

Mindful Eating Proficiency and Healthy Eating Literacy in Japanese Mothers: Associations with Their Own and Their Children's Eating Behavior

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Abstract

Purpose

Mindfulness is a psychological process that can be developed using meditation and other types of training to focus on the present moment. Applying this concept to eating (i.e., mindful eating; ME) is associated with regulated eating behavior, especially in overweight or obese people. Sustaining healthy eating habits requires both healthy eating literacy (HEL) and proficiency in ME. However, ME proficiency in Japanese people has not been sufficiently investigated.

Methods

We conducted a survey of mothers with 4 to 5-year-old children in Aomori City, Japan, to investigate their ME proficiency and HEL level, as well as eating behavior and self-reported body mass index in both mothers and their children. This study was the first to describe ME proficiency in Japanese mothers.

Results

ME proficiency in mothers was positively correlated with both their own and their children's eating behaviors, suggesting a potential relationship, while strong relationships were not observed between the HEL level and eating behaviors of mothers and children.

Conclusion

Improving ME skills, rather than HEL, may be an effective way to sustain healthier eating behaviors in mothers and their children.

Level of evidence:

Level I, Evidence obtained from experimental studies

1. Introduction

Mindfulness is the psychological process of focusing attention on the present moment [1–3], which can be developed through meditation and other training [1, 3, 4]. The application of mindfulness to eating has developed into a personal approach to improving eating behavior, referred to as *mindful eating* (ME) [5].

Regarding ME and its practice, previous research has suggested that ME includes awareness of internal and external cues influencing the desire to eat, food choices, the amount eaten, and the manner in which it is eaten [6]. Mindful eating also includes making conscious choices and learning to be more aware of cues indicating fullness [7]. Paying attention to these two factors has been shown to lead to healthier eating [8]. Further, ME includes awareness of hunger and satiety, eliminating distractions, knowing the consequences of eating

inattentively, choosing appealing and nutritious food, and judging how much to eat [9]. Thus, ME guides opinions on what, why, when, and how much to eat [10].

Studies have demonstrated ME's effectiveness in treating eating disorders in obese women [11], as well as emotional eating in overweight and obese women [10]. Mindful eating also appears to effectively manage binge eating [7, 12–16], emotional eating [17, 18], external eating [17, 19], cravings [20, 21], hunger awareness [22], food intake [8, 22–24], and food choice [24, 25]. Numerous studies have also demonstrated an association between ME and weight loss, as well as ME being a practical approach toward weight loss [7, 12, 14, 18, 19, 21–24].

Healthy eating literacy (HEL) is another approach to manage eating behavior. In contrast to ME, which is characterized by dietary awareness and mindfulness, *literacy* is the ability to use cognitive skills to understand, organize, and apply a descriptive system to enact change. HEL has been associated with behavioral transformation including practicing healthier eating [26]. Although learning and practicing healthier eating requires improvement in both HEL and ME proficiency, no studies have been published on the relationship between ME practice and HEL, or on how they may interact to influence eating behavior.

Furthermore, it is just as important to pass down healthy eating habits to children. Although many believe that a mother's eating behavior is passed onto her children [27], no studies have demonstrated the possible effects of a mother's ME proficiency and HEL on her children's eating behaviors. Therefore, the purpose of this study was to investigate 1) how proficient Japanese mothers are at practicing ME, 2) how their ME proficiency and HEL level relate to their eating behaviors, and 3) how those factors may relate to their children's eating behaviors.

2. Methods

2.1. Design and participants

Aomori Prefecture has prioritized the nutrition issues especially focusing on the control of overweight and obesity in their health promotion plan since 2000. Twenty nursery schools from 54 schools in Aomori City were randomly selected, of which 18 agreed to participate. From August through September 2019, all mothers with 4- to 5-year-old children attending one of those nursery schools received an anonymous self-administered questionnaire to be completed at home and collected at their school.

2.2. Data collection

The questionnaires were completed at home and collected through the nursery schools. It consisted of 77 items: eight demographic items, a Japanese translation of the 20-item Mindful Eating Questionnaire (MEQ) for Italian [28], the five-item HEL [26], and two 22-item Eating Behavior Scales (EBS), one for the mother to complete about herself and the other to complete about her child. Informed consent was obtained from all participants after informing them about the study's purpose, method, and assuring that participation was voluntary and their identity would be protected.

2.3. Japanese version of the 20-item Italian MEQ

To assess ME proficiency, we used a Japanese version of the 20-item Italian MEQ, for which the validity and reliability had been confirmed. The 20 items measure four factors—disinhibition, awareness, external cues, and

emotional response—using a four-point scale. After creating a Japanese version, it was back translated into English, and the equivalence of the original version and the back translated version was examined by the authors. We confirmed that it matched the concept that Clementi et al. had proposed [28].

