Examination of the reliability and validity of The Mindful Eating Questionnaire in pregnant women

John W. Apolzan, PhD, **Candice A. Myers, PhD**, **Amanda D. Cowley, MS**, **Heather Brady, MS**, **Daniel S. Hsia, MD**, **Tiffany M. Stewart, PhD**, **Leanne M. Redman, PhD**, and **Corby K. Martin, PhD**

Pennington Biomedical Research Center, 6400 Perkins Road, Baton Rouge, LA, 70808

John W. Apolzan: John.Apolzan@pbrc.edu; Candice A. Myers: Candice.Myers@pbrc.edu; Amanda D. Cowley: Mandydianne@gmail.com; Heather Brady: Heather.Walden@pbrc.edu; Daniel S. Hsia: Daniel.Hsia@pbrc.edu; Tiffany M. Stewart: Tiffany.Stewart@pbrc.edu; Leanne M. Redman: Leanne.Redman@pbrc.edu; Corby K. Martin: Corby.Martin@pbrc.edu

Abstract

Objective—Mindfulness is theorized to affect the eating behavior and weight of pregnant women, yet no measure has been validated during pregnancy.

Methods—This study qualitatively and quantitatively evaluated the reliability and validity of the Mindful Eating Questionnaire (MEQ) in overweight and obese pregnant women. Participants completed focus groups and cognitive interviews. The MEQ was administered twice to measure test-retest reliability. The Eating Inventory (EI) and Mindful Attention Awareness Scale (MAAS) were administered to assess convergent validity, and the Neighborhood Environment Walkability Scale (NEWS) assessed discriminant validity.

Results—Participants were 20±8 weeks gestation (mean±SD), 30±2 years old, and 55% were obese. The MEQ total score had good test-retest reliability (r=.85). The total score internal consistency reliability was poor (Cronbach's α=.56). The external cues subscale (ECS) was not internally consistent (α=.31). Other subscales ranged from a=.59–.68. When the ECS was excluded, the MEQ total score internal consistency was acceptable (α=.62). Convergent validity was supported by the MEQ total score (with and without ECS) correlating significantly with the MAAS and the EI disinhibition and hunger subscales. Discriminant validity of the MEQ was supported by the MEQ and NEWS total scores and subscales not being significantly correlated. The quantitative results were supported by the qualitative context and content analysis.

Conclusion—With the exception of the ECS, the MEQ's reliability and validity was supported in pregnant women, and most of the subscales were more robust in pregnant women than in the

Address correspondence to: Corby K. Martin, Ph.D., Pennington Biomedical Research Center, 6400 Perkins Road, Baton Rouge, LA, 70808; Phone: 225-763-2585; FAX: 225-763-3022; Corby.Martin@pbrc.edu.

This study was registered at www.clinicaltrials.gov and numbered: NCT 01734655

original sample of healthy adults. The MEQ's use with overweight and obese pregnant women is supported.

Keywords

Mindfulness; Pregnancy; Eating Behavior; MEQ; Obesity; Body Weight

Introduction

Mindfulness generally refers to a non-judgmental attention and awareness in the present moment (Brown & Ryan, 2003; Shapiro, Carlson, Astin, & Freedman, 2006). The application of mindfulness to eating and body weight regulation is relatively new and has appeared in the scientific literature over the past decade. Mindful eating includes an unbiased awareness of sensations surrounding eating and could be used to help people eat in response to hunger cues and better control in response to satiety signals (Framson, et al., 2009). It is thought that mindful eating could help manage food intake and impact energy balance and body weight (Barrington, Ceballos, Bishop, McGregor, & Beresford, 2012; Daubenmier, et al., 2012; Mantzios & Giannou, 2014; Mantzios & Wilson, 2014; Mason, et al., 2015; Thomas, et al., 2014; van Berkel, Boot, Proper, Bongers, & van der Beek, 2014; van Berkel, Proper, Boot, Bongers, & van der Beek, 2011). Indeed, a 9-week Mindfulness Based Eating Awareness Training (MB-EAT) program that includes training in meditation and mindful eating (J.L. Kristeller, 2003; J. L. Kristeller & Wolever, 2011), has been found to reduce compulsive overeating among people who are obese and result in a ~7 pound weight loss (J.L. Kristeller, 2003; J. L. Kristeller & Wolever, 2011), however not all studies demonstrate weight loss (K. L. Olson & Emery, 2015).

Maternal obesity and excess gestational weight gain are important health outcomes yet more than 50% of overweight and obese pregnant women exceed the gestational weight gain recommendations established by the Institute of Medicine (IOM) (IOM & NRC, 2009). Maternal obesity and weight gain above IOM guidelines (Keppel & Taffel, 1993) are thought to be associated with gestational diabetes, labor and delivery complications, and postpartum weight retention (Gore, Brown, & West, 2003; Rooney & Schauberger, 2002). Infants of overweight and obese mothers have a greater likelihood of being preterm (Beyerlein, Lack, & von Kries, 2010), large for gestational age (Frederick, Williams, Sales, Martin, & Killien, 2008), and increased risk for childhood obesity (Whitaker, 2004). Lifestyle interventions targeting healthy weight gain in overweight and obese pregnant women have not been very successful (Asbee, et al., 2009; C. M. Olson, Strawderman, & Reed, 2004; Phelan, et al., 2011a; Polley, Wing, & Sims, 2002; Shirazian, Monteith, Friedman, & Rebarber, 2010). Thus understanding new strategies that could be deployed for more efficacious weight management including mindfulness during pregnancy are needed.

For over 35 years, researchers have found food selection changes during pregnancy (Hook, 1978). This may be due to changes in hormones, senses, or cultural or psychosocial factors (Cooksey, 1995; Hook, 1978; Orloff & Hormes, 2014). Certain foods are reported to cause nausea, a symptom reported by many women early in pregnancy, while later in pregnancy, many women report that foods are craved. In an RCT of obese women, gestational weight

gain was associated with increased intake of added sugar. It was suggested craving of sweets and soft drinks caused increased gestational weight gain but food cravings were not tested (Renault, et al., 2015). However others have found that food cravings increase during pregnancy (Belzer, Smulian, Lu, & Tepper, 2010; Orloff & Hormes, 2014; Pope, Skinner, & Carruth, 1992) leading to increased food intake and thereby increased gestational weight gain. Food cravings and emotional eating are thought to decrease with mindfulness (May, Andrade, Batey, Berry, & Kavanagh, 2010; Paolini, et al., 2014) but this has not been empirically tested in pregnant women. Mindfulness may be especially helpful during pregnancy to promote healthier eating and decrease cravings and gestational weight gain in overweight and obese pregnant women.

