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Development and Validation of the Mindful Eating Questionnaire

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Abstract

"Mindful eating" describes a non-judgmental awareness of physical and emotional sensations associated with eating. This manuscript reports the development of a mindful eating questionnaire (MEQ) to support rigorous scientific inquiry into this concept. An item pool was developed based on hypothesized domains of mindful eating. A cross-sectional survey examined associations of MEQ scores with demographic and health-related characteristics. The MEQ was distributed to seven convenience samples between January- May, 2007, with an overall response rate of 62% (n=303). Participants were mostly female (81%) and white (90%), and had a mean age of 42±14.4 years (range 18–80 years). Exploratory factor analysis was used to identify factors, which were defined as the mean of items scored 1 to 4, where 4 indicated higher mindfulness; the mean of all factors was the summary MEQ score. Multiple regression analysis was used to measure associations of demographic characteristics, obesity, yoga practice and physical activity with MEQ scores. Domains of the final 28-item questionnaire were: Disinhibition, Awareness, External Cues, Emotional Response, and Distraction. The mean MEQ score was 2.92 ± 0.37, with a reliability (Chronbach's alpha) of 0.64. The covariate-adjusted MEQ score was inversely associated with BMI (3.02 for BMI <25 vs. 2.54 for BMI >30, p <0.001). Yoga practice, but neither walking nor moderate/intense physical activity, was associated with higher MEQ score. In this study sample, the MEQ had good measurement characteristics. Its negative association with BMI and positive association with yoga provide evidence of construct validity. Further evaluation in more diverse populations is warranted.

INTRODUCTION

Nutrition researchers and practitioners have recently adopted the construct of "mindfulness" to better understand and modify dietary behavior. Mindfulness, which is well described in the

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scientific literature by Kabat-Zinn and others (1–5) can be defined succinctly as an astute, non-judgmental awareness of the present moment. Mindfulness is a learned skill that is linked to many positive health outcomes, including increased immune function and decreased anxiety and chronic pain (1–4,6). When considered in the context of nutrition, "mindful eating" can be used to describe a non-judgmental awareness of physical and emotional sensations while eating or in a food-related environment. Because mindful eating engenders awareness of why one eats, it may be a helpful weight loss or maintenance skill. For example, mindful eating skills could help clients to recognize and respond to satiety, or to recognize but not respond to inappropriate cues for eating such as advertising, boredom or anxiety. Mindfulness skills are distinct from the cognitive skills most commonly taught for weight management, such as meal planning, record keeping and portion control. Indeed, some scientists have hypothesized that "mindless eating" explains the poor long-term success of most weight loss interventions (7, 8).

In a recent study, regular yoga practice was associated with an attenuation of weight gain in middle-age adults (9) which was independent of both diet and physical activity. Researchers hypothesized that yoga may have led to less weight gain because of the mindfulness skills taught in the context of yoga through its focus on breath, conscious movement through challenging physical poses, and meditation. To test whether yoga does in fact increase mindfulness and mindful eating, it is necessary to have a valid and reliable measure of mindful eating. There are several published scales of mindfulness (10–13), but none address the more focused construct of mindful eating. A valid and reliable tool for measuring mindful eating will allow nutrition researchers to investigate whether and how mindful eating skills are acquired through different practices/interventions and also whether and how mindful eating is associated with healthful dietary behavior and related health outcomes. This describes the development and preliminary evaluation of a new scale to measure mindful eating, called the Mindful Eating Questionnaire (MEQ). As part of this evaluation, yoga practitioners were tested to determine if they have higher MEQ scores than non-practitioners and whether lower MEQ scores are associated with body mass index.

METHODS

Questionnaire Development

Domains of Mindful Eating—Published research both in eating behavior and mindfulness was used to generate a list of potential constructs for the MEQ. For diet, these included the Three Factor Eating Scale (14), the Dutch Eating Behavior Questionnaire (15), and the Emotional Eating Scale (16), from which three constructs were selected: 1) Disinhibition, the inability to stop eating even when full; 2) External eating, eating in response to environmental cues; and 3) Emotional eating, eating in response to negative emotional states. Cognitive restraint was also included in the questionnaire to support an evaluation of its independence from mindful eating. For mindfulness, the Mindful Attention Awareness Scale (12), the Freiburg Mindfulness Inventory (11), the Kentucky Inventory of Mindfulness Skills (10), the Cognitive and Affective Mindfulness Scale (11), the Mindfulness Questionnaire (11) and a published factor analysis of items from these five scales (11), were evaluated, from which two very broad constructs were selected: 1) Observing, noticing or attending to sensations, perceptions, thoughts, and feelings; and 2) Acting with awareness. These were further refined to 1) Organoleptic awareness, being aware of and appreciating the effects of food on the senses; 2) Affective sensitivity, being aware of how food affects internal states; and 3) Distraction, focus on other activities while eating.

