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Disentangling orthorexia nervosa from healthy eating and other eating disorder symptoms: Relationships with clinical impairment, comorbidity, and self-reported food choices

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Abstract

Background: Orthorexia nervosa (ON) is characterized by obsessions about eating healthily and rigid adherence to a perceived healthy diet. This study uses the Eating Habits Questionnaire to investigate the relationship of ON symptoms with self-reported food intake, eating-related impairment, obsessive compulsive disorder symptoms (OCD), gender, and BMI while controlling for other eating disordered symptoms. The aim of this study is to provide further evidence for the construct of ON as distinct from other forms of disordered eating.

Methods: The sample consisted of 449 adults recruited on Amazon's Mechanical Turk. Self-reported symptoms of currently recognized eating disorders (anorexia and bulimia nervosa, AN/BN, avoidant/restrictive food intake disorder, ARFID) were statistically controlled in correlational analyses and MANCOVA exploring the relationship of ON domains to comorbidity, eating behavior, gender, and weight.

Results: Confirmatory factor analysis supported a three-factor solution for the EHQ, with factors representing normative healthy eating behaviors ("behaviors"), positive feelings associated with healthy eating ("feelings"), and interference/problems from rigid healthy eating ("problems"). Overall ON symptoms were more strongly related to AN/BN than to ARFID. Of the subscales, only Problems was related to other eating disorder symptomatology. Controlling for other eating disorder symptoms, overall ON symptomatology was not related to clinical impairment from eating or OCD, although it was related to higher self-reported intake of fruits/vegetables and lower intake of discretionary foods. When other eating disordered symptoms and ON domains were statistically controlled, Problems was related to clinical eating impairment, OCD symptoms, and higher intake of both fruits/vegetables and discretionary foods.

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Author contributions

HZ designed the study and collected the data, planned and conducted the analyses, and wrote the first draft of the manuscript. JME and JHE each contributed to the analysis and interpretation of the data and to the writing and editing of the manuscript. All authors approved the final submission.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2018.12.006.

Conclusions: The Problems scale of the EHQ appears to capture disordered eating symptomatology that is distinct from other eating disorders and from normative healthy eating behaviors, consistent with descriptions of ON.

1. Introduction

Orthorexia nervosa (ON) is a proposed psychological condition characterized by an extreme fixation on healthy eating and rigid, compulsive eating behaviors that result in psychosocial impairment (Bratman & Knight, 2000). Originally described by Steven Bratman (1997), orthorexic eating may begin with benign efforts to eat well in order to lose weight, adhere to nutritional guidelines, manage or prevent an illness, and/or avoid processed foods. Over time, however, some individuals appear to develop an excessive fixation on healthy eating and overly rigid adherence to idiosyncratic eating rules that lead to psychosocial interference, including conflict with family members over food choices and limited opportunities for socializing, as well as negative nutritional consequences (Bratman & Knight, 2000). ON is not a recognized diagnosis in the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; American Psychiatric Association, 2013) or the International Classification of Diseases and Related Health Problems (World Health Organization, 1992). The degree to which ON-like behaviors can be distinguished from recognized eating disorder symptoms is not well-understood. ON shares diagnostic similarities with currently recognized eating disorders, including anorexia nervosa and atypical anorexia nervosa (AN), bulimia nervosa (BN), and avoidant/restrictive food intake disorder (ARFID).

ON is perhaps less similar to ARFID than to AN/BN. Both ON and ARFID may be characterized by a rigid, narrow diet, but the reasons for food refusal in ARFID are related to the sensory and hedonic experience of eating (e.g., distaste for the sensory properties of the food, lack of appetite or enjoyment of food) or to the immediate consequences of eating (e.g., fear of vomiting, choking, or abdominal pain). Conversely, both ON and AN/BN are characterized by rigid diets with regard to the nutritional properties of food, and intense fear of longer-term outcomes of eating feared foods (e.g., becoming unhealthy or gaining weight, respectively). Additionally, ON and AN/BN are each associated with pronounced obsessions and compulsive behaviors, linking these conditions to obsessive compulsive disorder (OCD; Koven & Abry, 2015). ON differs from AN/BN in several ways. ON eating restrictions are not driven by extreme fear of weight gain, excessive influence of shape and weight on self-evaluation, or distorted body image (Dunn & Brattman, 2016). Whereas binging and purging or inappropriate compensation for caloric intake are not part of the proposed diagnostic picture of ON (e.g., Dunn & Brattman, 2016), compensatory behavior is very common in AN/BN, and binge eating is a required symptom to diagnose BN (APA, 2013).

The distinction of ON from AN/BN might be more difficult to make in practice than in theory. Weight loss dieting is very common in the United States; in a nationally representative study of adults, 38% of women and 24% of men reported currently being on a diet to lose weight, with higher rates among those with overweight or obesity (Kruger, Galuska, Serdula, & Jones, 2004). A more recent study conducted in a representative online survey panel in the United States found that 94% of participants reported that they had “tried to lose weight” in the last year, although no information about specific dieting behavior was reported (Puhl, Himmelstein, & Quinn, 2018). Dieters and restrained eaters report some degree of guilt and anxiety about eating foods that are perceived to be higher in fat content (Gonzalez & Vitousek, 2004), and tend to dichotomize foods as either “guilt-inducing” or “guilt-free” (King, Herman, & Polivy, 1987). In an experimental study of a group of college-aged women, restrained eaters perceived a target snack as less “healthy” only in a condition where the participants’ weight was made salient, and all participants, regardless of restraint, ate less of the snack when they perceived it as less healthy (Provencher, Polivy, & Herman, 2009). Consumer studies indicate that participants perceive products labeled as calorie-reduced as relatively “healthier” than other foods, and tend to underestimate the caloric content of foods perceived as “healthy” (e.g., Chandon & Wansink, 2007; Johansen, Naes, & Hersleth, 2011).

In general samples, therefore, there might be a considerable degree of overlap between subclinical symptoms of ON and of AN/BN, given that concerns about the healthiness and caloric content of food appear to be closely linked, particularly for women and restrained eaters. Indeed, in a recent study of individuals on weight loss diets, participants who reported following diets involving calorie-tracking, reduced calorie consumption, avoidance of carbohydrates, or programs like Weight Watchers, reported more symptoms of ON compared to weight-loss dieters who did report making specific dietary changes and people not trying to lose weight (Barthles, Meyer, & Pietrowsky, 2018). Additionally, because healthy eating intentions are so widespread, there is concern that normative and even adaptive concerns with healthy eating might be over-pathologized and mislabeled as ON, further clouding the field’s understanding of the characteristics of this potential disorder (e.g., Bratman, 2017).