To our knowledge, no measure has been validated to measure mindful eating in pregnant women and this is the first study to examine the reliability and validity of the MEQ in samples other than healthy adults. This study examined a questionnaire that was being utilized in a sample of overweight and obese pregnant women since simultaneously we were examining a lifestyle intervention ('Expecting Success') with the aim of keeping overweight and obese women within 2009 IOM guidelines for gestational weight gain. The Mindful Eating Questionnaire (MEQ) is a 28-item self-report instrument that measures five domains of mindful eating: disinhibition, awareness, external cues, emotional response, and distraction (Framson, et al., 2009). A previous study found the MEQ to be a valid measure of mindful eating in healthy adults (Framson, et al., 2009). Previously, the MEQ has been validated only in healthy adults (Framson, et al., 2009). Framson et al. utilized 18–80 year old (mean was 42) males and females (80% female) to examine reliability and validity. Multiple regression was used to examine obesity and physical activity with the MEQ. Higher BMI was associated with lower mindfulness however there were weak associations with mindfulness and physical activity. The objective of the present study was to determine the reliability and validity of the MEQ in a sample of overweight and obese pregnant women. We hypothesized that the MEQ and its subscales would be valid and reliable in pregnant women. Furthermore, we hypothesized that the MEQ total score would be positively correlated with the Eating Inventory (EI) restraint subscale, negatively correlated with the EI disinhibition subscale, positively correlated with the Mindful Attention Awareness Scale (MAAS), and not correlated with any Neighborhood Environment Walkability Scale (NEWS) subscales.

METHODS

The study reported herein was conducted according to the guidelines in the Declaration of Helsinki and all participants were given verbal and written explanations about the study, provided signed informed consent, and received a monetary stipend. The study was approved by the Pennington Biomedical Research Center's Institutional Review Board and was registered at clinical trials.gov NCT 01734655.

Study Population

Forty pregnant women were recruited from the Baton Rouge metro community. We utilized a variety of methods to recruit participants. This included targeted recruitment of pregnant

women at local Hospital events and mothers groups, and advertising through Craigslist, the Pennington Biomedical Research Center Clinical Trials email list, and the Pennington Biomedical Research Center Clinical Trial Website.

Inclusion criteria were: 1) 18–40 years of age, 2) overweight or obese at time of conception based on self-report (BMI ≥ 25 and <40 kg/m^2), 3) willingness to participate in either the focus group or the individual interview, 4) established prenatal care by 12 weeks of gestation, 5) fluent in the English language, and 6) singleton pregnancy.

Exclusion criteria were: 1) current multiple gestation, 2) Type I diabetes, 3) self-reported gestational diabetes mellitus, 4) history or current psychotic disorder; current major depressive episode, bipolar disorder, or eating disorder, 5) HIV; 6) current smoking, alcohol or drug abuse, and 7) current enrollment in an ongoing lifestyle intervention called 'Expecting Success'.

Screening

Initial screening was conducted through an online screening survey. The survey captures contact information and provides answers to basic inclusion and exclusion questions such as 'are you pregnant'. Following completion of the webscreener, all eligible participants were scheduled for an in-person screening visit. Before initiating any study procedures, participants provided written informed consent. Self-reported pre-pregnancy weight was collected followed by measured current height and weight (pre-pregnancy and current BMI were calculated). Eligible participants then completed a screening health questionnaire and the MEQ and scheduled their next study visit. Study visit 1 occurred approximately 1 week following the screening visit but this varied, especially with the women who participated in the focus groups, but overall we limited the length of time between sessions.

Procedures

Originally the qualitative evaluation was to include a focus group with 10 participants followed by 30 individual cognitive interviews. However, due to the timing of participant enrollment during the study, 11 participants completed one of two focus groups followed by 29 participants who completed individual cognitive interviews. The first 11 participants were enrolled in the 2 focus groups. Two focus groups were performed to ensure we did not lose any eligible participants due to the birth of their child. The focus groups and cognitive interviews were performed by the coauthors (JWA, CAM, ADC, and HB) according to standardized procedures and following mock interviews with the senior investigators (TMS, LMR, and CKM) to ensure fidelity. The focus groups were not completely anonymous, first names were given and used. Participants were compensated $50 for the screening and study visits.

The following were the instructions. 1) Encourage the participants to provide specifics about what she is thinking. 2) Interviewer should use the following prompts if the interviewee appears to be having difficulty thinking aloud; a) "Tell me what you're thinking." b) What are you thinking about right now?" 3) Listen to what the participant 'thinks' about or mentions so you can probe further on these items later on, if needed. For example, if an interviewee says she 'liked' a graphic or thought a section she read was 'interesting,' but

does not explain why, probe with additional questions. a) What thoughts came to mind while reading (section/phrase)? b) Why did you decide to read (section/phrase)?

The following instructions were provided verbally to the participants before the focus group started. Thank you for participating in this focus group. Your feedback will help us learn how to develop better education on mindful eating for pregnant women. The purpose of this project is to evaluate the MEQ to determine if it is a valid instrument for pregnant women. It is currently valid in an adult population, but we are determining if it is valid in pregnant women.

During the focus group, as you hear the questions, tell us out clearly out loud any thoughts that come to mind. "It is called the think aloud process." Also if possible, please try to speak one at a time. We will be tape recording the interview. Please remember that there are no wrong answers. We did not design any of the materials and you will not hurt our feelings. Feel free to say anything you're thinking. There will be no judgment. Lastly, what questions do you have before we begin?

We did not define mindfulness. We asked: 1) What comes to mind when you think of the term Mindfulness? 2) What comes to mind when you think of the term Mindful Eating?

All study participants completed four questionnaires. The MEQ was administered at two time points during the study (screening and visit 1) to assess test-retest reliability. The MEQ data from the screening visit were used for the internal consistency reliability and validity analyses (the results did not differ meaningfully when the MEQ data from screening or Visit 1 were used in the analyses). The focus groups or cognitive interviews were conducted at Visit 1, and the following three additional questionnaires were administered: 1) EI (A. J. Stunkard & Messick, 1985); 2) MAAS (Carlson & Brown, 2005); and 3) NEWS (Cerin, Saelens, Sallis, & Frank, 2006). The EI and MAAS were used to assess convergent validity of the MEQ in pregnant women. The NEWS was used to examine discriminant validity since we predicted that the questionnaire would not be related to the MEQ. The authors felt how the local environment related to physical activity would have no correlation with the parameter.

