behaviour.

Conclusion

Our findings suggest that MEQ-20 is a reliable and valid instrument for evaluating mindful eating in the Greek population which, after careful testing in non-healthy populations, can be useful for both clinical and research applications. Clinicians and researchers will have a practical instrument to evaluate mindful eating in healthy and, possibly, nonhealthy populations. Likewise, the availability of MEQ-20 for the Greek population may reinforce the consideration of mindful eating as part of the clinical practice and the integration of interventions tackling mindful eating into both general weight management and the specialised management of certain conditions, such as gestational diabetes mellitus.

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