2.4. *The healthy eating literacy (HEL) scale*

The HEL scale, whose validity and reliability were confirmed, [26] was used to measure HEL. It uses a five-point scale and includes five items, three measuring interactive literacy and two measuring critical literacy.

2.5. *The eating behavior scale (EBS)*

Finally, two EBS were used to assess eating behavior healthiness for the mother and her child, both to be completed by the mother. The scales' validity and reliability were confirmed [29]. EBS comprises 22 items measuring four factors (binge eating, dietary balance, eating rhythm, and manner of eating) and is scored on a five-point scale.

2.6. *Demographic items*

Respondents were asked to indicate their age, highest level of education, employment status, household income, marital status, the child's gender, number of children (including the child in the study), and both the mother's and child's self-reported height and weight to calculate BMI.

2.7. *Sample size calculations and statistical analyses*

Aomori City's nursery schools have about 700 children aged 4–5 registered, and as such, a sample size of about 80 would be representative of Aomori City (α -error 0.05, power (1–0.10)). Assuming a 60% response rate and a 50% valid response rate, we determined that 270 questionnaires needed to be distributed.

Descriptive statistics for the sample were reported using percentages for the categorical variable and means and standard deviations for the continuous variables. Multiple regression was performed with ME proficiency and HEL as the response variables and participant characteristics as the explanatory variables. Multiple regression was similarly performed with EBS as response variables and ME, HEL, age, education level, employment status, household income, marital status, child's gender, and total number of children in the family as explanatory variables. Pearson's correlation coefficient (r) was used to investigate correlations between mothers' EBS scores and their ME proficiency and HEL scores, between mother and child EBS scores, and between EBS scores and BMI for both the mothers and children. The Cronbach's alpha coefficient was used as the measure of the reliability and validity of the ME questionnaire. Using the median scores for ME proficiency and HEL, the sample was divided into four ME-HEL proficiency groups. The chi-squared test was used to identify significant between-group differences in categorical variables representing participant characteristics. For the continuous variables (ME, HEL, EBS scores, and BMI), two-way analysis of variance (ANOVA) was performed followed by post hoc multiple comparisons using Tukey's Test. *R* ver. 3.5.2 was used for the statistical analysis with the significance level set at $p < 0.05$ (2-tailed test).

3. Results

3.1. *Response rate and participant characteristics*

Of the 270 questionnaires distributed, 177 were returned (response rate = 65.6%). Of these, four participants did not include informed consent. After eliminating surveys with missing data, the analysis sample included 128 participants. Participant characteristics are shown in Table 1.

Table 1
Participant characteristics

| Age | n (%) |
|----------------------------------|-----------|
| 20s | 15(11.7) |
| 30s | 82(64.1) |
| 40s | 31(24.2) |
| Highest level of education | |
| Middle school/High school | 49(38.3) |
| Junior college/Vocational school | 52(40.6) |
| University/Postgraduate degree | 27(21.1) |
| Employment status | |
| Full-time | 86(67.2) |
| Part-time | 40(31.3) |
| Unemployed | 2(1.6) |
| Household income | |
| < 2 million yen | 15(11.7) |
| 2–4 million yen | 48(37.5) |
| 4–6 million yen | 38(29.7) |
| 6–8 million yen | 11(8.6) |
| > 8 million yen | 16(12.5) |
| Marital status | |
| Married | 108(84.4) |
| Widowed/Divorced | 18(14.1) |
| Never married | 2(1.6) |
| Gender of children in the study | |
| Male | 72(56.3) |
| Female | 56(43.8) |
| Number of children | |
| 1 | 24(18.8) |
| 2 | 73(57.0) |
| 3 | 23(18.0) |
| 4 | 7(5.5) |

| Age | n (%) |
|-----|--------|
| 5 | 1(0.8) |

3.2. Scores and BMI

For mothers, the mean scores were: ME, 2.85 ± 0.31 ; HEL, 3.60 ± 0.62 ; and EBS, 3.35 ± 0.55 . The mothers' mean BMI was $21.50 \pm 3.39 \text{ kg/m}^2$. Table 2 shows the mean ME scores by subscale. The children's mean EBS score was 3.60 ± 0.47 and mean BMI was $15.45 \pm 1.64 \text{ kg/m}^2$.

Table 2
Mindful eating scores by subscale using the 20-item MEQ

| Subscale | By subscale | |
|--------------------|-------------|------|
| | Mean | SD |
| Disinhibition | 2.70 | 0.88 |
| Awareness | 2.69 | 0.81 |
| External cues | 3.17 | 0.73 |
| Emotional response | 3.43 | 0.72 |

3.3. Reliability and validity of the ME questionnaire

The Cronbach's alpha coefficient of the ME questionnaire was 0.740 (data not shown).