Measures

The Mindful Eating Questionnaire (MEQ) is a 28-item self-report instrument that measures five domains of mindful eating: disinhibition (n= 8), awareness (n=7), external cues (n=6), emotional response (n=4), and distraction (n=3) (Framson, et al., 2009). The emotional and distraction subscales are reversed scored and 5 questions on the disinhibition are reverse scored. Each item is scored from 1–4, where higher scores signify more mindful eating. Each subscale score is calculated as the mean of items, excluding those with a 'not applicable' response. The summary score is the mean of the five subscales. Minimum scores all = 0. Maximum scores: disinhibition = 8, awareness n=7, external cues n=6, emotional response n=4, and distraction n=3. The measure has been shown to be reliable and valid.

The Eating Inventory (EI) is designed to measure different dimensions of eating behavior. Three factor-analyzed subscales (Cognitive Restraint (21 items), Disinhibition (16 items),

and Hunger (14 items)) are derived from the questionnaire (A. J. Stunkard & Messick, 1988; A.J. Stunkard & Waterland, 1997). Higher scores on Disinhibition and Hunger are indicative of loss of control of self-imposed rules and high levels of hunger, both of which are detrimental to successful treatment. High levels of restraint indicate greater control over eating behavior and the ability to limit energy intake and manage body weight. The 51-item questionnaire is divided into two parts: Part I is composed of 36 true-false items and Part II is composed of 15 rating scale items. One point is given for each item in Part I and II. The direction of the question in Part II is determined by splitting the responses at the middle. If the item is labeled '+', responses above the middle are given a 0. Minimum scores all = 0. Maximum scores: Cognitive restraint = 21, Disinhibition = 16, Hunger = 14. The measure has been shown to be reliable and valid with an internal consistency of 0.79–0.91.

The Mindful Attention Awareness Scale (MAAS) was designed to measure the frequency of mindful states in day to day life, using both general and situation specific questions (Carlson & Brown, 2005). The 15 item single factor scale uses a 6-point Likert scale from 1 (almost always) to 6 (almost never). Based on the mean of all items, MAAS scores can range from 1–6. Higher scores indicate greater mindfulness.

The Neighborhood Environment Walkability Scale (NEWS) is a 68 item instrument that measures perceived attributes of the local environment hypothesized to be related to physical activity and more specifically walking for transport and walking for recreation (Cerin, et al., 2006). This scale assesses residential density, proximity to nonresidential land uses, such as restaurants and retail scores (land use mix-diversity), ease of access to nonresidential uses (land use mix-access), street connectivity, walking/cycling facilities, aesthetics, pedestrian traffic safety, and crime safety. Besides residential density and land use mix-diversity subscales, items were rated on a 4-point Likert scale from 1 (strongly disagree) to 4 (strongly agree). Residential density items asked about the frequency of various types of residences from single family detached homes to 13 story or higher apartments/condominiums, with a response range of 1 (none) to 5 (all). Land use mix-diversity was assessed the walking proximity from home to various types of stores and facilities, with responses ranging from 1 to 5 min walking distance (5) to > 30 min walking distance 91). Higher scores on the land use mix-diversity indicated closer average proximity.

Focus Group

Focus groups allow researchers to obtain participant responses and data in a social context where peoples' responses are considered in the context of other peoples' responses. Focus groups are used frequently in health research (Vanslyke, et al., 2008) and for the development and evaluation of instruments (O'Donnell, Lutfey, Marceau, & McKinlay, 2007). As previously stated, during the focus group, participants were asked: "What does the term mindful eating mean to you?" Participants were asked to sequentially respond to each of the 28 items and the response choices from the MEQ and briefly discuss their reaction to the items and response choices. Finally, the focus group was asked: "Do you believe that the MEQ's items adequately represent what mindful eating means to you?" The audio during the focus groups was recorded and transcribed by a single individual impartial to the analysis, verbatim.

Cognitive Interviews

Cognitive interviews have been used for many years to evaluate the appropriateness of self-report instruments for special populations and to determine if the wording of questions and response choices could contribute to response error. Cognitive interviews were used in this study to evaluate the appropriateness of the MEQ and its items for pregnant women.

First, participants were asked to complete the questionnaires. During the interviews, the examiner then focused and recorded participants' cognitive processes that were used to derive answers to questions. We followed the cognitive interview process described in previous studies (Bolton, 1993; Tourangeau, 1984) by focusing the interview on participants': 1) comprehension of the question, 2) retrieval from memory of relevant information, 3) decision processes, and 4) the response processes.

The cognitive interview focused on each of these processes to gain a better understanding of how the questionnaire is interpreted by our study population – pregnant women. This was done by asking participants to use the think out loud technique and by using different verbal probing techniques including interpretation probes ("What does _____ mean to you?"), paraphrasing ("Can you repeat the question in your own words?"), and other probes ("How did you arrive at that answer? Tell me what you were thinking in arriving at your answer"). Using an iterative process, earlier cognitive interviews were used to inform later interviews and guide the examiner to explore and clarify themes from earlier interviews. All responses were tape-recorded and transcribed verbatim.

Qualitative Analysis

The process for recording and tracking insights and themes as outlined in Patton (Patton, 2002) was followed. With the exception of responses to the two general questions from the focus group ("What does the term mindful eating mean to you?", and "Do you believe that the MEQ's items adequately represent what mindful eating means to you?"), participants' responses were analyzed and summarized for each of the 28 items of the MEQ separately.

The qualitative analysis was conducted using the methodologies of content analysis (Weber, 1990) and observational monitoring of cognitive difficulties during the formation of responses (Bolton, 1993). Content analysis is traditionally used to make inferences from a text. For this particular study, we used inductive content analysis to assess the validity of the MEQ. All interviews were transcribed verbatim, open coding was used to identify themes about mindful eating and the impact of pregnancy on mindful eating that emerged from the text, those themes were collapsed into categories that could be summarized and reported on in comparison to the concept of mindful eating as an unbiased awareness of sensations surrounding eating. In addition to content analysis, the observational monitoring technique allowed us to trace the cognitive processes as the respondent formed an answer in an effort to identify any difficulty participants had in interpreting and responding to the MEQ. In the technique outlined by Bolton (Bolton, 1993) content is coded using an existing coding scheme to identify comprehension of the question, retrieval of relevant beliefs and feelings needed to form a response, judgment heuristics and biases that could allow for response errors, and difficulty formulating a response. When determining whether the MEQ is valid

for pregnant women, we evaluated several components of the interpretation of the questionnaire by our population. These include 1) comprehension (do the respondants interpretations match what is intended?), 2) retreival (is the respondant able to retrieve information needed to answer the question?), 3) judgement (does the repondant lack confidence in how to answer a question, leading to response errors?), and 4) response (is the respondant having difficulties answering the question due to double question, ambiguous question, misinterpretation, etc?). These analytic strategies provided a thorough evaluation and report on the utility, content validity, and appropriateness of using the MEQ to quantify mindful eating in pregnant women.