As the literature on ON develops, it will be important to consider the overlap and uniqueness of rigid healthy eating preoccupations and compulsions from similar behaviors in the context of AN/BN body image disturbances and fear of fatness, and potentially in the context of sensory, hedonic, or fear-related eating restrictions (e.g., ARFID). The overlap between ON symptoms and symptoms of ARFID has not yet been studied, but several previous studies have reported strong correlations between measures of ON and AN/BN (e.g., Asil & Surucuoglu, 2015; Barnes & Caltabiano, 2017; Oberle, Samaghabadi, & Hughes, 2017; Gleaves, Graham, & Ambwani, 2013). To date, researchers exploring correlates and characteristics of self-reported ON symptoms (e.g., interference, comorbidity) have yet to control for AN/BN symptomatology in their analyses. Such designs are needed to better understand the degree to which ON is distinct from other eating disorder symptoms.

Much of the prior literature investigating ON has relied on a single measure of orthorexia symptoms, the ORTO-15 (Donini, Marsili, Graziani, Imbriale, & Cannella, 2005). Despite the widespread use of the ORTO-15, the measure may have inadequate psychometric properties. The authors who initially aimed to validate the ORTO-15 did not report traditional tests of reliability or validity (Donini et al., 2005). Furthermore, several items appear unrelated to the construct of ON (e.g., “When you go in a food shop, do you feel confused?” “At present, are you alone when having meals?”) and lack face validity. The ORTO-15 and its shortened versions have exhibited variable internal consistency across studies, with reported alphas ranging from 0.14 to 0.82 (e.g., Depa, Schweizer, Beckers, Hilzendegen, & Strobele-Benschop, 2017; Koven & Abry, 2015). Perhaps most problematic, the measure appears to drastically overestimate rates of ON, with prevalence rates based on the cut-off score suggested by the ORTO-15 developers ranging from 6% to 86% across non-clinical samples (e.g., Dunn, Gibbs, Whitney, & Starosta, 2017). In a number of studies, the sample's mean score on the ORTO-15 actually exceeds the recommended clinical cut off (e.g., Alvarenga et al., 2012; Asil & Sürücüoğlu, 2015; Bundros, Clifford, Silliman, & Morris, 2016; Dell'Osso et al., 2016; 2018). A recent study directly compared the ORTO-15 to a definition of ON based on an explicit endorsement of restrictive eating (e.g., removing a type of food from the diet), and found that the "prevalence" of ON dropped from 71% to 20%; only 1% of the sample were found to experience impairment and medical problems due to their diets (Dunn, Gibbs, Whitney, & Starsota, 2017). The apparent inability to differentiate between normative eating and restrictive eating driven by a preoccupation with health that causes medical and/or psychosocial interference (e.g., Bratman, 2017; Dunn, Gibbs, Whitney, & Starosta, 2017) is a serious limitation of this measure. Even when the measure is explored continuously, the unidimensional nature of the ORTO-15 makes it impossible to differentiate healthy eating behaviors themselves from the interference and distress associated with becoming too preoccupied with them, or adhering to them too rigidly.

Perhaps due to the reliance on the ORTO-15, which appears to lack validity and reliability, the current literature is characterized by inconsistent findings on some correlates of ON. For example, the relationship between ON and body mass index (BMI) is unclear: while some studies have reported greater ON symptomatology associated with lower BMI (e.g., Dell'Osso et al., 2016), some have reported no relationship (e.g., Bosi, Çamur, & Güler, 2007), and the majority find, counterintuitively, that ON symptoms are associated with higher BMI (e.g., Asil & Sürücüoğlu, 2015; Grammatikopoulou et al., 2018; Hyrnik et al., 2016; Varga, Thege, Dukay-Szabo, Tury, & Furth, 2014). Given that weight-loss dieting is more common in adults with overweight and obesity (e.g., Puhl et al., 2018), this finding may be due to the inability of the ORTO-15 to differentiate between dieting behavior or adaptive healthy eating and impairment caused by rigid healthy eating. Results exploring the relationship between gender and ON are also contradictory: some authors have concluded that men appear to be at greater risk for ON than women (e.g., Malmborg, Bremander, Olsson, & Bergman, 2017); others have suggested the opposite (e.g., Dell'Osso et al., 2016; Sanlier, Yassibas, Bilici, Sahin, & Celik, 2016); and a few have failed to find any gender differences at all (e.g., Bosi et al., 2007; Byrtek-Matera et al., 2017; Hyrnik et al., 2016).

Given the limitations of the ORTO-15, more reliable and valid measures of ON are clearly needed. The Eating Habits Questionnaire (EHQ; Gleaves et al., 2013) appears to exhibit sounder psychometric properties than the ORTO-15. The EHQ is a 21-item self-report questionnaire with three factors that assess: (1) beliefs and behaviors related to healthy eating, (2) interference or problems as a result of rigid healthy eating, and (3) positive feelings about healthy eating. In contrast to the ORTO-15, the authors of the EHQ developed the measure using exploratory and confirmatory factor analysis, and conducted tests of reliability, internal consistency, and convergent, discriminant, and criterion-related validity. Although clinical cut-off scores have not been established for the EHQ, preliminary evidence suggests that the "problems" subscale may be particularly valuable when trying to distinguish ON from normative eating, as partial correlations controlling for the other two subscales indicate that only the problems subscale demonstrates convergent validity with other disordered eating symptoms, OCD, and depression (Gleaves et al., 2013). While this finding suggests that the problems subscale is able to discriminate problematic eating behaviors from normative healthy eating, evidence for divergent validity with other forms of disordered eating is needed.

The three-factor structure of the EHQ has recently been evaluated by an independent group using exploratory factor analysis, although with three items that originally loaded on the problems scale loading onto the healthy behavior scale (Oberle et al., 2017). In this validation sample, for men, but not women, more pronounced ON symptomatology was associated with higher body mass index (Oberle et al., 2017). Because Oberle and colleagues detected a slightly different factor structure from the measure's developers, additional research investigating the factor structure of the EHQ is indicated.