3.4. Estimating the effects of participant characteristics on ME, HEL and EBS

Multiple regression was performed on the entire sample using ME and HEL as response variables and age, education level, employment status, household income, marital status, child's gender, and the total number of children in the family as explanatory variables. Results showed that most explanatory variables were not significant predictors of ME or HEL (Tables 3 and 4). Likewise, multiple regression was performed on the entire sample using EBS as response variables and ME, HEL, and demographic items as explanatory variables. EBS scores were significantly associated by ME (Table 5).

Table 3
Estimated effects of participant characteristics on mindful eating

| | Independent variable | Partial regression coefficient | p-value | 95% CI ^a | |
|--|----------------------------------|--------------------------------|---------|---------------------|-------------|
| | | | | Lower limit | Upper limit |
| Age ^b | 30s | 0.169 | 0.152 | -0.063 | 0.401 |
| | 40s | 0.116 | 0.360 | -0.134 | 0.367 |
| Highest level of education ^c | Junior college/Vocational school | -0.044 | 0.549 | -0.187 | 0.100 |
| | University/Postgraduate degree | 0.001 | 0.992 | -0.164 | 0.166 |
| Employment status ^d | Part-time | -0.015 | 0.823 | -0.144 | 0.115 |
| | Unemployed | 0.105 | 0.644 | -0.344 | 0.554 |
| Household income ^e | 2–4 million yen | 0.163 | 0.139 | -0.054 | 0.379 |
| | 4–6 million yen | 0.156 | 0.220 | -0.095 | 0.406 |
| | 6–8 million yen | 0.217 | 0.123 | -0.060 | 0.495 |
| | > 8 million yen | 0.297 | 0.039 | 0.015 | 0.579 |
| Marital status ^f | Widowed/Divorced | 0.248 | 0.030 | 0.024 | 0.472 |
| | Never married | -0.087 | 0.740 | -0.608 | 0.434 |
| Gender of child ^g | Female | -0.035 | 0.558 | -0.151 | 0.082 |
| Number of children ^h (including the child in the study) | 2 | -0.099 | 0.225 | -0.259 | 0.062 |
| | 3 | -0.184 | 0.063 | -0.379 | 0.010 |
| | 4 | 0.079 | 0.573 | -0.198 | 0.355 |
| | 5 | -0.342 | 0.287 | -0.976 | 0.292 |

^aCI: confidence interval. Group of reference: ^b20s, ^cMiddle school/High school, ^dFull-time, ^e<2 million yen, ^fMarried, ^gMale and ^h1.

Table 4
Estimated effects of participant characteristics on healthy eating literacy

| | Independent variable | Partial regression coefficient | p-value | 95% CI ^a | |
|--|----------------------------------|--------------------------------|---------|---------------------|-------------|
| | | | | Lower limit | Upper limit |
| Age ^b | 30s | -0.318 | 0.181 | -0.787 | 0.151 |
| | 40s | -0.365 | 0.156 | -0.872 | 0.141 |
| Highest level of education ^c | Junior college/Vocational school | -0.134 | 0.361 | -0.425 | 0.156 |
| | University/Postgraduate degree | 0.010 | 0.952 | -0.323 | 0.344 |
| Employment status ^d | Part-time | 0.159 | 0.230 | -0.102 | 0.420 |
| | Unemployed | -0.037 | 0.935 | -0.944 | 0.869 |
| Household income ^e | 2–4 million yen | -0.126 | 0.568 | -0.564 | 0.311 |
| | 4–6 million yen | -0.219 | 0.392 | -0.725 | 0.287 |
| | 6–8 million yen | 0.186 | 0.513 | -0.374 | 0.746 |
| | > 8 million yen | 0.164 | 0.570 | -0.406 | 0.734 |
| Marital status ^f | Widowed/Divorced | -0.113 | 0.622 | -0.565 | 0.339 |
| | Never married | -0.994 | 0.064 | -2.045 | 0.058 |
| Gender of child ^g | Female | 0.135 | 0.259 | -0.101 | 0.370 |
| Number of children ^h (including the child in the study) | 2 | -0.226 | 0.169 | -0.550 | 0.098 |
| | 3 | -0.172 | 0.387 | -0.566 | 0.221 |
| | 4 | -0.429 | 0.131 | -0.986 | 0.129 |
| | 5 | -0.228 | 0.725 | -1.508 | 1.052 |

^a CI: confidence interval. Group of reference: ^b20s, ^cMiddle school/High school, ^dFull-time, ^e<2 million yen, ^fMarried, ^gMale and ^h1.