Content validity was evaluated based on responses from the focus group and cognitive interviews, and MEQ items were evaluated for comprehension, retrieval, judgment, and response.

Power Analysis and Quantitative Statistical Analysis

The present validation study did not attempt to replicate the factor structure of the MEQ; hence, the very large sample sizes needed for factor analysis were not needed. Rather, the tests of reliability and validity relied on Cronbach's alpha and correlation coefficients. For such analyses, adequate power is obtained with ~40 participants. For a bivariate correlation, a 2 tailed test, alpha = 0.05, power = 0.80, and a sample size of 40, the minimum detectable effect size is r=0.43, indicating that we were adequately powered.

Test-retest reliability for the MEQ total score and each of the five MEQ subscales was evaluated between the MEQ administered at screening and the study visit. Cronbach alpha is a measure of internal consistency of an instrument. Following Framson et al., (Framson, et al., 2009) Cronbach's α was used to measure internal consistency reliability of the MEQ and item-total correlations were calculated to quantify the relation between MEQ subscale scores and the total score, and individual MEQ items and their respective subscale score. Pearson correlation coefficients were used to describe the relations among the 5 MEQ subscales. Convergent validity was assessed with correlation analysis between the MEQ and the EI and MAAS. Discriminant validity was assessed with correlation analysis between the MEQ and NEWS. Statistical analyses were carried out using IBM© SPSS© Statistics 20 and alpha was set at 0.01.

RESULTS

Descriptive Characteristics of the Study Sample

Subject characteristics are described in Table 1. Participants were on average 30 years of age, obese, and in their 2nd trimester. Eighteen overweight and 22 obese women enrolled and completed the study. The average MEQ subscale and total scores from screening and visit 1 are presented in Table 2. The mean MEQ total score among all study participants was 2.9±0.3 and with the external cues subscale and 3.0±0.4 without the external cues subscale. The median was 3.0. No differences were seen by body mass index category.

The test-retest reliability of the MEQ was supported; test-retest coefficients were: total score = 0.85; disinhibition = 0.84; awareness = 0.76; external cues = 0.62; emotional response = 0.81; and distraction = 0.77.

For the five subscales, internal consistency reliability ranged from α=0.31 to α=0.68 (Table 3). The internal consistency of the MEQ total score (mean of the five subscale scores) was 0.58. The external cues subscale was not internally consistent (α=0.31); therefore, internal consistency reliability analyses were re-ran after elimination of that subscale. With its elimination, the internal consistency of the MEQ total score increased to α=0.62 and ranged from α=0.59–0.68 for the subscales. Also, with the elimination of 'When I eat at 'all you can eat' buffets, I tend to overeat' the disinhibition subscale increases to 0.74 from 0.63. Correlations between the subscale scores and the total score ranged from 0.45 to 0.68 (Table 3) and Table 3 also includes item-total correlations between the individual items of the MEQ and the respective subscale score. Scores on the MEQ subscales did not correlate significantly with each other (p's > .01; Table 4).

Convergent and Discriminant Validity

The results in Table 5 are presented with and without in the external cues subscale included in the calculation of the MEQ total score. The convergent validity of the MEQ was assessed using the EI subscales (Table 5A) and the MAAS (Table 5B). As expected, correlation analysis indicated that the MEQ total score (without the external cues subscale) and the EI's three subscales (restraint, disinhibition, and hunger) were significantly correlated (p<0.01). The MEQ total score was positively correlated with the restraint subscale and negatively correlated with the disinhibition and hunger EI subscales. The MEQ disinhibition and emotional response subscales were significantly positively correlated with the EI restraint subscale and negatively correlated with the disinhibition, and hunger subscales, respectively. The MAAS and MEQ total scores (with and without the external cues subscale) were significantly positively correlated (total score r=0.58 and 0.63, respectively). Also the disinhibition, emotional response, and distraction subscales were positively correlated with the MAAS total score (disinhibition r=0.40; emotional response r=0.44; distraction r=0.64).

The discriminant validity of the MEQ was assessed using the NEWS (Table 5C). Neither the MEQ total score nor any of the MEQ subscales were significantly correlated (p>0.01) with any of the NEWS factor scores, which supports the discriminant validity of the MEQ in pregnant women (Table 5C).

Qualitative Analysis - External Cues Subscale

Although there are a variety of potential reasons why the external cues subscale was not found to be valid, one topic that came up during the focus groups and the subsequent cognitive interviews was the structure of the questions for this particular subscale. Unlike the other four subscales, the external cues subscale refers to noticing motivations to eat and not about eating behavior itself. For instance, question number 24 states "I *notice* when I'm eating from a dish of candy just because it's there [emphasis added]". The hope is that the subject answered this question about their ability to notice their awareness for the eating behavior. However, in the interview process very few participants spoke about the

recognition aspect but focused solely on the eating behavior itself. For instance, in the question mentioned above (question 24) only eight of the forty participants (20%) talked about awareness- being aware or unaware of the motivation for their eating behavior. Instead the majority of participants talked solely about the associated eating behavior - their likelihood to eat from the dish of candy.

> Subject 11: "I clearly can't pass up a candy bowl."

> Subject 81: "It doesn't happen to me often, and if I do I usually find myself satisfied with one or two pieces and not keep going for it."

> Subject 60: "What I notice is that I just did that on Monday. I did not want candy. I was not thinking about candy. Nothing. But we were somewhere. The kids were by the candy jar, and I was like oh there's a candy jar. Oh those are jelly beans. I like jelly beans. I want some. And I took some. So, I think sometimes, yea… you happen to glance and you see some and you're like now I want it."

As these responses show, many of the participants focused their responses on the part of the question about the eating behavior rather than answering whether or not they recognize their motivation for engaging in it.

Additionally, confusion over the structure of the external cues questions was discussed by participants.

> Subject 63: "I was kind of confused by that question (4)…yesterday I read it as does food in advertisements make you want to eat… but today I read it as do you recognize when that happens and so I kind of found that confusing."

Participants in the focus group also brought up this issue as well.

> Subject 67: "I have a question about the question because the…all the "do you recognize" questions, I focus more on the "recognize" [part] than the part where, you know, does it make you want to eat. Cause if it's "do you recognize" the answer is yes. Now does it make you want to eat, it's not always yes. So I hope I answered it the right way."

> Subject 19: "A lot of the questions were like that. It's like which part of the question do I answer. Is it do I recognize it or do I act upon it?"