The study had three overall aims. The primary aims were 1) to explore relationships of overall orthorexia symptoms and symptom domains with symptoms of AN/BN (e.g., severe restriction for thinness/binging and purging) and ARFID (e.g., selective eating, poor appetite/limited interest in eating, fear of immediate aversive consequences from eating), and 2) to explore the relationships of overall orthorexia symptoms and symptom domains with measures of comorbidity (i.e., obsessive compulsive disorder), clinical impairment from eating, self-reported food choices (e.g., relative fruit/vegetable and snack/dessert intake), BMI, and gender, while adjusting for variance shared between orthorexia and other disordered eating symptoms. The secondary aim 3) was to assess the factor structure of the EHQ in a new sample, using confirmatory factor analysis to compare the fit of the factor solution identified by the developers (Gleaves et al., 2013) and the alternate solution proposed by Oberle et al. (2017).

If ON is to be seen as a separate eating disorder diagnosis its distinctness from other forms of disordered eating, and its independent associations with relevant outcomes after accounting for related disordered eating symptoms, must be better understood. The degree to which ON symptomatology is actually associated with both clinical impairment and "healthy" eating (e.g., diets that are high in fruits and vegetables, or low in processed, high-sugar, and high-fat foods) is currently unknown. To our knowledge, this is the first study to use a measure other than the ORTO-15 (e.g., Grammatikopoulou et al., 2018; Varga, Thege, Dukay-Szabó, Túry, & van Furth, 2014) to investigate the association between self-reported food choices and symptoms of ON, to explore the impairment uniquely associated with ON symptomatology using a validated measure of eating-disorder related impairment, or to control for other eating disordered symptoms in analyses involving the correlates of ON. It is also the first to explore these aims in a sample recruited to over-represent eating related issues such as picky eating, vomit phobia, irritable bowel syndrome, and poor appetite. We expect to replicate findings by Oberle et al. (2017) who found that the EHQ total score and subscales were related to BMI and gender in college students, and findings by Gleaves and colleagues (2014) suggesting that the EHQ subscale measuring ON-related impairment and interference is uniquely related to comorbidity and other measures of disordered eating

(ARFID, AN/BN). We also expect this subscale to be uniquely related to clinical impairment. Analyses involving participant-reported food choices are exploratory.

2. Methods

2.1. Participants

Participants were 449 adults recruited on Amazon's Mechanical Turk (MTurk). Participants all responded from within the United States. The sample was recruited for an earlier study that focused on eating problems related to ARFID (Zickgraf & Ellis, 2018). Participants were recruited through five advertisements seeking participants for "Research on eating habits" and "Research on eating habits related to …" vomit phobia, picky eating, poor appetite, and irritable bowel syndrome. Participants responded to the questionnaires in a single online session; most participants completed the study in 45 min or less and all were compensated ($4.00 USD). Data were collected from a total of 504 participants; 16 participants began the study but did not progress beyond providing demographic information, 33 participants failed one or more of four attention check questions designed to detect bots and careless responding, and two participants passed all attention checks but were missing data on the EHQ. Attention checks were multiple choice questions with four syntactically similar sentences, and participants were instructed to choose the sentence that did not make sense (e.g., "pigs eat red and anger"). The final sample was 49% female and 50.6% male; one participant reported a gender of "other" and one did not report gender. The sample was 74.7% White, 10.3% African American/Black, 8.9% Asian, 2.0% Native American, 4.8% Hispanic/Latinx, and 8.6% multiracial, and had a mean age of 33.6 (9.5), ranging from 20 to 69 years. Study procedures and materials were approved by the Institutional Review Board of the University of Pennsylvania; all participants provided informed consent.

2.2. Measures

2.2.1. Eating habits questionnaire (EHQ)—

The EHQ is a multidimensional measure of orthorexia symptomatology with factors measuring: healthy eating behaviors ("behaviors," which the original developers also referred to as "knowledge"), positive feelings about healthy eating ("feelings"), and problems associated with rigid healthy eating ("problems; " Gleaves et al., 2013). . Items are scored on a 1–4 Likert type agreement scale, with anchors "false, not at all true," "slightly true," "mainly true," and "very true." Scale and total scores were created by averaging the items for a possible range of 1–4. There are two slightly different published factor solutions for the EHQ. The two models each have the same three factors, only differing in the factor loadings of three items: "I follow a diet with many rules," "I only eat what my diet allows," and "I follow a health-food diet rigidly." Oberle et al. (2017) found that these items loaded onto the behaviors factor, whereas the original model (Gleaves et al., 2013) loaded them onto the problems factor. Both groups of authors reported adequate internal consistency and evidence for convergent and divergent validity.

2.2.2. Clinical impairment assessment—Eating only (CIA-E)—

The CIA is a measure of interference from disordered eating (Bohn et al., 2008; Bohn & Fairburn, 2008).

Wildes, Zucker, and Marcus (2012) modified the instrument to assess interference only from eating behavior, whereas the original measure instructs participants to respond about the extent to which their "eating habits," "exercising," and "feelings about your eating, shape, or weight" affected their mood, interpersonal functioning, and cognitive performance during the previous four weeks. The modified CIA-E has since been used to assess impairment related to subclinical ARFID symptoms (e.g., Ellis, Galloway, Webb, & Martz, 2017; Wildes et al., 2012; Zickgraf & Ellis, 2018). The CIA-E shares the same 16 items as the original CIA; participants use a 0–3 Likert scale, with anchors "not at all," "a little," "quite a bit," and "a lot," to respond to completions for the stem "to what extent your eating habits …" including "… made you forgetful," "… interfered with meals with family or friends," and "… made you worry." In the present study, the CIA-E demonstrated excellent internal consistency: $\alpha = 0.94$.