Table 5
Estimated effects of participant characteristics on the eating behavior scale

| Independent variable | | Model 1 | | Model 2 ^a | | Model 3 ^b | |
|---|----------------------------------|--------------------------------|---------|--------------------------------|---------|--------------------------------|---------|
| | | Partial regression coefficient | p-value | Partial regression coefficient | p-value | Partial regression coefficient | p-value |
| ME | | 0.761 | < 0.001 | 0.752 | < 0.001 | 0.756 | < 0.001 |
| HEL | | -0.012 | 0.876 | | | | |
| Marital status ^c | Widowed/Divorced | -0.093 | 0.581 | -0.089 | 0.575 | -0.252 | 0.040 |
| | Never married | 0.897 | 0.031 | 0.877 | 0.029 | 0.549 | 0.107 |
| Household income ^d | 2–4 million yen | 0.166 | 0.323 | 0.138 | 0.370 | | |
| | 4–6 million yen | 0.118 | 0.533 | 0.081 | 0.635 | | |
| | 6–8 million yen | 0.128 | 0.559 | 0.096 | 0.638 | | |
| | > 8 million yen | 0.389 | 0.082 | 0.364 | 0.072 | | |
| Age ^e | 30 s | 0.227 | 0.211 | 0.193 | 0.256 | | |
| | 40 s | 0.235 | 0.234 | 0.201 | 0.281 | | |
| Highest level of education ^f | Junior college/Vocational school | -0.074 | 0.525 | | | | |
| | University/Postgraduate degree | -0.030 | 0.819 | | | | |
| Employment status ^g | Part-time | 0.019 | 0.859 | | | | |
| | Unemployed | -0.093 | 0.796 | | | | |

Notes: ^aAdjusted for HEL, Highest level of education, and Employment status.

^bAdjusted for HEL, Household income, Age, Highest level of education, and Employment status

Group of reference: ^cMarried, ^d<2 million yen, ^e20s, ^fMiddle school/High school, and ^gFull-time

3.5. Maternal eating behavior by ME-HEL group

A positive correlation was found between ME proficiency and maternal eating behavior ($r = 0.43$, $P < 0.001$), while the correlation between maternal eating behavior and HEL was weak ($r = 0.17$, $P < 0.05$). Given that the purpose of the study was to understand the effect of different levels of ME proficiency and HEL in Japanese mothers on their own eating behaviors, as well as on their children's, we performed an ME-HEL category analysis. Using the median values for ME and HEL scores (2.80 and 3.60, respectively), the sample was divided into four groups:

Group A ($ME \geq 2.80$, $HEL \geq 3.60$), Group B ($ME \geq 2.80$, $HEL < 3.60$), Group C ($ME < 2.80$, $HEL \geq 3.60$) and Group D ($ME < 2.80$, $HEL < 3.60$). Chi-squared test results showed no significant between-group differences in participant characteristics (Table 6). The results of two-way ANOVA ($ME \times HEL / EBS$) showed that ME had a significantly greater effect on EBS than HEL (Fig. 1) and there is no significant interaction between ME and HEL (Table 7). However, for the children, no significant between-group differences were found. For BMI, no significant between-group differences were found for either mothers or children.

Table 6
 Number of participants by characteristic and mindful eating-healthy eating literacy (ME-HEL) group

| | Group A | Group B | Group C | Group D | p-value |
|---------------------------------------|---------|---------|---------|---------|---------|
| Age | | | | | 0.788 |
| 20s | 8 | 2 | 3 | 2 | |
| 30s | 29 | 19 | 15 | 19 | |
| 40s | 8 | 9 | 7 | 7 | |
| Education level | | | | | 0.488 |
| Middle school/High school | 20 | 10 | 9 | 10 | |
| Junior college/Vocational school | 14 | 16 | 9 | 13 | |
| University/Postgraduate degree | 11 | 4 | 7 | 5 | |
| Employment status | | | | | 0.950 |
| Full-time | 30 | 19 | 17 | 20 | |
| Part-time | 14 | 10 | 8 | 8 | |
| Unemployed | 1 | 1 | 0 | 0 | |
| Household income | | | | | 0.269 |
| < 2 million yen | 6 | 2 | 3 | 4 | |
| 2–4 million yen | 20 | 13 | 9 | 6 | |
| 4–6 million yen | 7 | 8 | 7 | 16 | |
| 6–8 million yen | 5 | 2 | 4 | 0 | |
| > 8 million yen | 7 | 5 | 2 | 2 | |
| Marital status | | | | | 0.303 |
| Married | 34 | 25 | 23 | 26 | |
| Widowed/Divorced | 10 | 5 | 2 | 1 | |
| Never married | 1 | 0 | 0 | 1 | |
| Gender of child in study | | | | | 0.794 |
| Male | 25 | 17 | 12 | 18 | |
| Female | 20 | 13 | 13 | 10 | |
| Total number of children | | | | | 0.253 |
| 1 | 13 | 4 | 3 | 4 | |
| * p-value obtained in Chi-square test | | | | | |

| | Group A | Group B | Group C | Group D | p-value |
|---------------------------------------|---------|---------|---------|---------|---------|
| 2 | 21 | 20 | 17 | 15 | |
| 3 | 8 | 3 | 4 | 8 | |
| 4 | 3 | 3 | 0 | 1 | |
| 5 | 0 | 0 | 1 | 0 | |
| * p-value obtained in Chi-square test | | | | | |