Development of Item Pool—For each of the seven eating behavior and mindfulness constructs, 2–6 items were generated that addressed either awareness or behaviors associated

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with each construct. For example, “I snack without noticing that I am eating” addresses behavior related to distraction whereas “I recognize when food advertisements make me want to eat” addresses awareness related to external eating. This process resulted in a total pool of 40 items for further evaluation. For all items, response options were “Never/Rarely,” “Sometimes,” “Often,” and “Usually/Always.” Four items included an option to indicate that a question did not apply.

Pilot studies—The preliminary item pool was piloted in two stages. One author (CF) conducted interviews either in person or via telephone with five participants (ages 28–60 years, four women, all college graduates) to ensure items were intelligible and unambiguous. For each item, participants reported on clarity of meaning and gave their interpretation. Based on these interviews, three items were eliminated and several were modified to reduce ambiguity. The 37-item written questionnaire was administered to 20 nutrition professionals, and their feedback was used to further clarify item text.

Study Population

Data for this cross-sectional study were collected between January-May, 2007. Questionnaires with self-addressed stamped envelopes were distributed to 510 individuals who comprised seven convenience samples: 200 at one yoga studio; 100 at a university fitness facility; 40 at a weight loss program; 40 at a women’s weight loss and fitness facility; 40 at a software development company; 40 at a non-profit company; and 50 teachers and administrators at a preparatory school. A yoga studio, fitness facilities, and weight loss programs were deliberately sampled to address hypotheses on the associations of mindful eating with obesity and yoga practice. Participants also provided self-reported information on weight, height, age, sex, race/ethnicity, highest level of education achieved, yoga practice (usual frequency and duration and years of practice), walking for exercise or transportation (days per week and minutes per day) and moderate or strenuous exercise (days per week and minutes per day). All activities were approved by the Institutional Review Board of the Fred Hutchinson Cancer Research Center.

Statistical Analysis

Exploratory Factor Analysis—Exploratory factor analysis was conducted using the maximum likelihood method with oblique rotation to allow for easier interpretation of the factor structure. To incorporate the “not applicable” option for several items, the matrix of pairwise correlation coefficients was used rather than raw data, and Cognitive Restraint items were not included because of the *a priori* hypothesis that it was not related to mindful eating. Based on an examination of eigenvalues, scree plots and item loading a 5 factor solution was selected. Three items were eliminated because their factor loadings were <0.3, and one additional item was dropped because it loaded similarly on 3 factors. The final scale consisted of 28 items and 5 subscales: 1) Disinhibition; 2) Organoleptic Awareness (subsequently renamed “Awareness”); 3) External Cues; 4) Emotional Response; and 5) Distraction. The questionnaire items are given in Table 1.

Scoring—Each item was scored from 1 to 4, where higher scores signified more mindful eating. Each subscale score was calculated as the mean of items, excluding those with a “not-applicable” response. The summary score was the mean of the 5 subscales.

Data Analyses and Hypotheses Testing—Body mass index (BMI) was calculated as weight (kg)/ height $(m)^2$. Categorical variables were created for years of age (18–30, 31–50, ≥51), years of education (<16, 16, >16), BMI (<25, 25–29, ≥30), and years of yoga practice (<2, 2–4, ≥5). To derive variables for yoga, walking, and moderate/strenuous exercise, the reported number of days per week was multiplied by the number of minutes per day to create categorical variables for minutes of yoga per week (≤60, 61–120, >120), minutes of walking

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per week (<90, 90–200, >200) and minutes of moderate/strenuous exercise per week (≤90, 91–160, >160). For statistical analyses, race was categorized as White and Other because only 10% of the sample was non-White Cronbach's alpha was used to measure the internal consistency reliability. Pearson correlation coefficients were used to describe the relations among the subscales. Linear regression was used to examine associations of MEQ scores with demographic characteristics, BMI, yoga, walking and exercise. Tests for linear trend were performed using an ordinal variable, as described by Breslow and Day (17). Statistical analyses were performed using SAS (version 9.1, 2007, SAS Institute, Cary, NC).