2.2.3. Eating attitudes test-Severe restricting for thinness/bingeing and purging (EAT-26-SRT/BP)—The EAT-26 is a measure of symptoms associated with AN and BN (Garner, Olmsted, Bohr, & Garfinkel, 1982). The measure uses a 6-point Likert-type frequency scale. Items are then scored such that responses of "never," "rarely," and "sometimes" receive scores of 0, "often" is scored as 1, "very often" as 2, and "always" as 3. The measure has three validated subscales, measuring oral control (e.g., intentional restriction of oral intake), dieting (e.g., efforts to restrict for weight loss or to avoid weight gain), and bulimia (e.g., binging and purging behaviors). The full EAT-26 includes many items that are not specific to AN/BN symptoms, and could apply to any eating disorder, such as "I feel that food controls my life," and "I give too much time and thought to food." Other items might overlap specifically with ON, as they relate to avoiding particular types of food without specifying that the restriction is driven by fear of fatness or body image distortion: "I avoid foods with sugar in them," and "I avoid foods with high carbohydrate content." To reduce content overlap, and because items mentioned above load onto all three of the existing EAT-26 subscales, we chose 13 items (1, 2, 4, 8, 9, 10, 11, 12, 13, 14, 20, 24, and 26 from the original EAT-26) judged to have minimal overlap with other eating disorders or ON. These items assess fear of fatness/drive for thinness, food restriction for thinness, and binging and purging behaviors. They include items like "I am terrified about being overweight," "I prefer my stomach to be empty," "I think about burning up calories when I exercise," and "other people think I am too thin." The modified EAT-26-SRT/BP was computed by summing the scored EAT-26 variables as described above. The full EAT-26 and the 13-item EAT-26-SRT/BP each demonstrated good internal consistency in this sample: α = .88 and $\alpha = 0.84$ respectively.

2.2.4. Obsessive compulsive inventory-Revised (OCI-R)—The OCI-R is a well-validated measure of obsessive compulsive disorder symptoms (Foa et al., 2002; Huppert et al., 2007). The OCI-R includes 18 items related to distress/impairment from six domains of obsessive compulsive symptomatology: hoarding (e.g., "I have saved up so many things that they get in the way"), checking/doubting (e.g., "I check things more often than necessary"), ordering (e.g., "I get upset if objects are not arranged properly"), mental neutralizing (e.g., "I feel compelled to count while I am doing things"), contamination (e.g., "I find it difficult to touch an object when I know it has been touched by strangers or certain people"), and obsessing (e.g., "I find it difficult to control my own thoughts"). The 0–4 Likert-type response scale assesses the degree to which respondents are "bothered or distressed" by symptoms described in each item, using anchors "not at all," "a little," "moderately," "a lot," and "extremely." The subscale scores can be summed to yield a total score, which has demonstrated validity in identifying cases of OCD and discriminant validity with other anxiety disorder (Huppert et al., 2007). The measure has been validated in non-clinical samples, and is frequently used to assess subclinical OCD symptoms (e.g., Hajcak, Huppert, Simons, & Foa, 2004; Tolin, Woods, & Abromowitz, 2006). The OCI-R total score had excellent internal consistency in this sample: $\alpha = 0.94$.

2.2.5. Nine-item ARFID screen (NIAS)—The NIAS assesses the degree to which respondents restrict their eating based on each of the three presentations of ARFID: selective/picky eating (e.g., "I dislike most of the foods that other people eat"), poor appetite/limited interest in eating (e.g., "Even when I am eating a food I really like, it is hard for me to eat a large enough volume at meals"), and fear of negative consequences from eating (e.g., "I restrict myself to certain foods because I am afraid that other foods will cause GI discomfort, choking, or vomiting; " Zickgraf & Ellis, 2018). The nine items are scored on a 0–5 Likert-type scale, with anchors "strongly disagree, disagree, slightly disagree, slightly agree, agree, and strongly agree." Scale scores are computed by summing the items, for a range of 0–15, and total score ranges from 0 to 45. In the measure's validation study, the NIAS subscales and total score showed divergent validity with the EAT-26, and convergent validity with measures of related constructs (e.g., picky eating, poor appetite, enjoyment of eating, and fear of visceral sensations). The scales and total score all showed excellent internal consistency: $\alpha's = 0.85–0.91$.

2.2.6. Dietary intake—Participants were asked to self-report the number of servings of fruits and vegetables as well as snack and dessert foods (i.e., discretionary foods) they consumed in a typical day (Zickgraf & Schepps, 2016). Participants reported number of servings (defined as approximately ½ cup) on a 10-point scale from 0 (none) to 9 or more. Participants were also asked to report the number of servings of protein-containing foods, grains/starches, and dairy. All food servings were summed, and the number of fruit/vegetable and snack/dessert servings were divided by the total number of servings to create scores that reflected the proportion of total daily food intake accounted for by fruits/vegetables and snacks/desserts, respectively. Participants were given examples of what to count as a snack food ("chips, pretzels") and a dessert ("ice cream, cake, cookies, candy"), as well as a protein ("meat, fish, eggs, nuts"), starch/carbohydrate ("bread, potatoes, pasta, rice") and dairy ("milk, cheese").

2.2.7. Body mass index (BMI)—BMI was calculated from participants' self-reported weight and height. The sample was categorized according to BMI ranges: BMI ≤24.9 was considered under/healthy weight, BMI ≥25.0 and ≤29.9 was considered overweight, and BMI ≥30.0 was considered obese. See Table 1 for descriptive data on BMI.

2.3. Data analysis

Confirmatory factor analysis using a robust maximum likelihood estimator (MLR) was used to compare the fit of the two published three-factor solutions for the EHQ (Gleaves et al., 2013; Oberle et al., 2017). Model fit, based on the Comparative Fit Index (CFI), the root mean square residual (RMSEA), and the standardized root man square residual (SRMR) were assessed, and model changes (i.e., covarying residuals or dropping items) were considered based on modification indices. Values at or above 0.90 on the CFI represent a cutoff for an acceptable fitting model and values at or below 0.08 for the RMSEA and 0.06 for the SRMR further represent a good model fit (Hu & Bentler, 1999). CFA analyses were conducted using the R lavaan package in RStudio (Rosseel, 2012; RStudio, 2012). The study was powered for confirmatory factor analysis, following guidelines that recommend N > 300 (Meyers, Ahn, & Jin, 2011). Post-hoc power analysis using the "pwr" package for R suggest that our sample had .989 power to detect *r*-type effect sizes of 0.2 or greater (Champley et al., 2018).

Our correlational analyses had two aims. The first was to explore relationships of ON symptoms with AN/BN and ARFID symptoms. For the full EHQ, we explored zero-order correlations with the NIAS-Total and the modified EAT-26-SRT/BP. To explore whether orthorexia symptoms were more strongly related to ARFID or AN/BN symptoms, we used Fischer's r-to-z transformation for dependent samples (Lee & Preacher, 2013; Stieger, 1980). Next, to explore the unique relationships between each of the three domains of orthorexia symptoms and AN/BN vs. ARFID symptoms, we conducted a partial correlation analysis for each of the three EHQ-subscales, controlling for the other two subscales. The second aim was to explore the relationships of orthorexia and its domains with measures of comorbidity (OCI-R), functional impairment (CIA-E), and self-reported eating behavior (fruit/vegetable and snack/dessert proportions) while partialling out variance shared with other eating disordered symptoms (AN/BN and ARFID) and, in the case of the subscales, other ON domains. For the EHQ-total, we used partial correlations controlling for AN/BN and ARFID symptoms. For each of the three EHQ subscales, we controlled for the other two EHQ subscales in addition to AN/BN and ARFID symptoms. Participants with missing data were excluded casewise from the correlational analyses.