Table 7
Two-way ANOVA test for the EBS by ME and HEL

| Source | Sum Sq | Df | F value | P-value |
|-------------|---------|-----|-----------|---------|
| (Intercept) | 1391.75 | 1 | 5135.4788 | < 0.001 |
| ME | 3.12 | 1 | 11.5135 | < 0.001 |
| HEL | 0.13 | 1 | 0.4624 | 0.498 |
| ME * HEL | 0.08 | 1 | 0.2952 | 0.588 |
| Residuals | 33.60 | 124 | | |

3.6. EBS scores and BMI in mothers and children

There was a significant correlation between the mother's and child's EBS scores ($r = 0.55$, $p < 0.001$), but not between EBS scores and BMI in either the mothers ($r = -0.02$, $p = 0.783$) or the children ($r = 0.01$, $p = 0.935$).

4. Discussion

Maternal EBS scores positively correlated with ME proficiency, while no strong correlation emerged between maternal EBS scores and HEL. Mother and child EBS scores were significantly related. These results suggest that maintaining healthy eating behaviors in both mothers and their children may be associated with the mother's proficiency at practicing ME. To our knowledge, this study is the first to measure ME proficiency in Japanese mothers.

From the Cronbach's α coefficient of each ME questionnaire item, no major problem in the ME scale's reliability and validity was determined. The mean ME proficiency score of 2.85 ± 0.31 in the present study was similar to those found in previous studies, even though the sample was comparatively young (73.3% were in their 20s or 30s). This may indicate that ME proficiency in Japanese mothers is relatively higher than in other countries.

The mean HEL score in the present study was 3.60 ± 0.62 (interactive literacy score 3.78 ± 0.95 and critical literacy score 3.33 ± 0.85), which largely matched the results of prior studies [26, 30, 31]. Although literacy on a healthy diet was generally associated with dietary behavior, no strong relationship between HEL and EBS was found. This may be because the HEL scale is so simple that it may not comprehensively cover the concept of interactive and critical literacy defined by Nutbeam [26, 32].

In the analyses of the ME-HEL group, no significant between-group differences were found in participant characteristics (Table 6). This shows that both ME proficiency and HEL can be improved posteriorly regardless of socioeconomic status.

A multiple regression analysis showed that EBS is affected by ME and unaffected by HEL (Table 5). The results of the two-way ANOVA also suggested that the maternal EBS score was more affected by ME than by HEL (Fig. 1).

A significant positive correlation was found between mothers' and their child's EBS scores, which is consistent with the findings of another study [33]. A child's eating behavior is also associated with their current health status, along with their physical and emotional development [34]. It is extremely important to establish healthy eating behavior in childhood since it could affect their eating habits, and thus their health in adulthood. No relationship was found between eating behaviors and BMI in either the mothers or children. This may be because many factors outside of eating behavior can affect weight, such as exercise, sleep, and in adults, drinking and smoking [35].

5. Strengths And Limits

This study has two strengths. First, the ME proficiency of Japanese mothers was revealed for the first time, so it is expected to be the basis of the research for the development of mindful eating in Japan. Second, the mother's ME proficiency may have a stronger influence on dietary behavior than HEL. Since the main method was to improve eating behavior by increasing HEL in conventional nutrition education, adding the ME concept to dietary education is expected to lead to proper eating behaviors of mothers and children.

This study also had two important limitations, first of which is the cross-sectional design. Despite finding a potential relationship between ME proficiency and eating behavior, the two factors were not measured independently because a questionnaire was used; hence, a cause-and-effect relationship could not be determined. Therefore, an intervention study is necessary to investigate causality. Secondly, this study did not find any participant characteristic affecting ME, HEL, and EBS, though it is generally believed that age, household income, educational background, etc. have an effect. In order to re-verify these results, a multivariate analysis was performed by adding samples including missing data, but the results were unclear. It may be necessary to increase the sample size or change the question items to verify them.

6. What Is Already Known On This Subject

Mindful eating is known to be associated with regulating eating behavior. Although practicing healthier eating behavior requires improvement in both HEL and ME proficiency, there are few studies on the relationship between ME practices and HEL, or how they interact to affect the dietary behavior of mothers and their children.

7. What This Study Adds

The simultaneous investigation of the effects of ME and HEL on eating behavior suggested that ME had more of an effect than HEL. Based on this result, we speculated that improving ME skills may be an effective way to sustain healthier eating behaviors in mothers and their children. Since this was the first time a measure of ME proficiency was used in a study of Japanese people, the study provides a basis for future research in Japan.