RESULTS AND DISCUSSION

Of the 510 questionnaires mailed to study participants, 314 (62%) were returned and 11 (3%) were excluded from analysis due to missing data. Response rates ranged from 73% from the yoga studio to 34% from the preparatory school. Participant characteristics are given in Table 2. Study participants were predominantly female (81%), white (90%), and well educated (86% had ≥16 years of school), and ranged in age from 18 to 80 years (mean = 42.0±14.4 years). Almost 41% of participants practiced yoga more than 1 hr per week, 46% walked for exercise or transportation for at least 90 minutes per week, and more than 52% engaged in more than 90 minutes of moderate and/or strenuous physical activity per week. BMI ranged from 17.7 to 62.0 (mean = 24.2±5.1), and was lower among participants practicing yoga compared to those not (mean = 23.1±2.9 vs. 25.8±2.9), and lower among participants engaging in moderate or strenuous exercise compared to those not (mean = 23.9±4.4 vs. 25.4±7.1). Yoga practitioners were older than non-practitioners (mean = 47.0±13.7 vs. 37.0±13.6 years), and participants who engaged in moderate or strenuous exercise were younger than those who did not (mean = 42.0±14.7 vs. 46.0±12.7 years). This study sample consisted of persons who were more physically active and less obese than in the United States (US) population overall, which was expected and intentional given our sampling procedures and hypotheses.

The MEQ had good psychometric properties. Each subscale, although consisting of between only 3 and 8 items, had good internal consistency reliability, ranging from 0.64 to 0.83 (Table 1). The reliability of the MEQ summary score (mean of the 5 subscale scores) was also good (0.64). With the exception of the 0.03 correlation between External Cues and Emotional Response, there were modest (0.14) to moderate (0.47) correlations among all subscales, and correlations between the subscales and summary score ranged from 0.57 to 0.71 (Data on correlations among scale scores are available from authors).

The subscales for the final MEQ were consistent with the hypothesized domains with two exceptions. First, the Affective Sensitivity domain became subsumed by the Awareness domain; two of the three items measuring affective sensitivity loaded strongly on the Awareness subscale and the third item was dropped due to low factor loading. The difference between affective sensitivity, which involves awareness of internal states, and organoleptic awareness, which involves awareness of the senses, is quite subtle and it is reasonable that they be part of the same construct. Second, two items, "I have trouble not eating ice cream, cookies or chips if they're around the house" (hypothesized to belong to the External Eating subscale) and "I snack without noticing that I am eating" (hypothesized to belong to the Distraction subscale) loaded on the Emotional Response factor. The clustering of these items with Emotional Eating may reflect a unique characteristic of the study sample or a common behavioral response to emotional stress.

The mean MEQ summary score was 2.92±0.37. In a model including sex, race, age, education and BMI, only age and BMI were associated with the MEQ summary score. (Data are available upon request from authors). Participants aged ≤30 years had lower mean scores than those older (2.79 vs. 2.99, $p<0.01$) and contrasts of MEQ means across BMI groups (<25, 25–<30,

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≥30) were 3.02, 2.77 and 2.54 (p_{trend}<0.001). Higher age was associated with higher scores on all MEQ subscales except distraction; however after control for yoga practice these associations were no longer significant. Higher BMI was associated with lower scores on all MEQ subscales, which suggests that mindful eating can play an important role in long-term weight maintenance. Among the subscales, the largest difference between BMI categories was for Emotional Response; across BMI categories (<25, 25–<30, ≥30) the mean Emotional Response scale scores were 3.21, 2.83 and 2.50 (p_{trend} <0.001). The mean emotional response scale score was also significantly lower in women than men (3.26 vs. 3.01, p<0.01), which suggests that women may be more likely than men to respond to emotional distress by eating. More research in a larger and more diverse population is needed to better understand how these demographic characteristics are predictive of mindful eating.