Multivariate ANCOVA, with EAT-26 and NIAS total as covariates, was used to explore the relationships among the EHQ total score, the EHQ's three subscales, gender, and BMI. So that our results could be more directly and intuitively compared to previous findings using the same measures, we used the same analytic method as Oberle et al. (2017), exploring main effects of gender and BMI and the interaction of gender*BMI classification. Our analyses differed from Oberle and colleagues' in one respect: whereas these authors used a median split to create two BMI categories, we chose to categorize participants according to the healthy, overweight, and obese BMI ranges to aid interpretation of the findings. Because few participants in this sample had a BMI in the underweight range (10 participants, 2.2%), we chose to retain these participants in the analyses (as Oberle and colleagues did by including underweight participants in their low BMI category) by grouping them with healthy weight participants. No participant fell in the severely underweight BMI range (e.g., BMI < 16). Correlational analyses and MANCOVA were computed using SPSS version 25.0

(SPSS Inc. Chicago, IL, USA).See Table 1 for descriptive statistics of all study measures including BMI.

3. Results

3.1. Factor structure and scale intercorrelations

Confirmatory factor analysis indicated that the original three-factor solution (Gleaves et al., 2013), $\chi^2(186) = 839.42$, $p < .001$, CFI = 0.89, SRMR = 0.06, RMSEA = 0.085, had near-adequate fit, whereas fit was marginally poorer for the alternate solution proposed by Oberle et al. (2017): $\chi^2(186) = 881.82$, $p < .001$, CFI = 0.88, SRMR = 0.06, RMSEA = 0.088. Conceptually, the original loading appears to better reflect the distinction between potentially normative and adaptive healthy eating behavior (the behaviors subscale) from rigid adherence to healthy eating that causes distress and interference (the problems subscale). Following the examination of item content differences between the two solutions, we decided to proceed with the original factor solution proposed by Gleaves et al. (2013).

After examining modification indices and considering item content overlap, the model was re-estimated with covarying residuals between item 5 ("My eating habits are superior to others") and item 11 ("My diet is better than other people's diets"); which showed the highest modification index of any two items (MI = 96.03). These items, both from the behaviors subscale, likely share residual variance due to overlapping item content. Model fit for the original factor solution was improved: $\chi^2(185) = 745.41$, $p < .001$, CFI = 0.91, RMSEA = 0.078 [0.07, 0.085], SRMR = 0.06. Although adjustments for residual covariance between other closely related items from the same scale might have improved fit, we chose to minimize model adjustments to avoid overfitting. Standardized loadings for both the final model and the original model with no residual covariance were high. See Table 1 for descriptive statistics on the EHQ scales and other study measures, and Table 2 for standardized loadings of EHQ items for the final model. The subscales demonstrated good internal consistency (α′s > 0.80; Table 2) and were strongly positively intercorrelated (Table 3).

3.2. Relationships with disordered eating, impairment, OCD, and eating behavior

Fischer's r-to-z transformation for correlated correlation coefficients was used to compare the magnitude of the relationship between the EHQ total score and eating disorder symptom measures. Before using the theoretically derived 13-item version of the EAT-26 intended to minimize content overlap, we compared the magnitude of the correlations of the EHQ total score with the full EAT-26, the modified EAT-26-SRT/BP, and with a variable consisting of the remaining 13 EAT-26 items that we removed because they were judged to overlap with ON. There were large correlations between the EHQ and the full EAT-26 ($r = 0.56$) and the overlapping items ($r = 0.62$), whereas there was a moderate relationship with the items judged to have less overlap ($r = 0.37$). The magnitude of the correlation between the EHQ and overlapping EAT-26 items was significantly greater than the correlation with the non-overlapping items chosen to reflect severe restriction for thinness/binging and purging: z = 7.50, p < .001. Because the goals of these analyses were to explore relationships with AN/BN symptomatology and to remove variance shared with AN/BN, we proceeded with the modified EAT-26-severe restricting for thinness/bingeing and purging scale (EAT-26-SRT/BP). Sensitivity analyses with the full EAT-26 were conducted, and the results were the same as those reported below.

The EHQ-total score was more strongly related to a measure of severe restricting for thinness and binge/purge symptoms (EAT-26-SRT/BP) than to a measure of ARFID symptoms (NIAS-total). The NIAS-total and EAT-26-SRT/BP were positively correlated with each other at $r = .25$ (Table 3); the correlation between the EHQ-total and EAT-26-SRT/BP ($r = 0.37$) was significantly larger than the correlation between the EHQ-total and NIAS-total ($r = 0.21$): $z = 2.94$, $p < .002$.

Next, we explored the relationships of the EHQ subscales with AN/BN and ARFID symptoms. Because of the high intercorrelations among the subscales, we used partial correlations to control for two subscales while exploring the relationship of the third to AN/BN and ARFID symptoms. Controlling for the feelings and problems subscales, the healthy eating subscale was uncorrelated with ARFID symptoms and had a small negative correlation with AN/BN symptoms. Controlling for the healthy eating and interference subscales, the feelings subscale was also uncorrelated to AN/BN symptoms and had small negative partial correlations with the NIAS total score and the subscales measuring eating restrictions related to poor appetite/lack of interest and fear of aversive consequences from eating. Controlling for the healthy eating and feelings subscales, the interference subscale was moderately positively related to all NIAS symptom scales and the total score and to AN/BN symptoms (Table 4).

To better understand the unique relationship between orthorexia and its domains and measures of comorbidity, clinical eating impairment, and food choice, we used partial correlations to adjust for AN/BN and ARFID symptoms (Table 4). In analyses with each EHQ subscale, we also controlled for the other two subscales. Partialling out AN/BN and ARFID symptom measures, the EHQ total score was not independently related to clinical eating impairment or OCD symptoms and it was moderately positively correlated with fruit/vegetable proportion and moderately negatively correlated with snack/dessert proportion. Partialling out AN/BN and ARFID symptoms and the problems and feelings subscales, the behaviors subscale had a small negative relationship with functional impairment and snack/dessert proportion, and was not independently correlated with OCD symptoms or fruit/vegetable intake. The feelings subscale also had a small, negative independent relationship with snack/dessert intake, but not with any other variable. The problems subscale showed a different pattern of partial correlations compared to the other two subscales. It was moderately positively related to clinical impairment and OCD symptoms and had small, positive correlations with both fruit/vegetable and snack/dessert intake.