8. Conclusion

Using a sample of mothers with 4 and 5-year-olds attending nursery schools in Aomori City, Japan, this study examined ME proficiency and HEL in the mothers as well as eating behavior and BMI in both the mothers and their children. To the best of our knowledge, this was the first time ME was studied in Japanese mothers. In these mothers, ME proficiency appeared to influence eating behavior more than HEL and their eating behaviors appeared to influence their children's eating behaviors. Therefore, to sustain healthier eating behaviors in Japanese mothers and their children, it may be effective to help mothers eat more mindfully in addition to improving their HEL.

Declarations

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Conflicts of interest

The authors have no conflicts of interest directly relevant to the content of this article.

Availability of data and material

Not applicable

Code availability

Not applicable

Ethics approval

The study was conducted with the approval of the Aomori University of Health and Welfare Research Ethics Committee (approval no. 19009; May 22, 2019). The study was performed in accordance with the Declaration of Helsinki.

Consent to participate

Informed consent was obtained from the participants. Participant anonymity was ensured.

Publication consent

Not applicable

References

1. Kabat-Zinn J (2013) Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness. Bantam Dell, New York.
2. Creswell J D (2017) Mindfulness Interventions. *Annu Rev Psychol* 68:491-516. <https://doi.org/10.1146/annurev-psych-042716-051139>
3. Slagter H, Davidson R, Lutz A (2011) Mental Training as a Tool in the Neuroscientific Study of Brain and Cognitive Plasticity. *Front Hum Neurosci* 5 <https://doi.org/10.3389/fnhum.2011.00017>
4. Pagnini F, Philips D (2015) Being mindful about mindfulness. *Lancet Psychiatry* 2:288-289. [https://doi.org/10.1016/s2215-0366\(15\)00041-3](https://doi.org/10.1016/s2215-0366(15)00041-3)
5. Warren J M, Smith N, Ashwell M (2017) A structured literature review on the role of mindfulness, mindful eating and intuitive eating in changing eating behaviours: effectiveness and associated potential mechanisms. *Nutr Res Rev* 30:272-283. <https://doi.org/10.1017/s0954422417000154>
6. Hanh T, Cheung S L (2010) *Mindful eating, mindful life*. HarperCollins, New York.
7. Dalen J, Smith B W, Shelley B M, Sloan A L, Leahigh L, Begay D (2010) Pilot study: Mindful Eating and Living (MEAL): Weight, eating behavior, and psychological outcomes associated with a mindfulness-based intervention for people with obesity. *Complement Ther Med* 18:260-264. <https://doi.org/10.1016/j.ctim.2010.09.008>
8. Miller C K, Kristeller J L, Headings A, Nagaraja H (2014) Comparison of a mindful eating intervention to a diabetes self-management intervention among adults with Type 2 diabetes: A randomized controlled trial. *Health Educ Behav* 41:145-154. <https://doi.org/10.1177/1090198113493092>
9. Lofgren I E (2015) Mindful eating: An emerging approach for healthy weight management. *Am J Lifestyle Med* 9:212-216. <https://doi.org/10.1177/1559827615569684>
10. Fung T T, Long M W, Hung P, Cheung L W (2016) An Expanded Model for Mindful Eating for Health Promotion and Sustainability: Issues and Challenges for Dietetics Practice. *J Acad Nutr Diet* 116:1081-1086. <https://doi.org/10.1016/j.jand.2016.03.013>
11. Kristeller J L, Hallett C B (1999) An Exploratory Study of a Meditation-based Intervention for Binge Eating Disorder. *J Health Psychol* 4:357-363. <https://doi.org/10.1177/135910539900400305>
12. Kristeller J, Wolever R Q, Sheets V (2014) Mindfulness-Based Eating Awareness Training (MB-EAT) for Binge Eating: A Randomized Clinical Trial. *Mindfulness* 5:282-297. <https://doi.org/10.1007/s12671-012-0179-1>
13. Boutelle K N, Zucker N L, Peterson C B, Rydell S A, Cafri G, Harnack L (2011) Two novel treatments to reduce overeating in overweight children: A randomized controlled trial. *J Consult Clin Psychol* 79:759-771. <https://doi.org/10.1037/a0025713>
14. Tapper K, Shaw C, Ilesley J, Hill A J, Bond F W, Moore L (2009) Exploratory randomised controlled trial of a mindfulness-based weight loss intervention for women. *Appetite* 52:396-404. <https://doi.org/10.1016/j.appet.2008.11.012>
15. Smith B W, Shelley B M, Leahigh L, Vanleit B (2006) A preliminary study of the effects of a modified mindfulness intervention on binge eating. *Complement Health Pract Rev* 11:133-143. <https://doi.org/10.1177/1533210106297217>
16. Baer R A, Fischer S, Huss D B (2005) Mindfulness and Acceptance in the Treatment of Disordered Eating. *J Ration Emot Cogn Behav Ther* 23:281-300. <https://doi.org/10.1007/s10942-005-0015-9>