Table 3 gives results of multiple regression analyses, examining associations of yoga practice, walking and exercise with the summary MEQ score. Both the number of years of yoga practice and the number of minutes of practice per week were associated with higher MEQ scores and, although these relationships were attenuated somewhat by control for BMI, they remained strong and statistically significant. In contrast, there were no or very weak inverse associations of other measures of physical activity with the MEQ score, suggesting that the association of yoga with the MEQ score was attributable to mindfulness training and not to the physical activity aspect of yoga practice. The association between current minutes per week of yoga practice and MEQ summary score was independent of other physical activity (walking and moderate/strenuous exercise). Walking more than 200 minutes per week was associated with a lower MEQ score, however this was likely a chance finding because there was no dose-response relationship and no association except in the statistical model that controlled for BMI plus moderate/vigorous exercise. Yoga encourages practitioners to adopt and maintain challenging physical poses with an accepting, calm mind and focus on the breath. This type of experience teaches mindfulness skills and may enable individuals to successfully navigate difficult food environments and more accurately judge their motivations for eating.

The Cognitive Restraint subscale was inversely correlated with all MEQ subscales, providing good evidence that cognitive weight loss/maintenance strategies (use of calorie counting, weight monitoring and other cognitive strategies) are independent from the construct of mindful eating. The internal consistency of the Cognitive Eating subscale was good (0.73), suggesting that construct was measured reliably. This finding is reassuring regarding the potential utility of teaching mindful eating skills in addition to cognitive strategies to improve the effectiveness of weight loss interventions.

This study confirmed several hypotheses regarding the nature of mindful eating, which supports the construct validity of the MEQ (at least in this study sample). As hypothesized, there were significant and strong inverse associations of all subscales and the summary score with BMI, and these were independent of age, sex, race and education. In a linear model adjusted for these demographic characteristics, each unit increase in BMI was associated with a 0.028± 0.004 decrease in the MEQ summary score (p <0.001). Also as hypothesized, regular yoga practice, which is associated with mindfulness generally, but not other types of physical activity, was associated with a higher MEQ summary score. Finally, Cognitive Restraint, which was hypothesized to be distinct from mindful eating, was indeed independent of constructs measured by the MEQ.

There are several limitations to this study. Most importantly, the study sample consisted of seven convenience samples, and was not representative of the broad race, educational and social diversity that characterizes the US population. In addition, response rates differed across samples and were particularly low in the school, which may further weaken the generalizability of results. Additional research is needed to evaluate the MEQ in more diverse populations.

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Second, most of the yoga practitioners included in this study were recruited from a single yoga studio in which mindfulness is emphasized. There are many approaches to teaching and practicing yoga, and our findings regarding yoga and mindful eating require replication in a broader range of types of yoga practice. This study was cross sectional and observational, and it is not possible to make inferences about temporal associations or cause and effect. Third, the measure of physical activity was based on few items and, although this measure correlates well with more detailed measures of physical activity (18), it may not have been sufficiently precise to detect associations with the MEQ. Finally, test-retest reliability was not measured, and this will need to be evaluated before the scale can be used in applied research settings.

CONCLUSION

A 28-item scale was developed to measure the construct of mindful eating. It is relatively short, yet has good internal consistency reliability. Based on its associations with yoga practice and BMI, and its independence from cognitive restraint, there is also evidence that the scale has good construct validity. The association of mindful eating with yoga practice suggests that mindful eating is a skill that, similar to mindfulness overall (2,3), can be learned. Further research is needed to better characterize the instrument's psychometric characteristics, including test-retest reliability and predictive validity, and to document the relationship of the MEQ with actual dietary practices. Nevertheless, the MEQ as developed here is a first step in characterizing and measuring mindful eating, and it may be useful both in clinical practice and research to understand and promote healthful dietary behavior.

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Table 1

Items and subscales of the Mindful Eating Questionnaire, with subscale internal consistency reliability and item-total correlations