3.3. Gender, BMI, and ON

The EHQ total score and subscales all met MANCOVA assumptions including non-multicollinearity (r's < 0.90), normality, and homogeneity of variance between men and women and among the three BMI categories. MANCOVA multivariate effects on the four dependent EHQ variables, controlling for restricting for thinness, binge/purge, and ARFID symptoms, were significant for gender ($F(3, 436) = 5.00$, Wilks' Lambda = 0.98, $p = .003$, partial η^2 = 0.03), BMI (F(6, 872) = 2.81, Wilks' Lambda = 0.97, p = .01, partial η^2 = 0.016), and their interaction (F(6, 872) = 2.73, Wilks' Lambda = 0.97, p = .02, partial η^2 = 0.017). When univariate effects were explored (Table 5), there was an effect of gender on the problems subscale such that men (M = 1.83, SE = 0.04) scored higher overall compared to women (M = 1.69, SE = 0.04). In addition there were significant univariate effects of BMI on the behaviors subscale, with individuals with healthy weight/underweight (M = 2.25, SE = 0.05), scoring higher than those with overweight (M = 2.15, SE = 0.07), or obesity (M = 2.00, SE = 0.08); only the difference between the behaviors subscale scores in participants with healthy weight/underweight and participants with obesity was statistically significant (p healthy/underweight vs. overweight = 0.19, p healthy/underweight vs. obese = 0.01). However, these results should be interpreted in light of the interaction of gender*BMI on behaviors (F(2, 438) = 2.04, p = .03, partial η^2 = 0.016), which suggested that this difference was only present for women with healthy/underweight vs. women with obesity, but not for men with healthy/underweight vs. men with obesity (See Table 5 for scale means by gender and BMI category).

4. Discussion

The present study aimed to extend the orthorexia literature using the EHQ, a recently validated multidimensional measure of ON-related behaviors and symptoms intended to assess healthy eating behaviors, positive feelings about those behaviors, and interference from rigid adherence to a perceived healthy diet. The results of our confirmatory factor analyses of the EHQ supported the three-factor model proposed by the measure's developers (Gleaves et al., 2013).

This is the first study to compare the magnitude of the relationships between the EHQ and AN/BN vs. ARFID symptoms, or to explore the relationship of orthorexia symptom domains with clinical impairment from disordered eating (CIA), OCD symptoms, or self-reported food intake while controlling for symptoms of other eating disorders. This represents an important step in establishing the validity of orthorexia as a potential eating disorder diagnosis that is both distinct from other forms of disordered eating, and that is associated with impairment and disorder-specific eating behaviors. In addition, we explored the relationships of the EHQ and its subscales to gender, and BMI while controlling for symptoms of other eating disorders, adding to a somewhat inconsistent literature, where ON symptoms have previously been found to be positively, negatively, and unrelated to each of these constructs (e.g., Depa, Schweizer, Bekers, Hilzendegen, & Stroebele-Benschop, 2017).

After removing items that might apply to both ON and AN/BN, ON symptoms assessed with the EHQ total score were more strongly related to AN/BN symptoms than to ARFID symptoms. ON has similarities with AN/BN that it does not share with ARFID, particularly the goal-driven, ego-syntonic and/or positively reinforcing nature of the eating restrictions. Despite this, the correlation was moderate, suggesting that the EHQ assesses a distinct, though related, construct. When symptoms of AN/BN and ARFID were partialled out, the EHQ total score was not related to clinical eating impairment or OCD symptoms. While this might appear to challenge the divergent validity of the EHQ, or the distinctness of ON itself from other forms of disordered eating, the behaviors, feelings, and problems subscales demonstrated convergent and divergent validity in their pattern of partial correlations with measures of disordered eating, clinical eating impairment, OCD, and snack and dessert consumption. The results of the subscale analyses support an interpretation of the behaviors and feelings subscales as reflecting non-pathological eating behaviors and attitudes and the problems subscale as a measure of ON-specific disordered eating. Whereas the behaviors subscale showed slight negative correlations with clinical impairment from eating, and OCD symptoms, and no relation to ARFID symptoms, and the feelings subscale had slight negative relationships with ARFID symptoms, the problems subscale was strongly related to AN/BN symptoms and moderately correlated with ARFID symptoms, clinical eating impairment, and OCD symptoms.

Notably, although the total EHQ score was moderately negatively related with discretionary food intake and positively related to fruit and vegetable intake, and the behaviors and feelings subscales both negatively related to discretionary food intake, the problems subscale was positively related to both discretionary food and fruit/vegetable intake. ON-specific interference is associated with eating behavior that appears to be relatively “healthy” (e.g., a larger proportion of fruits and vegetables relative to other food groups in the daily diet), but also with food choices that are seemingly inconsistent with healthy eating (e.g., a high proportion of snacks and desserts). Different domains of ON-specific interference might be differentially associated with food choices; e.g., eating behavior that is inconsistent with healthy eating preoccupations might lead to feelings of guilt and anxiety, whereas eating behavior that is rigidly adherent to these preoccupations might lead to weight loss/nutritional problems or impaired social functioning. It may be the case that individuals with ON symptomatology are more distressed when their actual eating behavior is inconsistent with their healthy eating preoccupations. These findings are novel and highlight a promising area of future research, but should be replicated and extended using more sensitive and well-validated measures of eating behavior and food choice (e.g., laboratory-based choice studies, ecological momentary assessment of eating, food frequency questionnaires, or semi-structured 24-h recall interviews).