17. Alberts H J, Thewissen R, Raes L (2012) Dealing with problematic eating behaviour. The effects of a mindfulness-based intervention on eating behaviour, food cravings, dichotomous thinking and body image concern. *Appetite* 58:847-851. <https://doi.org/10.1016/j.appet.2012.01.009>
18. Corsica J, Hood M M, Katterman S, Kleinman B, Ivan I (2014) Development of a novel mindfulness and cognitive behavioral intervention for stress-eating: A comparative pilot study. *Eat Behav* 15:694-699. <https://doi.org/10.1016/j.eatbeh.2014.08.002>
19. Daubenmier J, Kristeller J, Hecht F M, Maninger N, Kuwata M, Jhaveri K, Lustig R H, Kemeny M, Karan L, Epel E (2011) Mindfulness Intervention for Stress Eating to Reduce Cortisol and Abdominal Fat among Overweight and Obese Women: An Exploratory Randomized Controlled Study. *J Obes* 2011:651936. <https://doi.org/10.1155/2011/651936>
20. Alberts H J, Mulkens S, Smeets M, Thewissen R (2010) Coping with food cravings. Investigating the potential of a mindfulness-based intervention. *Appetite* 55:160-163. <https://doi.org/10.1016/j.appet.2010.05.044>
21. Dunn C, Haubenreiser M, Johnson M, Nordby K, Aggarwal S, Myer S, Thomas C (2018) Mindfulness Approaches and Weight Loss, Weight Maintenance, and Weight Regain. *Curr Obes Rep* 7:37-49. <https://doi.org/10.1007/s13679-018-0299-6>
22. Boutelle K N, Zucker N, Peterson C B, Rydell S, Carlson J, Harnack L J (2014) An intervention based on Schachter's externality theory for overweight children: The regulation of cues pilot. *J Pediatr Psychol* 39:405-417. <https://doi.org/10.1093/jpepsy/jst142>
23. Timmerman G M, Brown A (2012) The effect of a mindful restaurant eating intervention on weight management in women. *J Nutr Educ Behav* 44:22-28. <https://doi.org/10.1016/j.jneb.2011.03.143>
24. Mantzios M, Wilson J C (2015) Mindfulness, eating behaviours, and obesity: A review and reflection on current findings. *Curr Obes Rep* 4:141-146. <https://doi.org/10.1007/s13679-014-0131-x>
25. Stites S D, Singletary S B, Menasha A, Cooblall C, Hantula D, Axelrod S, Figueredo V M, Phipps E J (2015) Pre-ordering lunch at work. Results of the what to eat for lunch study. *Appetite* 84:88-97. <https://doi.org/10.1016/j.appet.2014.10.005>
26. Takaizumi K, Harada K, Shibata A, Nakamura Y (2012) Reliability and validity of the healthy eating literacy scale among Japanese adult - from online web research data -. *Japanese Journal of Health Education and Promotion* 20:30-40. <https://doi.org/10.11260/kenkokyoiku.20.30>
27. Larsen J K, Hermans R C, Sleddens E F, Engels R C, Fisher J O, Kremers S P (2015) How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite* 89:246-257. <https://doi.org/10.1016/j.appet.2015.02.012>
28. Clementi C, Casu G, Gremigni P (2017) An Abbreviated Version of the Mindful Eating Questionnaire. *J Nutr Educ Behav* 49:352-356.e351. <https://doi.org/10.1016/j.jneb.2017.01.016>
29. Utsumi T, Tayama J, Nishiura K, Chishima Y, Yoshihara Y, Oosaka K, Kikuchi K, Nii S, Suzuki M, Magara C (2015) Development of Eating Behavior Scale focus on nutritional balance and examine the reliability and validity. *Journal of Developmental Science* 15:33-40. <https://doi.org/info:doi/10.20641/00000095>
30. Sato Y, Chiba T, Umegaki K (2018) Personality and dietary supplement use among Japanese female students [in Japanese]. *Jpn J Public Health* 65:300-307. https://doi.org/10.11236/jph.65.6_300