Qualitative Analysis - Mindful Eating and the Validity of the MEQ

Despite confusion over the external cues subscale items, most of the participants expressed an understanding of mindful eating that was reflective of the concept that the questionnaire aims to measure. According to the researchers that created the MEQ, mindful eating describes a "non-judgmental awareness of physical and emotional sensations while eating" (Framson, et al., 2009). The component of no judgment implies that there is neither a positive or negative affiliation with this awareness, simply recognition of the feelings of satiety, the motivations to eat, and the factors that influence eating behavior. During the cognitive interview process, several of the subjects reflected this nonjudgmental awareness, discussing mindful eating in terms of noticing several factors- how the environment influences eating behaviors (100%; n=40), why you are eating (12.5%; n=5), or how you are

eating (20%; n=8) without judgment associated with the awareness. Below are a few examples of the responses to the question "What comes to mind when you think of the term mindful eating?"

Subject 24: … paying attention to what you're eating, how you're eating, your eating habits. Um, whether or not you're aware that you're eating. You're aware of how much you're eating

Subject 82: Being aware of things (that) are going on around me or in my life that would change the way I would choose to eat or not eat

Subject 53: Thoughtful eating, being mindful of what you're eating, um I think of the ways that you would eat and you would be mindful of those...like…speed in which you eat.

Subject 92: … it's obvious from the questionnaires; it pertains to like the things that are going on while you're eating.

However, others expressed judgment as a key component of the way they conceptualized mindful eating. 68% (n=27) of the subjects reported that mindful eating was about paying attention to what you were eating in terms of how healthy that item or the portion size was, assigning judgment to the eating behavior often before the eating behavior even started.

Subject 38: [It's] being mindful of what you're eating whether it's you're counting calories or you're saying ok this is or isn't healthy

Subject 73: Yea, uh actually the funny thing was that the thing that just came to mind was guilt…some people can um just eat whatever and not have that emotional component, but if I have the mindful component then the emotional component is there, too. Like wow I just ate a whole gallon of ice cream. I'm kind of feeling guilty.

Subject 55: Um, just noticing what you eat…um I guess the amount too but I don't do a good job of that.

Subject 70: Um, instead you're saying "Ok, let me evaluate what's on my plate". You know…is this good for me? Is this not good for me? Is this too much? Is this too little? Um, is this my portion that I need right now? Do I even need to eat it right now? So, you're really thinking about and trying to make a, a good quality decision.

Subject 82: It's actually being cognizant of what you're eating or choosing…or at least awareness of it's caloric value or otherwise health.

By including judgment as a component of mindful eating, it is possible that participants answered the questions, particularly during the 1:1 interview, in a way that would reflect "acceptable" eating behaviors. One of the participants even noted that the questionnaire was perhaps a bit "leading" in soliciting the "right" responses.

Subject 70: I feel like there are a lot of hints (laughs) of how you're supposed to live, you know?

> Interviewer: Do you feel like that influenced your answers at all? Were you thinking I know what I'm supposed to say…?
>
> Subject 70: Yea. I don't want to say it influenced [my answers], well it, it influenced me to [think] I need to pick up this habit. (laughs) …like this is trying to teach me something, so I believe it did have an influence in…that kind of aspect but I guess it hurt me because I knew how I had to answer.

Below are some of the responses to the question, "what comes to mind when you think of the term *mindful eating*?"

> Subject 20: "Paying attention to what you're eating, how you're eating, your eating habits. Whether or not you're aware that you're eating. You're aware of how much you're eating. I guess that's kind of what comes to mind."
>
> Subject 82: "Being thoughtful before I either purchase foods, thoughtful before plan and pre-planning, before I eat foods…um probably a lot of it is being aware of my emotional state or, or things are going on around me or in my life that would change the way I would choose to eat or not eat."
>
> Subject 14: "Being aware of your food, and your body, and your hunger."
>
> Subject 94: "Staying present during a meal….keeping my mind in what I'm doing, what I'm eating, what's in front of me."

Participants believed that mindful eating is about awareness on many levels just as Framson et al. suggested. Similarly, the majority of participants indicated that the MEQ adequately reflected what mindful eating meant to them.

DISCUSSION

The results of this study support the reliability and validity of the MEQ in overweight and obese pregnant women. Our study determined for the first time that the questionnaire has good test re-test reliability. However, the present study found that the external cues subscale was neither reliable nor valid and this was supported by both the qualitative and quantitative analyses. This subscale was not adequately measuring the construct of interest and was chosen for elimination, which improved the internal consistency reliability of the MEQ total score. The remaining subscales had acceptable internal consistency.

The Cronbach alpha levels were comparable with the previously validated sample of healthy adults. For instance, the overall Cronbach alpha level reported in healthy non-pregnant adults was 0.64. The Cronbach's alpha for Disinhibition, Awareness, External Cues, Emotional Response, and Distraction were 0.83, 0.74, 0.70, 0.71, and 0.64, respectively (Framson, et al., 2009). In overweight and obese pregnant women, with the elimination of 'When I eat at 'all you can eat' buffets, I tend to overeat' the disinhibition subscale increases to 0.74 from 0.63. All other questions (beside questions within the external cues subscale) have an item-total correlation above 0.25 thus should not be considered for elimination (Field, 2005). Previously, a cut-score for these correlations of 0.25 has been proposed to identify items that do not sufficiently measure the construct assessed by the questionnaire and thus can be considered for elimination (Field, 2005). However also removed the "I

notice when the food I eat affects my emotional state and I notice when foods and drinks are too sweet" item, then the Cronbach alpha for awareness increased to 0.75 from 0.59. Overall, based on previous work there is a rationale for removing the item with an item-total correlation of 0.01 but none of these items were above 0.25.

The external cues subscale includes verbiage about noticing if a person is participating in mindful eating. This is distinctly different from specific statements about mindful eating itself and its domains. Participants were confused about the structure of the external cues questions. Thus, the structure of the statements on the external cues subscale may be one reason that this particular subscale was not found to be valid. Specifically 4 of the 6 questions within the external cues subscale used the verb "notice" and the 2 other questions used "recognize". The 2 statements that used the verb "recognize" compared to the verb "notice" had 2 of the 3 highest item-total correlations for the subscale. Perhaps the word "notice" elicits more subjective/unreliable responses in pregnant women. Also, and of potential interest, the external cues subscale and the awareness subscale were the only subscales that did not utilize any reverse scoring (the distraction and emotional response subscales were fully reversed scored whereas five out of eight disinhibition questions were reverse scored.) Reverse scoring questions may have required a greater attention to detail by the participant since phrasing may have been the opposite or contradictory of traditional thinking. The MEQ had 5 questions that allowed 'not applicable' as a response. One of these 5 'not applicable' questions was in regards to working (employment), so the external cues subscale had 3 out of 4 questions regarding a food question allowing 'not applicable' to be scored. The other 'not applicable' question was 'When I eat at "all you can eat" buffets, I tend to overeat' in the disinhibition subscale. This question had an item total correlation of 0.01 and could be removed. Thus, allowance of a 'non applicable' response may have been another issue with the external cues subscale.