Factor and Items	Cronbach's Alpha	Item-Total Correlation[a]
Factor 1: Disinhibition	**0.83**	**0.71**
I stop eating when I'm full even when eating something I love.		0.67
When a restaurant portion is too large, I stop eating when I'm full.		0.65
When I eat at "all you can eat" buffets, I tend to overeat.		0.63
If there are leftovers that I like, I take a second helping even though I'm full.		0.61
If there's good food at a party, I'll continue eating even after I'm full.		0.60
When I'm eating one of my favorite foods, I don't recognize when I've had enough.		0.53
When I'm at a restaurant, I can tell when the portion I've been served is too large for me.		0.43
If it doesn't cost much more, I get the larger size food or drink regardless of how hungry I feel.		0.30
Factor 2: Awareness	**0.74**	**0.69**
I notice when there are subtle flavors in the foods I eat.		0.59
Before I eat I take a moment to appreciate the colors and smells of my food.		0.57
I appreciate the way my food looks on my plate.		0.55
When eating a pleasant meal, I notice if it makes me feel relaxed.		0.41
I taste every bite of food that I eat.		0.41
I notice when the food I eat affects my emotional state.		0.36
I notice when foods and drinks are too sweet.		0.35
Factor 3: External Cues	**0.70**	**0.57**
I recognize when food advertisements make me want to eat.		0.61
I notice when I'm eating from a dish of candy just because it's there.		0.54
I recognize when I'm eating and not hungry.		0.48
I notice when just going into a movie theater makes me want to eat candy or popcorn.		0.43
When I eat a big meal, I notice if it makes me feel heavy or sluggish.		0.32
At a party where there is a lot of good food, I notice when it makes me want to eat more food than I should.		0.24
Factor 4: Emotional Response	**0.71**	**0.65**
When I'm sad I eat to feel better.		0.61
When I'm feeling stressed at work I'll go find something to eat.		0.60
I have trouble not eating ice cream, cookies, or chips if they're around the house.		0.42
I snack without noticing that I am eating.		0.39
Factor 5: Distraction	**0.64**	**0.57**
My thoughts tend to wander while I am eating.		0.55
I think about things I need to do while I am eating.		0.48
I eat so quickly that I don't taste what I'm eating.		0.33

[a]Individual item scores are correlated with the score of the factor which contains that item; factor scores are correlated with summary score.

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Table 2

Characteristics of study population completing the Mindful Eating Questionnaire (n=303)

	n[a]	%
Sex		
Male	59	19.5
Female	244	80.5
Age (yrs)		
18–30	87	28.7
31–50	108	35.6
≥51	107	35.3
Race		
White	272	89.8
Asian	14	4.6
Other	16	5.3
Education (yrs)		
<16	41	13.5
16	108	35.6
>16	148	48.8
Body Mass Index (kg/m^2)		
<25	207	68.3
25–29.9	72	23.8
≥30	24	7.9
Walking (min/wk)		
0	50	16.6
1 – <90	113	37.4
90–200	72	23.8
>200	67	22.2
Moderate and/or Strenuous Exercise (min/wk)		
0	62	20.5
>0 – ≤90	82	27.1
91 – 160	94	31.0
>160	65	21.4
Current Yoga Practice (min/wk)		
0	129	43.1
>0 – ≤60	46	15.4
61–120	61	20.4
>120	63	21.1

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	n[a]	%
Lifetime Yoga Practice (yrs)		
0	129	43.1
>0 – <2	28	9.4
2–4	23	7.7
≥5	119	39.8

[a]Numbers vary slightly due to missing responses

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Table 3

Regression coefficients (β ± se) for models examining associations of yoga and physical activity with the Mindful Eating Questionnaire summary score (n=303)

	Model 1[a]	Modal 2[b]	Modal 3[c]
Lifetime Yoga Practice (years vs. none)			
<2	0.15 ± 0.08[d]	0.07 ± 0.07	
2–4	0.12 ± 0.08	0.05 ± 0.08	
≥5	0.26 ± 0.05[f]	0.16 ± 0.05[e]	
Current Yoga (min per week vs. none)			
≤60	0.11 ± 0.06	0.04 ± 0.06	0.05 ± 0.06
61–120	0.20 ± 0.06[d]	0.12 ± 0.06[d]	0.14 ± 0.06[d]
>120	0.30 ± 0.06[f]	0.21 ± 0.06[f]	0.22 ± 0.06[f]
Walking (min per week vs. none)			
<90	0.06 ± 0.06	0.03 ± 0.06	0.02 ± 0.06
90–200	0.08 ± 0.07	0.03 ± 0.06	0.002 ± 0.06
>200	−0.01 ± 0.07	−0.10 ± 0.06	−0.13 ± 0.06[d]
Exercise (min per week vs. none)			
≤90	0.05 ± 0.06	0.03 ± 0.06	0.02 ± 0.06
91–160	0.09 ± 0.06	0.05 ± 0.06	0.07 ± 0.06
>160	−0.02 ± 0.07	−0.06 ± 0.06	−0.04 ± 0.06

[a] Adjusted for covariates (sex, age, race, and education level)

[b] Adjusted for covariates and BMI

[c] Adjusted for covariates and BMI, controlled mutually for yoga minutes per week, walking, and moderate/strenuous exercise

[d] p<0.05

[e] p<0.01

[f] p<0.001