31. Iwabe M, Yoshiike N (2019) Relationship between health literacy and vegetable intake related to dietary habit of school-children and guardians [in Japanese]. *Aomori Health & Welfare Research*:1-10. <https://doi.org/info:doi/10.24552/00002140>
32. Nutbeam D (2000) Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Prom Int* 15:259-267. <https://doi.org/10.1093/heapro/15.3.259>
33. Balantekin K N (2019) The Influence of Parental Dieting Behavior on Child Dieting Behavior and Weight Status. *Curr Obes Rep* 8:137-144. <https://doi.org/10.1007/s13679-019-00338-0>
34. Wu X Y, Zhuang L H, Li W, Guo H W, Zhang J H, Zhao Y K, Hu J W, Gao Q Q, Luo S, Ohinmaa A, Veugelers P J (2019) The influence of diet quality and dietary behavior on health-related quality of life in the general population of children and adolescents: a systematic review and meta-analysis. *Qual Life Res* 28:1989-2015. <https://doi.org/10.1007/s11136-019-02162-4>
35. Egger G (2011) Obesity, chronic disease, and economic growth: a case for "big picture" prevention. *Adv Prev Med* 2011:149158. <https://doi.org/10.4061/2011/149158>

Figures

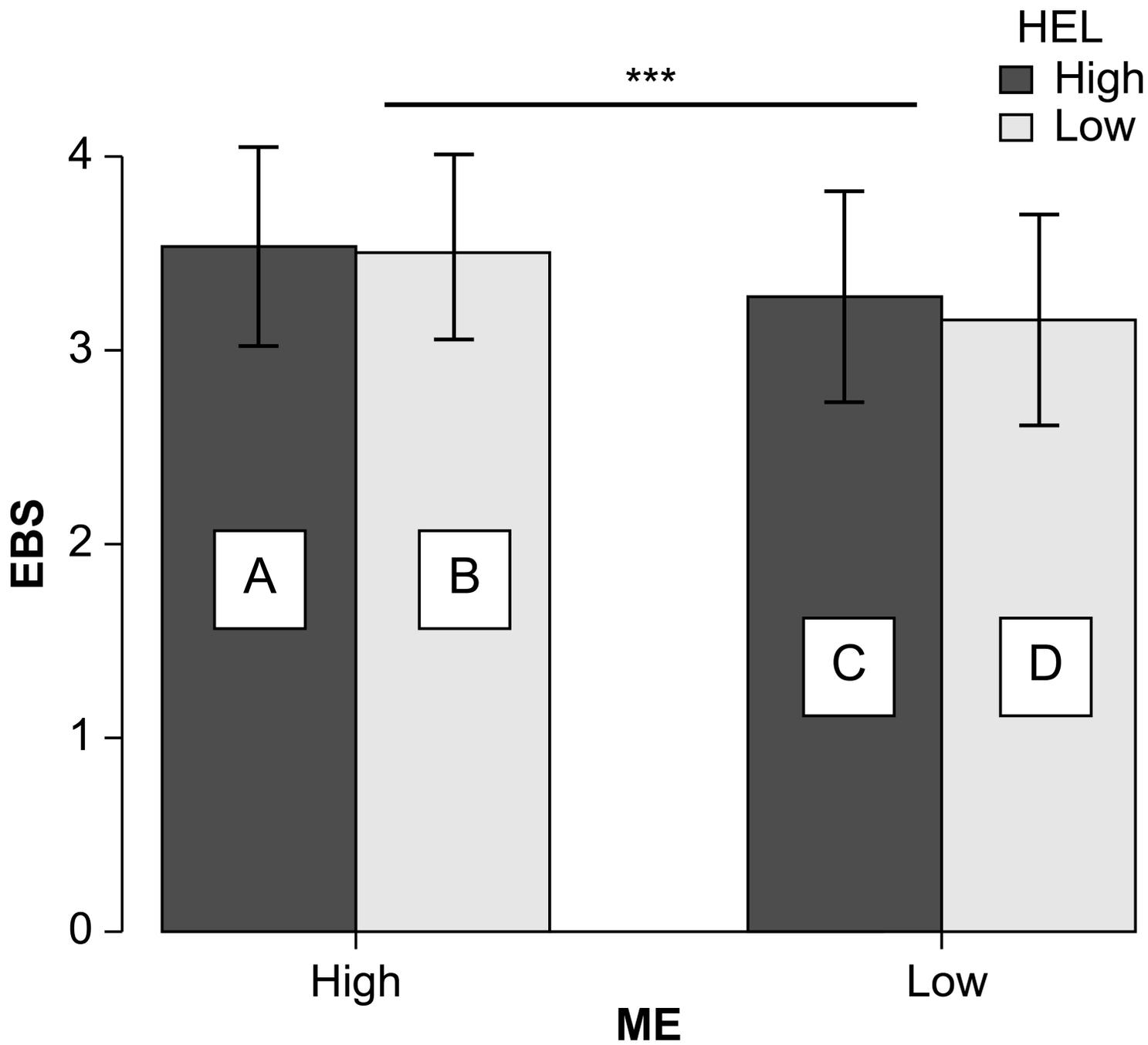


Figure 1

Effects of ME and HEL on EBS