We did not replicate Oberle and colleagues’ 2017 finding that for men, but not women, higher BMI was associated with higher scores on each EHQ subscale. In the current sample, we found that men reported more ON interference, with no gender differences on any other variable. For women, but not for men, participants with obesity scored lower on the healthy behavior subscale compared to those with healthy weight or underweight. The lack of convergence with respect to demographic correlates of ON is consistent with the overall literature, where gender and BMI are very inconsistently related to ON symptoms. Differences between our findings and Oberle and colleagues’ previous finding using the same measure might be accounted for, in part, by the differences between their undergraduate sample, and our adult online sample, which was recruited to oversample problematic eating behaviors. However, the discrepancies might also be explained by our analyses controlling for other eating disordered symptoms. AN/BN and ON symptoms are highly correlated, and individuals with overweight or obese BMI tend to report higher scores on self-report measures of eating disorder cognitions, potentially due to the higher prevalence of normal/high weight eating disorders (e.g., BN, binge eating disorder, atypical AN) compared to low-weight AN, or due to the effect of weight stigma and bias on people with higher weight (e.g., Desai, Miller, Staples, & Bravender, 2008; Mond, Hay, Rodgers, Owen, & Beaumont, 2004). Controlling for AN/BN symptomatology could therefore account for our failure to find an association between BMI and the EHQ total score and feelings and problems scales.

4.1. Limitations

Although our findings are novel and add to an emerging literature, they have several limitations. One was the use of self-reported height and weight to assess BMI, and self-reported "typical" daily food servings to assess dietary intake. Self-report tends to underestimate BMI and over-estimate fruit and vegetable intake, and to the currently unmeasured extent that orthorexic traits may systematically relate to individual differences in these response tendencies, this would limit interpretation of the results (Gorber, Tremblay, Moher, & Gorber, 2007; Marks, Hughes, & van der Pols, 2006). This sample was recruited on Amazon's MTurk, which might limit its generalizability to older, less educated populations, and populations that lack computer literacy or internet access. In addition, this particular MTurk sample is less generalizable than others, because participants were recruited for problematic eating behaviors associated with ARFID (e.g., selective eating, disinterest in eating, and fear of negative consequences from eating). Because we recruited for specific eating difficulties, we might have inadvertently excluded a subset of individuals with ON symptoms who had no other eating restrictions or difficulties. In addition, the nature and presentation of ON symptomatology in people with no other eating difficulties might differ from ON symptoms in the context of picky eating, poor appetite/lack of enthusiasm for eating, or anxiety about aversive consequences from eating. Although potential influences of sampling on our findings should be considered, ARFID symptoms were controlled in analyses involving clinical eating impairment, OCD symptomatology, eating behavior, BMI, and gender.

4.2. Conclusions

The EHQ is a promising replacement for the psychometrically questionable ORTO-15, and the interference subscale in particular appears to be a valid measure of ON symptomatology. While we found evidence that the EHQ subscales can differentiate between adaptive healthy eating and ON-specific disordered eating impairment, variance accounted for by the other subscales must be statistically controlled to reveal these specific relationships. Given the high intercorrelations of the ON subscales, their zero-order relationships with constructs of interest were not unique or specific. This limits the utility of the total score, which encompasses highly correlated items capturing both potentially normative and adaptive healthy eating and eating-related positive feelings and rigidity, interference, and impairment from ON symptoms.

This study presents preliminary evidence to support the validity of the construct of ON as a separate form of eating disordered behavior, distinct from both AN/BN and ARFID symptoms. As research interest in ON increases, there is a need for measures of ON symptomatology that: 1) assess cognitions associated with restrictive eating, including drive for thinness and distorted body image, 2) identify domains of impairment from restrictive eating, e.g., distress vs. nutritional consequences vs. social/occupational interference, and 3) differentiate excessively rigid or rule-bound healthy eating from more normative healthy eating concerns and behaviors. A single measure that could differentiate between ON and both normative healthy eating and other disordered eating would have greater utility than current measures. Until such measures are available, however, the EHQ interference subscale appears able to isolate ON symptomatology when measures of healthy eating behavior (i.e., the behaviors subscale of the EHQ) and other disordered eating are statistically controlled. In studies that use the EHQ to explore orthorexia symptomatology, therefore, researchers should consider using the problems subscale score, rather than the total score, and include in their study design measures of other disordered eating with minimal content overlap, such as the NIAS (to capture symptoms of ARFID) and the Eating Disorders Examination Questionnaire or Eating Disorders Inventory (to capture symptoms of AN/BN and binge eating; Garner, Olmstead, & Polivy, 1983; Hilbert, Tuschen-Caffier, Karwautz, Niederhofer, & Munsch, 2007). To date, no study of ON has accounted for disordered eating in its design or analyses, and prior to the introduction of the EHQ, none accounted for normative healthy eating behavior. The adoption of the EHQ should help to improve the quality of the ON literature.

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Table 1

Sample descriptive statistics.

	Total *M(SD)*	Range	Men *M(SD)*	Women *M(SD)*	*t(445)*, p
EHQ healthy behavior	2.18 (0.81)	1–4	2.20 (0.85)	2.17 (0.75)	0.29, .77
EHQ positive feelings	2.64 (0.77)	1–4	2.60 (0.78)	2.69 (0.74)	−1.25, .21
EHQ problems	1.77 (0.68)	1–4	1.81 (0.71)	1.74 (0.65)	1.21, .23
EHQ total	2.20 (0.66)	1–4	2.20 (0.71)	2.20 (0.62)	0.52, .23
Clinical impairment assessment	9.67 (10.14)	0–48	9.36 (9.94)	10.01 (10.36)	−0.69, .96
Eating attitudes test-26	13.77 (11.01)	0–78	13.41(10.91)	14.19 (11.15)	−0.88, .38
Eating attitudes test-restricting for thinness and binge/purge symptoms	4.02 (5.47)	0–39	3.80 (5.24)	4.25 (5.72)	−0.86, .45
NIAS picky	6.95 (4.08)	0–15	7.04 (4.01)	6.83 (4.16)	0.55, .58
NIAS appetite	5.66 (4.10)	0–15	5.52 (3.98)	5.77 (4.20)	−0.64, .53
NIAS fear	5.80 (4.79)	0–15	5.18 (4.03)	5.81 (4.79)	−1.50, .13
NIAS total	18.09 (9.98)	0–45	17.74 (9.72)	18.41 (10.26)	−0.70, .48
Obsessive compulsive inventory-R	13.22 (13.41)	0–68	13.09(13.31)	13.35 (13.57)	−0.21, .83
Fruit/vegetable proportion	0.34 (0.16)	0-.87	0.33 (0.17)	0.36 (0.16)	−1.80, .74
Snack/dessert proportion	0.17 (0.13)	0-.60	0.16 (0.12)	0.17 (0.13)	−1.17, .64
BMI	26.50 (6.46)	16.5–59.99	26.63 (6.03)	26.35 (6.90)	0.44, .28
	Total *N* (%)		**Men *N* (%)**	**Women *N* (%)**	$\chi^2(2)$
Under/healthy	211 (46.8%)		97 (42.4%)	114 (51.6%)	
Overweight	144 (31.9%)		86 (37.6%)	58 (26.2%)	
Obese	93 (20.6%)		45 (19.7%)	48 (21.7%)	6.77^{*}

* $p < .05$

** $p < .001$.

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Table 2

Confirmatory factor analysis: Standardized scores.