As expected, the convergent and discriminant validity of the MEQ was supported. The MEQ total score, as well as the disinhibition, emotional response, and distraction subscales, correlated significantly and positively with the MAAS, which was the other measure of mindfulness utilized in this study. Additionally, mindfulness, measured with the MEQ, was associated with greater restraint and decreased hunger and disinhibition, which is also supportive of the validity of the MEQ since higher MEQ scores reflect greater thoughtfulness and volition regarding food intake, while disinhibition and hunger are associated with limited control over eating and erratic eating behavior, such as episodic overeating.

Food cravings are thought to decrease with mindfulness (May, et al., 2010; Paolini, et al., 2014) but this has not been tested in pregnant women. Mindfulness may be especially helpful during pregnancy to promote healthier eating and decrease cravings and gestational weight gain in overweight and obese pregnant women. Also, future research may examine if differences in the validity of the MEQ exist among all trimesters within pregnant women and if the questionnaire is valid with pregnant women of normal weight.

There were a few limitations to the present study. First, recruitment and enrollment of participants in the study was not stratified based on trimester. Secondly, we relied on self-

reported pre-pregnancy weight to determine overweight or obese status at conception. Studies validated self-reported weights to hospital records and found high agreement (Phelan, et al., 2011b). Thirdly, questionnaires or assessment procedures were not performed in regards to physical and leisure activities or life events. Lastly, this study does not provide evidence of predictive or concurrent validity (i.e., relationship between the MEQ and behavior measured at the same time (concurrent) or behavior measured at a future time (predictive)).

This study was the first to establish the reliability and validity of a MEQ in a sample of pregnant women. Nonetheless, the external cues subscale of the MEQ was not found to be valid in the study population. The psychometric properties of the MEQ in this study were similar to the original validation sample, which was comprised of healthy adults. Furthermore, the questionnaire exhibited excellent test re-test reliability.

Acknowledgments

References

Asbee SM, Jenkins TR, Butler JR, White J, Elliot M, Rutledge A. Preventing excessive weight gain during pregnancy through dietary and lifestyle counseling: a randomized controlled trial. Obstetrics and gynecology. 2009; 113:305–312. [PubMed: 19155899]

Barrington WE, Ceballos RM, Bishop SK, McGregor BA, Beresford SA. Perceived stress, behavior, and body mass index among adults participating in a worksite obesity prevention program, Seattle, 2005–2007. Preventing chronic disease. 2012; 9:E152. [PubMed: 23036611]

Belzer LM, Smulian JC, Lu SE, Tepper BJ. Food cravings and intake of sweet foods in healthy pregnancy and mild gestational diabetes mellitus. A prospective study. Appetite. 2010; 55:609–615. [PubMed: 20869416]

Beyerlein A, Lack N, von Kries R. Within-population average ranges compared with Institute of Medicine recommendations for gestational weight gain. Obstetrics and gynecology. 2010; 116:1111–1118. [PubMed: 20966696]

Bolton RN. Pretesting Questionnaires: Content Analyses of Repondents' Concurrent Verbal Protocols. Marketing Science. 1993; 12:280–303.

Brown KW, Ryan RM. The benefits of being present: mindfulness and its role in psychological well-being. J Pers Soc Psychol. 2003; 84:822–848. [PubMed: 12703651]

Carlson LE, Brown KW. Validation of the Mindful Attention Awareness Scale in a cancer population. J Psychosom Res. 2005; 58:29–33. [PubMed: 15771867]

Cerin E, Saelens BE, Sallis JF, Frank LD. Neighborhood Environment Walkability Scale: validity and development of a short form. Medicine and science in sports and exercise. 2006; 38:1682–1691. [PubMed: 16960531]

Cooksey NR. Pica and olfactory craving of pregnancy: how deep are the secrets? Birth. 1995; 22:129–137. [PubMed: 7575860]

Daubenmier J, Lin J, Blackburn E, Hecht FM, Kristeller J, Maninger N, Kuwata M, Bacchetti P, Havel PJ, Epel E. Changes in stress, eating, and metabolic factors are related to changes in telomerase activity in a randomized mindfulness intervention pilot study. Psychoneuroendocrinology. 2012; 37:917–928. [PubMed: 22169588]

Field, A. Discovering statistics using SPSS. 2. London: Sage; 2005.

Framson C, Kristal AR, Schenk JM, Littman AJ, Zeliadt S, Benitez D. Development and validation of the mindful eating questionnaire. J Am Diet Assoc. 2009; 109:1439–1444. [PubMed: 19631053]

Frederick IO, Williams MA, Sales AE, Martin DP, Killien M. Pre-pregnancy body mass index, gestational weight gain, and other maternal characteristics in relation to infant birth weight. Maternal and child health journal. 2008; 12:557–567. [PubMed: 17713848]

Gore SA, Brown DM, West DS. The role of postpartum weight retention in obesity among women: a review of the evidence. Annals of behavioral medicine : a publication of the Society of Behavioral Medicine. 2003; 26:149–159. [PubMed: 14534032]

Hook EB. Dietary cravings and aversions during pregnancy. The American journal of clinical nutrition. 1978; 31:1355–1362. [PubMed: 277064]

IOM, & NRC. Weight Gain During Pregnancy. Washington D. C: The National Academies Press; 2009.

Keppel KG, Taffel SM. Pregnancy-related weight gain and retention: implications of the 1990 Institute of Medicine guidelines. American journal of public health. 1993; 83:1100–1103. [PubMed: 8342716]

Kristeller JL. Mindfulness, wisdom, and eating: Applying a multi-domain model of meditation effects. Constructivism in the Human Sciences. 2003; 8:107–118.

Kristeller JL, Wolever RQ. Mindfulness-based eating awareness training for treating binge eating disorder: the conceptual foundation. Eating disorders. 2011; 19:49–61. [PubMed: 21181579]

Mantzios M, Giannou K. Group vs. single mindfulness meditation: exploring avoidance, impulsivity, and weight management in two separate mindfulness meditation settings. Applied psychology Health and well-being. 2014; 6:173–191. [PubMed: 24585500]

Mantzios M, Wilson JC. Making concrete construals mindful: a novel approach for developing mindfulness and self-compassion to assist weight loss. Psychology & health. 2014; 29:422–441. [PubMed: 24215123]

Mason AE, Lustig RH, Brown RR, Acree M, Bacchetti P, Moran PJ, Dallman M, Laraia B, Adler N, Hecht FM, Daubenmier J, Epel ES. Acute responses to opioidergic blockade as a biomarker of hedonic eating among obese women enrolled in a mindfulness-based weight loss intervention trial. Appetite. 2015; 91:311–320. [PubMed: 25931433]

May J, Andrade J, Batey H, Berry LM, Kavanagh DJ. Less food for thought. Impact of attentional instructions on intrusive thoughts about snack foods. Appetite. 2010; 55:279–287. [PubMed: 20600411]

O'Donnell AB, Lutfey KE, Marceau LD, McKinlay JB. Using Focus Groups to Improve the Validity of Cross-National Survey Research: A Study of Physician Decision Making. Qualitative Health Research. 2007; 17:971–981. [PubMed: 17724109]

Olson CM, Strawderman MS, Reed RG. Efficacy of an intervention to prevent excessive gestational weight gain. Am J Obstet Gynecol. 2004; 191:530–536. [PubMed: 15343232]

Olson KL, Emery CF. Mindfulness and weight loss: a systematic review. Psychosomatic medicine. 2015; 77:59–67. [PubMed: 25490697]

Orloff NC, Hormes JM. Pickles and ice cream! Food cravings in pregnancy: hypotheses, preliminary evidence, and directions for future research. Frontiers in psychology. 2014; 5:1076. [PubMed: 25295023]

Paolini BM, Burdette JH, Laurienti PJ, Morgan A, Williamson DA, Rejeski WJ. Corrigendum: Coping with brief periods of food restriction: mindfulness matters. Frontiers in aging neuroscience. 2014; 6:345. [PubMed: 25627846]

Patton, MQ. Qualitative Research and Evaluation Methods. Thousand Oaks, CA: Sage Publications; 2002.

Phelan S, Phipps MG, Abrams B, Darroch F, Schaffner A, Wing RR. Randomized trial of a behavioral intervention to prevent excessive gestational weight gain: the Fit for Delivery Study. The American journal of clinical nutrition. 2011a

Phelan S, Phipps MG, Abrams B, Darroch F, Schaffner A, Wing RR. Randomized trial of a behavioral intervention to prevent excessive gestational weight gain: the Fit for Delivery Study. The American journal of clinical nutrition. 2011b; 93:772–779. [PubMed: 21310836]

Polley BA, Wing RR, Sims CJ. Randomized controlled trial to prevent excessive weight gain in pregnant women. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity. 2002; 26:1494–1502.

Pope JF, Skinner JD, Carruth BR. Cravings and aversions of pregnant adolescents. Journal of the American Dietetic Association. 1992; 92:1479–1482. [PubMed: 1452960]

Renault KM, Carlsen EM, Norgaard K, Nilas L, Pryds O, Secher NJ, Olsen SF, Halldorsson TI. Intake of Sweets, Snacks and Soft Drinks Predicts Weight Gain in Obese Pregnant Women: Detailed Analysis of the Results of a Randomised Controlled Trial. PloS one. 2015; 10:e0133041. [PubMed: 26192183]

Rooney BL, Schauberger CW. Excess pregnancy weight gain and long-term obesity: one decade later. Obstetrics and gynecology. 2002; 100:245–252. [PubMed: 12151145]

Shapiro SL, Carlson LE, Astin JA, Freedman B. Mechanisms of mindfulness. Journal of clinical psychology. 2006; 62:373–386. [PubMed: 16385481]

Shirazian T, Monteith S, Friedman F, Rebarber A. Lifestyle modification program decreases pregnancy weight gain in obese women. American journal of perinatology. 2010; 27:411–414. [PubMed: 20013602]

Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. J Psychosom Res. 1985; 29:71–83. [PubMed: 3981480]

Stunkard, AJ.; Messick, S. Eating Inventory Manual (The Psychological Corporation). San Antonio, TX: Harcourt Brace & Company; 1988.

Stunkard, AJ.; Waterland, RA. The Three-Factor Eating Questionnaire-Eating Inventory. In: St Jeor, ST., editor. Obesity assessment: Tools, methods, interpretation. New York: Chapman and Hall; 1997. p. 343-370.

Thomas M, Vieten C, Adler N, Ammondson I, Coleman-Phox K, Epel E, Laraia B. Potential for a stress reduction intervention to promote healthy gestational weight gain: focus groups with low-income pregnant women. Women's health issues : official publication of the Jacobs Institute of Women's Health. 2014; 24:e305–311.

Tourangeau, R. Cognitive sciences and survey methods. Washington, D.C: National Academy Press; 1984.

van Berkel J, Boot CR, Proper KI, Bongers PM, van der Beek AJ. Effectiveness of a worksite mindfulness-based multi-component intervention on lifestyle behaviors. The international journal of behavioral nutrition and physical activity. 2014; 11:9. [PubMed: 24467802]

van Berkel J, Proper KI, Boot CR, Bongers PM, van der Beek AJ. Mindful "Vitality in Practice": an intervention to improve the work engagement and energy balance among workers; the development and design of the randomised controlled trial. BMC public health. 2011; 11:736. [PubMed: 21951433]

Vanslyke JG, Baum J, Plaza V, Otero M, Wheeler C, Helitzer DL. HPV and cervical cancer testing and prevention: knowledge, beliefs, and attitudes among Hispanic women. Qualitative health research. 2008; 18:584–596. [PubMed: 18337618]

Weber, RP. Basic Content Analysis. 2. Newbury Park, California: Sage Publications; 1990.

Whitaker RC. Predicting preschooler obesity at birth: the role of maternal obesity in early pregnancy. Pediatrics. 2004; 114:e29–36. [PubMed: 15231970]

Figure 1.
Average Mindful Eating Questionnaire Total Scores for all Participants

Table 1

Characteristics of study sample

	Mean	SD	Range	%
Age (y)	30	4	20 – 39	
Race				
White				55
African American				42.5
Asian				2.5
Pre-pregnancy				
BMI (kg/m^2)	30.0	4.1	25.0 – 40.0	
Body Weight (kg)	83.5	17.6	63.6 – 155.7	
Current				
BMI (kg/m^2)	31.8	4.7	23.6 – 45.2	
Body Weight (kg)	86.5	14.9	64.6 – 123.4	
Gestational Age (weeks)	19.9	8.3	5.9 – 39.0	

N=40.