Item		Healthy behavior	Problems	Positive feelings
		α = .87	α = .92	α = .80
1	I am more informed than others about healthy eating	.71		
3	The way my food is prepared is important in my diet	.70		
5*	My eating habits are superior to others	.74		
11*	My diet is better than other people's diets	.71		
21	I prepare food in the most healthful way	.84		
2	I turn down social offers that involve eating unhealthy food		.74	
4	I follow a diet with many rules		.85	
6	I am distracted by thoughts of eating healthily		.69	
7	I only eat what my diet allows		.77	
8	My healthy eating is a significant source of stress in my relationships		.61	
10	My diet affects the type of employment I would take		.58	
13	In the past year, friends or family members have told me that I'm overly concerned with eating healthily		.68	
14	I have difficulty finding restaurants that serve the foods I eat		.65	
16	Few foods are healthy for me to eat		.59	
17	I got out less since I began eating healthily		.63	
18	I spend more than 3 h a day thinking about healthy food		.60	
20	I follow a health-food diet rigidly		.81	
9	I have made efforts to eat more healthily over time			.71
12	I feel in control when I eat healthily			.77
15	Eating the way I do gives me a sense of satisfaction			.72
19	I feel great when I eat healthily			.64

Italicized items were loaded on the HB factor to test the fit of Oberle and colleagues' 2017 model.

Standardized factor scores from the final model (Gleaves et al., 2013).

*items with residual covariance.

Table 3

Zero-order correlations among study variables.

	EHQ total	EHQ HB	EHQ PROB	EHQ PF	CIA	EAT-26-SRT/BP	NIAS picky	NIAS appetite	NIAS fear	NIAS total	OCI-R	F/V prop	S/D prop
EHQ HB	.94**	1	-	-	-	-	-	-	-	-	-	-	-
EHQ PROB	.85**	.74**	1	-	-	-	-	-	-	-	-	-	-
EHQ PF	.85**	.72**	.52**	1	-	-	-	-	-	-	-	-	-
CIA	.31**	.31*	.51**	.12*	1	-	-	-	-	-	-	-	-
EAT-26-SRT/BP	.37**	.28**	.49**	.26**	.59**	1	-	-	-	-	-	-	-
NIAS picky	.21**	.16*	.35**	.06	.24*	.15**	1	-	-	-	-	-	-
NIAS appetite	.11*	.08	.27**	−.05	.31**	.24**	.55**	1	-	-	-	-	-
NIAS fear	.19**	.17**	.31**	.03	.39**	.21**	.30**	.47**	1	-	-	-	-
NIAS total	.21**	.18**	.39**	.01	.40**	.25**	.77**	.85**	.76**	1	-	-	-
OCI-R	.25**	.18**	.41**	.09	.60**	.58**	.24**	.26**	.26**	.32**	1	-	-
F/V prop	.43**	.41**	.34**	.39**	.03	.05	.03	.04	.15*	.10*	−.03	1	-
S/D prop	−.30**	−.31**	−.14*	−.33**	.12*	.01	.01	.02	−.02	.01	.20**	−.53**	1

Abbreviations: EHQ=Eating habits questionnaire, HB=healthy behavior, PROB=problems, PF=positive feelings, CIA=clinical impairment assessment, EAT-26=Eating attitudes test restricting for thinness and binge/purge symptoms, NIAS = Nine item ARFID screen, OCI-R = Obsessive compulsive inventory, F/V prop=Fruit/vegetable proportion, S/D prop=Snack/dessert proportion.

Table 4

Correlations with measures of disordered eating symptoms, impairment, comorbidity, eating behaviors.

	EHQ total	**Partial *r* controlling for other subscales**		
		Healthy behaviors	**Problems**	**Positive feelings**
EAT-26-SRT/BP	.37**	−.16*	.44**	.06
NIAS picky	.21**	−.09	.35**	−.07
NIAS appetite	.11*	−.07	.32**	−.16*
NIAS fear	.19**	.01	.28**	−.15*
NIAS total	.21**	−.07	.40**	−.17*
	Partial *r* controlling for EAT-26-SRT/BP and NIAS			
	EHQ total	Partial *r* controlling for other subscales		
		Healthy behaviors	Problems	Positive feelings
CIA	.09	−.15*	.30**	−.04
OCI-R	.01	.09	.18**	−.06
Fruit/vegetable proportion	.44**	.04	.22**	.04
Snack/dessert proportion	−.34**	−.11*	.16*	−.12*

* $p < .05$

** $p < .001$.

Table 5

MANCOVA results.

	EHQ total		**Healthy behavior**		**Positive feelings**		**Problems**	
	F	**Partial η^2**	**F**	**Partial η^2**	**F**	**Partial η^2**	**F**	**Partial η^2**
Gender	0.74	0.00	1.50	0.00	1.02	0.00	6.17*	0.01
BMI	1.60	0.01	3.74*	0.02	0.12	0.00	1.43	0.01
Gender × BMI	2.15	0.01	3.55*	0.02	1.41	0.01	2.02	0.01

Scale means by BMI weight range and gender

	EHQ total		Healtdy behavior		Positive feelings		Problems	
	M	SE	M	SE	M	SE	M	SE
Healthy/under-weight								
Women	2.28	0.06	2.33_a	0.07	2.72	0.07	1.78	0.05
Men	2.18	0.06	2.18	0.08	2.56	0.08	1.79	0.06
Overweight								
Women	2.11	0.08	2.01_{ab}	0.10	2.58	0.10	1.74	0.07
Men	2.27	0.07	2.28	0.08	2.68	0.08	1.86	0.06
Obese								
Women	2.05	0.09	1.92_b	0.11	2.68	0.11	1.54	0.08
Men	2.14	0.09	2.08	0.11	2.52	0.11	1.83	0.08

* $p < .05$

** $p < .001$.

Means in the same column with different subscripts are significantly different.