Table 2

Average values for the Mindful Eating Questionnaire subscales and total score

	Mean	SD	Range
Disinhibition	3.0	0.5	2.1 – 3.9
Awareness	2.7	0.5	1.7 – 3.7
External Cues	2.8	0.5	1.8 – 3.8
Emotional Response	3.2	0.6	1.8 – 4.0
Distraction	3.0	0.6	1.3 – 4.0
Total Score (w ECS)	2.9	0.3	2.2 – 3.7
Total Score (w/o ECS)	3.0	0.4	2.1 – 3.7

N=40.

Table 3

Cronbach's alpha coefficients for the Mindful Eating Questionnaire's subscales, and item total correlations between the subscale scores and the total score, and individual items and the subscale scores

Subscales and Items	Cronbach's α	Item total correlation[a]
Disinhibition	0.63	0.64
I stop eating when I'm full even when eating something I love.		0.54
When a restaurant portion is too large, I stop eating when I'm full.		0.55
When I eat at "all you can eat" buffets, I tend to overeat.		0.01
If there are leftovers that I like, I take a second helping even though I'm full.		0.51
If there's good food at a party, I'll continue eating even after I'm full.		0.58
When I'm eating one of my favorite foods, I don't recognize when I've had enough.		0.55
When I'm at a restaurant, I can tell when the portion I've been served is too large for me.		0.50
If it doesn't cost much more, I get the larger size food or drink regardless of how hungry I feel.		0.50
Awareness	0.59	0.53
I notice when there are subtle flavors in the foods I eat.		0.49
Before I eat I take a moment to appreciate the colors and smells of my food.		0.50
I appreciate the way my food looks on my plate.		0.66
When eating a pleasant meal, I notice if it makes me feel relaxed.		0.43
I taste every bite of food that I eat.		0.47
I notice when the food I eat affects my emotional state.		0.28
I notice when foods and drinks are too sweet.		0.30
External cues	0.31	0.45
I recognize when food advertisements make me want to eat.		0.44
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.		0.57
I notice when just going into a movie theater makes me want to eat candy or popcorn.		0.25
When I eat a big meal, I notice if it makes me feel heavy or sluggish.		0.35
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.		0.38
Emotional response	0.59	0.69
When I'm sad I eat to feel better.		0.68
When I'm feeling stressed at work I'll go find something to eat.		0.50

Subscales and Items	Cronbach's α	Item total correlation[a]
I have trouble not eating ice cream, cookies, or chips if they're around the house.		0.73
I snack without noticing that I am eating.		0.76
Distraction	0.68	0.61
My thoughts tend to wander while I am eating.		0.84
I think about things I need to do while I am eating.		0.82
I eat so quickly that I don't taste what I'm eating.		0.50

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

Table 4

Correlations among the Mindful Eating Questionnaire's subscales

MEQ Subscales	MEQ Subscales				
	Disinhibition	Awareness	External cues	Emotional response	Distraction
Disinhibition	1				
Awareness	0.19	1			
External cues	0.05	0.29	1		
Emotional response	0.38	0.09	0.16	1	
Distraction	0.31	0.09	−0.05	0.28	1

No correlation coefficients were significant at the 0.01 level (2-tailed).

Table 5

Convergent validity. A) Correlation coefficients among the subscales of the Eating Inventory (EI) and Mindful Eating Questionnaire (MEQ), and correlation coefficients between the EI subscales and the total score of the MEQ with and without the External Cues Subscale. B) Correlation coefficients among the total score of the Mindful Attention Awareness Scale (MAAS) and the subscales of the Mindful Eating Questionnaire, and correlation coefficient between the MAAS and the total score of the MEQ with and without the External Cues Subscale. Discriminant validity. C) Correlation coefficients among the subscales of the Neighborhood Environment Walkability Survey (NEWS) and Mindful Eating Questionnaire (MEQ), and correlation coefficients between the NEWS subscales and the total score of the MEQ with and without the External Cues Subscale.

A)

MEQ Subscales	EI Subscales		
	Restraint	Disinhibition	Hunger
Disinhibition	0.46 [**]	−0.64 [**]	−0.54 [**]
Awareness	0.07	−0.30	−0.04
External Cues	−0.07	−0.04	−0.01
Emotional Response	0.48 [**]	−0.68 [**]	−0.41 [**]
Distraction	0.26	−0.33	−0.40
Total Scores (w ECS)	0.40	−0.65 [**]	−0.46 [**]
Total Score (w/o ECS)	0.46 [**]	−0.70 [**]	−0.51 [**]

B)

MEQ Subscales	MAAS
Disinhibition	0.40 [**]
Awareness	0.25
External Cues	0.01
Emotional Response	0.44 [**]
Distraction	0.64 [**]
Total Score (w ECS)	0.58 [**]
Total Score (w/o ECS)	0.63 [**]

C)

NEWS Subscales							
	Residential density	Land use mix diversity	Land use mix access	Street connectivity	Infrastructure and safety for walking	Aesthetics	Traffic hazards
MEQ Subscales							
Disinhibition	-0.04	0.13	0.07	-0.13	0.23	0.28	-0.15
Awareness	0.01	0.06	0.04	0.09	0.29	0.30	-0.16
External cues	-0.17	-0.36	-0.26	0.13	-0.11	-0.20	0.01
Emotional response	-0.18	0.03	-0.21	-0.06	0.11	0.16	-0.18
Distraction	-0.07	-0.11	-0.19	-0.18	0.01	0.02	-0.14
Total Score (w ECS)	-0.14	-0.07	-0.18	-0.06	0.16	0.18	-0.20
Total Score (w/o ECS)	-0.11	0.03	-0.12	-0.11	0.22	0.26	-0.22

NEWS Subscales							
	Crime	Lack of parking	Lack of cul-de-sacs	Hilliness	Physical barriers	Walkways connecting cul-de-sacs	Social interaction while walking
MEQ Subscales							
Disinhibition	-0.21	0.23	-0.09	0.03	0.01	0.29	0.18
Awareness	-0.21	0.03	0.18	0.19	-0.37	0.04	0.29
External cues	-0.17	-0.37	0.16	0.00	-0.22	0.00	-0.08
Emotional response	-0.26	-0.02	0.03	0.07	-0.83	0.11	0.18
Distraction	-0.18	0.27	0.06	0.22	0.06	0.09	0.21
Total Score (w ECS)	-0.33	0.06	0.10	0.18	-0.18	0.17	0.26
Total Score (w/o ECS)	-0.31	0.19	0.06	0.20	-0.13	0.19	0.31

[**] Correlation is significant at the 0.01 level.

No correlation coefficients were significant at the 0.01 level (2-tailed).